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State of Oregon
Department of Environmental Quality

State of Oregon
Department of Environmental Quality — Memorandum

Date: July 30, 1992

To: Environmental Quality Commission

From: Fred Hansen, Director

Subject: Consideration of Contractor's Report on Proposed Chemical Mining Rules, and Recommendation for Adoption of Proposed Chemical Mining Rules

Background

On December 13, 1991, the Environmental Quality Commission (Commission or EQC) considered adoption of rules to require mining operations using cyanide or other toxic chemicals to protect soils, groundwater, surface waters, and wildlife from contamination or harm by process solutions and waste waters. The protective measures required by the proposed rules included (but were not limited to) cyanide recovery and re-use, chemical detoxification of cyanide residues, and extensive lining and engineered closure of waste disposal facilities.

During the public participation process on the proposed rules, mining companies and associations argued that some of the requirements are unnecessarily stringent, unproven, or unavailable. Environmental protection organizations argued that the proposed rules may not be adequately protective in certain respects.

The Commission studied the proposed rules and public comments received, and extensively debated the policy issues associated with the rule proposal. The Commission elected to defer action on the adoption of proposed rules for chemical mining, and to seek an evaluation and advice on specific technical questions from an independent, knowledgeable contractor.

The Commission directed the Department to employ a consultant to provide technical advice on specific technical questions related to provisions of the proposed rules. The Department drafted a **Request for Proposal** (RFP) in consultation with the Commission, and issued notice of the RFP on February 7, 1992. The RFP identified DEQ's intent to issue a fixed price contract and required proposers to submit a project budget.

Notice was published in newspapers in Portland, Denver, Reno, and Vancouver, B.C. Locations outside Portland were selected because they are known centers of activity and expertise on mining.

The RFP was sent to more than 50 individuals and consulting firms, based on requests in response to ads, or other indications of potential interest. The RFP was also sent to the Advocate for Minority, Women & Emerging Small Businesses (Executive Dept., Salem). Proposals were to be submitted by March 10, 1992.

Two proposals were received. Proposals were independently reviewed by three reviewers. All three reviewers deemed one proposal unacceptable for reasons that the proposer lacked the experience and expertise desired, the proposal was not fully responsive to the RFP, and the price was too high. The selected proposal was responsive to the RFP, the proposers team displayed the experience and expertise desired and was the lowest price proposal. Selected references were checked for the responsive proposal; no negative responses were received. The selected proposal was submitted by TRC Environmental Consultants, Inc. in Englewood, Colorado.

DEQ entered into a contract with TRC Environmental Consultants, Inc. The consultant received written notice that work on the contract could commence on April 27, 1992. The Contract required submittal of a draft report to DEQ for review and comment within 45 days after notified to start work. The contract further provided that, following receipt of DEQ comments on the draft report, the Contractor would have 15 days to submit the final report. As work began on the contract, the Department and the Contractor agreed on June 19, 1992, as the reasonable target date for submittal of the draft report. The public was advised at a public meeting on May 5, 1992, that the date for submittal was approximately June 19. Since 45 days from receipt of notification of contract execution would fall on June 11, 1992, an amendment to the contract was executed to formalize June 19, 1992, as the target date for draft report submittal.

DEQ elected to make the draft report available to others for review and comment. This extra review was not originally contemplated when the RFP was drafted. The draft report was provided to persons who attended a May 5, 1992, public meeting on the matter and asked to receive a copy. People who asked to review the draft report subsequent to that meeting were also being provided a review copy. Copies of the draft report were distributed to reviewers on Monday, June 22, 1992. Reviewers were asked to submit written comments to DEQ by 5:00 p.m. on Monday, June 29, 1992.

DEQ forwarded all comments received from reviewers to the Contractor. By letter dated July 2, 1992, DEQ provided its comments to the Contractor. It also advised the Contractor that some of the comments which were forwarded from others related to matters that were outside the scope of work in the contract and the Contractor should make no attempt to consider or respond to such comments. DEQ's comments included suggestions for clarifications, format revisions, and direction to delete some conclusions that were considered to be outside the scope of work in the contract.

The Contractor advised DEQ that review of comments and preparation of revisions and responses would delay delivery of the final report from July 17, 1992 to July 22, 1992. The final report from the Contractor was received on July 22, 1992. Copies were forwarded to interested parties and the Commission on July 23 and 24, respectively.

Discussion of Issues Related to the Process

There are several issues related to the process and scope of work that warrant discussion.

1. **Potential Conflict of Interest**

The Department has received a letter and comments suggesting that the Contractor may be unable to render an unbiased report for a number of reasons, including that the principal consultant is on the board of directors of the Colorado Mining Association and is a member of the Northwest Mining Association. One of the other team members had also done some work with regard to two mining proposals in Oregon.

The RFP incorporated the following disclosure requirement:

> "Proposing contractors (including subcontractors) shall disclose any potential conflicts of interest. A potential conflict of interest includes, but is not limited to, any involvement during the past five years with mining companies, mining industry groups, or environmental groups active in working on mining regulations and permitting or holding any interest in property in Oregon that may have mineral development potential. During the proposal development period and, if awarded the contract, during the contract period, the selected contractor shall maintain an arm's length relationship with all parties who are or could be interested in the rule making procedure before the Commission. The selected contractor is required to disclose all contacts, either to or by them, during the proposal process and the life of the contract."

The potential conflicts of interest cited by persons during the process were disclosed by the consultant in their written proposal and orally at the May 5, 1992, public meeting. The Department evaluated the potential conflicts identified by the consultant, and concluded that they would not prevent the consultant from appropriately responding to the technical questions in the scope of work. Exhibit A attached to and part of the contract entered into with the consultant included the following language:

> "D. Managing Conflict of Interest
>
> Contractor shall disclose any potential conflicts of interest. A potential conflict of interest includes, but is not limited to, any involvement during the past five years with mining companies, mining industry groups, or environmental groups active in working on mining regulations and permitting or holding any interest in property in Oregon that may have mineral development potential. Contractor shall maintain an arm's length relationship with all parties who are or could be interested in the rule making procedure before the Commission. Contractor shall make a written record of all contacts, either to or by them, during the proposal process and the life of the contract, and shall provide a copy of the written record to the Department when the final report is presented."

A record of contacts pursuant to the contract was provided by the consultant as Appendix A-2 of their report.

The Department concludes that the Contractor fully complied with the requirements regarding "Conflict of Interest". Further, the Department concludes that although there is and has been in the past some relationship between the contractor and the mining industry, the contractor is capable of rendering unbiased judgment on the limited technical questions contained within the Scope of Work. The Department also concludes that had the contract called for policy recommendations from the Contractor, an unbiased report could not have been assured. Since this is not what was asked of the Contractor, the Department concludes that the report meets our goal of addressing the questions the Commission posed in an unbiased fashion, although we do have some technical differences of opinion with the Contractor which we note in subsequent discussion.

2. Consideration of Economics in the Evaluation

The Oregon Mining Council (OMC), in material provided for the contractor to consider, and in their comments on the Draft Contractor's Report, suggests that the Contractor's report should provide the Department and Commission with adequate information to determine the most cost effective ways of meeting the EQC's policies, and the report fails to do so. OMC appears to interpret the discussion leading to the

Commission decision to employ a contractor as intent to include a strong economic component in the study.

The Department does not share the OMC view of the Contractor's charge. The Department believes that the record of the discussions leading up to the decision to hire a contractor, when taken as a whole, clearly reflects that the Commission did not want an economic study or a cost/benefit study. Further, the Scope of Work reflected in the RFP and the contract specifically states that "[t]he Commission is <u>not</u> asking for alternative policy recommendations or evaluation of economic issues." The Commission wanted response to specific questions regarding the technical feasibility of control technology, and the environmental effects of various control technologies.

The Scope of work did ask the contractor to provide a simple comparison of typical costs for installation of the various liner configurations. The Contractor was asked to determine if there were other technologies that could meet the Commission policies. The Department believes that the record is also clear that the Commission expected that the Contractor's report would include some relative judgments regarding cost implications of any other technologies identified that would meet the specific policy objectives of the Commission.

In addition, the Department believes that the Commission intends to take economics into account as it seeks to find an appropriate balance between environmental protection goals and requirements, the pollution control technology necessary to achieve the environmental protection requirements, and the perceived costs of implementing the technology and requirements. The Department would further note that information is available in the record to make reasonable judgments regarding costs of various technologies in relation to environmental protection.

Based on these views, the Department has advised the Contractor both informally and in writing to disregard any suggestions that the report be expanded to include economic considerations.

OMC has also noted that redundancy between various rule requirements was not addressed and should be. The Department simply notes that the RFP and the contract do not ask the Contractor to provide an opinion on the issue of potential redundancy between different components of the rules.

3. Contractor's Comments not Related to the Scope of Work

The draft report submitted by the contractor contained some discussion and conclusions that the Department viewed as deviating from the charge and specific technical questions presented in the Scope of Work. The scope of work in the RFP and contract specifically stated as follows:

> "B. Scope of Work
>
> Three policies have been established by the Commission. Contractor shall evaluate and address specific technical questions surrounding these policies. The Commission is not asking for alternative policy recommendations or evaluation of economic issues. Contractor's task is to answer the questions posed in the following paragraphs based on Contractor's knowledge, expertise, experience, review of current published technical data, and technical evaluation of the issues. ......"

In its comments on the draft report, the Department advised the Contractor as follows:

> "Your draft report deviated from the specific technical questions in the scope of work and inappropriately presented suggestions on policy issues that have been extensively considered and debated by the Commission. As noted in our attached comments, all such policy suggestions must be eliminated from the final report. You are welcome to submit your views on policy issues to the Commission if you choose by letter or separate document. If you do so, we and the Commission will consider them as we would any other commenter — but we will not consider them a part of the work we contracted for nor a formal part of the report. This report, to be consistent with the scope of work in the contract, must present technical information and analysis in response to the questions posed, and be free of recommendations or opinions you may hold which were not a part of the contract or scope of work."

The Northwest Mining Association has reacted to the Department's directions to the Contractor by suggesting that the Department's action constitutes a conflict of interest and an effort to manipulate the report. The Department obviously disagrees. The Contractor was not asked or directed to modify the technical response to the questions posed in the scope of work. The Contractor was asked to clarify the response in some cases. The Contractor was asked to delete from the report some conclusions that were deemed to be beyond the scope of work of the contract and was invited to submit those or other opinions to the Commission by separate letter.

Specifically, the scope of work did not ask the Contractor to provide information on the level of cyanide that should be deemed toxic to birds. The Department asked that discussion on this issue be removed from the report. Similarly, the scope of work did not ask the Contractor to speculate on whether the regulatory framework of the proposed rules should be modified. The Department recommended that conclusions on this issue be removed from the report and invited a separate letter submittal.

The final report submitted by the Contractor contains a response to the Department's comments in Appendix B-1. This appendix describes how the report was modified to address Department comments. In the response to comments, the Contractor specifically states that they complied with the Department's directive even though they did not believe that their draft report had deviated from the scope of work of the contract.

<u>Summary of the Evaluation and Findings of the Contractor's Report</u>

Following is a recap of the questions posed in the Scope of Work, and the Contractor's response shown in italics, as quoted from the Record of Findings in the Introduction to the Contractor's Report. This summary will be followed by a discussion of issues for Commission consideration.

I. LINERS, LEAK DETECTION AND LEAK COLLECTION SYSTEMS

<u>Scope of Work</u>

1. <u>Questions on Liners, Leak Detection, and Leak Collection Systems</u>

    a. <u>Statement of Policy</u>:

    The Commission establishes as policy that a liner, leak detection and leak collection system are necessary to assure that any leak will be detected before toxic materials escape from the liner system and are released to the environment. These systems must assure that if a leak is found, sufficient time is available to allow for the repair of the leak and clean up of any leaked material before there is a release to the environment. Natural conditions, such as depth to groundwater or net rainfall, shall be considered as additional protection but not in lieu of the protection required by the required engineered protection.

NOTE: Definition of "environment" or use of defining qualifiers is central to the issue. The Commission considers that the environment begins at the bottom of the last liner.

b. Issue:

In the proposed rule contained in 340-43-065(4), the requirements for heap leach pad liners are as follows:

(4) The heap leach pad liner system shall be of triple liner construction with between liner leak detection consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous flexible membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec);

(c) A leak detection system between the synthetic liners capable of detecting leakage of 400 gallons/day acre within ten weeks of leak initiation.

As opposed to this liner system, the Oregon Mining Council has proposed a liner characterized either as a composite liner or as a double liner and generally described as follows:

Composite Liner -- a composite liner system construction with between liner leak detection consisting of:

- An engineered, stable, low-permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 12 inches;

- Continuous flexible membrane top liner of suitable synthetic material;

- A geotextile layer between the liner materials for leak detection. The leak detection and recovery system would also include collector pipes tied to the geotextile, spaced at appropriate intervals to achieve the 10-week leak initiation detection performance standard.

c. Question:

Will either or both liner systems meet the stated policy objective of the Commission?

d. Method to Answer or Address Question:

(1) Are each of the various liner systems proposed technically feasible?

(2) Will each of the various liner systems meet the stated Commission policy?

(3) For those liner systems which will meet the stated Commission policy, what level of certainty for achieving this policy do you assign to each system?

(4) Are there other liner systems which will achieve this policy and what level of certainty for achieving this policy do you assign to each?

The consultant is also asked to provide a simple comparison of typical costs for installation of the various liner configurations.

Summary of the Contractor's Evaluation

(1) Are each of the various liner systems proposed technically feasible?

- *The OAR 340-43-065(4) Triple Liner System is technically feasible.*

- *The OMC Double Liner System is technically feasible.*

- *The Alternative Candidate Liner System is technically feasible.*

(2) Will each of the various liner systems meet the stated Commission Policy?

- *The OAR 340-43-065(4) Triple Liner System will generally meet the stated Commission Policy.*

- *The OMC Double Liner System will have difficulty meeting the stated Commission Policy.*

- *The Alternative Candidate Liner System will meet the stated Commission Policy.*

(3) For those liner systems which will meet the stated Commission policy, what level of certainty for achieving this policy to you assign to each system?

- *Using assigned values (refer to Section 2.3 for discussion), mathematically generated weighted average levels of certainty (the greater the number, the higher the level of certainty) are as follows:*

Liner System	*Equal Weight on all Components*	*Emphasis on Lower Components*	*Emphasis on Upper Components*
OAR 340 Triple Liner	28.0	51.0	61.0
OMC Double Liner	19.0	41.0	35.0
Alternative Candidate Triple Liner	29.0	62.0	54.0

(4) Are there other liner systems which will achieve this policy and what level of certainty for achieving this policy do you assign to each?

- *There are a number of other liner systems which will achieve this policy. TRC selected one (the Alternative Candidate Triple Liner) for additional analysis, the results of which are presented above.*

- *There are a number of variations on the permeable zone component of the Alternative Candidate Triple Liner System (as well as for the OAR 340 system permeable zone) that can also achieve this policy with equivalent levels of certainty while offering varying cost advantages (based on the simple comparison of typical costs for installation) over the proposed Alternative Candidate Liner*

System. The presented Alternative Candidate Liner System design purposefully incorporated certain components equivalent to those in the OAR 340-43-065(4) system, however, alternative engineered geodrain materials for those components have been identified and evaluated as capable of performing at an equivalent level of certainty.

II. TAILINGS TREATMENT TO REDUCE THE POTENTIAL FOR RELEASE OF TOXICS

Scope of Work

2. Questions on Tailings Treatment to Reduce the Potential for Release of Toxics

   a. Statement of Policy:

   The Commission establishes as policy that the toxicity and potential for long-term cyanide and toxic metals release from mill tailings should be reduced to the greatest degree practicable through tailings treatment.

   b. Issue:

   The proposed rules in 340-43-070(1) state the following:

   (1) Mill tailings shall be treated by cyanide removal and re-use prior to disposal to reduce the amount of cyanide introduced into the tailings pond. Chemical oxidation or other means shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the liquid fraction of the tailings. The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm.

   The rules do not require removal of potentially toxic metals from tailings prior to placement in the tailings pond. The rules do require steps to control acid formation in the tailings pond and require covering upon closure with a composite cover designed to prevent water and air infiltration.

c. Question:

Do the requirements for **removal** and **reuse** of cyanide materially reduce toxicity and potential for long-term cyanide and toxic metals release from mill tailings?

d. Method to Answer or Address Question:

(1) Are **removal** and **reuse** technically feasible?

Potential factors for consideration include:
- Is the process technically defined and understood?
- Has the process been demonstrated in practical application, and if so, where?
- Are engineering firms available to design and oversee construction?
- Are materials and equipment available to construct?

(2) Do **removal** and **reuse** (evaluated separately) materially reduce the toxicity and potential for long-term cyanide and toxic metals release from mill tailings?

(3) What is the level of certainty you give to the answers provided above?

(4) Are there other tailings treatment technologies which will equally, or more effectively achieve the policy of the Commission?

Summary of the Consultant's Evaluation

(1) Are removal and reuse technically feasible?

- *Removal and reuse are technically feasible, but limit the operator to technologies with limitations on operating efficiency.*

- *The process has been demonstrated in practical application, for example, at the Golden Cross Mine in New Zealand, operated by Cyprus Gold Company, as well as at the DeLamar (silver) Mine in Idaho, operated by NERCO Minerals.*

- *Engineering firms are available to design and oversee construction.*

- *Materials and equipment are available to construct.*

(2) Do removal and reuse (evaluated separately) materially reduce the toxicity and potential for long-term cyanide and toxic metals release from mill tailings?

- *Removal of cyanide from tailings <u>does</u> materially <u>reduce</u> the <u>cyanide toxicity</u> and potential for long-term release. Cyanide removal <u>may</u>, dependent on specific tailing chemistry, <u>contribute to a reduction</u> in toxicity and potential for release of toxic metals over the long-term.*

- *Reuse of cyanide <u>does not</u> reduce the <u>cyanide toxicity</u> or potential for long-term cyanide and toxic metals release from mill tailings. It does reduce the total quantity of cyanide reagent consumed over the life of the operation. There is a material reduction in operating efficiency when cyanide reuse is employed, in comparison to chemical destruction techniques, particularly at lower concentrations of cyanide in process solutions.*

(3) What is the level of certainty you give to the answers provided above?

- *The generic level of certainty that <u>removal and reuse</u> are technically feasible is high, however, removal and reuse limits the available technology that can be applied to either solid/liquid separation or AVR (acidification/volatilization/reneutralization) processes, which may not provide maximum removal under many tailing chemistry conditions.*

- *The level of certainty that <u>removal</u> of cyanide material reduces the toxicity and potential for long-term cyanide release from mill tailings is high.*

- *The level of certainty that <u>removal</u> of cyanide materially reduces the toxicity and potential for long-term toxic metals release from mill tailings is variable, again dependent upon the specific tailings chemistry.*

- *The level of certainty that <u>reuse</u> of cyanide materially reduces the toxicity potential for long-term cyanide release from mill tailings is nil. <u>Reuse does not in any way contribute to a reduction of "toxicity"</u> or potential for release of solutions released to tailings, as reagent concentration in process solutions ideally remains constant at all times. It simply reduces the quantity of make-up reagent required over the life of the operation.*

- *The level of certainty that <u>reuse</u> of cyanide materially reduces the toxicity and potential for long-term toxic metals release from mill tailings is nil. Reuse does not in any way impact toxicity or potential for release as regent concentration in* *process solutions ideally remains constant at all times. It simply reduces the quantity of make-up reagent required over the life of the operation.*

(4) Are there other tailings treatment technologies which will equally or more effectively achieve the policy of the Commission?

- *There are a number of tailings treatment technologies which will equally or more effectively achieve the stated policy of the Commission. In addition, these technologies are oftentimes technically more appropriate than removal and reuse under given tailings chemistry, offer significant economic advantage, greater operational flexibility, and result in more efficient utilization of resources. These technologies are discussed in Section 3.1.4.*

III. CLOSURE OF HEAP LEACH AND TAILINGS FACILITY

Scope of Work

3. Questions on Closure of the Heap Leach and Tailings Facilities

   a. Statement of Policy:

   The Commission establishes as policy that the closure of the heap leach and tailings disposal facilities will prevent release to the environment of toxic chemicals contained in the facility.

   b. Issue:

   Rule 340-43-080(4)(a), as proposed, requires that the heap shall be "... detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm."

   In 340-43-080(4)(b), the proposed rules require that the closure of the heap shall be "... by covering the heap with a cover designed to prevent water and air infiltration."

   In 340-43-080(5), the proposed rules state that "The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time."

c. <u>Question</u>:

Do the requirements of detoxification (cyanide removal by rinsing) of the heap and covering of the heap and tailings facility to exclude air and water materially reduce the likelihood of any release to the environment of toxic chemicals and metals contained in the heap over the long term?

d. <u>Method to Answer or Address Question</u>:

(1) Are detoxification and covering (as prescribed in this rule) technically feasible?

(2) Do detoxification and covering (evaluated separately and together) materially reduce the likelihood of a release of toxic chemicals and metals to the environment?

(3) What is the level of certainty you give to the answers provided above?

(4) Are there other technologies which can equally or more effectively achieve the policy of the Commission?

<u>Summary of the Consultant's Evaluation</u>

(1) Are detoxification and covering (as prescribed in this rule) technically feasible?

- *Detoxification and covering of heap leach facilities is technically feasible.*

- *Detoxification and covering of tailings facilities is technically feasible.*

(2) Do detoxification and covering (evaluated separately and together) materially reduce the likelihood of a release of toxic chemicals and metals to the environment?

<u>Heap Leach Facilities</u>

Toxic Chemical Release Potential

- *Detoxification of heap leach materials (spent ore) does materially reduce the likelihood of a release of toxic chemicals to the environment.*

- *Covering of heap leach materials (spent ore) without prior detoxification does not materially reduce the likelihood of a release of toxic chemicals to the environment.*

- *Covering of decommissioned heap leach facilities, following detoxification of cyanide concentrations within the spent ore, may materially reduce the likelihood of a release of toxic chemicals to the environment in some instances, but this primarily results from the contribution of detoxification. Conversely, covering in addition to detoxification, if applied inappropriately, can adversely affect control of releases of toxic chemicals to the environment.*

Toxic Metals Release Potential

- *Detoxification of heap leach materials (spent ore) does not materially reduce the likelihood of a release of toxic metals to the environment.*

- *Covering of heap leach materials (spent ore) without prior detoxification does material reduce the likelihood of a release of toxic metals to the environment.*

- *Covering of decommissioned heap leach facilities, following detoxification of cyanide concentrations within the spent ore, where spent ore chemistry dictates (due to acid-generating potential), does materially reduce the likelihood of a release of toxic metals to the environment. However, where acid-generating potential is not a concern, little, if any additional benefit is realized toward materially reducing the likelihood of a release of toxic metals to the environment by covering after detoxification.*

<u>Tailings Facilities</u>

Toxic Chemical Release Potential

- *Detoxification of mill tailings does materially reduce the likelihood of a release of toxic chemicals to the environment.*

- *Covering of mill tailings without prior detoxification does not materially reduce the likelihood of a release of toxic chemicals to the environment, except in the case of net precipitative buildup.*

- *Covering of decommissioned tailings facilities, following detoxification of the cyanide concentrations within the tails, in most instances does not materially reduce the likelihood of a release of toxic chemicals to the environment.*

Conversely, covering may inhibit further reduction of toxic chemicals by natural degradation.

Toxic Metal Release Potential

- *Detoxification of mill tailings may not materially reduce the likelihood of a release of toxic metals to the environment.*

- *Covering of mill tailings without prior detoxification may not materially reduce the likelihood of a release of toxic metals to the environment, except in the case of net precipitative buildup.*

- *Covering of decommissioned tailings facilities, following detoxification of the cyanide concentrations within the tails, in some instances may materially reduce the likelihood of a release of toxic metals to the environment, primarily as a result of reducing the potential for acid generation and resultant mobilization of toxic metals.*

(3) What is the level of certainty you give to the answers provided above?

- *Level of certainty of findings described above is high. Level of certainty with respect to application if findings varies with given site conditions (i.e., in many instances, prescriptive proposed rule requirements may function favorably; likewise, in many instances the prescriptive rule requirements may function with adverse consequences, resulting in non-achievement of Commission policy).*

(4) Are there other technologies which will equally, or more effectively achieve the policy of the Commission?

- *There are variants on the proposed technologies that can equally or more effectively achieve the policy of the Commission. Specific site conditions dictate where variants on detoxification and/or cover requirements are appropriate.*

- *Specifically, once heap leach or tailing materials are detoxified, typical earthen cover systems can equally or more effectively achieve the policy of the Commission at significant economic advantage over prescriptive composite liner systems designed for "hazardous waste" impoundment cover systems.*

In order to help clarify the above findings of the Contractor, the Department would summarize them as follows:

Item	Toxic Chemicals Release Potential (Cyanide)	Toxic Metals Release Potential
Heap Leach Facility		
Detoxification Only	Materially reduces	Does not materially reduce
Cover Only	Does not materially reduce	Materially reduces
Cover after Detoxification	Cover adds little if any benefit to detoxification, and may be a detriment	Materially reduces where acid generating potential exists. Little if any benefit if acid generating potential does not exist
Tailings Facility		
Detoxification Only	Materially reduces	May not materially reduce
Cover Only	Does not materially reduce, except in case of net precipitation buildup	May not materially reduce
Cover after Detoxification	Cover adds little if any benefit beyond detoxification, and may inhibit natural degradation	May materially reduce, by reducing the potential for acid generation

Discussion of Issues and Options for Modification of the December 13, 1992 Rule Draft

Review of the Contractor's report raises several issues which should be further discussed along with the potential for rule modification.

1. **Should the policy statements presented in the RFP and Scope of Work for the Contractor's evaluation be included in the proposed rules to further articulate the Commission's intent with respect to environmental protection?**

   During the discussion and formulation of the RFP, the Commission articulated three statements of policy regarding the level of environmental protection that was deemed appropriate for Oregon. Although these policies were not explicitly included in the rules, staff understood the direction of the Commission regarding content of the rules to include the elements of the policy statements.

The Department believes that it would be appropriate to include the essence of these policy statements within the rules as a further statement of the intent of the rules. The Department has proposed to edit the wording of the policy statements from the RFP and Scope of Work for the Contractor to fit the context of the rules. The proposed amendment to include the policies is shown as an addition to OAR 340-43-006 beginning on page 3 of Attachment A.

2. **Should the rules be modified to clarify the intent for interpretation and application of the guidelines sections of the proposed rules?**

Staff discussions with the Contractor identified some confusion in understanding how the "guideline" sections of the rules (OAR 340-43-040 to 095) should be interpreted in relation to the "requirements" sections (OAR 340-43-016 to 035). For example, 340-43-031 (renumbered from 030) provided as follows:

> "Alternative methods of control of wastes may be acceptable if the permit applicant can demonstrate that the alternate methods will provide fully-equivalent environmental protection. The burden of proof of fully-equivalent protection lies with the permit applicant."

The Department intended that this section allow for approval of fully equivalent alternatives to the criteria that are presented in subsequent guideline sections of the rules. However, the lack of specific wording relating to the guidelines leaves the matter potentially unclear. Staff believes that this lack of clarity caused the contractor to be concerned about the ability to address site specific variables and conditions in a technically sound manner.

The Department believes this concern is legitimate, and needs to be addressed. At the December 14, 1990, EQC meeting, the Commission reflected upon the previous day's work session discussion and provided direction to the staff for development of this rule package. Following are several of the specific directions as quoted from the minutes:

- "Use a blended approach involving both rules and guidelines. The rules should not be too detailed, and the guidelines ought to be dynamic but sufficiently precise to send a reasonable and sufficiently predictable message about the regulatory expectations of Oregon."

- "Direct the rules toward eliminating risk to the environment."
- "Make the rules a combination of performance-based and technology based requirements."
- "Require the best technology available anywhere as a starting point. If technology is being used anywhere else commercially, that technology will be the starting point for requirements. Make the rules technology forcing."
- "Clearly place the burden on the applicant to show why specific technology or performance standards shouldn't apply or why alternative approaches should be considered equivalent and acceptable."
- "Assure that the regulatory approach is preventative and that the need for future superfund cleanup is eliminated."
- "Consider interagency coordination to the maximum extent practicable to minimize duplication of efforts by applicants and the public."

The Department believes the rules proposed to the Commission on December 13, 1991, meet these directions. However, there is need for some clarification to make sure that others interpret the rules as intended.

To achieve this needed clarification, the Department is proposing a number of amendments to the December 13, 1991, rule draft (see Attachment A). The rule on Design, Construction, Operation and Closure Requirements (OAR 340-43-031 {renumbered from 030}) is specifically proposed to be amended to clarify the relationship between the requirements and the guidelines and to more clearly state that alternatives which will provide "..environmental protection that is fully equivalent or better than that achieved by the facilities specified in the guidelines" can be approved. Such alternatives would include other combinations of existing technology, technology adapted for site specific conditions that influence the selection and effectiveness of particular technologies, and newly evolving technology, consistent with the stated Commission desire for a program which is technology forcing.

The wording of this rule amendment may be interpreted by some to provide an unwelcomed degree of flexibility that will result in extreme pressures from permit applicants to relax requirements to reduce costs. There is also concern that Department staff may not have the technical expertise necessary to evaluate the equivalency of alternative technologies and that the increased workload on Department staff to evaluate alternatives will be too great.

The evaluation of alternative proposals is already provided for in the rules -- just not with the clarity desired. The Department routinely evaluates alternative technology with respect to the anticipated ability of that technology to meet environmental standards in individual applications. These rules also provide in OAR 340-43-045 for the permittee to hire a third party contractor, subject to Department approval, to assist the Department with review and evaluation of design and construction specifications. Assistance with evaluation of alternative technologies for equivalency could fall within the scope of work for such a third party contractor.

Finally, the purpose statement of the guidelines section, OAR 340-43-040(1), is proposed to be amended to again clarify the intended application of the guidelines and the ability and process for securing approval of equivalent alternatives.

3. **Should the provisions of the proposed rules related to liners under the heap leach pad be retained as initially proposed or modified in some manner based upon information presented in the Contractor's report?**

The Contractor presented a great deal of information regarding liner systems, factors to be considered in installation, repair, and so on. The double liner system evaluated (OMC Double Liner) was found to be questionable in its ability to meet the Commission's leak criteria. The other two liners systems evaluated would meet the Commission's policy with some difference in characteristics and strengths. The Contractor's alternative liner placed more emphasis on the uppermost liner in terms of its ability to minimize leaks. The triple liner was judged to have a greater risk of puncture due to the placement of the uppermost membrane liner directly on top of the leak detection permeable material without cushioning.

If the objective is to rapidly detect a leak, and take action to repair it, the triple liner configuration is preferred. A leak in the upper membrane would tend to enlarge rapidly, resulting in a greater volume of leakage and earlier detection. If the objective is to minimize leakage through the uppermost liner, the Contractor's alternative would be preferred. The combination of the membrane in direct contact with clay would minimize the volume of material passing through a leak (unless it was a major tear) and extend the time before it would be likely to detect a leak. The bottom liner of the triple liner configuration provides greater environmental protection (membrane in contact with 3 feet of clay) than the alternative (one foot of clay, no membrane).

The Department notes that the Contractor found that there are many possible liner configurations that could meet the Commission's policy. In short, there is no single "best" liner configuration.

As noted above, the Contractor identified the top membrane/leak detection system interface in the OAR 340 Triple Liner configuration as a weakness and suggested the need for providing a protective cushion of some sort between the membrane and the gravel of the leak detection system. The Commission could elect to modify the specification on the OAR 340 Triple Liner to require a cushioning layer to assure protection of the liner, or could leave that decision to the applicant. An applicant's decision to design and install an appropriate cushioning layer would increase the cost of the liner, but would be expected to reduce the delays, inconvenience and extra costs associated with repair of leaks. The Department has not proposed to add a requirement for a cushioning layer.

In evaluating the information in the report, staff found it helpful to look at the information in a slightly different way than presented in the Contractor's report. Rather than describing a liner as a triple liner, it seemed helpful to view liner systems in terms of the primary function of each component as follows:

- <u>Primary Liner</u> -- This would be the uppermost liner. Its primary purpose would be to prevent loss of the process chemical solutions -- from the heap, or pond. As such its purpose is containment. In the heap, the primary liner, together with the process chemical collection system (potentially a system consisting of leachate collection piping imbedded in two feet or more of graded crushed ore or other drainage material placed on top of the primary liner) functions to recover the cyanide solution that has leached through the heap. The primary liner would, as specified in the guidelines, be a continuous flexible membrane of suitable synthetic material. A composite liner consisting of a membrane liner in direct contact with clay could also be used.

- <u>Leak Detection System</u> -- This would be installed immediately below the primary liner, and on top of a secondary liner. Its purpose would be to detect any loss of process solutions by leakage through the primary liner. Upon detection of leakage, its location would have to be identified, and repairs undertaken. Repairs could be accomplished by removal of material to expose the liner for repairs, or potentially by sealing the material in the area of the leak by grouting, or by other means such as abandoning that section of a leach pad. Leak detection technology is evolving. The time-proven system specified in the guidelines relies on approximately 12 inches of graded material that will rapidly transmit leakage to a pipe collection system which will transport the leaked solutions to the edge of the heap or pond. This system can be reliably designed to support the weight of the heap. Newer leak detection systems are using manufactured materials to accomplish the same purpose. These have the advantage of being lower cost. There is less experience with their durability. Finally, electronic leak detection technology is evolving. The Department would expect to receive proposals for consideration of alternatives to the leak detection system defined in the guidelines.

- Secondary Liner -- The secondary liner is placed below the leak detection layer. It is intended to provide assurance that any process solutions that penetrate the primary liner into the leak detection system are contained and are not released into the environment. The secondary liner must reliably contain any leakage pending location of the leak, repair of the leak, and cleanup of the leaked material as required in the guidelines. The secondary liner must also reliably prevent any release of residual process materials into the environment following closure of the facility. In short, the secondary liner is the main component of both the short range and long range environmental protection system. The most reliable secondary liner, as specified in the guidelines, would be a composite liner consisting of a continuous flexible membrane in direct contact with an engineered, stable, low permeability soil/clay layer. In general, increasing thickness of the clay layer will increase the long range protection of the environment.

The proposed rules in Attachment A present two alternatives for criteria for the heap leach pad liner. The first alternative is the triple liner proposal (OAR 340 Triple Liner) presented in the December 13, 1991, rules and evaluated by the Contractor. The second alternative proposal presents the same basic liner components in terms of a primary liner, a leak detection system, and a secondary liner as discussed above. Recognizing that alternative configurations which accomplish fully equivalent or better environmental protection can be approved, the liner configuration specified under either alternative is intended to establish in tangible form the minimum equivalent performance level for the liner system.

The Department would recommend that the wording in alternative 2 (page 15 of Attachment A) be selected because it relates liner system components to their primary purpose and provides a better framework for consideration of potentially equivalent alternative proposals. We note that the liner configurations specified in the December 13, 1991, rules were nearly identical for the heap leach pad liner and the liner under process chemical storage ponds. For purposes of consistency, the Department would also propose that the processing chemical storage pond liner specification be revised in a similar manner to alternative 2 for the heap leach pad. A similar Alternative 2 is presented for the process chemical storage pond liner provision beginning on page 16 of Attachment A.

In reviewing the rules regarding correction of leaks upon detection, the Department notes that OAR 340-43-065(10) refers to Table 2 for the requirements for responding to leakage detected in the heap leach and processing chemical storage pond leak detection systems. Table 2, however, only mentions leakage detected from the leach pad. The Department proposes to amend the table to clearly indicate that it applies to both the heap leach pad and the processing chemical storage ponds.

There remains one issue. The Contractor concluded that the Commission policy could be met with a secondary or bottom liner that utilized a one foot thick low permeability clay layer. The Department is not proposing any reduction from the three foot thick layer initially proposed. The direction provided to the staff in December 1990 stressed the desire for a preventive approach which eliminated any potential need for a future superfund type cleanup. The Department views the three foot clay layer as a better long range protective feature. The Contractor presented information suggesting that the clay layer cost, while not insignificant, was relatively small in comparison to the pipe and gravel leak detection system. The Department believes that the added security of the long range protection provided justifies the incremental cost for the additional clay thickness.

4. **Should the requirements of the proposed rules related to removal of cyanide from mill tailings and reuse of that cyanide be retained as initially proposed or modified in some manner based upon information presented in the Contractor's report?**

The Contractor concluded that removal of cyanide from mill tailings prior to release of tailings to the disposal facility and reuse of the removed cyanide solution in the process was technically feasible, and has been demonstrated. The Contractor further concluded that removal of cyanide from the tailings prior to disposal would reduce the cyanide toxicity and potential for long term release, and may in some instances contribute to reduction in toxicity and potential for release of toxic metals over the long term. The Contractor concluded that reuse, by itself, would not affect the residual cyanide levels in the disposed tailings, and would not result in a reduction of toxicity or the potential for long term release of cyanide from the tailings facility. The Contractor did note that reuse would reduce the total quantity of cyanide reagent consumed over the life of the facility. Finally, the Contractor noted that there are a number of chemical treatment technologies that will equally or more effectively reduce cyanide concentrations in the tailings prior to their disposal, and that these chemical treatment technologies may have some advantages including lower cost, and greater flexibility. The Contractor also noted that if removal and reuse were required, it may be necessary to also utilize some chemical treatment in addition to meet target levels for residual cyanide in the disposed tailings.

The Department continues to recommend that removal of cyanide from the tailings and reuse of recovered cyanide in the process be required. The reuse of any substance, assuming that the process mixture is of a set concentration, will never lower the toxicity. The Department fully agrees. The real issue, however, is that reuse lowers the total volume of chemicals which must be transported to and handled at the facility, thereby reducing the risk of accidental release during these activities.

The removal and reuse requirement would be consistent with the legislative goals for reduction in the quantity of toxic or potentially toxic chemicals used -- both the cyanide used in the leaching process, and the chemicals that would otherwise be used for chemical destruction of cyanide. It would also be consistent with earlier Commission direction to the Department. Finally, there are two potential process that were identified as feasible for achieving the removal and reuse goal.

5. Should the requirements for detoxification and cover of the heap and tailings facility upon closure be retained as initially proposed or modified in some manner based upon information presented in the Contractor's report?

The Contractor concluded that detoxification of the heap prior to closure was technically feasible and would materially reduce the potential for release of toxic chemicals to the environment. Further, detoxification of the tailings prior to disposal to the tailings pond (by removal of cyanide and potentially by further chemical destruction as required) would materially reduce the likelihood of a release of toxic chemicals to the environment. The Contractor concluded that covering of the heap and tailings facilities, without prior detoxification, would not materially reduce the likelihood of release of toxic chemicals to the environment. Finally, the Contractor concluded that covering following detoxification would be beneficial if there is a potential for acid formation based on the chemistry of the ore, otherwise, there would be little if any benefit of covering after detoxification, providing there is no potential for net accumulation of liquid in the heap or tailings facility after closure. The Contractor noted that covering could have a negative result by impeding natural degradation of cyanide by exposure to oxygen and direct sun.

The Department has chosen to not rely on natural degradation of cyanide for meeting an acceptable level of detoxification for closure. Further degradation of residual cyanide may occur prior to covering, but the rate and extent is not predictable, and should not be relied upon. Also, the permittee could elect to delay covering to allow for some additional natural degradation if that was necessary for meeting the detoxification requirements.

The Department has not proposed to modify the December 13, 1991, rule proposal relative to detoxification and cover upon closure. Given the size of a heap leach pad, it seems reasonable to assume that detoxification efforts will not be uniformly effective throughout the entire pad volume. Differences in density of material and other factors would allow for the potential of "hot spots" that are not effectively detoxified. On average, the residual cyanide level in the rinsate may meet the target, but that does not mean that uniform detoxification has been achieved. If precipitation is allowed to percolate through the heap after closure, further leaching of chemicals could occur. The Department concludes that covering, after detoxification, affords an increased level of security and long term environmental protection for the site.

6. **Should some consideration be given to the potential for redundancy that may occur as a result of the cumulative effects of the various provisions of the rules?**

The Contractor, in the introduction to their summary of findings, noted that "... due to the structuring of the RFP, the cumulative result of all proposed rule components, while significant, is not portrayed." Some would argue that if the liner is sufficient to contain the material and prevent loss to the environment, it should not be necessary to go to the added cost and trouble of detoxifying. Similarly, some would argue that the liner should negate the need for a cover -- the protection of the liner proposed by the Department is sufficient.

In reviewing this issue, the Department notes that the liner system is necessary during active operations to assure that process solutions are not released to the environment. The liner system also can continue to function during and after closure to prevent loss of residual chemicals to the environment. Detoxification is intended to reduce the potential for release of potentially toxic materials to the environment after closure. Cover is intended to prevent precipitation from entering the heap or tailings facility after closure and causing instability, or continued leaching and transport of chemicals to the environment. Thus, to address concerns during the active operation phase, **a fully effective liner system is required.** Thus, any potential for redundancy would be related to the closure phase of the requirements.

The Department believes that it is all but impossible to predict all of the possible things that could occur at a site during operation and after closure that would result in an unintended environmental effect. The Contractor's findings clearly state that detoxification materially reduces the likelihood of a release of toxic chemicals (cyanide) to the environment and that the certainty of their findings is high. If acid forming condition exist, the combination of detoxification and cover may materially reduce the likelihood of toxic metals release to the environment. The Department concludes that detoxification is a high priority requirement for long term environmental protection, and is not redundant of the liner system.

It may be appropriate for the Commission to consider the potential tradeoff between covering of the heap and the thickness of the clay layer of the secondary (bottom) liner and the level of short term and long term environmental protection that is afforded by the secondary liner. The Department notes that the cover would work to prevent fluid passing through the heap where it could potentially create a problem -- either by penetration of the liner system to reach the environment, or by moving laterally along the liner system to exit via drainage to the surface drainage system. The liner system would minimize any release to the environment below the liner, but would not preclude the potential release to the ground surface adjacent to the heap. Thus the Department concludes the liner and cover work together to minimize the potential for creation of problems after closure. The question would be whether the three foot thick clay portion of the secondary liner could be reduced in relation to cover requirement. In the discussion on liners (issue 3), the Department concluded that the cost of the clay layer, although not insignificant, was small compared to the cost of other components of the liner system, and elected to recommend retaining the requirement for three feet of clay (or an equivalently protective alternative) as a long range protective feature. The Department is not persuaded to alter that recommendation in light of the above analysis.

Finally, it is noted that a decision regarding the liner requirements is necessary at the beginning of the process since liners are among the first facilities to be installed. Covers may not be installed on the first components at a project site for 5 or more years. Thus, there is an opportunity to reevaluate the desirability for cover requirements if and when new information becomes available up to the time cover installation would begin. The Department believes that prudent planning for any project at this time should include provisions for cover after detoxification to assure appropriate long range environmental protection.

7. Should the provisions of the proposed rules be modified to more clearly provide for independent on-site inspection during liner installation and loading of the leach pad?

The Contractor's report stresses the importance of using care when installing the leachate collection layer on top of the primary liner and then loading the initial ore on the heap leach pad. Care is needed to assure that the liner system is not damaged in the process. Other consultants who called staff during the period when the RFP was being circulated also stressed the critical importance of continuous on-site regulatory inspections during this process.

The existing rules provide for a third party contractor to be employed to assist in design review, and during construction of disposal facilities but did not clearly provide for any review or inspection functions during operations. Commissioner Lorenzen asked at the December 13, 1991, meeting that the scope of inspection during construction be broadened beyond "disposal" facilities. The Department proposes to modify this section of the rules (OAR 340-43-045(6)) as suggested by Commissioner Lorenzen and to clearly expand the universe of activities that would be within the scope of work for a third party contractor to include inspection of operations after construction (see page 12 of Attachment A).

An additional issue may warrant some consideration by the Commission. The Department's Contractor informally advised that one approach that is being used relative to third party contractor inspection services includes routine provisions to change contractors after about 3 years to make sure that the relationship between the contractor's field inspector and the permittee do not become too friendly. There are other possible procedures that could be explored for contractor selection, contractor hiring, and payments to the third party contractor to assure that the contractor is not perceived to be an employee of the permittee. The current rule wording was selected because of concern regarding the budget restrictions which limit the ability of the Department to accept funds from the applicant and expend them for employing the third party consultant. It may be appropriate to explore some form of escrow account for this purpose. The Department is not making a specific proposal on these issues at this time, but feels they merit some discussion, and could be the subject of additional policy direction from the Commission.

8. Miscellaneous changes to the proposed rules

There are a number of minor changes to the rules proposed in Attachment A that have not been discussed. Some rule renumbering is proposed to comply with the requirements of the Secretary of State that rule numbers that have been used in the past not be reused.

The Attorney General's office has advised the Department that the process for land use compatibility determination needs to be clarified in the rule. Additional language is proposed to be inserted into OAR 340-43-016 to achieve this purpose. The Department intends to rely on a determination coordinated by the Department of Geology and Mineral Industries pursuant to the provisions of HB 2244. This issue will likely have to be addressed in further detail when the Department's State Agency Coordination Program and related rules are updated.

Finally, some additional editorial changes have been made to improve the clarity of the rules and remove potential ambiguity.

Department Recommendation

The Department recommends that the rules last considered by the Commission on December 13, 1991, with modifications as recommended above, including approval of Alternative 2 for the heap leach pad liner requirements, and Alternative 2 for the processing chemical pond liners be adopted as presented in Attachment A.

Attachments

A. Chemical Mining Rules Proposed for Adoption

B. Procedural Documentation of Rulemaking Process

   1. Public Notice
   2. Rulemaking Statements
   3. Fiscal and Economic Impact Statement
   4. Land Use Compatibility Statement
   5. Abstract of Technical Comments Received Regarding Proposed Rules for Chemical Mining
   6. Response to Public Comment Regarding Proposed DEQ Chemical Mining Rules
   7. December 13, 1991 Rule Draft Showing Revisions to June 14, 1991 Draft
   8. Summary of Record of EQC Discussions of Mining Rules

<u>References</u> (Available upon request)

1. Final Consultant's Report
2. Letters of Comment on Draft Consultant's Report
3. Draft Consultant's Report
4. RFP
5. Proposal submitted by TRC Environmental Consultants
6. Contract between DEQ and TRC
7. Amendment No. 1 to Contract between DEQ and TRC
8. <u>Issue Paper on Proposed Chemical Mining Rules</u> prepared by CH_2M Hill and Stoel Rives Boley Jones & Grey, May 5, 1992.

HLS:1

Note: Underlined text is proposed language to be added to the rule draft presented to the Commission on 12/13/91.

~~[Bracketed and struck through]~~ text is proposed language to be deleted from the rules presented to the Commission on 12/13/91.

RULES PROPOSAL:

OREGON ADMINISTRATIVE RULES

CHAPTER 340

DIVISION 43

CHEMICAL MINING

OAR 340-43-006~~[5]~~	Purpose and Policies
OAR 340-43-011~~[0]~~	Definitions
OAR 340-43-016~~[5]~~	Permit Required
OAR 340-43-021~~[0]~~	Permit Application
OAR 340-43-026~~[5]~~	Plans and Specifications
OAR 340-43-031~~[0]~~	Design, Construction, Operation and Closure Requirements
OAR 340-43-035	Exemption from State Permits for Hazardous Waste Treatment or Disposal Facilities

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

OAR 340-43-040	Purpose
OAR 340-43-045	General Provisions
OAR 340-43-050	Control of Surface Water Run-On and Run-Off
OAR 340-43-055	Physical Stability of Retaining Structures and Emplaced Mine Materials
OAR 340-43-060	Protection of Wildlife
OAR 340-43-065	Guidelines for Design, Construction, and Operation of Heap-Leach Facilities
OAR 340-43-070	Guidelines for Disposal of Mill Tailings
OAR 340-43-075	Guidelines for Disposal or Storage of Wasterock, Low-Grade Ore and Other Mined Materials
OAR 340-43-080	Guidelines for Heap-Leach and Tailings Disposal Facility Closure
OAR 340-43-085	Post-Closure Monitoring
OAR 340-43-090	Land Disposal of Wastewater
OAR 340-43-095	Guidelines for Open-Pit Closure

PURPOSE and POLICIES

340-43-006~~[5]~~

Renumber to comply with Secretary of State requirement that prior numbers not be used.

(1) The purpose of these rules and guidelines is to prevent water pollution and protect the quality of the environment and public health in Oregon, consistent with the policies of ORS 468B.015 and 468B.020, by requiring application of ~~["...]~~ all available and reasonable methods~~[...", Oregon Revised Statutes (ORS) 468.710,]~~ for control of wastes and chemicals relative to design, construction, operation, and closure of mining operations which use cyanide or other toxic chemicals to extract metals or metal-bearing minerals from the ore and which produce wastes or wastewaters containing toxic materials.

Original statute citation did not match quote. Statutes renumbered following 1991 legislature. Amendments intended to more clearly state original intent.

(2) The following policies are established to provide further guidance regarding the level of environmental protection these rules are intended to achieve:

This new section is intended to codify the policies that were articulated by the Commission as part of the RFP for the Contractor's evaluation. Wording of these policy statements has been modified for clarity and to be compatible with the rule format.

(a) Liner, leak detection and leak collection systems (systems) are necessary for heap leach pads, solution ponds, and tailings facilities to assure that any leak will be detected before toxic materials escape from the liner system and are released to the environment. For purposes of these rules, the environment is considered to begin at the bottom of the last liner. These systems shall assure that a leak is found, and that sufficient time is available to allow for the repair of the leak and clean up of any leaked material before there is a release to the environment. Natural conditions, such as depth to groundwater or net rainfall, shall be considered as additional protection but not in lieu of the protection required by the engineered liner system.

(b) The toxicity of mill tailings and the potential for long-term cyanide and toxic metals release from mill tailings shall be reduced to the greatest degree practicable through removal and reuse of chemical solutions prior to placement of tailings in the tailings disposal facility.

(c) The closure of heap leach pads and tailings disposal facilities shall prevent future release to the environment of residual potentially toxic chemicals contained in the facility.

DEFINITIONS

340-43-011~~[0]~~

Renumber to comply with Secretary of State requirement that prior numbers not be used.

Unless the context requires otherwise, as used in this Division:

(1) "Chemical process mine" means a mining and processing operation for metal-bearing ores that uses chemicals to dissolve metals from ores.

(2) "Department" means the Department of Environmental Quality.

(3) "Guidelines" means this body of rules contained in 340-43-045 through 340-43-100.

(4) "Positive exclusion of wildlife" means the use of such devices as tanks, pipes, fences, netting, covers and heap-leach drip-irrigation emitters or covered emitters.

(5) "Tailings" means the spent ore resulting from the milling and chemical extraction process.

PERMIT REQUIRED

340-43-016~~[5]~~

Renumber to comply with Secretary of State requirement that prior numbers not be used.

The reference for statutory authority for requiring a permit is added for clarity.

(1) As required by ORS 468B.050, a~~[A]~~ person proposing to construct a new chemical mining operation, commencing to operate an existing non-permitted operation, or proposing to substantially modify or expand an existing operation shall first apply for, and receive, a permit from the Department. The permit may be an NPDES (National Pollutant Discharge Elimination System) permit if there is a point-source discharge to surface waters or a WPCF (Water Pollution Control

Facility) permit if there is no discharge. Consideration may be given to site-specific conditions such as climate, proximity to water, and type of wastes to establish the final permit type and requirements for the facility.

(2) The permit application shall comply with the requirements of OAR Chapter 340, Divisions 14 and 45 and be accompanied by a report that fully addresses the requirements of this Division.

(3) Prior to issuance of a permit for a chemical process mining activity under this Division, a determination of compliance with statewide planning goals and compatibility with local land use plans must be made. The Department shall determine compliance with Statewide Planning Goals and compatibility with acknowledged comprehensive plans and land use regulations in a manner consistent with its approved State Agency Coordination Program and the rules in OAR Chapter 340, Division 18. In making these determinations, the Department shall consider and may rely on the findings and recommendations made by the project coordinating committee authorized by ORS 517.965 and by the Department of Geology and Mineral Industries pursuant to their State Agency Coordination Program and OAR Chapter 632, Divisions 1 and 37.

The Attorney General advised that the process for land use compatibility determination needs to be clarified in the rule. The Department intends to rely on a determination coordinated by the Department of Geology and Mineral Industries pursuant to the provisions of HB 2244 (Chapter 735, Oregon Laws 1991).

PERMIT APPLICATION

340-43-021~~[0]~~

Renumber to comply with Secretary of State requirement that prior numbers not be used.

(1) The permit application shall fully describe the existing site and environmental conditions, with an analysis of how the proposed operation will affect the site and its environment. The application ~~[Department]~~ shall, at a minimum, contain ~~[require]~~ the information specified for the DOGAMI (Department of Geology and Mineral Industries) consolidated application under ORS 517.971 (Section 13, Chapter 735, 1991 Oregon Laws). The Department will also use the information contained in NEPA (National Environmental Policy Act), EA (Environmental Assessment), or EIS (Environmental

Amendments intended to clarify requirements, terms, and statutory reference.

Impact Statement) documents, if they are required for ~~[by]~~ the project, as partial fulfillment of the requirements of this paragraph.

(2) The permit application shall, in addition to the information described in Paragraph (1) above, include the following information, unless the information has been otherwise submitted:

(a) Climate/meteorology characterization, with supporting data;

(b) Soils characterization, with supporting data;

(c) Surface water hydrology study, with supporting data;

(d) Characterization of surface water and groundwater quality;

(e) Inventory of surface water and groundwater beneficial uses;

(f) Hydrogeologic characterization of groundwater, with supporting data;

(g) Geologic engineering, hazards and geotechnical study, with supporting data;

(h) Characterization of mine materials and wastes which include, for example, overburden, waste rock, stockpiled ore, leached ore and tailings. Characterization of mine materials and wastes shall include, but not be limited to the following:

(A) Chemical and mineral analysis related to toxicity;

(B) Determination of the potential for acid water formation;

(C) Determination of the potential for long-term leaching of toxic materials from the wastes;

(i) Characterization of wastewater (quantity and chemical and physical quality) produced by the operation;

(j) Assessment of the potential for acid-water formation from waste disposal facilities, low-grade ore stockpiles, waste rock piles and for surface water or groundwater accumulation in open pits that will remain after mining is ended.

(3) Data submitted by the permit applicant should be based on analysis of the actual materials, when possible, or may be based on estimates from knowledge of similar operations and professional judgment.

PLANS AND SPECIFICATIONS

340-43-026~~[5]~~

Renumber to comply with Secretary of State requirement that prior numbers not be used.

(1) A person constructing or commencing to operate a chemical process mine or substantially modifying or expanding an existing chemical process mine shall first submit plans and specifications to the Department for construction, operation and maintenance of the facilities intended for treatment, control and disposal of wastes.

(2) ~~[The Department shall approve the plans, in writing, before construction of the facilities may be started.]~~ The plans shall address all applicable requirements of this Division and shall include, but not be limited to, the following:

Deleted text is relocated to a new paragraph (3). Intent of change is to improve clarity.

(a) A description of the facilities to be constructed, including tanks, pipes and other storage and conveyance means for processing chemicals and solutions and wastewaters;

(b) A management plan for control of surface water;

(c) A management plan for treatment and disposal of excess wastewater, including provisions for reuse and wastewater minimization;

(d) A facility construction plan including, as applicable, the design of low-permeability soil barriers, the type of geosynthetics to be used and a description of their installation methods, the design of wastewater treatment facilities and processes, a quality assurance plan for applicable phases of construction and a listing of construction certification reports to be provided to the Department;

(e) A preliminary closure plan;

(f) A preliminary post-closure monitoring and maintenance plan;

(g) A spill containment and control plan.

(3) The Department shall approve the plans, in writing, before construction of the facilities may be started.

DESIGN, CONSTRUCTION, OPERATION AND CLOSURE REQUIREMENTS

340-43-031~~[0]~~

Renumber to comply with Secretary of State requirements that prior numbers not be used.

(1) All chemical process and waste disposal facilities and facilities for mixing, distribution, and application of chemicals associated with on-site mining operations; ore preparation and beneficiation facilities; and processed ore disposal facilities shall be designed, constructed, operated and closed in accordance with the guidelines contained in this Division.

(2~~[3]~~) Alternative facilities and methods of control of wastes and potential pollutants may be approved by the Department ~~[acceptable]~~ if the permit applicant can demonstrate that the alternate facilities and methods will provide ~~[fully equivalent]~~ environmental protection that is fully equivalent or better than that achieved by the facilities specified in the guidelines in Sections 43-040 to 43-095 of these rules. The burden of proof of fully equivalent protection lies with the permit applicant. Written approval of any alternative by the

Amendments are intended to clarify that equivalent technology can be substituted for that specified in the guidelines section. In addition, the wording was broadened in response to the concern of Commissioner Squier that the term waste was too narrow in

Department shall be evidence of acceptance as equivalent or better level of environmental protection.

(3~~[2]~~) A groundwater monitoring plan shall be submitted to, and be approved by the Department. Monitoring wells shall be installed for detection of groundwater contamination as required by OAR Chapter 340, Division 40, unless the Department concludes in writing that the hydrogeology of the site or other technical information indicates that an adverse impact on groundwater quality is not likely to occur.

(4) The Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with these rules.

scope. This new wording intended to allow appropriate consideration of site specific factors in the selection of appropriate technologies as well as allow for selection and use of new technologies that may be developed.

EXEMPTION FROM STATE PERMIT FOR HAZARDOUS WASTE TREATMENT OR DISPOSAL FACILITIES

340-43-035

(1) The state hazardous waste program requires a permit for the "treatment", "storage" or "disposal" of any "hazardous waste" as identified or listed in OAR Chapter 340, Division 101 from the Department, prior to the treatment and disposal of wastes. Permitting requirements can be found in OAR Chapter 340, Division 105, Hazardous Waste Management.

(2) However, any operation permitted under this Division, which would otherwise require the neutralization or treatment of hazardous waste and would require a permit pursuant to OAR Chapter 340, Division 105, shall be exempt from the requirement to obtain such hazardous waste treatment permit.

(3) All mined materials disposed of under this Division shall pass Oregon's hazardous waste rule criteria or they will be considered a state hazardous waste and must be disposed of accordingly.

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

PURPOSE

340-43-040

(1) This Division establishes criteria for the design, construction, operation and closure of chemical mining operations and supplements the provisions of OAR 340-43-006~~[5]~~ through OAR 340-43-035. These criteria are intended to establish the minimum level of environmental protection that is necessary using a combination of performance standards and minimum design criteria. Approval of alternative facilities or methods to achieve an equivalent or better environmental result is allowed as defined in OAR 340-43-031.

This addition is intended to further clarify the intended application of the guidelines, and the ability and process for securing approval of alternatives.

(2) Any disapproval of submitted plans or specifications, or imposition of requirements by the Department to improve existing facilities or their operation will be referenced when appropriate, to applicable guidelines or rules.

GENERAL PROVISIONS

340-43-045

(1) Facilities permitted under either a WPCF or NPDES permit shall not discharge wastewater or process solutions to surface water, groundwater or soils, except as expressly allowed by the permit.

(2) Facilities subject to these rules shall not be sited in 100-year floodplains or wetlands. A buffer zone (a minimum of 200 feet wide) shall be established between waste disposal facilities and surface waters.

(3) All chemical conveyances (ditches, troughs, pipes, etc.) shall be equipped with secondary containment and

leak detection means for preventing and detecting release of chemicals to surface water, groundwater or soils.

(4) Acid water accumulation in open pits resulting from the mining operation must be prevented by appropriate mining practices, by measures taken in the closure process, or be treated to control pH and toxicity, for the life of the pit.

(5) Construction of surface impoundment liner systems shall conform generally to the principles and practices described in EPA/600/2-88/052, Lining of Waste Containment and Other Impoundment Facilities, September 1988.

(6) The Department may require the permittee to hire a third-party contractor to perform the functions set forth below. Selection of the contractor shall be subject to Department approval.

(a) Review and evaluate the design and construction specifications of all mined-materials disposal facilities permitted under this Division for functional adequacy and conformance with Department requirements. The Department shall not approve construction of the disposal facilities until the design and construction specifications have been evaluated.

(b) Monitor the course of construction of all mined-materials ~~[disposal]~~ facilities for compliance with the approved design and construction specifications. The third-party contractor shall regularly document the progress of construction and the Department shall require the permittee to take corrective action if construction does not satisfactorily conform to the approved design and construction specifications.

Commissioner Lorenzen expressed concern that the term "disposal facilities" is too narrow. He requested the word "disposal" be removed from this rule regarding independent review.)

(c) Provide on-site inspections during ongoing operations, including but not limited to the loading of the heap, to assure protection of the integrity of

This provision is added in response to the importance noted by the Contractor regarding loading of the

the liner system and other environmental protection measures.

heap so as to not damage the liner.

CONTROL OF SURFACE WATER RUN-ON AND RUN-OFF

340-43-050

(1) Surface water run-on and run-off shall be controlled such that it will not endanger the facility or become contaminated by contact with process materials or loaded with sediment. The control systems shall be designed to accommodate a 100-year, 24-hour storm event, or any other defined climatic event that is more appropriate to the site, and be placed so as to allow for restoration of the natural drainage network, to the maximum extent practicable, upon facility closure.

(2) All mined materials shall be properly placed and protected from surface water and precipitation so as not to be eroded and contribute sediment to site stormwater run-off or to otherwise contaminate surface water.

PHYSICAL STABILITY OF RETAINING STRUCTURES AND EMPLACED MINE MATERIALS

340-43-055

(1) Permit applicants must demonstrate to the Department that the design of chemical processing facilities and waste disposal facilities is adequate to ensure the stability of all structural components of the facilities during operation, closure and post closure.

(2) Retaining structures, foundations and mine materials emplacements shall be designed by a qualified, registered professional and be constructed for long-term stability under anticipated loading and seismic conditions.

(3) Temporary structures and materials emplacements may, with written approval from the Department, be con-

structed to a lesser standard if it can be shown that they pose no, or minimal, threat to public safety or the environment.

PROTECTION OF WILDLIFE

340-43-060

(1) Wildlife shall be positively excluded from contact with chemical processing solutions and wastewaters containing chemicals.

(2) The Department may waive the positive exclusion requirement if the Oregon Department of Fish and Wildlife (ODF&W) certifies to the Department that the project is designed such that it will adequately protect wildlife.

GUIDELINES FOR DESIGN, CONSTRUCTION, AND OPERATION OF HEAP-LEACH FACILITIES

340-43-065

(1) This paragraph applies to heap-leach facilities using dedicated, or expanding, pads. Heap-leach facilities using on-off, reusable pads may require variations from these rules; they shall be approved on a case-by-case basis by the Department.

(2) The heap-leach facility (pad and associated ponds, pipes and tanks) shall be sized to prevent flooding of any of its components.

(3) TABLE 1 of this Division establishes minimum capacity-sizing criteria for the leach-pad and ponds. The pad and ponds may be designed to act separately or in conjunction with each other to obtain the required storage volumes. Other design criteria may be used, with Department approval, if local conditions warrant. The best available climatic data shall be used to confirm the critical design storm event and estimate the liquid levels in the system over a full seasonal cycle.

The liquid mass balance may include provision for evaporation.

<u>Heap Leach Pad Liner Alternative 1</u>

(4) The heap-leach pad liner system shall be of triple liner construction with between-liner leak detection consisting of:

(As proposed in the December 13, 1991 rules.)

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous flexible-membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec);

(c) A leak-detection system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre within ten weeks of leak initiation.

<u>Heap Leach Pad Liner Alternative 2</u>

<u>(4) The heap leach pad liner system shall be designed, constructed, and operated to meet the following criteria:</u>

<u>(a) A primary liner consisting, at a minimum, of a continuous flexible-membrane of suitable synthetic material shall be provided. This liner shall function together with the process chemical collection system installed immediately above this liner (see section (8) of this rule) to remove process chemicals from the heap.</u>

<u>(b) A leak detection system shall be installed immediately below the primary liner for the purpose of detecting loss of process solutions by leakage through the primary liner. The leak detection system shall be capable of detecting leakage through the primary liner of 400 gallons/day-acre within ten weeks of leak initiation. The leak</u>

This alternative is intended to define the liner system more in terms of the intended purpose of each component in relation to operational purposes and environmental protection purposes. It is recognized that there are alternative configurations for the primary liner, the leak detection system, and the secondary liner that may achieve equivalent environmental protection and be more appropriate for an individual facility. The applicant would have the opportunity to secure approval of an alternative detection system shall consist of appropriately sized collection piping placed within a minimum thickness of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec) that is capable of withstanding the anticipated weight of the heap without loss of function.

design that would achieve equivalent or better environmental protection as provided in OAR 340-43-031.

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the operation of the heap and following closure of the heap is not released to the environment. The Secondary liner shall be of a composite design with a continuous flexible-membrane of suitable synthetic material in direct contact with an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches.

Processing Chemical Pond Liner Alternative 1

(5) The processing-chemical pond liners shall be of triple liner construction with between-liner leak detection consisting of:

(Original rule language from December 13, 1991 Draft.)

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous flexible-membrane middle and top liners of suitable synthetic material separated by a permeable material (minimum coefficient of permeability of 10^{-2} cm/sec);

(c) A leak detection system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre, within ten weeks of leak initiation.

Processing Chemical Pond Liner Alternative 2

(5) The processing chemical pond liner system shall be designed, constructed, and operated to meet the following criteria:

This proposed alternative is patterned after Alternative 2 for the Heap Leach Pad Liner. It is intended to

(a) A primary liner consisting, at a minimum, of a continuous flexible-membrane of suitable synthetic material shall be provided. This liner shall provide for positive containment of processing chemical solutions.

(b) A leak detection system shall be installed immediately below the primary liner for the purpose of detecting loss of process chemical solutions by leakage through the primary liner. The leak detection system shall be capable of detecting leakage through the primary liner of 400 gallons/day-acre within ten weeks of leak initiation. The leak detection system shall consist of appropriately sized collection piping placed within a layer of permeable material (minimum permeability of 10^{-2} cm/sec).

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the use of the pond is not released to the environment. The Secondary liner shall be of a composite design with a continuous flexible-membrane of suitable synthetic material in direct contact with an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches.

capture the liner specifications in Alternative 1 but in different words.

(6) Emergency ponds may be constructed as an alternative to larger pregnant and barren ponds. The emergency pond may be constructed to a lesser standard, with the limitation that it is to be used only infrequently and for short periods of time. The Department will specify reporting and use limitations for the ponds in the permit. A between-liner leak detection system is not required for the emergency pond.

(7) The emergency-pond liner shall be of composite construction consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-6}

cm/sec) with a minimum thickness of 12 inches, and

(b) A single flexible-membrane synthetic top liner of suitable material.

(8~~[6]~~) The heap-leach pad shall be provided with a process chemical collection system above the upper-most liner that will prevent an accumulation of process chemical within the heap greater than 24 inches in depth.

The numbering for this and subsequent sections was incorrectly shown in the December 13, 1991 rule draft.

(9~~[7]~~) The permittee shall prepare a written operating plan for safe temporary shut-down of the heap-leach facility and train employees in its implementation.

(10~~[8]~~) The permittee shall respond to leakage collected by the heap-leach and processing-chemical storage pond leak-collection systems according to the process defined in TABLE 2.

(11~~[9]~~) The permittee shall determine the acid-generating potential of the spent ore by acid\base accounting and other appropriate static and dynamic laboratory tests. If the spent ore is shown to be potentially acid generating under the conditions expected in the heap at closure, the permittee shall submit a plan for acid correction for Department approval prior to loading the heap.

GUIDELINES FOR DISPOSAL OF MILL TAILINGS

340-43-070

(1) Mill tailings shall be treated by cyanide removal and re-use prior to disposal to reduce the amount of cyanide introduced into the tailings pond. Chemical oxidation or other means shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the liquid fraction of the tailings. The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD

No change is proposed in the requirements for removal and reuse of cyanide. See discussion in staff report.

cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm.

(2~~[3]~~) The permittee shall determine the potential for acid-water formation from the tailings by means of acid-base accounting and other suitable laboratory static and dynamic tests. If acid formation can occur, basic materials shall be added to the tailings in the amount of three (3) times the acid formation potential or to give a net neutralization potential of at least 20 tons of $CaCO_3$ per 1000 tons of tailings, whichever is greater, before placing tailings in the disposal facility.

Section 2 was previously deleted, and the subsequent sections were not renumbered. The amended numbering corrects this error.

(3~~[4]~~) The disposal facility shall be lined with a composite double liner consisting of a flexible-membrane synthetic top liner in tight contact with an engineered, stable, soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) having a minimum thickness of 36 inches.

Construction of the liner shall generally follow the principles and practices contained in EPA/600/2-88/052, "Lining of Waste Containment and Other Impoundment Facilities, September, 1988.

(4~~[5]~~) The disposal facility shall be provided with a leachate collection system above the liner suitable for monitoring, collecting and treating potential acid drainage.

GUIDELINES FOR DISPOSAL OR STORAGE OF WASTEROCK, LOW-GRADE ORE AND OTHER MINED MATERIALS

340-43-075

The permittee shall determine the acid-producing and metals-release potential of the wasterock, low-grade ore or other mined materials by acid/base accounting and other appropriate static and dynamic laboratory tests. If the mined materials are shown to be potentially acid forming, or capable of releasing toxic metals, the permittee shall submit a plan for correction and disposal for Department approval prior to permanently placing the materials.

GUIDELINES FOR HEAP-LEACH AND TAILINGS DISPOSAL FACILITY CLOSURE

340-43-080

(1) The waste disposal facilities shall be closed under these rules in conjunction with the reclamation requirements of DOGAMI (Oregon Department of Geology and Mineral Industries).

(2) An up-dated closure plan and post-closure monitoring and maintenance plan shall be submitted to the Department by the permittee at least 180 days prior to beginning closure operations or making any substantial changes to the operation. The closure plan must be compatible with DOGAMI's reclamation plan and may be part of it.

(3) Chemical conveyances (ditches, troughs, pipes, etc.) not necessary for post-closure monitoring shall be removed. The secondary containment systems shall be checked before closure for process-chemical contamination, and contaminated soil or other materials, if any, shall be removed to an acceptable disposal facility.

(4) Closure of the heap-leach facility.

(a) The heap shall be detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm.

(b) Following detoxification as defined in (a) above, the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water and air infiltration. The cover should consist, at a minimum, of a low-permeability layer and suitable drainage and soil layers to prevent erosion and damage by animals and to sustain

No change is proposed in the cover requirement. See staff report for discussion.

vegetation growth, in accordance with DOGAMI's reclamation rules.

(c) The ponds associated with the heap shall be closed by folding in the synthetic liners and filling and contouring the pits with inert material. Residual sludge may be disposed of in one of the on-site waste disposal facilities, provided it meets the criteria for such wastes in these guidelines. The process chemical collection system of the heap shall be maintained in operative condition so that it can be used to monitor the amount and quality of infiltrated water, if any, draining from the heap.

(5) The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time. Maximum effort shall be made to isolate the tailings from the environment. Construction of the cover shall generally follow the principles and practices contained in <u>EPA/530-SW-89-047, Technical Guidance Document -- Final Covers on Hazardous Waste Landfills and Surface Impoundments</u>.

No change is proposed in the cover requirement. See staff report for discussion.

POST-CLOSURE MONITORING

340-43-085

(1) The Department may continue its permit in force for thirty (30) years after closure of the operation and will include permit requirements for periodic monitoring to determine if release of pollutants is occurring.

(2) Monitoring data will be reviewed regularly by the Department to determine the effectiveness of closure of the disposal facilities. The Department will consult with DOGAMI on release of security funds that would otherwise be needed to correct problems resulting from ineffective closure.

LAND DISPOSAL OF WASTEWATER

340-43-090

(1) To qualify for land disposal of excess wastewater, the permit applicant shall demonstrate to the Department that the process has been designed to minimize the amount of excess wastewater that is produced, through use of water-efficient processes, wastewater treatment and reuse, and reduction by natural evaporation. Excess wastewater that must be released shall be treated and disposed of to land under the conditions specified in the permit.

(2) A disposal plan shall be submitted as part of the permit application that, at a minimum, includes:

(a) Wastewater quantity and quality characterization;

(b) Soils characterization and suitability analysis;

(c) Drainage and run-off characteristics of the site relative to land application of wastewater;

(d) Proximity of the disposal site to groundwater and surface water and potential impact;

(e) Wastewater application schedule and water balance;

(f) Disposal site assimilative capacity determination;

(g) Soils, surface water and groundwater monitoring plan;

(h) Potential impact on wildlife or sensitive plant species.

(3) The Department will evaluate the disposal plan and set site-specific permit conditions for the wastewater discharge.

GUIDELINES FOR OPEN-PIT CLOSURE

340-43-095

(1) Open pits that will be left as a result of the mining operation shall be assessed prior to, and following, mining operations for the potential to contaminate water to the extent that it might not meet water-quality standards due to build-up of acid or toxic metals.

(2) If the Department finds that the potential for water accumulation in the pit(s) exists, the permit applicant shall submit a closure plan for the pit that will address contamination prevention and possible remedial treatment of the water. The closure plan shall, at a minimum, examine the following alternatives:

(a) Avoidance, during mining, of acid-generating materials that can be left in place, rather than being exposed to oxidation and weathering;

(b) Removal from the pit and disposal, during or after the mining operation, of residual acid-generating materials that would otherwise be left exposed to oxidation and weathering;

(c) Protective capping in-situ of residual acid-generating materials;

(d) Treatment methods for correcting acidity and toxicity of accumulated water;

(e) Installation of an impermeable liner under ponded water to prevent groundwater contamination;

(f) Backfilling of the pit(s) above the water table to reduce oxidation of residual acid-generating materials.

TABLE 1

Heap-Leach Liquid Storage Criteria

Component	Pregnant-Solution Pond	Barren-Solution Pond
Operating Volume	Minimum necessary to maintain recirculation	Minimum necessary to maintain recirculation
Operational Surge	Anticipated draindown and rinse volume	Anticipated draindown and rinse volume
Climatic Surge	100-yr, 24-hr storm plus 10-yr snowmelt	100-yr, 24-hr storm plus 10-yr snowmelt
Safety Factor	2-ft dry freeboard	2-ft dry freeboard

TABLE 2

Required Responses to Leakage Detected from the Leach Pad and Processing Chemical Storage Ponds

Leakage Category	Response
Zero leakage to 200 gal/day-acre	Notify the Department; increase pumping and monitoring
Leakage from 200 gal/day-acre to 400 gal/day-acre	Change operating practices to reduce leakage
Leakage in excess of 400 gal/day-acre	Repair leaks under Department schedule.

Oregon Department of Environmental Quality

A CHANCE TO COMMENT ON...

OAR Chapter 340, Division 43--Proposed Rules For
MINING OPERATIONS WHICH USE CYANIDE OR OTHER TOXIC CHEMICALS
TO EXTRACT METALS OR METAL-BEARING MINERALS FROM ORES

Notice Issued: 4-12-91
Comments Due : 5-20-91

WHO IS AFFECTED:

Mining and ore-processing operations which use chemicals to extract metals or metal-bearing minerals from the ore and Oregonians who could be affected by or have an interest in these types of mining operations.

WHAT IS PROPOSED:

The Department of Environmental Quality is proposing to adopt rules to regulate affected mining and ore-processing operations. The rules would apply to heap-leaching, a process that uses cyanide compounds or other chemicals to extract gold and silver from ore as well as vat-leaching and milling. The rules would constitute a separate division in Oregon's water-quality control rules (OAR Chapter 340).

WHAT ARE THE ENVIRONMENTAL CONCERNS:

The primary environmental concern about heap-leaching, vat-leaching and milling is the potential to contaminate the environment. Chemicals that spill or escape devices designed to contain them may reach nearby surface water or may filter through soils to reach groundwater.

If people use water near a leaching or milling operation for irrigation, recreation or drinking, health concerns may become an issue. Wildlife or livestock may drink from water that could be contaminated by chemicals. Mine processing ponds that hold cyanide solution may attract birds and other wildlife in areas where water is scarce.

Spent ore, from which gold and silver have been extracted, must be treated and disposed of properly to protect people and wildlife from contact with toxic metals, cyanide or other chemicals.

deq
811 S.W. 6th Avenue
Portland, OR 97204

11/1/86

FOR FURTHER INFORMATION:

Contact the person or division identified in the public notice by calling 229-5696 in the Portland area. To avoid long distance charges from other parts of the state, call 1-800-452-4011.

Other issues that are not unique to leaching and milling operations may also be of concern. Land disturbance destroys vegetation and the general environment of the mined area. When a mine closes down, contaminated soils may remain at the mining site.

WHAT ARE THE HIGHLIGHTS:

The proposed rules require affected mining and ore-processing operations to:

- o Reduce heap-leach residual cyanide toxicity by rinsing and through hydrogen peroxide oxidation before the mine can close
- o Reduce levels of cyanide and toxic metals in discharged mill tailings by chemical and physical treatment
- o Reduce long-term risk of acid water and toxic metals releases by preventing acid water formation from mill tailings disposal facilities
- o Provide composite liners and leak detection under processing-solution ponds, leach heaps and tailings disposal facilities
- o Isolate and repair leaks in processing-solution ponds and leach heaps, if they occur
- o Provide positive protection such as covers, nets or fences to exclude wildlife from contact with chemical processing solutions
- o Install monitoring wells, when necessary, to detect possible contamination of groundwater
- o Provide long-term monitoring to determine effectiveness of leach heaps and tailings disposal facilities, after the mine is closed

HOW DOES DEQ REGULATE MINING?

DEQ has drafted these proposed mining operation rules to address the leaching process. Any company that wants to operate a mine using leaching or milling processes must go through a separate permit process. Applications for a water quality permit are reviewed using DEQ's rules to determine if the proposed mine will meet environmental regulations. DEQ's permit process includes the opportunity for public input on every proposed permit. Every permit must be accompanied by:

- A statement from the local land use planning agency
- Site characterization and design plans and specifications of the equipment and devices that may control pollution
- Estimates of the amount of contaminants that will be created and how they will be treated
- An analysis of how the environment will be affected.

The permit applicant must prove that the proposed mine will meet environmental standards and regulations that apply to the activity. If DEQ finds that an applicant has met the technical requirement, DEQ will mail out a public notice, inviting the public to comment on the proposed permit during a 30-day comment period. A hearing is held when DEQ anticipates significant public interest or at the request of interested citizens.

HOW TO COMMENT:

DEQ invites your review and comment of the proposed rules. If a permit application is received, DEQ will review that separately and will invite the public to comment on conditions of the proposed permit.

Hearings are scheduled for:

Date:	Time:	Location:
May 15, 1991	9:30 am	DEQ Headquarters, Room 3A 811 S.W. Sixth Avenue Portland, Oregon
May 16, 1991	7:00 pm	Nyssa High School Auditorium 820 Adrian Boulevard Nyssa, Oregon
May 20, 1991	7:00 pm	City Council Chambers 101 NW "A" Street (Corner of 6th & "A") Grants Pass, Oregon

Written comments will be received by the Department until 5:00 pm May 20, 1991, and should be sent to the Department at the following address:

Attn: Mary Lynn
Department of Environmental Quality
Water Quality Division
811 S.W. Sixth Avenue
Portland, OR 97204
Telephone (503) 229-5425

Copies of the proposed rules are available from the Department at the above address, and at DEQ's regional offices in Pendleton, Bend, Medford and Salem. Copies are also available at the Malheur County Library in Ontario, the Nyssa Library, the Lakeview Library, the Baker City Library and the Josephine County Library in Grants Pass.

WHAT IS THE NEXT STEP:

Following the public comment period, DEQ makes changes in the draft rules and submits the revised rules to the Environmental Quality Commission for approval. The Commission may adopt the proposed rule, adopt a modified rule on the same subject matter, or decline to act. The Commission's deliberation may come in June, 1991, at its regularly scheduled meeting.

A Statement of Need, Fiscal and Economic Impact Statement and Land Use Consistency Statement are attached to this notice.

IW\WC8\WC8131
JET 4/9/91

RULEMAKING STATEMENTS
for

OAR 340, Chapter 43--Proposed Rules for MINING OPERATIONS WHICH USE CYANIDE OR OTHER TOXIC CHEMICALS TO EXTRACT METALS OR METAL-BEARING MINERALS FROM ORES

STATEMENT OF NEED:

Pursuant to ORS 183.335(7), this statement provides information on the Environmental Quality Commission's intended action to adopt a rule.

1. Legal Authority

These proposed rules were prepared for adoption by the Environmental Quality Commission under its general rule-making authority as expressed in ORS 468.020; "...the commission shall adopt such rules and standards as it considers necessary and proper in performing the functions vested by law in the commission.

2. Need for the Rule

Oregon presently has no rules which specifically regulate mining activities that utilize chemicals to extract metals or metal-bearing minerals from the ore. The Department has concluded that it needs to develop rules specific to such mining operations to effectively regulate the potentially large-scale impact they may have on the environment.

3. Principal Documents Relied Upon in this Rulemaking

These documents are available from the sources indicated or may be reviewed at the Department's Water Quality Division offices at 811 S.W. Sixth Avenue, Portland, Oregon 97204, Fifth Floor. (503) 229-5425

Cyanide Destruction--The INCO SO_2-Air Process, 1990, a compilation of literature published by INCO TECH, Mississauga, Ontario, (416) 822-3323

State-of-the-Art of Processes for the Treatment of Gold Mill Effluents, Ingles, J. and J.S. Scott, Mining, Mineral and Metallurgical Processes Division, Environmental Protection Programs Directorate, Environment Canada, Ottawa, Ontario, K1A 0E7, 1987

Proceedings of the Nevada Wildlife/Mining Workshop, Reno, Nevada, 1990, Sponsored by the Nevada Mining Association, Reno, Nevada, (702) 829-2121

EPA/530-SW-89-047 Final Covers on Hazardous Waste Landfills and Surface Impoundments, July, 1989, Office of Solid Waste and Emergency Response, EPA, Washington, DC 20460

Draft Acid Rock Drainage Technical Guide, Vol. 1, British Columbia Acid Mine Drainage Task Force Report, August, 1989, Prepared by Steffen Robertson and Kirsten (B.C.) Inc., Vancouver, B.C., V6E 2N7

Discharges of Waste to Land, California Code of Regulations Title 23, Chapter 3, Subchapter 15, Department of General Services, P.O. Box 1015, North Highland, CA 95660

Heap Leach Technology Workshop, Pegasus Gold Corporation, July 1990, Presented by EIC Corporation, Denver, Colorado, (303) 692-0272

Proceedings, Gold Mining Effluent Treatment Seminars, Conference, Vancouver, B.C., February 15-16, 1989, Environment Canada, West Vancouver, British Columbia, V7T 1A2

Strawman II Recommendations for a Regulatory Program For Mining Waste and Materials Under Subtitle D of RCRA, EPA and The Western Governors' Assn., (303) 534-7309, 1990

Introduction to Evaluation, Design and Operation of Precious Metal Heap Leaching Projects, Soc. Of Mining Engineers, Inc., Littleton, Colorado, 1988, van Zyl, Hutchison and Kiel, editors

FISCAL AND ECONOMIC IMPACT STATEMENT:

1. Other State Agencies

These proposed rules are not expected to have any added fiscal impact on other state agencies because the rules will be administered and enforced entirely by the Department.

2. Municipalities

These proposed rules are not expected to have any added fiscal impact on municipalities and counties. They may save time and effort for those municipalities and counties that evaluate the environmental impact of proposed mining projects by defining the environmental control measures that the Department will employ in its permits.

3. Overall Economic Impact on Business

These proposed rules are expected to add operating and capital costs to all subject mining operations, above what they might currently experience in other states. It is the Department's intent to require preventive environmentally-protective measures that may cost more during the life of the mine but which should minimize the potential future cost of remediation due to toxic pollution.

Increased costs could be incurred under these rules by the mining companies, particularly in regard to the following waste-treatment processes.

a. Cyanide detoxification of mill tailings

Using cost estimates from INCO TECH as an example, the capital costs of cyanide destruction by the SO_2-Air process for a 1,000 metric-ton per day CIP (carbon-in-pulp) operation would be $248,000 (Can.) and the operating cost would be $1.61 (Can.) per metric ton of ore.

b. Cyanide recovery and re-use

Costs associated with cyanide recovery and re-use may vary considerably with the particular process used and the nature of the ore being treated. Economic studies have been done by CANMET (Energy, Mines and Resources, Canada) and Steffan, Robertson and Kirsten. Both studies estimate, under the assumptions that were used, that cyanide recovery and re-use could pay for itself and return the capital cost required to install the process.

c. Composite liners with leak detection for disposal facilities

The added cost of a triple liner over a double liner could be expected to be at least $0.50 per square foot of liner. The added cost of a plastic-pipe-based between-liner leak detection system would consist primarily of labor costs and would be dependent upon the size and complexity of the system; no cost estimate has been made.

4. The Small Business Impact

Small businesses are not anticipated to be engaged in full-scale mining operations because of their capital-intensive nature. Small businesses might, however, be engaged in secondary mining/ore processing operations such as chemical processing of tailings or low-grade ore from earlier mining.

Small businesses may propose alternatives to the environmental control requirements of these rules. The Department can accept the alternatives if the operator can demonstrate that they will be equally protective. The Director may also grant a variance from these rules on a case-by-case basis.

LAND-USE COMPATIBILITY STATEMENT:

The proposed rules may affect land use and appear to be consistent with the Statewide Planning Goals.

The rules are designed to preserve water quality in the areas affected by mining and are considered consistent with Goal Six (air, water and land resources quality). The proposed rules, after adoption, will be implemented through the Department's current land-use compatibility procedures for WPCF (Water Pollution Control Facility) and NPDES (National Pollutant Discharge Elimination System) permits.

Public comment on any land use issue involved is welcome and may be submitted in the same fashion as indicated for testimony in this notice.

The Department requests that local, state and federal agencies review the proposed action and comment on possible conflicts with their programs which affect land use and with statewide planning goals within their expertise and jurisdiction.

The Department will request that the Department of Land Conservation and Development mediate any apparent rule conflicts brought to its attention by local, state or federal authorities.

Jerry Turnbaugh
(503) 229-5374
April 10, 1991

ABSTRACT OF TECHNICAL COMMENTS RECEIVED REGARDING PROPOSED RULES FOR CHEMICAL MINING (OAR Chapter 340, Division 43)

Foreword

Extensive written and oral comment was received before, during, and after the thirty-day period that the rules were open for public comment. The following is the author's attempt to abstract the significant technical comments that were received and to note at least one source for the comment. Much of the comment was duplicative but no attempt was made to tally the number of commentators since the comment process focusses on the content of issues rather than their popularity.

The comment abstracts are the author's paraphrasing of the comments and are intended to be essentially correct but it should be understood that they may not exactly portray what the commentator intended.

The number(s) following each comment abstract refer to a commentator listed in the attached List of Referenced Commentators. The list does not identify all the commentators; it is intended only to refer to at least one commentator who raised a particular issue.

General Comments

ORS 468.710, under which DEQ is authorized, establishes a policy for water pollution control. While water law is appropriate for waste waters, it does not appear to provide sufficient basis for regulating mine processing and mine wastes beyond a potential to release contaminants to the environment. These DEQ rules are not supported by the Oregon water pollution control laws (which focus on point-source control). 10

DEQ should require further bonding for environmental damage, beyond DOGAMI's reclamation bonding. 1

Use the rules of other states, instead of trying to reinvent the rules. 28

Add a section prohibiting liquid cyanide transport to the site. 26

Add a section on fees--all fees should come from the miners for DEQ to monitor the sites. 26

Add a section on disposal of operational garbage. Burying on site should not be allowed. 26

Add a provision to require DEQ to check the past compliance record of the company requesting the permit. Companies with unresolved or ongoing problems in other states should not be allowed to operate in Oregon. 26

Add a section regulating transportation of chemicals. 1

DEQ should devise a strict air quality control program to protect against the hazards of dust and toxics raised by hauling and blasting. 6

Safe Drinking Water Act provisions which allow aquifers to be exempt from Safe Drinking Water standards should not apply to chemical process mines. 6

Facility construction should be monitored, inspected and approved by DEQ or a third party contractor. 6

340-43-005

Define "reasonable" as found in ORS 468.715

In order to exercise its authority under ORS 468.715(b), the department must show that (1) the technology required is necessary for the prevention of the new pollution and the abatement of existing pollution and (2) that the technology is both available and reasonable. The department has failed to meet these standards with its proposed regulations of mining activities. The rule-making process should follow the policies in ORS 468.710 and .715. The standard should be developed under 468.735(3) and .694. Rules should allow for site specific conditions. 12

The rules do not seem to recognize the regulations and standards enforced by federal land management agencies, which is not in keeping with 468.710(5) which calls for cooperation with federal agencies. 12

The department is charged with fostering the cooperation of people, industry, cities and counties in order to prevent, control and reduce pollution of the waters of the state. (ORS 468.715(a). 12

ORS 183.335 (2)(b)(D) imposes on the DEQ a requirement that it prepare a statement of fiscal impact and economic effect of the proposed action on the local government and the public and project any significant economic effect of the regulations on industry. 12

ORS 183.545 requires an agency to periodically review its rules to minimize economic effect on businesses. 12

ORS 468.735(h) requires the DEQ to consider the impact of its regulations on the development of industry when setting standards of quality and purity. The DEQ must show that the methods described by the rules are reasonable. 12

ORS 183.335 (2)(b)(D) A determination of reasonableness involves not only a determination that the method is effective but that it does not have any unreasonable negative economic impact on the regulated industry. 12

DEQ has decided to regulate mining wastes as a solid waste under subtitle D of RCRA rather than as hazardous waste under subtitle C, without clearly stating the policies or scientific evidence which justifies this more stringent treatment of mining waste. 12

340-43-010

Define "small...operations" as those with a production level of (less than) 1000 tons per day. 12

Clarify reference to the exclusion of small-scale froth-flotation operations. 37

Define "small" mineral extraction operations or establish a procedure for excluding small operations. 17

Limit scope to toxic chemicals and wastewaters containing toxic materials. 10

340-43-015

Does not correspond to the purpose section because it appears to apply to all operations using chemicals. Also, define "small" for the froth-flotation exemption. 39

Define "acid mine drainage" as "low pH water which contains high levels of sulphate and dissolved solids and which may also contain various levels of heavy metals". 25

Define "toxic chemicals" as those substances so listed by EPA (40 CFR Part 261). 10, 24

Define "toxic" (includes chlorine, bromine, lime, acids, etc.?)--rules should address only cyanide. 39

340-43-020

Consideration should be given to special areas of concern; e.g., State Parks, Research Natural Areas, BLM areas of Critical Environmental Concern, Endangered Species habitat, State Natural Heritage Conservation Areas, etc. 37

Should specify time frame for DEQ to respond to permittee and the fees to be charged. 35

Streamline the amount of redundant information required of permittees by committing to accepting the information submitted to other agencies. 27

340-43-025

(2) Soils characterization not necessary unless agency is prepared to consider soil attenuation capacities, otherwise soil information bears no relationship to water quality. 10

(2) Need a process for verifying submitted data to prevent falsification. 16

(2h) Specify what will be an adequate characterization of hydrogeology. 8

(2)(1) Delete because there should be no open pits; they should be refilled and reclaimed. 16

(3) This section is too weak; would allow applicant to falsify data under the guise of error. 16

(3) Add, "Site map <u>including floodplain information, if appropriate;</u> 14

(3) Add, "Data submitted...and professional judgement. <u>All data submitted shall be according to collection methodologies approved by department staff, and shall be reviewed for adequacy by department staff before the permit application is processed.</u> 14

(3) add after "...professional judgement <u>on the part of an engineer or geologist registered with the State of Oregon.</u> 8

Require information on special areas of concern and relationship to land use plans and, in coastal zones, consistency with Oregon Coastal Zone Management Plan. 37

Proposed rule gives little incentive for consideration of site-specific conditions. 10

Permit application info should be reviewed by a reputable qualified firm with appropriate quality assurance included in the report. 1

Require applicant to identify "areas of special concern" in the application that are critical to the existence of endangered or threatened animal or plant species. Areas should include Areas of Critical Environmental Concern (ACEC), Research Natural Areas (RNA), Outstanding Areas (ONA) and areas designated by the Oregon Natural Heritage Plan. There should be protection for these areas from adjacent mining. 4

All baseline data and plans should be approved by DEQ or a third party contractor hired by DEQ, with no input from the applicant. 6

Registrations of professionals should be verified and stamps required. 8

Specify what is an adequate characterization of the hydrogeology. 8

340-43-030

(1) define "substantial" 37

(1) leaves "toxic" open to subjective judgement by DEQ. 18

(1) Define "toxic wastes" 8

(2) Should include requirements for a preliminary clean up, detoxification and restoration plan, with evidence of adequate financial ability to carry out the plan. 16

(2) Should specify time frame for DEQ response. 35
Water quality monitoring should begin <u>before</u> construction in order to establish baseline water quality data. 13

(2c) Add ...of excess wastewater, <u>control of acid mine drainage,</u>...8

(2d) Scope of DEQs review of construction plans should be limited to assessing whether or not the design will adequately protect the waters of the state. The guidelines essentially design the facility. ORS 468.735 (3) specifically assigns the design opportunity to the project proponent, not the DEQ and requires DEQ to review those designs for compliance with established water standards. 10

Allow preliminary design plans to be sufficient to start the application process. Allow applicants to prepare final plans during permitting. 39

Add provision to allow applicant to meet with Department to determine the scope of information the applicant must submit. "This would provide an excellent opportunity to obtain confidentially agreements on certain portions of the operation or flowsheet which may be proprietary or patentable."12

340-43-035

(1) Include a "grandfathering" provision for existing facilities which may be successfully operating with a lesser degree of design containment. 10

(2) List what the groundwater monitoring plan should include. 8

(2) Specify that wells must meet construction, use, maintenance and abandonment standards of Water Resources Department. 8

(2) Specify what happens if the monitoring program finds something. 8

(2) eliminate "unless hydrogeology ..."--do not allow this loophole. 26, 33

(2) define phrase "is not likely to occur"--too vague. 23

(2) eliminate "unless the...likely to occur" This is a possible loophole. 20, 31

(2) Paragraph should end at line 5, following "40"; paragraph as-is invites falsification of data. 16

(3) doesn't make sense. 17, 8

(3) Change wording in "...indicates that [an] <u>no</u> adverse impact on groundwater quality [is not likely to] <u>will</u> occur." 14

(3) Should include text to the effect: "The Department may approve protective means <u>other than those required by parts (1) and (2) of this section</u> if the permit applicant can demonstrate..." 10

(3) Missing text. 8

Local site characteristics may provide protection without the added requirement of redundant lining systems. Operator who will use best available technology should not have to prove that he will not affect the environment outside the isolated system. 18

340-43-040

(1) Clarify criteria DEQ will use to grant variations from the rules. 9

(1) Provide for state-wide public input on proposed variances to the rules. 29

(1) Rule does not clearly provide for a variance procedure based on a case-by-case evaluation. 22

(1) Delete entire section--should be no waivers for these types of operations. 16, 23, 26, 33

(1) Add at end; Any variances requested by the applicant must provide equivalent protection for human health and the environment. 14

(1) Should specify which rule requirements are subject to granting of variance. Should not grant variances for -070 for protection of wildlife. 9

(2) Should grandfather existing facilities which have a history of non-degradation of surface and groundwaters. Changes to such facilities should require consideration under existing rules on a case-by-case basis. 10

(2) "reasonable time" is too vague; should be a maximum of 90 days for minor matters, 180 days for major compliance issues. Operation of mine should be halted until compliance occurs. 16

340-43-045

(1) Should require HW permits only when wastes exceed hazardous criteria. The hazardous waste criteria for cyanide are expected to be much higher than 0.2 mg/l. 39

(1) Proposed program is contemplated under the Oregon Water Pollution Control Laws - there is an erroneous correlation between water pollution control and solid/hazardous waste regulation. Solid wastes from the beneficiation of ores has been expressly excluded rom Oregon hazardous waste management rules. The proposed rules go far beyond the scope of the Oregon Water Pollution Control Laws to include mining wastes in their purview. 10

(1) OAR 340-101-004 expressly deletes the Bevill Exclusion by references and replaces it with the exclusion of "residues

from the extraction and beneficiation of ores and minerals...", thus being more restrictive than the federal requirement by the elimination of processing in the state exclusion. Regardless, the term beneficiation is still included, which is presumed to retain the definition provided in 40 CFR 261..4(b)(7) for lack of a state proposed definition. In nearly all applications of this definition, mining wastes will fail to meet the criteria for being characterized as hazardous under OAR 340-101-100 and 340-101-033. 10

(1) If intent is to allow an exemption to the criteria in the rules for processing wastes provided that a state hazardous waste permit is obtained, the criteria should be specified under which the DEQ would grant the exemption. 9

(3) Define "processing waste". 17

Intent is confusing. Rules should state that the Department retains authority to permit such operations under either OAR 340-105 or these rules. 14

340-43-050

(2) Use "applicant", rather than "permit applicant". 8

(2) Is an unconstitutional statement; the applicant should be presumed innocent until proven not to be in compliance. 18

(2) The procedure for getting approval of alternative techniques needs to be clearly spelled out. 17

(2) DEQ has not offered any relationship between the prescriptive standards suggested in these guidelines and an improvement in environmental protection. Reference to full-equivalent protection is meaningless absent some method of measuring environmental improvement. Liner redundancy does not equate to environmental improvement. "One effective liner system is equivalent to any number of [in?]effective liner systems in terms to [of?] environmental protection". 10

(2) Some cost-benefit justification should be considered when prescriptively requiring liner systems in excess of what is normally considered adequate minimum design redundancy. 10

(2) Allowing alternative control methods invites legal challenge to agency decisions. DEQ should accept suggestions, however the agency should be under no obligation to make a determination on these suggestions as they relate to a particular permit application. 6

(2) Use "applicant" for "permit applicant". 8

340-43-055

(1) Clarify "inadequately treated". 9

(2) Define "flood plain, wetlands and seismic instability". 39

(2) Define "surface waters" 35

(2) Should delete since leak detection and waste treatment are required. 12

(2) Increase to one mile because dams may break. 26, 33

(2) 200 feet seems arbitrary--dam failure a danger and should be on the order of a mile. 23

(2) Should have a buffer zone of at least 1,000 feet. 34

(2) Requirements in (2) may conflict with (3) 34, 37

(2) 200 feet should read, "one mile"--too many dams break at these operations" 20, 31

(2) 200 foot buffer is inadequate. A minimum 6000 foot buffer should be required, with a greater buffer if drainage configuration merits. 16

(2) A 100 foot buffer would be much more practical than 200 feet. 15

(2) Use "perennial surface waters" as the scientific term for waters that the regulations appear to refer to. 15, 39

(2) Clarify that a buffer is required for both sides of a river or stream, if necessary. and that each shall meet a minimum of 1250 feet. 14

(2) Minimum buffer zone between any chemical process water containment structure or conduit, any ore processing site or any chemical storage site and surface waters should be 500 feet. 6

(3) Contradiction between (2) and (3) needs clarification. 37

(3) Change the text to "...or otherwise geologically unstable areas are <u>structurally adequate to protect the waters of the State</u> during operation, closure and post-closure. 10

(3) Define "seismic impact zones". 8

(2,3) Clarify siting requirements in seismic areas; (2) and (3) seem at odds. 4

(3) Is an unreasonable demand by not being specific about post closure requirements. "Post closure" implies forever, which is longer than these sites will pose a true threat to the environment if measures toward long-term mitigation of toxics are taken. 18

(4) Requirement for secondary containment for all chemical conveyances is too broad--should be limited to cyanide solutions only. 39

(4) Secondary containment for pipes is beyond any industry standard. 7

(5) Should require appropriate bonding for perpetuity. 23

(5) Should require "lifetime bond" since it uses "lifetime of pit" term. 20, 31

(5) The need for a 200 foot buffer between surface water and a facility is questionable. Placement within 200 feet of a stream could be advantageous for other engineering design reasons. 17

(5) Define "acid" by an acceptable pH range related to adjacent springs, wells and groundwater. 15

(5) Add provisions for dealing with acid water accumulation in filled-in pits. 8

340-43-060

(1) Run-off from the site should be regulated under DEQ stormwater criteria. 10

(1) 100 year, 24 hour storm should be the minimum standard. Any other allowed event should be more stringent. 16

(1) Use "excessively or abnormally ladened with sediment". 15

(2) Clarify this requirement. 35

(2) Define "temporary" or delete; too much chance for abuse of this requirement. 16

(2) Use "the mine material be sloped to minimize erosion".

340-43-065

(1) Specify who bears clean-up responsibility if a containment fails. 35

(1) Should be able to use mine or other local professionals. 18

(1) Verify registrations and stamps of registered professionals. 8

(1) Requirement for an independent professional seems overly restrictive. The QA/QC should be independent. Perhaps another section should address a comprehensive QA/QC procedure with independent sign-off. 17

(1) Inappropriate for DEQ to require engineering designs by independent contractors. ORS 469.735(3) expressly states that "any person responsible for complying...shall determine the means, methods, processes....". The requirement for independent contractors is unwarranted and clearly inconsistent with the ORS. 10

(1) Define "registered professional". 7

(1) Option to "independent" professional would be to let the work be done by the mining company and then checked by the independent professional. 8

(2) Define "temporary structures and "materials emplacements". 14

340-43-070

(1) Define wildlife to include "non-game" animals. 37

(1) Provide alternate off-site source of clean water for wildlife, in addition to positive exclusion. 36

(1) Require positive exclusion from chemical sprayers on top of the heap. 34

(1) Allow fine-spray sprinklers which allow for evaporation of excess solution and do not necessarily create ponding. 27

(1) Do not allow netting--require "totally enclosed tanks and ponds" 26
Must use totally-enclosed tanks and ponds to protect wildlife. 20, 31, 33

(1) All tanks and ponds should be enclosed; the heap should be double netted. Fences should be adequate to keep out burrowing wildlife. 16

(1) add "closed containment" to positive exclusion devices 37

(1) Define "wildlife"; use "vertebrate wildlife". 15

(1) Rewrite this section to define positive exclusion more narrowly. The only positive exclusion is complete containment. Fences will not deter small mammals, reptiles or amphibians. Netting is more a deterrent than a positive exclusion, and drip-irrigation emitters do not necessarily eliminate puddling. 14

(1) Require pregnant and barren ponds be in tanks, that pipes replace open ditches, that drip emitters on the top of heaps be covered with loose gravel and that all tailings from milling operations be dewatered and buried in special lined landfill areas. 14

(1) Need complete description of "wildlife". ALL wildlife species must be protected. 13

(1) Wildlife protection is irrelevant with regards to Oregon Water Pollution Control Laws. It may be more appropriate for DEQ rules to include a requirement such as: "Permits issued pursuant to these rules do not release an operator from his obligations under the jurisdiction of applicable agencies, including but not limited to, the Oregon Department of Fish and Wildlife and U.S. Fish and Wildlife Service." 10

(1) Establish priority ranking for protective measures with impenetrable barriers as highest. Allow netting only upon demonstration that impenetrable barriers are impracticable. 9

(1) Move standards in 70 to 005, General Provisions. 9

(1) Plans and construction specifications for positive exclusion methods proposed by an applicant should be reviewed by a reputable, qualified individual or group. 1

(1) Exclusion devices should be monitored regularly for effectiveness. 1

(1) Clarify that non-game species are included in the wildlife definition. 4

(1) Make positive protection means more explicit; require that all process chemicals be totally enclosed in tanks or with synthetic covers. 6

(1) If netting is used, the ponds should be rectangular (3:1 aspect ratio) so they can be netted more easily. 6

(1) Netting should be polypropylene, solid strand and uv-resistant. 6

(1) Drip irrigation should be used instead of spraying and the emitters covered with gravel to prevent ponding. 6

(1) All chemical ponds and conveyances should be enclosed with an 8-foot high cyclone fence with hardware cloth extending two feet below and two feet above the surface. 6

(1) All tailings should be totally detoxified to remove processing chemicals, heavy metals and sulfide. 6

340-43-075

(1) Should specifically refer to type of professional as "engineer, hydrogeologist, etc.". 34, 35

(1) Do not need to require "independent"--company engineers have more in-depth experience and are equally qualified. 12, 39

(4) Requiring tank tightness testing before covering or enclosing is not appropriate because some tanks can be tested by pressurizing. 39
Specify third-part quality assurance in -035 since installation of each process component requires it. 27

Requirements are inappropriate unless they are required for all industries using chemicals in their processes. This section should be limited to exterior tanks where the tank bottoms directly contact soils. 39

340-43-080

(1) Secondary containment needed only for toxic chemicals--change "all". 12

(3)(a) Define "failure" or delete (thickness has no realistic correlation to liner performance. 11

(3c) Require electronic sensors for "immediate leak detection". 26

(3c) 24 hours too long--use electronic means to detect as soon as leak occurs. 23

(3)(c) Need detection sooner than 24 hours--use electronic rather than mechanical detection system. 20, 31, 33

(3)(c) 24 hours is too long for detection of leaks. BAT should be specified and a minimum time should be set; perhaps 8 hours. Applicant should show why 8 hours can't be met. 16

(3)(c) This implies a third containment system in order to be able to detect leaks in the secondary containment system. 11

(3)(d) Delete after "24 hours" in line 6. Operator may be allowed to prove it was not possible to act or complete removal within 24 hours, but 24 hours should be standard. 16

(4a) Should read "liner". 11

(5a) Should require 110% of capacity, plus estimated amount of run-on from 25 year storm. 16

(5c) 24 hours too long--use electronic sensors. 26

(5c) Eliminate this section (see 3c). 23

(5c) Change section because 24 hours too long. 20, 31

(5c) 24 hours is too long for detection of leaks; require same as my comment in (3)(c). 16

(6) Use "inspected on a daily basis when in use. 15

Should be provisions for bringing existing mining operations into compliance with regard to secondary containment. 16

340-43-085

(3) Change wording "...of this section, <u>and shall provide monthly summary reports to the department.</u> 14

Require periodic inspections of structures, tanks and other facilities by an independent, registered consultant who makes written findings. 16

Inspection timing should be determined by the type of system rather than by regulation. 7

340-43-090

(1) Must specify requirements for on-off pads. 26

(1) "variations" is too open-ended and potentially useful to companies determined to bypass the rules. 23

(1) Should identify the possible "variations". 20, 31, 33

(1) Define "variations". 16

(2), (6) Do not allow lesser standards for temporary, overflow or emergency structures. 16

(2) Should not allow lesser requirements for cyanide containing structures. 26

(2) Should eliminate lesser requirements for emergency ponds. 20, 31, 33

(3) Table I--operating volume may be low since solution concentrations and slime precipitation must be considered. 12

(3) clarify Table I--to remove ambiguity that both ponds should have the required capacity. 38

(3) Impractical and unnecessary to design process water ponds for containment of rinse volumes. Process waters contained in solution ponds can be detoxified and recirculated as rinse water should it be necessary to rinse a heap prematurely. 10

(3) Should require containment volume for the anticipated operating volume, the design storm (100 year, 24 hour) and two feet of freeboard. Require excess capacity for drain-down, depending upon availability of back-up power sources. The rain on snow event should be required only when there is increased risk to human health or the environment. 10

(3) Delete rinse volume--assume it will be the operating volume. 39

(3) The projected draindown volume and the climatic surge volume should be determined by the applicant and only the largest volume required. 39

(4) Triple liner and 36" of clay are unnecessary--double liner and 12" works well. 28

(4) Change design requirements for pads to more closely reflect current standards and practice in neighboring states. 24

(4) Include provision for more flexibility in pad design if site conditions so warrant. 24

(4) Add a figure to describe the liner system. 8

(4) Prudent minimum design criteria should be a synthetic primary liner overlying an effective leak detection and removal system. The secondary liner should be equivalent to 12 inches of compacted soil with a maximum permeability of 10-6 cm/sec. 10

(4) The minimum synthetic liner thickness should be specified. 11

(4) Define "free flow", specify the head on the liner. 11

(4) Define the basis for the one-week requirement. 11

(4) The liner designs are too restrictive--should allow triple liner with 36" base <u>or</u> LDS as described <u>or</u> monitoring wells. 38

(4) Triple liner is unnecessary and excessive. NRC doesn't require this degree of caution. Double liner is more than adequate. 15

(4) "Maximum permeability" should read "coefficient of permeability". 11

(4) Leak detection system performance requirement appears to be unrealistically conservative. DEQ should provide the reasoning behind establishing this prescriptive requirement. 10

(4) 36 inches is excessive; 12 inches is protective. 14

(4) A 36" clay liner is excessive and probably unworkable. 7

(4) Triple liners are overkill--should allow soil attenuation of cyanide. 32

(4b) Minimum permeability of synthetic liners should be 10E-7 cm/sec. 26

(4)(b) drainage nets or other alternates to the specified 12 inches should be considered. 11

(4c) "one week" too long for detection of leaks. 23

(4c) Specify the head. 8

(4)(c) The intention of this regulation is to require a standard (single) composite liner. The work "double" should be deleted to prevent confusion with the term "double composite liner". 11

(4)(c) Specify the head. 8

(4) Triple liner is excessive--fails to take natural degradation processes in surrounding soil. 22

(5) Leak detection requirements excessively stringent and fails to set realistic points of compliance at a reasonable distance from the facility. 22

(5)(b) and (c) List the minimum thickness as is done in (4)(b). 8

(4)(c) & (5)(c) Should use two leak detection systems operating independently and simultaneously between the three pad liners. Electronic moisture sensors are far superior to mechanical devices. 19, 20, 26, 31, 33

(4,5) Leak detection sensors should be placed between both sets of liners, not just between middle and top liners. 16

(5a) 36" of 10D-7 clay is overkill 35

(5b) Specify the minimum thickness. 8

(4,5,7) Rules require more protection from puncture and leakage from the pad than the pond and the head is limited to 2 feet on the pad. Should be some trade-off in liner construction. 17

(5c) Specify the head. 8

(6) Do not allow emergency ponds--they would be used too often. 26, 33

(6) Time limit should be stated for allowable use of emergency ponds. 1

(6) Make "infrequently and for short periods of time" more specific. The ponds should be used only in emergency situations. 9

(6) Define "infrequently" and "short periods of time". 11

(6) Change wording; "...may be constructed as an [alternative] back-up to larger pregnant and barren ponds. The emergency pond may be constructed to a lesser standard which still ensures protection of human health and the environment,....and for time periods not to exceed 48 hours [short periods of time]. Add, All uses of the emergency pond shall be reported to the department immediately. 14

(7) Leak detection is just as important for emergency ponds. 14

(8) Should not limit depth to 24 inches since pond liners are the same and depth is not limited. 15

(9) Operator should conduct quarterly emergency drills which are observed by an independent observer making a written analysis of the drill; operators who fail to train should be shut down until they demonstrate capability to respond to emergencies. 16

(9) This rule needs more definitive standards regarding protection of human health and the environment during temporary closure and should define a limit so a permittee cannot walk away from a site for years.. Require prior notice of temporary closure and require ongoing maintenance, monitoring and reporting during closure. 14

(10) Requirement for leak repair "at first opportunity" too vague. Operation should immediately cease when leak is detected and the fix should be inspected by DEQ prior to resumption of operations. 6

(10) Change wording; "...actual liquid depth shall [either be repaired at the first opportunity] be reported to the department immediately and repaired under department supervision and [or] ...below the specified rate until repair is certified by the department to be complete. [The Department shall set a time schedule for repair with the permittee, if necessary.] 14

(10) Use EPA guideline for acceptable leakage (Background Document on Proposed Liner & Leak Detection Rule) of 2500 gallons per day per acre which requires closure or repair. 39

(10) Operation of pad should be shut down while leak is being repaired. 16

(10) Should suspend operations at once until repairs are made. 23, 26

(10) Replace entire section with "Operations shall be discontinued while the pad is unloaded and the detectable leak is repaired" 20, 31, 33

(11) Clarify intent of last sentence. Suggest "If the spent ore is shown to be potentially acid generating, the permittee shall submit a plan to prevent acid generation after heap abandonment and reclamation." 17

(11) Should not be left to operator to determine if spent ore will be acid generating. Should be a timeline for submitting and implementing plan to deal with acid generating spent ore. 16

Coefficient of permeability and thickness are equivalent trade-offs with soil/clay liners. 11

No basis for the prescriptive liner system requirement, nor any relief from the prescriptive requirement based on site-specific conditions. 10

Allow lower design standards for smaller leach operations; e.g., a pad with 15' of ore does not need the same depth of underlayment as one with an ore height of 90'. Set requirements on tonnage/area basis. 24

A figure would be helpful to describe the liner system. 8

Level of containment is unreasonably high; the minimum prescriptive standard and evaluation of acid generating waste is inadequately addressed. 30

340-43-095

(1) Liners not needed if chemicals and metals are removed. 10

(1) Delete "second consideration". The process indicated by "first consideration" is the only acceptable process for detoxification. 16

(1) Unnecessary and excessive to detoxify since pond is lined. 15

(1) Should spell out why prefer removal over detoxification. 37

(1) Eliminate "second consideration"--should be no second consideration 20, 27, 31, 33

(2) Values for ANP/AGP should serve as "trigger values" to initiate kinetic testing. The results of the kinetic tests should determine whether or not acid generation is likely to occur. 10

(3) A test is needed to demonstrate that non-acid-generating tailings also are not toxic metal producers. Use TCLP 1311. 17

(3) EPA Method 1312 (Synthetic Precipitation Leaching Procedure more nearly simulates processes expected to occur with mine wastes and tailings than TCLP 1311. 10

(3) Should require 36 inches, not 12 inches. 16

(3) Specify the criteria DEQ will use to determine whether disposal of tailings in slurry form will be allowed. Allow only upon demonstration that disposal in de-watered form is impracticable. Amend (3) to require criteria of Table 2 <u>and</u> of 070 -- both must be met. 9

(3) Tables 2 and 3 are generic values. The limits should be determined on a site-specific basis. 7

(3) All values in Tables 2 and 3 correspond to the EPA recommended levels using either method except copper and zinc. The maximum EPA values for these two elements are 20 and 100 times higher that the values in Tables 2 and 3. There is no apparent basis for this selective discrimination on copper and zinc. 10

(3b) The criteria in Tables 2 and 3 will not prevent wildlife deaths with exposure to the slurry or dewatered solids. (data was provided) 14

(3b4b) Should use EPA Method 1312 instead of 1311. 12

(3b4b) Should use a multiplier of 100 for cyanide also--allow 20 mg/kg for WAD cyanide and 1000 mg/kg total cyanide. 12

(3b4b) Allow material passing 1311 (or 1312) to be placed in an unlined pond or a pond with a minimal 12 inch impervious clay liner. 12

(3b4b) Criteria for tailings impossible--because they are below the average crustal abundance for many of the metals. 22

(3)(c) Should read "minimum thickness of 36 inches" 20, 23, 26, 31

(3)(c) Liner not required under non-toxic, dewatered (or even wet) tailing structure. Should allow drainage; specify whether the collection system is a surface or subsurface structure. 17

(4) Soils in the area contain "trace elements" at levels greater than those proposed for tailings (e.g. arsenic at 100-500 ppm, background is 10-12 ppm) 21

(4) Clarify objective of this section. Alternative is to screen the tailings for sulfide and heavy metals. If neither are present, allow disposal under DOGAMI regulations with attention to long-term stability, re-vegetation, etc. 17

(4) If toxic metals were present in the liquid, must address protection of wildlife. The standards should address more than cyanide concentration in the tailings water and should be worked out with ODF&W. 17

(4) If the solid portion exceeds the TCLP limits or if acid generation is possible, a lined impoundment with long-term stability would be the appropriate control technology. 17

(4) The present draft implies that any rock with metal levels exceeding the TCLP criteria would fall under Oregon's hazardous waste rules. This should be very clearly stated if this is the intent. 17

(4) The screening method for acid and toxics needs careful evaluation. Total sulfur determinations should be done with LECO furnace methods; other methods fail to detect low levels of pyrite that can readily oxidize. 17

(4) For low levels of pyrite, a specific amount of $CaCO_3$ should be specified rather than the ratio; suggest somewhere between five and 20 tons of $CaCO_3$. 17

(4) Should use kinetic testing, especially for low levels of pyrite. 17

(4) Total sulfur (sulfide) of 1 g/kg is too low and doesn't measure the susceptibility of rocks to contribute acid; use another method. 15

(4) Sulfide or pyritic sulfur appropriate indicator of acid generating potential--determine by ASTM Method 02493 or difference between total and sulfate sulfur. 10

(4) Define "separate facility"--Arlington or on-site? 8

(4) Dry tailings are emphasized; good argument can be made for permanent storage of saturated tailings. 17, 22

(4a) Define "separate facility" (on-site or off-site?). 8

(4b) Zinc requirement is too low--secondary drinking-water standard is 5 mg/l. Operations using Merrill-Crowe zinc-dust precipitation may have 200 mg/l or higher zinc in the tailings. Delete zinc from Tables 2 and 3. 39

(4b) Tailings detoxification levels of Tables 2 & 3 are not technically or economically possible--Nevada considers 20-50 mg/l WAD as being detoxified. 39

(4b) This section seems to allow (a) to be violated--is that the intent? 8

(4b) Cyanide removal is a new and unproven technology compared with INCO SO_2/air. SCN^- and CNO^- should be removed from Table 2 because there is no basis for regulating them and they are produced by the process. 40

(4b) Only known technology for removing SCN^- and CNO^- is chlorine which is discouraged in the rules. By products of chlorine are ammonia and possible chlorinated compounds, both of which can be more toxic than SCN- or CNO-. 40

340-43-100

(2) Change wording to: The closure plan must be compatible with the reclamation plan on file with DOGAMI. 8

(4) Allow pond liners to be buried in place rather than removing them to another disposal site. 28

(4) Should regulate mining under RCRA-D

(4)(b) Specify type of cover and that it will withstand seismic events and penetration by large roots. 20, 26, 31

(4)(b) Heap cover will prevent natural degradation of cyanide. Heaps also contain minerals, water and fertilizer that help sustain vegetation better than an impermeable cover. 18

(4b) If spent ore is detoxified to the rule requirements, should not have to cover. Soil cover will deplete thin-soil areas of Oregon. 38, 39

(4)(b) and (4) should include the word "native" to specify vegetation to ensure that the species are adapted to the site. 34

(4)(c) Sludges should be left in heap ponds as an appropriate means of disposal. 18

(4)(b) Should allow some spent and detoxified ore to be pushed off the edge of the pad to facilitate re-contouring for reclamation. Clarify last sentence. 17

(4) Low-permeability and soil layers will not provide any erosion protection for the coarse material on the pad. 17

(4) The cover to prevent water infiltration should be specified. Should be designed to withstand penetration by roots, seismic events and other likely intrusive events. 16

(4) After a heap is detoxified to the criteria of Table 4, it should be considered to meet closure requirements. Unnecessary to require a low-permeability layer over the material unless there is a toxic-metal issue. The environment is not well served by "encapsulating" residual low-levels of cyanides unless such measures are necessary to contain other materials deleterious to the environment. 10

(4) Should the heap need a cover if it has been detoxified? 4

(4) Requirements are too vague; the heaps and mining waste products should be totally detoxified and backfilled, otherwise should require strict containment. 6

(4) How will water infiltration be monitored? 4

(4) Table 4 is generic values. The limits should be determined on a site-specific basis. 7

(4)(c) Why remove the liner and bury it someplace else? 7

(4c) Define "inert material". 8

(5) Tailings should not be covered for same reasons given in (4). 18

(5) Define the "low permeability layer" 20, 26, 31

(5) Requiring low-permeability covers on non-toxic materials could, in some locations, be counter productive: Letting water drain through could be preferable to having it flow over the edges. 17

(4)(a), (5) Should require analysis for heavy metals, not just for residual cyanides. 14

(6) Should require a "lifetime" bond. 20, 26, 31

(6) Should require a bond to make repairs if containment fails. 16

(4)(b), (5) and (6) Terminology is too vague. Requirement that the closed facility should be environmentally stable for "an indefinite period of time" is too broad to be able to develop a post-closure plan and to determine financial assurance requirements for post-closure monitoring. 11

340-43-110

30 years too long, given the other protective provisions of the rule. 38

Require monitoring for 30 years; if leakage occurs, monitor for 30 years from the date of last pollutant release. 34

Monitoring for 30 years is out of the question-unnecessarily expensive; why not 2 years? 28

Replace "may" with <u>must</u>. 23, 26

In line 1 should read permit <u>must</u> be continued. 20, 31

In line 1, delete "may" and insert "must"; all costs of monitoring should be borne by operator and guaranteed by an adequate bond. 16

Change wording: "...permit [may] <u>shall</u> be continued ...for a [nominal] period of <u>at least</u> thirty...and [would] <u>shall</u> include...monitoring <u>by the permittee</u> ..." 14

Define "periodic" monitoring. 13

If mining companies are allowed to monitor their own operations, DEQ should have the authority to conduct unannounced quality control reviews of monitoring methods and results. 13

A 30 year post-closure monitoring period is inconsistent with the non-hazardous nature of most mining waste. Require post-closure monitoring for a pre-determined period following demonstrated site stabilization, perhaps consistent with a permit renewal term of five years. 10

Monitoring period should be based on the system and technology (rather than an arbitrary 30 years). 7

340-43-115

Limit "toxic" only to chemicals, materials and wastes identified as "hazardous" under 40 CFR Parts 260 and 261. 12

(1) Change wording; "...the permit <u>and in a manner that will not adversely impact human health and the environment.</u> 14

(2h) Add after word wildlife, <u>including non-game species</u>. 37

(2) Disposal plan should include analysis of potential impacts to Areas of Special Concern and to Fisheries, as well as to wildlife and sensitive plants. 13

(2) Require demonstration that disposal of wastewater will not adversely affect wildlife, sensitive plant species or aquatic life. 9

340-43-120

(1) Change to "pits must be backfilled". 23

(1) Eliminate present wording. Add requirement that pit must be refilled and aquifers must be restructured. 20, 31, 33

(1) Mining sites, aquifers and pits must be fully restored. 19

(1) Add requirement that pond be fenced for wildlife protection. 34

(1) Delete. This section must require the restoration of pits by filling in with detoxified wastes, reclamation of aquifers and surface areas. 16

(2e) Requirement of liner under the pond seems conditional and doesn't address site conditions. 18

(2)(b) This would leave even greater scar and would place more acid-generating material in a disposal facility. 14

(2c) Has potential for failure of the cap, especially on steep slopes. 14

(2d) Requires perpetual treatment with related costs and potential for failure. 14

(2e) Has potential for failure that requires perpetual monitoring and remedial action, as well as exclusion from wildlife access. 14

(2) Only (a) and (f) should be allowed. 14

(2f) Change wording; "...of the pit(s) [above the water table] to the level necessary to [reduce] prevent oxidation of residual acid-generating materials. 14

(2e) Omit possibility of a liner under the pond in a pit; it may prevent groundwater contamination but a toxic pond could endanger wildlife. 1

(2f) State criteria used to decide what materials will be suitable for backfill material. 4

(2f) Pit backfilling is necessary in all cases to protect wildlife and water quality and should be a condition of mining. 6

(2f) Requirements for backfilling should be spelled out with strict guidelines which will also help DEQ avert legal challenge for arbitrariness. 6

Jerry Turnbaugh
Industrial & On-Site Waste Section
Water Quality Division
Oregon Department of Environmental Quality

9/18/91

LIST OF REFERENCED COMMENTATORS

1. U.S. Dept. of the Interior
   Fish and Wildlife Service
2. Bob Powne
3. Malheur Mining
4. Native Plant Society of Oregon
5. Cornelia DuBois
6. National Wildlife Federation
7. E. L. Hunsaker III
8. Oregon Water Resource Department
9. Oregon Department of Fish and Wildlife
10. Knight Piesold and Co.
11. Jim Coskey
12. Simplot Resources
13. The Wildlife Society
14. Oregon Environmental Council
15. Chris Broili, Marvin Niccum
16. David M. Johns
17. Oregon Department of Geology and Mineral Industries
18. Loren A. Lovejoy
19. Thea Weiss Tarbet
20. Fred Farrand, Pat Thomassen
21. Phelps Dodge Mining Company
22. Ernest K. Lehman & Associates
23. Michael A. Sequeira
24. John H. Cogswell
25. Teck Corporation

26. Concerned Citizens for Responsible Mining

27. U.S. Department of the Interior, Bureau of Mines

28. City of Nyssa

29. Orval R. Layton

30. Sunshine Mining Company

31. Ralph Steils

32. Horizon Gold Corporation

33. Willamette University

34. Valerie R. Elliot

35. Dan Maws

36. Grant County Conservationists

37. Sierra Club

38. Glenbrook Nickel Company

39. Merco Minerals Company

40. INCO Exploration and Technical Services, Inc.

RESPONSE TO PUBLIC COMMENT REGARDING PROPOSED DEQ CHEMICAL MINING RULES (OAR CHAPTER 340, DIVISION 43)

Comment: Public Policy Issues

Considerable testimony was received on issues that are essentially "public policy" issues; e.g. whether Oregon should allow chemical mining at all, what should be the trade-offs between the possible adverse environmental impacts of chemical mining or open-pit mines and economic development, etc.

Response: The Department has not made recommendations on these public policy issues. The following comments and responses are directed primarily toward the technical issues raised by the proposed rules.

Comment: Department's Regulatory Authority

Commentators questioned the Department's authority to regulate chemical mining under its water-quality rules, rather than its solid-waste rules. It was suggested that the Department wait until EPA (the US Environmental Protection Agency) promulgates rules to govern chemical mining. It was also suggested that DOGAMI (Oregon Department of Geology and Mineral Industries) or the federal agencies should regulate mining, rather than the Department.

Response: The EQC (Environmental Quality Commission) has reviewed its regulatory responsibilities relative to mining and environmental protection and has concluded that the potential for adverse environmental impact resulting from large-scale chemical mining, especially mining of the open-pit type, is great enough that the Department should be regulating such mining.

The EQC requested that the Department propose rules to regulate chemical mining. The Department believes it is inappropriate to wait for EPA to promulgate rules, since it is not certain when, or if, EPA will do so. Further, the Department considers that the greatest potential adverse environmental impact from chemical mining is to waters of the state and has, therefore, chosen to propose regulation of mining under its water quality protection authority.

The proposed rules exempt chemical mining operations that would otherwise need one, from obtaining a state hazardous waste treatment or disposal permit if process wastes are treated to the criteria contained in the proposed rules.

The Department understands that it has environmental protection responsibility on federal lands as well as state and private lands and recommends the exercise of that responsibility in the case of mining rather than relying on the federal agencies involved to provide the necessary environmental protection regulation.

Comment: Recognition of Environmentally-Sensitive Special Areas

Some commentators felt that the proposed rules should give consideration to special areas of concern; e.g., State Parks, Research Natural Areas, BLM areas of Critical Environmental Concern, Endangered Species habitat, State Natural Heritage Conservation Areas, etc.

Response: The proposed rules do not single out any one type of environmental situation. The proposed rules attempt to adequately address all environmental concerns, regardless of their particular setting.

Comment: Permit Application Information and Baseline Data Collection

Some commentators were concerned that the requirements for baseline data and environmental characterization were too extensive and duplicated the data required by DOGAMI and the federal EA (Environmental Assessment), EIS (Environmental Impact Statement) process.

Other commentators recommended that all environmental data be collected and verified by the Department or a third-party contractor to ensure the validity of the data.

Response: The proposed rules are not intended to require unnecessary duplication of data and other information required in its permitting process. The rules provide that the Department will accept applicable data that permit applicants have gathered to fulfill their other permitting requirements.

The Department will review the baseline data applicable to its permit and may further verify, using internal or external resources, critical portions of the data.

Comment: Plans Review by the Department

There was some comment regarding the purpose, scope, and timing of the Departmental plan review process referred to in the proposed rules.

Response: The Department believes that its plan review process and responsibilities are effective and adequately described elsewhere in its rules and has not proposed to change them in this set of rules.

Comment: Grandfathering Provision

It was suggested that the rules include a "grandfathering" provision for existing facilities which may be successfully operating with a lesser degree of design containment.

Response: The proposed rules provide that the Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with the proposed rules.

Comment: Site-Specific Flexibility and Formal Variance from the Proposed Rules

A significant part of the comment related to the desirability on the part of potential permit applicants for site-specific flexibility in applying general performance-based rules and the desirability on the part of others in rigidly applying very prescriptive rules.

Response: The Department has attempted to strike a compromise in its proposed rules between rules that are performance-based and those that specification-based. The rules contain design, operation and closure guidelines that provide a relatively high degree of specificity. On the other hand, the Department recognizes that each site can differ significantly from the next and has acknowledged this in the proposed rules by allowing alternate environmental protective means if the permit applicant can demonstrate that they provide equivalent protection.

The Department has deleted the variance provision in this version of the proposed rules because it feels there is sufficient flexibility in the rules to allow it to fit the requirements of the rules to the situation. The Department is regularly called upon to make decisions regarding permits that are based on its best professional judgment since it is impossible to write rules that are sufficiently complete and explicit to address every situation.

Comment: Siting Prohibitions

Considerable comment was made on the prohibitions against siting mine-waste facilities in areas of seismic instability and on the appropriate width of the buffer zone between facilities and surface waters. Suggestions on the appropriate buffer zone width ranged from the proposed 200 feet up to a mile or more.

Response: The Department has deleted prohibitions against siting mine-waste disposal facilities in areas of seismic instability in the present proposed rules because such areas are hard to define and because dams and other retaining structures must be designed to accommodate anticipated seismic loadings anyway. The general prohibitions against siting facilities within 200 feet of surface water and in wetlands are retained.

The Department has retained the 200-foot minimum width as being sufficient to provide at least some margin of safety from readily-identifiable spills or leaks.

Comment: Requirement for Design by Independent Professionals

Considerable comment was directed at whether an "independent" professional person should be required for designing retaining structures, foundations, and materials emplacements. Some mining companies regard their registered professionals as being competent and qualified by experience to perform such design work. On the other hand, considerable comment urged the added "safety factor" of a qualified professional who is independent of the permittee.

Response: The Department recommendation proposes to delete the "independent" requirement so that mining companies are not precluded from using their own design expertise.

However, the Department has added a provision which allows it to require the permittee to hire a third-party consultant subject to approval by the Department, to review the facility plans and specifications and to monitor the course of construction.

Comment: Wildlife Protection

Appropriate means of protecting wildlife against the toxic effects of chemical processing solutions was a topic of major comment. The proposed rules required positive exclusion of wildlife from chemical processing solutions and wastewaters as the only sure means of preventing wildlife mortality. Commentators asked for a definition of wildlife, and variously objected to or approved the positive exclusion requirement.

Response: The Department has not proposed to define "wildlife" but to continue to use the word in its broadest sense. The Department has modified its positive exclusion provision by requiring exclusion only from those solutions and wastewaters that pose a threat to wildlife, as determined by ODF&W (Oregon Department of Fish and Wildlife). Passage of HB 2244 by the 1991 Oregon Legislature required ODF&W to establish standards by rule for wildlife protection.
The Department has defined "positive exclusion" in the present proposed rules as the use of pipes, fences, netting covers and heap-leach drip-irrigation emitters or covered emitters.

Reference to hazing has been deleted since positive exclusion is required and hazing is felt to be, at best, a non-positive exclusion means.

The Department will waive the positive exclusion requirement if ODF&W certifies to the Department that the project is designed such that it will adequately protect wildlife.

Comment: Requirements for Containment Tanks

The earlier proposed rules contained a section on requirements for tanks used for containment of chemicals. Little comment was received regarding tanks except that tanks were generally regarded as being more protective than lined ponds.

Response: The Department has deleted the entire section on tanks from the present proposed rules. The Department feels it has adequate authority through its design and specification review process to ensure the proper installation and operations of tanks containing chemicals. It was also felt that inclusion of the rather extensive section on tanks tended to confuse the proposed rules and make them more difficult to understand.

Comment: Lesser Design Standards for Emergency Ponds

A number of commentators were concerned that emergency overflow ponds should not be allowed or should be designed to as strict a standard as the working ponds.

Response: The Department has retained provision for emergency ponds to be used in a temporary fashion and designed to a lesser liner standard than the working ponds. Emergency ponds provide an important margin of safety against accidental flooding and the Department is confident that it can prevent abuse of the intended temporary use of the ponds by means of permit conditions.

Comment: Heap-Leach Facility Liner Requirements

Extensive comment was received on the proposed design criteria for heap-leach pad liners. Comments ranged from the position that the proposed "triple liner" configuration consisting of a low-permeability soil/clay bottom liner and two flexible-membrane synthetic liners with a leak detection system in between was barely adequate, to the position that it was grossly overprotective.

Response: The Department has retained the triple liner configuration with a "between-liner" leak detection system. It was decided that the value of the between-liner leak detection system outweighed any disadvantage of the third liner.

Comment: Repair of Heap-Leach Leaks

Considerable comment was received on the difficulty of determining the acceptable leak rate that the Department specified.

Response: The Department has continued the repair requirement and has included in the proposed rules the graduated response program suggested by the Oregon Mining Council.

Comment: End-of-Pipe Treatment of Mill Tailings

The proposed detoxification requirement and accompanying numeric detoxification criteria for mill tailings caused extensive comment. Comment ranged from rejection of the requirement as being impractical and unnecessary to full approval.

Response: The Department has specified cyanide recovery and re-use as the required detoxification technology. The permittee is required under the present proposed rules to conduct tests on their tailings to determine the lowest practicable concentration of WAD (weak-acid dissociable) cyanide attainable. The Department has, however, proposed a maximum allowable concentration of WAD cyanide of 30 ppm (parts per million) as a technology-based criterion.

The 30 ppm WAD cyanide criterion is not intended to be protective of wildlife. The Department will rely on ODF&W to determine the appropriate wildlife protection criteria for chemical mining processing solutions and wastes.

The proposed rules specify that mill tailings shall pass the EPA TCLP (toxicity characteristic leach procedure) Method 1311 test or else they will be considered a state hazardous waste and must be regulated under the state hazardous waste program.

Comment: Mill Tailings Pond Liner Requirement

Some commentators objected to the proposed liner requirements on the basis that they were over-protective and expensive. Other commentators supported the liners as being appropriate for protection against leakage.

Response: The Department has retained the proposed double liner system for tailings, with no distinction as to whether the tailings are potentially acid-generating or are deposited as a slurry or as dewatered solids.

Comment: Heap-Leach Facility Closure

Some commentators objected to the separate detoxification criteria for spent ore on the heap and the rinsate. The criteria were considered to be too stringent and too difficult to measure since generally-accepted standard analytical methods are not available. Other commentators supported the requirements as being appropriate.

Other objections related to the requirement for cover layers on the heap. The argument was made that cyanide detoxification could better take place if the heap were left open to the elements.

Response: The Department has simplified the heap detoxification requirement by specifying only a maximum allowable WAD cyanide rinsate concentration of 0.2 ppm. It is assumed that once the rinsate reaches 0.2 ppm, only the relatively stable cyanide compounds will be left in the heap.

The spent ore is required to pass the EPA TCLP Method 1311 test or it will be considered a state hazardous waste.

The Department has also retained the cover requirement as an appropriate means of preventing possible long-term acid-water generation and release of cyanide and toxic metals by water and oxygen infiltration.

Comment: Mill Tailings Disposal Facility Closure

Comments regarding closure requirements for the tailings facility were generally the same as those for closure of the leach heap.

Response: The Department continues to assume that the best means of preventing long-term release of toxic materials from a closed tailings facility is end-of-pipe detoxification prior to disposal, addition of acid-neutralizing materials to the tailings, if necessary, and installation of a composite cap that will exclude infiltration of water and oxygen. These requirements have been continued in the present proposed rules.

Comment: Post-Closure Monitoring

Comments on the period for post-closure monitoring of potential releases from the disposal facilities ranged from nothing to 30 years and more.

Response: The Department will require post-closure monitoring in its permit with regular review of the data to determine the effectiveness closure. If toxic leakage problems arise, the Department has the authority to modify the permit to include remedial action to solve the problem. The present proposed rules specify that the Department may continue its permit in effect for up to 30 years.

The Department will also coordinate closure monitoring with DOGAMI and consult with them on retention of security funds that may be needed for remedial action to correct problems from ineffective closure.

Once closure is considered to be effective, the permit may be terminated.

Comment: Open-Pit Closure Requirements

Considerable interest was shown by commentators on the guidelines for closure of the open pit. Most of the comment was directed at additional requirements, especially backfilling of the pits and restructuring of affected aquifers.

Response: The Department has generally addressed the potential problems of acid-water formation and collection in residual open pits in the draft rules by requiring the permittee to estimate from the site data what the potential for problems is and to address several specific strategies for possible alleviation of the problem.

Complete backfilling of open pits is not necessarily a water-pollution prevention method and thus the Department has not included backfilling as a requirement per se. Other protective regulations exist (DEQ groundwater protection rules) and WRD's (Oregon Water Resources Department rules) that also relate to potential water pollution problems arising from residual mining pits.

Jerry Turnbaugh
Industrial & On-Site Waste Section
Water Quality Division
Oregon Department of Environmental Quality

Key for revisions to June 14, 1991 Draft:
Added Text
~~Deleted Text~~

RULES PROPOSAL:

OREGON ADMINISTRATIVE RULES

CHAPTER 340

DIVISION 43

CHEMICAL MINING

~~**MINING OPERATIONS WHICH USE CYANIDE OR OTHER TOXIC CHEMICALS TO EXTRACT METALS OR METAL-BEARING MINERALS FROM ORES**~~

OAR 340-43-005	Purpose
~~OAR 340-43-010~~	~~Scope~~
OAR 340-43-01~~5~~0	Definitions
OAR 340-43-0~~20~~15	Permit Required
OAR 340-43-02~~5~~0	Permit Application ~~Information~~
OAR 340-43-0~~30~~25	Plans and Specifications
OAR 340-43-03~~5~~0	Design, Construction, Operation and Closure Requirements
~~OAR 340-43-040~~	~~Granting of Variances from Specified Requirements~~
OAR 340-43-035~~045~~	Exemption from State Permits for Hazardous Waste Treatment or Disposal Facilities

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS ~~SUBJECT TO THESE RULES~~

OAR 340-43-040~~050~~	Purpose
OAR 340-43-045~~055~~	General Provisions
OAR 340-43-050~~060~~	Control of Surface Water Run-On and Run-Off

OAR 340-43-055~~065~~	Physical Stability of Retaining Structures and Emplaced Mine Materials
OAR 340-43-060~~070~~	Protection of Wildlife
~~OAR 340-43-075~~	~~Guidelines for Design and Installation of Vat-Leach Tanks, Vessels and Secondary Containment Systems~~
~~OAR 340-43-080~~	~~Guidelines for Containment and Detection of Releases from Vat-Leach Tanks, Vessels and Secondary Containment Systems~~
~~OAR 340-43-085~~	~~Guidelines for Inspection of Vat-Leach Tanks, Vessels and Secondary Containment Systems~~
OAR 340-43-065~~090~~	Guidelines for Design, Construction, and Operation of Heap-Leach Facilities
OAR 340-43-070~~095~~	Guidelines for Disposal of Mill Tailings
OAR 340-43-075	Guidelines for Disposal or Storage of Wasterock, Low-Grade Ore and Other Mined Materials
OAR 340-43-080~~100~~	Guidelines for Heap-Leach and Tailings Disposal Facility Closure
OAR 340-43-085~~110~~	Post-Closure Monitoring
OAR 340-43-090~~115~~	Land Disposal of Wastewater
OAR 340-43-095~~120~~	Guidelines for Open-Pit Closure

PURPOSE

340-43-005

The purpose of these rules and guidelines is to protect the quality of the environment and public health in Oregon by requiring application of "... all available and reasonable methods...", Oregon Revised Statutes (ORS) 468.710, for control of wastes and chemicals relative to design, construction, operation, and closure of mining operations which use cyanide or other toxic chemicals to extract metals or metal-bearing minerals from the ore ~~or~~ and which produce wastes or wastewaters containing toxic materials.

~~SCOPE~~

~~340-43-010~~

~~These rules and guidelines apply to mining operations which use chemicals to extract metals or metal-bearing minerals from the ore except for small mineral-extraction operations using froth flotation.~~

~~The rules do not apply to mining and mineral extraction operations which do not use chemical extraction methods. Examples of mining activities to which the rules do not apply are aggregate mines and those placer mines which use only gravity separation methods. Any mining operation, however, that produces waste rock or spent ore that has the potential for forming acidic leachate may be covered by one or more of the provisions of these rules.~~
~~Non-mining operations, such as smelters, are not covered by these rules.~~

DEFINITIONS

340-43-01~~5~~0

Unless the context requires otherwise, as used in ~~these rules~~ this Division:

(1) "Chemical process mine" means a mining and processing operation for metal-bearing ores that uses chemicals to dissolve metals from ores.

(2) ~~(1)~~ "Department" means the Department of Environmental Quality.

(3) ~~(2)~~ "Guidelines" means this body of rules contained in 340-43-04~~5~~0 through 340-43-1~~2~~00.

(4) "Positive exclusion of wildlife" means the use of such devices as tanks, pipes, fences, netting, covers and heap-leach drip-irrigation emitters or covered emitters.

~~(3) "Slurry" means a suspension of ore or waste materials in water.~~

(5) ~~(4)~~ "Tailings" means the spent ore resulting from the milling and chemical extraction process.

PERMIT REQUIRED

340-43-0~~20~~15

(1) A person proposing to construct a new chemical mining operation, commencing to operate an existing non-permitted operation, or proposing to substantially modify or expand an existing operation shall first apply for, and receive, a permit from the Department. The permit may be an NPDES (National Pollutant Discharge Elimination System) permit if there is a point-source discharge to surface waters or a WPCF (Water Pollution Control Facility) permit if there is no discharge. Consideration may be given to site-specific conditions such as climate, proximity to water, and type of wastes to establish the final permit type and requirements for the facility.

(2) The permit application shall comply with the requirements of OAR Chapter 340, Divisions 14 and 45 and be accompanied by a report that fully addresses the requirements of this Division ~~OAR 340, Division 43~~.

PERMIT APPLICATION ~~INFORMATION~~

340-43-02~~5~~0

(1) The permit application shall fully describe the existing site and environmental conditions, with an analysis of how the proposed operation will affect the site and its environment. The Department shall, at a minimum, require the information specified for the DOGAMI consolidated application under Section 13, Chapter 735, 1991 Oregon Laws. The Department will also use the information contained in NEPA (National Environmental Policy Act), EA (Environmental Assessment), or EIS (Environmental Impact Statement) documents, if they are required by the project, as partial fulfillment of the requirements of this paragraph. ~~The Department may accept the information and operating plan required by DOGAMI (Department of Geology and Mineral Industries) under OAR 632, Division 35, or the information contained in a NEPA (National Environmental Protection Act), EA (Environmental Assessment), or EIS (Environmental Impact Study) document as partial fulfillment of the requirements of this paragraph.~~

(2) The permit application shall, in addition to the information~~ required by the application forms,~~ described in Paragraph (1) above, include the following information, unless the information has been otherwise submitted:

~~(a) Site description;~~

~~(b) Site map;~~

(a) ~~(c)~~ Climate/meteorology characterization, with supporting data;

(b) ~~(d)~~ Soils characterization, with supporting data;

(c) ~~(e)~~ Surface water hydrology study, with supporting data;

(d) ~~(f)~~ ~~Surface~~ Characterization of surface water and groundwater quality;

(e) ~~(g)~~ Inventory of surface water and groundwater beneficial uses;

(f) ~~(h)~~ Hydrogeologic characterization of groundwater, with supporting data;

(g) ~~(i)~~ Geologic engineering, hazards and geotechnical study, with supporting data;

(h) ~~(j)~~ Characterization of mine materials and wastes which include, for example, overburden, waste rock, stockpiled ore, leached ore and tailings. Characterization of mine materials and wastes shall include, but not be limited to the following:

(A) Chemical and mineral analysis related to toxicity;

(B) Determination of the potential for acid water ~~generation~~ formation;

(C) Determination of the potential for long-term leaching of toxic materials from the wastes;

(i) ~~(k)~~ Characterization of wastewater (quantity and chemical and physical quality) produced by the operation;

(j) ~~(l)~~ Assessment of the potential for ~~residual~~ acid-water formation from waste disposal facilities, low-grade ore stockpiles, waste rock piles and for surface water or groundwater accumulation in open pits that will remain after mining is ended. ~~and accumulation in open pits remaining after mining;~~

~~(m) Any other relevant baseline data.~~

(3) Data submitted by the permit applicant should be based on analysis of the actual materials, when possible, or may be based on estimates from knowledge of similar operations~~,~~ and professional judgment.

PLANS AND SPECIFICATIONS

340-43-0~~30~~25

(1) A person constructing or commencing to operate a chemical process mine or substantially modifying or expanding an existing chemical process mine ~~mining operation which will use cyanide or other toxic chemicals to extract metals or metal-bearing minerals from the ore or which will produce wastes or wastewaters containing toxic materials or substantially modifying or expanding an existing such operation~~ shall first submit plans and specifications to the Department for construction, operation and maintenance of the facilities intended for treatment, control and disposal of ~~potentially toxic~~ wastes.

(2) The Department shall approve the plans, in writing, before construction of the facilities may be started. The plans shall address all applicable requirements of this Division ~~these rules~~ and shall include, but not be limited to, the following:

(a) A description of the facilities to be constructed~~;~~, including tanks, pipes and other storage and conveyance means for processing chemicals and solutions and wastewaters;

(b) A ~~surface water~~ management plan for control of surface water;

(c) A ~~wastewater~~ management plan for treatment and disposal of excess wastewater, including provisions for reuse and wastewater minimization;

(d) A facility construction plan including, as applicable, the design of low-permeability soil barriers, ~~the installation method for geosynthetics,~~ the type of geosynthetics to be used and a description of their installation methods, the design of wastewater treatment facilities and processes, a quality assurance plan for applicable phases of construction and a listing of construction certification reports to be provided to the Department;

(e) A preliminary closure plan;

(f) A preliminary post-closure monitoring and maintenance plan;

(g) A spill containment and control plan.

DESIGN, CONSTRUCTION, OPERATION AND CLOSURE REQUIREMENTS

340-43-03~~5~~0

(1) All chemical process and waste disposal facilities~~,~~ ~~including~~ and facilities for mixing, distribution, and application of chemicals associated with on-site mining operations; ore preparation and beneficiation facilities; and processed ~~waste~~ -ore disposal facilities~~; and tailings disposal facilities~~ shall be designed, constructed, operated and closed in accordance with the guidelines contained in ~~these rules~~ this Division.

(2) A groundwater monitoring plan shall be submitted to, and be approved by the Department. Monitoring wells shall be installed for detection of groundwater contamination as required by ~~OAR 340-40~~ OAR Chapter 340, Division 40, unless the hydrogeology of the site or other technical information indicates that an adverse impact on groundwater quality is not likely to occur.

~~(3) The Department may approve other protective means if the permit applicant can demonstrate that they provide equivalent protection, or the Department may grant a variance from the requirement as provided in OAR 340-43-040.~~

(3) Alternative methods of control of wastes may be acceptable if the permit applicant can demonstrate that the alternate methods will provide fully-equivalent environmental protection. The burden of proof of fully-equivalent protection lies with the permit applicant.

(4) The Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with these rules.

~~GRANTING OF VARIANCES FROM SPECIFIED REQUIREMENTS~~

~~340-32-040~~

~~(1) The Department may, by written variance, waive certain requirements of these rules when size of operation, location, topography, operational procedures, or other site specific conditions indicate that the purpose of these rules can be achieved without strict adherence to the requirements.~~

~~(2) The Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with these rules.~~

EXEMPTION FROM STATE PERMITS FOR HAZARDOUS WASTE TREATMENT OR DISPOSAL FACILITIES

340-43-04~~4~~35

(1) The state hazardous waste program requires a permit for the "treatment", "storage" or "disposal" of any "hazardous waste" as identified or listed in OAR Chapter 340, Division 101 from the Department, prior to the treatment and disposal of wastes. Permitting requirements can be found in OAR Chapter 340, Division 105, Hazardous Waste Management. ~~The Department may, by written variance, waive certain requirements of these rules when size of operation, location, topography, operational procedures, or other site specific conditions indicate that the purpose of these rules can be achieved without strict adherence to the requirements.~~

(2) However, any operation permitted under ~~these rules~~ this Division, which would otherwise require the neutralization or treatment of hazardous waste and

would require a permit pursuant to OAR ~~340-105~~ Chapter 340, Division 105, shall be exempt from the requirement to obtain such hazardous waste treatment permit.

~~(3) If processing wastes are not treated to the criteria contained in these rules, the permit applicant shall obtain a state hazardous waste treatment and disposal permit.~~

(3) All mined materials disposed of under this Division shall pass Oregon's hazardous waste rule criteria or they will be considered a state hazardous waste and must be disposed of accordingly.

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS ~~SUBJECT TO THESE RULES~~

PURPOSE

340-43-040~~5~~

(1) ~~The guidelines contained in these rules~~ This Division establishes criteria for the design, construction, operation and closure of ~~facilities subject to these rules~~ chemical mining operations and supplements the provisions of ~~paragraphs~~ OAR 340-43-005 through OAR 340-43-~~045~~035.

~~(2) Alternative methods of control of wastes may be acceptable if the permit applicant can demonstrate that the alternate methods will provide fully-equivalent environmental protection. The burden of proof of fully-equivalent protection lies with the permit applicant.~~

~~(3)~~ (2) Any disapproval of submitted plans or specifications, or imposition of requirements by the Department to improve existing facilities or their operation will be referenced when appropriate, to applicable guidelines or ~~appropriate sections of these~~ rules.

GENERAL PROVISIONS

340-43-0~~5~~45

(1) Facilities permitted under either a WPCF or NPDES permit shall not discharge ~~inadequately treated~~ wastewater or process solutions to surface water,

groundwater or soils, except as expressly allowed by the permit.

(2) Facilities subject to these rules shall not be sited in 100-year floodplains~~, in~~ or wetlands~~, or on geological features of demonstrated seismic instability~~. A buffer zone (a minimum of 200 feet wide ~~at a minimum~~) shall be established between waste disposal facilities and surface waters.

~~(3) Permit applicants must demonstrate to the Department that the design of ore treatment facilities or waste disposal facilities sited in seismic impact zones or otherwise geologically unstable areas is adequate to ensure the integrity of all structural components of the facilities during operation, closure and post closure.~~

~~(4)~~ (3) All chemical conveyances (ditches, troughs, pipes, etc.) shall be equipped with secondary containment and leak detection means for preventing and detecting release of chemicals to surface water, groundwater or soils.

(~~5)~~ (4) Acid water accumulation in open pits resulting from the mining operation must be prevented by appropriate mining practices, by measures taken in the closure process, or be treated to control pH and toxicity, for the life of the pit.

~~(6)~~ (5) Construction of surface impoundment liner systems shall conform generally to the principles and practices described in EPA/600/2-88/052, Lining of Waste Containment and Other Impoundment Facilities, September 1988.

(6) The Department may require the permittee to hire a third-party contractor to perform the functions set forth below. Selection of the contractor shall be subject to Department approval.

(a) Review and evaluate the design and construction specifications of all mined-materials disposal facilities permitted under this Division for functional adequacy and conformance with Department requirements. The Department shall not approve construction of the disposal facilities until the design and construction specifications have been evaluated.

(b) Monitor the course of construction of all mined-materials disposal facilities for compliance with the approved design and construction specifications. The third-party contractor shall regularly document the progress of construction and the Department shall require the permittee to take corrective action if construction does not satisfactorily conform to the approved design and construction specifications.

CONTROL OF SURFACE WATER RUN-ON AND RUN-OFF

340-43-0~~6~~50

(1) Surface water run-on and run-off shall be controlled such that it will not endanger the facility or become contaminated by contact with process ~~toxic~~ materials or loaded with sediment. The control systems shall be designed to accommodate a 100-year, 24-hour storm event, or any other defined climatic event that is more appropriate to the site, and be placed so as to allow for restoration of the natural drainage network, to the maximum extent practicable, upon facility closure.

(2) All mined materials shall be properly placed and protected from surface water and precipitation so as not to be eroded and contribute sediment to site stormwater run-off or to otherwise contaminate surface water.

PHYSICAL STABILITY OF RETAINING STRUCTURES AND EMPLACED MINE MATERIALS

340-43-0~~6~~55

(1) Permit applicants must demonstrate to the Department that the design of chemical processing facilities and waste disposal facilities is adequate to ensure the stability of all structural components of the facilities during operation, closure and post closure.

~~(1)~~ (2) Retaining structures, foundations and mine materials emplacements shall be designed by a~~n independent,~~ qualified, registered professional and be constructed for long-term stability under anticipated loading and seismic conditions.

~~(2)~~ (3) Temporary structures and materials emplacements may, with written approval from the Department, be constructed to a lesser standard if it can be shown that they pose no, or minimal, threat to public safety or the environment.

PROTECTION OF WILDLIFE

340-43-0~~7~~60

(1) Wildlife shall be positively excluded from contact with chemical processing solutions and wastewaters containing chemicals.

(2) The Department may waive the positive exclusion requirement if the Oregon Department of Fish and Wildlife (ODF&W) certifies to the Department that the project is designed such that it will adequately protect wildlife.

~~(1) Provision shall be made for positive exclusion of wildlife from contact with processing chemicals, contaminated surface waters or wastewaters which are toxic to wildlife. Positive exclusion requires the use of such devices as pipes, fences, netting, covers and heap-leach drip-irrigation emitters.~~

~~(2) Hazing or other non positive protective measures are not acceptable.~~

~~**GUIDELINES FOR DESIGN AND INSTALLATION OF VAT-LEACH TANKS, VESSELS AND SECONDARY CONTAINMENT SYSTEMS**~~

~~**340-43-070**~~

~~(1) Owners or operators of new tank, vessel and secondary containment systems or components must ensure that the foundation, structural support, seams, connections, and pressure controls (if applicable) are adequately designed and that the system has sufficient structural strength, compatibility with the materials to be stored or treated, and corrosion protection so that it will not collapse, rupture, or fail. The owner or operator must obtain a written assessment reviewed and certified by an independent, qualified, registered professional attesting that the system has sufficient structural integrity and is acceptable for the storing and treating of materials.~~

~~This assessment shall include, at a minimum, the following information:~~

~~(a) Design standard(s) according to which the tank(s), vessel(s) and ancillary equipment is or will be constructed;~~

~~(b) Hazardous characteristics of the materials to be handled;~~

~~(c) For new tank systems or components in which the external shell of a metal tank or any external metal component of the tank system is or will be in contact with the soil or with water, a determination by a corrosion expert of:~~

~~(A) Factors affecting the potential for corrosion, including but not limited to:~~

~~(i) Soil moisture content;~~

~~(ii) Soil pH;~~

~~(iii) Soil sulfides level;~~

~~(iv) Soil resistivity;~~

~~(v) Structure to soil potential;~~

~~(vi) Influence of nearby underground metal structures (e.g., piping);~~

~~(vii) Stray electric current;~~

~~(viii) Existing corrosion-protection measures (e.g., coating, cathodic protection);~~

~~(B) The type and degree of external corrosion protection that is needed to ensure the integrity of the tank or vessel system during the use of the system or component, consisting of one or more of the following:~~

~~(i) Corrosion-resistant materials of construction such as special alloys or fiberglass-reinforced plastic;~~

~~(ii) Corrosion-resistant coating (such as epoxy or fiberglass) with cathodic protection (e.g., impressed current or sacrificial anodes);~~

~~(iii) Electrical isolation devices such as insulating joints and flanges.~~

~~(d) For underground tank system components that are likely to be affected by vehicular traffic, a determination of design or operational measures that will protect the tank system against potential damage;~~

~~(e) Design consideration to ensure that:~~

~~(A) Tank and vessel foundations will maintain the load of a full tank or vessel;~~

~~(B) Tank and vessel systems will be anchored to prevent flotation or dislodgement where the system is placed in a saturated zone, or is located within a seismic fault zone;~~

~~(C) Tank and vessel systems will withstand the effect of frost heave.~~

~~(2) The owner or operator of a new tank or vessel system must ensure that proper handling procedures are adhered to in order to prevent damage to the system during installation. Prior to covering, enclosing, or placing a new tank or vessel system or component in use, an independent, qualified professional who is trained and experienced in the proper installation of such systems, shall inspect the system or component for the presence of any of the following items:~~

~~(a) Weld breaks;~~

~~(b) Punctures;~~

~~(c) Scrapes of protective coatings;~~

~~(d) Cracks;~~

~~(e) Corrosion;~~

~~(f) Other structural damage or inadequate construction or installation.~~

~~All discrepancies shall be remedied before the system is covered, enclosed or placed in use.~~

~~(3) New tank or vessel systems or components and piping that are placed underground and backfilled shall be provided with a backfill material that is a noncorrosive, porous, homogenous substance and is carefully installed so that the backfill is placed completely around the system and compacted to ensure that the tank and piping are fully and uniformly supported.~~

~~(4) All new tanks, vessels and ancillary equipment shall be tested for tightness prior to being covered, enclosed or placed in use. If a tank or vessel system is found not to be tight, all repairs necessary to remedy the leak(s) in the system shall be performed prior to the tank or vessel system being covered, enclosed or placed in use.~~

~~(5) Ancillary equipment shall be supported and protected against physical damage and excessive stress due to settlement, vibration, expansion or contraction.~~

~~(6) The owner or operator shall provide the type and degree of corrosion protection necessary, to ensure the integrity of the tank or vessel system during use of the system. The installation of a corrosion protection system that is field fabricated shall be supervised by an independent corrosion expert to ensure proper installation.~~

~~(7) The owner or operator shall obtain and keep on file at the facility written statements by those persons required to certify the design of the tank or vessel system and supervise the installation of the system to attest that the system was properly designed and installed and that repairs, if necessary, were properly performed.~~

~~GUIDELINES FOR CONTAINMENT AND DETECTION OF RELEASES FROM VAT-LEACH TANKS, VESSELS AND SECONDARY CONTAINMENT SYSTEMS~~

~~340-43-080~~

~~(1) In order to prevent the release of toxic materials or wastes to the environment, secondary containment that meets the requirements of this section shall be provided for all new tank or vessel systems or components, prior to their being put into service.~~

~~(2) Secondary containment systems shall be:~~

~~(a) Designed, installed, and operated to prevent any migration of toxic materials or accumulated liquid out of the system to the soil, groundwater, or surface water at any time during the use of the system;~~

~~(b) Capable of detecting and collecting releases and accumulated liquids until the collected material is removed.~~

~~(3) Secondary containment systems shall be at a minimum:~~

~~(a) Constructed or lined with materials that are compatible with the materials to be placed in the system and of sufficient thickness to prevent failure due to pressure gradients (including static head and external hydrological forces), physical contact with the materials to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation (including stresses from nearby vehicular traffic);~~

~~(b) Placed on a foundation or base capable of providing support to the secondary containment system and resistance to pressure gradients above and below the system and capable of preventing failure due to settlement, compression, or uplift;~~

~~(c) Provided with a leak detection system that is designed and operated so that it will detect the failure of either the primary and secondary containment structure or any release of hazardous materials or accumulated liquid in the secondary containment system within 24 hours, or at the earliest practicable time if the existing detection technology or site conditions will not allow detection of a release within 24 hours;~~

~~(d) Sloped or otherwise designed or operated to drain and remove liquids resulting from leaks, spills, or precipitation. Spilled or leaked materials and accumulated precipitation shall be removed from the secondary containment system within 24 hours, or in as timely a manner as is possible to prevent harm to human health or the environment, if removal of the released waste or~~

~~accumulated precipitation cannot be accomplished within 24 hours.~~

~~(4) Secondary containment for tanks or vessels shall include one or more of the following:~~

~~(a) A line (external to the tank);~~

~~(b) A vault;~~

~~(c) A double-walled tank; or~~

~~(d) An equivalent device as approved by the Department.~~

~~(5) In addition to the requirements of paragraphs (2), (3), and (4) of this section, secondary containment systems shall satisfy the following requirements:~~

~~(a) External liner systems shall be:~~

~~(A) Designed or operated to contain 100 percent of the capacity of the largest tank within its boundary;~~

~~(B) Designed or operated to prevent run-on or infiltration of precipitation into the secondary containment system unless the collection system has sufficient excess capacity to contain run-on or infiltration. Such additional capacity shall be sufficient to contain precipitation from a 25-year, 24-hour rainfall event;~~

~~(C) Free of cracks or gaps; and~~

~~(D) Designed and installed to completely surround the tank or vessel and to cover all surrounding earth likely to come into contact with the waste if released from the tank(s) (i.e., capable of preventing lateral as well as vertical migration of the waste).~~

~~(b) Vault systems shall be:~~

~~(A) Designed or operated to contain 100 percent of the capacity of the largest tank or vessel within its boundary;~~

~~(B) Designed or operated to prevent run-on or infiltration of precipitation into the secondary containment system unless the collection system has sufficient excess capacity to contain run-on or infiltration. Such additional capacity shall be sufficient to contain precipitation from a 25-year, 24-hour rainfall event;~~

~~(C) Constructed with chemical-resistant water stops in place at all joints (if any);~~

~~(D) Provided with an impermeable interior coating or lining that is compatible with the stored materials and that will prevent migration of material into the concrete;~~

~~(E) Provided with an exterior moisture barrier or be otherwise designed or operated to prevent migration of moisture into the vault if the vault is subject to hydraulic pressure.~~

~~(c) Double-walled tanks shall be:~~

~~(A) Designed as an integral structure (i.e., an inner tank within an outer shell) so that any release from the inner tank is contained by the outer shell;~~

~~(B) Protected, if constructed of metal, from both corrosion of the primary tank interior and the external surface of the outer shell; and~~

~~(C) Provided with a built-in continuous leak detection system capable of detecting a release within 24 hours or at the earliest practicable time, if the owner or operator can demonstrate to the Department and the Department concurs, that the existing leak detection technology or site conditions will not allow detection of a release within 24 hours.~~

~~(6) Ancillary equipment shall be provided with full secondary containment (e.g., trench, jacketing, double-walled piping) except for:~~

~~(a) Above ground piping (exclusive of flanges, joints, valves, and connections) that are visually inspected for leaks on a daily basis;~~

~~(b) Welded flanges, welded joints, and welded connections that are visually inspected for leaks on a daily basis;~~

~~(c) Sealless or magnetic coupling pumps and sealless valves, that are visually inspected for leaks on a daily basis; and~~

~~(d) Pressurized above ground piping systems with automatic shut-off devices (e.g., excess flow check valves, flow metering shutdown devices, loss of pressure actuated shut-off devices) that are visually inspected for leaks on a daily basis.~~

~~GUIDELINES FOR INSPECTION OF VAT-LEACH TANKS, VESSELS AND SECONDARY CONTAINMENT SYSTEMS~~

~~340-43-085~~

~~(1) The owner or operator shall inspect, at least once each operating day:~~

~~(A) Overfill/spill control equipment (e.g., waste-feed cutoff systems, bypass systems, and drainage systems) to ensure that it is in good working order;~~

~~(B) The above-ground portions of the tank or vessel system, if any, to detect corrosion or releases of waste;~~

~~(C) Data gathered from monitoring equipment and leak-detection equipment (e.g., pressure and temperature gauges, monitoring wells) to ensure that the tank or vessel system is being operated according to its design; and~~

~~(D) The construction materials and the area immediately surrounding the externally accessible portion of the tank system including secondary containment structures (e.g., dikes) to detect erosion or signs of releases of materials (e.g., wet spots, dead vegetation).~~

~~(2) The owner or operator shall inspect cathodic protection systems, if present, according to, at a minimum, the following schedule to ensure that they are functioning properly:~~

~~(a) The proper operation of the cathodic protection system shall be confirmed within six months after initial installation, and annually thereafter;~~

~~(b) All sources of impressed current shall be inspected and/or tested, as appropriate, at least bimonthly (i.e., every other month).~~

~~(3) The owner or operator shall document in the operating record of the facility an inspection of those items in paragraphs (1) and (2) of this section.~~

GUIDELINES FOR DESIGN, CONSTRUCTION, AND OPERATION OF HEAP-LEACH FACILITIES

340-43-065~~090~~

(1) ~~These guidelines apply~~ This paragraph applies ~~generally~~ to heap-leach facilities using dedicated, or expanding, pads. Heap-leach facilities using on-off, reusable pads may require variations from these rules; they ~~that~~ shall be approved on a case-by-case basis by the Department.

(2) The heap-leach facility (pad and associated ponds, pipes and tanks) shall be sized to prevent flooding of any of its components. ~~A limited-use, emergency overflow pond (or tank) constructed to lesser requirements as described in this paragraph may be used in addition to the pregnant-solution pond (or tank) to reduce the required design capacity of the pregnant-solution pond(or tank).~~

(3) TABLE 1 of this Division establishes minimum capacity-sizing criteria for the leach-pad and ponds. The pad and ponds~~, pond and tank components~~ may be designed to act separately or in conjunction with each other to obtain the required storage volumes. Other design criteria may be used, with Department approval, if local conditions warrant. The best available climatic data shall be used to confirm the ~~most appropriate~~ critical design storm event and estimate the liquid levels in the system over a full

seasonal cycle. The liquid mass balance may include provision for evaporation.

(4) The heap-leach pad liner system shall be of triple liner construction with between-liner leak detection consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous ~~full~~ flexible-membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec);

(c) A leak-detection system between the synthetic liners capable of detecting leakage ~~equivalent to free flow from a total hole area of 0.05 square inches per acre of liner~~ of 400 gallons/day-acre within ten ~~one~~ weeks of leak initiation.

(5) The processing-chemical pond liners shall be of triple liner construction with between-liner leak detection consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous ~~full~~ flexible-membrane middle and top liners of suitable synthetic material separated by a ~~suitable~~ permeable material (minimum coefficient of permeability of 10^{-2} cm/sec);

(c) A leak detection system between the synthetic liners capable of detecting leakage ~~equivalent to free flow from a total hole area of 0.05 square inches per acre of liner~~ of 400 gallons/day-acre, within ~~one~~ ten weeks of leak initiation.

(6) Emergency ponds may be constructed as an alternative to larger pregnant and barren ponds. The emergency pond may be constructed to a lesser standard, with the limitation that it is to be used only infrequently and for short periods of time. The Department will specify reporting and use limitations

for the ponds in the permit. A between-liner leak detection system is not required for the emergency pond.

(7) The emergency-pond liner shall be of composite construction consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of $10^{-6\,\cancel{-7}}$ cm/sec) with a minimum thickness of 12 inches, and

(b) A single ~~full~~ flexible-membrane synthetic top liner of suitable material.

~~(8)~~ (6) The heap-leach pad shall be provided with a process chemical collection system above the upper-most liner that will prevent an accumulation of process chemical within the heap greater than 24 inches in depth.

~~(9)~~ (7) The permittee shall prepare a written operating plan for safe temporary shut-down of the heap-leach facility and train employees in its implementation.

~~(10)~~ (8) The permittee shall respond to leakage collected by the heap-leach and processing-chemical storage pond leak-collection systems according to the process defined in TABLE 2.

~~(10) Leaks detected by the heap-leach and processing-chemical pond leak-detection systems with leak rates in excess of the rate for free flow through 0.05 square inches of hole per acre of liner at the actual liquid depth shall either be repaired at the first opportunity or operations shall be modified such that the leakage is reduced below the specified rate. The Department will set a time schedule for repair with the permittee, if necessary.~~

~~(11)~~ (9) The ~~permit applicant~~ permittee shall determine the acid-generating potential of the spent ore by acid\base accounting and other appropriate static and dynamic laboratory tests. If the spent ore is shown to be potentially acid generating under the conditions expected in the heap at closure, the permittee shall submit a plan for acid correction for Department approval prior to loading the heap.

GUIDELINES FOR DISPOSAL OF MILL TAILINGS

340-43-09~~5~~70

(1) Mill tailings shall be treated by cyanide removal and re-use prior to disposal to reduce the amount of cyanide introduced into the tailings pond. Chemical oxidation or other means shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the liquid fraction of the tailings. The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm. ~~Mill tailings shall be treated prior to disposal to remove or detoxify process chemicals and available toxic metals, and minimize potential formation of acid leachate in the waste disposal facility. The Department places first consideration on use of treatment technologies which will remove toxic metals, cyanide or other process chemicals and acid-generating minerals from the wastestream and use them in a beneficial manner. Second consideration will be given to cyanide oxidation or other "detoxification" treatments which will convert or remove toxic metals and cyanide complexes to reduce overall toxicity.~~

~~(2) The liquid-retention capacity of tailings disposal facilities which receive tailings as a slurry shall be designed to the (applicable) criteria of TABLE 1 to prevent overflow.~~

(3) The permittee shall determine the potential for acid-water formation from the tailings by means of acid-base accounting and other suitable laboratory static and dynamic tests. If acid formation can occur, basic materials shall be added to the tailings in the amount of three (3) times the acid formation potential or to give a net neutralization potential of at least 20 tons of $CaCO_3$ per 1000 tons of tailings, whichever is greater, before placing tailings in the disposal facility.

~~Disposal of non-acid-generating tailings.~~

~~(a) Non-acid-generating tailings should be disposed of as de-watered solids and the disposal area progressively covered, but disposal as a slurry will be considered.~~

~~(b) Tailings disposed of either as a slurry or as de-watered solids, shall meet the criteria of TABLE 2 or 3 of this Division, respectively.~~

~~(c) The disposal facility shall be lined with an engineered, stable, soil/clay liner with a maximum permeability of 10^{-6} cm/sec, having a minimum thickness of 12 inches and shall be provided with a collection system to remove stormwater.~~

(4) The disposal facility shall be lined with a composite double liner consisting of a flexible-membrane synthetic top liner in tight contact with an engineered, stable, soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) having a minimum thickness of 36 inches.

Construction of the liner shall generally follow the principles and practices contained in EPA/600/2-88/052, "Lining of Waste Containment and Other Impoundment Facilities, September, 1988.

~~Disposal of acid-generating tailings.~~

~~(a) Tailings, or waste materials that have been separated from tailings, which contain more than 1.0 g/kg of total sulfide sulfur and are acid generating, shall be disposed of in a separate disposal facility.~~

~~(b) Tailings or waste materials disposed of as a slurry or as de-watered solids shall meet the treatment criteria of TABLE 2 or 3, respectively, except that the sulfur criterion may be exceeded.~~

~~(c) The disposal facility shall be lined with a composite double liner consisting of a full-membrane synthetic top liner in tight contact with an engineered, stable, soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) having a minimum thickness of 36 inches.~~

~~Construction of the liner shall follow the principles and practices contained in EPA/600/2-88/052, "Lining of Waste Containment and Other Impoundment Facilities, September, 1988.~~

~~(d) The disposal facility shall be provided with a leachate collection system above the liner~~

~~suitable for monitoring, collection and treatment of potential acid drainage.~~

~~(e) The permittee shall segregate and place acid-generating and acid-neutralizing tailings in such a manner as to minimize acid water generation formation by maximizing neutralization and exclusion of water and oxygen, according to a Department-approved plan.~~

(5) The disposal facility shall be provided with a leachate collection system above the liner suitable for monitoring, collecting and treating potential acid drainage.

GUIDELINES FOR DISPOSAL OR STORAGE OF WASTEROCK, LOW-GRADE ORE AND OTHER MINED MATERIALS

340-43-075

The permittee shall determine the acid-producing and metals- release potential of the wasterock, low-grade ore or other mined materials by acid/base accounting and other appropriate static and dynamic laboratory tests. If the mined materials are shown to be potentially acid forming, or capable of releasing toxic metals, the permittee shall submit a plan for correction and disposal for Department approval prior to permanently placing the materials.

GUIDELINES FOR HEAP-LEACH AND TAILINGS DISPOSAL FACILITY CLOSURE

340-43-~~1~~080

(1) The waste disposal facilities shall be closed under these rules in conjunction with the reclamation requirements of DOGAMI (Oregon Department of Geology and Mineral Industries).

(2) An up-dated closure plan and post-closure monitoring and maintenance plan shall be submitted to the Department by the permittee at least 180 days prior to beginning closure operations or making any substantial changes to the operation. The closure plan must be compatible with DOGAMI's reclamation plan and may be part of it.

(3) Chemical conveyances (ditches, troughs, pipes, etc.) not necessary for post-closure monitoring shall be

removed. The secondary containment systems shall be checked before closure for process-chemical contamination, and contaminated soil or other materials, if any, shall be removed to an acceptable disposal facility.

(4) Closure of the heap-leach facility.

(a) The heap shall be detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm.~~, prior to closure by a combination of rinsing and chemical treatment as, for example, with hydrogen peroxide. Chlorine compounds shall not be used. Statistically-representative samples of the spent ore and the rinse water shall be taken and analyzed for the parameters listed in TABLE 4 of this Division. Residual cyanide levels shall meet the criteria of TABLE 4.~~

(b) Following detoxification as defined in (a) above, the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water and air infiltration. ~~Following detoxification and correction for acid-generation formation potential, if any, the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water infiltration.~~ The cover should consist, at a minimum, of a low-permeability layer ~~to prevent water infiltration~~ and suitable drainage and soil layers to prevent erosion and damage by animals and to sustain vegetation growth, in accordance with DOGAMI's reclamation rules.

(c) The ponds associated with the heap shall be closed by folding in the synthetic liners and filling and contouring the pits with inert material. Residual sludge may be disposed of in one of the on-site waste disposal facilities, provided it meets the criteria for such wastes in these guidelines. ~~removing the residual solid sludge and the synthetic liners and filling in and contouring the pits with inert material. The sludge may be disposed of in one of the on-site waste disposal facilities, with Department approval.~~ The process chemical collection system of the heap shall be maintained in operative condition so that it can be used to monitor the amount and quality of infiltrated water, if any, draining from the heap.

(5) The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time. ~~Closure of the non-acid-generating tailings disposal facility. The facility shall be closed in place by covering the tailings with a composite cover consisting, at a minimum, of a low-permeability layer to minimize water infiltration and suitable soil layers to prevent erosion and damage by animals and to sustain vegetation growth, in accordance with DOGAMI's reclamation rules.~~

~~(6) Closure of the acid-generating tailings disposal facility. The acid-generating tailings disposal facility shall be closed by covering with a composite cover designed to prevent water infiltration and be environmentally stable for an indefinite period of time.~~ Maximum effort shall be made to isolate the tailings from the environment. Construction of the cover shall generally follow the principles and practices contained in EPA/530-SW-89-047, Technical Guidance Document -- Final Covers on Hazardous Waste Landfills and Surface Impoundments.

POST-CLOSURE MONITORING

340-43-085~~110~~

(1) The Department may continue its permit in force for thirty (30) years after closure of the operation and will include permit requirements for periodic monitoring to determine if release of pollutants is occurring.

(2) ~~The facility water-quality permit may be continued in force for a nominal period of thirty years after closure of the operation and would include appropriate requirements for periodic monitoring to determine if release of pollutants is occurring.~~ Monitoring data will ~~would~~ be reviewed regularly by the Department ~~with DOGAMI regularly~~ to determine the effectiveness of closure of the disposal facilities. The Department will consult with DOGAMI on release of

security funds ~~before DOGAMI releases bond funds~~ that would otherwise be needed to correct problems resulting from ineffective closure.

LAND DISPOSAL OF WASTEWATER

340-43-090~~115~~

(1) To qualify for land disposal of excess wastewater, the permit applicant shall demonstrate to the Department that the process has been designed to minimize the amount of excess wastewater that is produced, through use of water-efficient processes, wastewater treatment and reuse, and reduction by natural evaporation. Excess wastewater that must be released shall be treated and disposed of to land under the conditions specified in the permit.

(2) A disposal plan shall be submitted as part of the permit application that, at a minimum, includes:

(a) Wastewater quantity and quality characterization;

(b) Soils characterization and suitability analysis;

(c) Drainage and run-off characteristics of the site relative to land application of wastewater;

(d) Proximity of the disposal site to groundwater and surface water and potential impact;

(e) Wastewater application schedule and water balance;

(f) Disposal site assimilative capacity determination;

(g) Soils, surface water and groundwater monitoring plan;

(h) Potential impact on wildlife or sensitive plant species.

(3) The Department will evaluate the disposal plan and set site-specific permit conditions for the wastewater discharge.

GUIDELINES FOR OPEN-PIT CLOSURE

340-43-<u>095</u>~~120~~

(1) Open pits that will be left as a result of the mining operation shall be assessed prior to, and following, mining operations for the potential <u>to contaminate</u> ~~accumulation of~~ water <u>to the extent</u> that <u>it</u> might not meet water-quality standards due to build-up of acid or toxic metals.

(2) If the Department <u>finds</u> ~~judges~~ that the potential for water accumulation in the pit(s) exists, the permit applicant shall submit a closure plan for the pit that will address contamination prevention and possible remedial treatment of the water. The closure plan shall, at a minimum~~,~~ examine the following alternatives:

(a) Avoidance, during mining, of acid-generating materials that can be left in place, rather than being exposed to oxidation and weathering;

(b) Removal <u>from the pit</u> and disposal, during or after the mining operation, of residual acid-generating materials that would otherwise be left exposed to oxidation and weathering;

(c) Protective capping in-situ of residual acid-generating materials;

(d) Treatment methods for <u>correcting acidity and toxicity of</u> accumulated water ~~for correcting acidity and toxicity~~;

(e) Installation of an impermeable liner under ponded water to prevent groundwater contamination;

(f) Backfilling of the pit(s) above the water table to reduce oxidation of residual acid-generating materials.

TABLE 1

Heap-Leach Liquid Storage Criteria

Component	Pregnant-Solution Pond	Barren-Solution Pond
Operating Volume	Minimum necessary to maintain recirculation	Minimum necessary to maintain recirculation
Operational Surge	Anticipated draindown and rinse volume	Anticipated draindown and rinse volume
Climatic Surge	100-yr, 24-hr storm plus 10-yr snowmelt	100-yr, 24-hr storm plus 10-yr snowmelt
Safety Factor	2-ft dry freeboard	2-ft dry freeboard

TABLE 2

Required Responses to Leakage Detected from the Leach Pad

Leakage Category	Response
Zero leakage to 200 gal/day-acre	Notify the Department; increase pumping and monitoring
Leakage from 200 gal/day-acre to 400 gal/day-acre	Change operating practices to reduce leakage
Leakage in excess of 400 gal/day-acre	Repair leaks under Department schedule.

~~Tailings Slurry Treatment Criteria~~

~~Parameter~~	~~Allowable Concentration~~
~~Filtered Liquid Fraction:~~	
~~Cyanide Total)~~	~~10 mg/l~~
~~Cyanide (Wad)~~	~~0.2 mg/l~~
~~Thiocyanate ion~~	~~75 mg/l~~
~~Cyanate ion~~	~~50 mg/l~~
~~Filtered Solid Fraction:~~	
~~Total Sulfur (Sulfide)~~	~~1.0 g/kg~~
~~ANP > 3 APP~~	~~(See Notes)~~
~~Both Liquid and Solid Fractions By EPA TCLP Method 1311:~~	
~~Arsenic~~	~~5 mg/l~~
~~Barium~~	~~100 mg/l~~
~~Cadmium~~	~~1 mg/l~~
~~Chromium~~	~~5 mg/l~~
~~Copper~~	~~1 mg/l~~
~~Lead~~	~~5 mg/l~~
~~Mercury~~	~~0.2 mg/l~~
~~Selenium~~	~~1 mg/l~~
~~Silver~~	~~5 mg/l~~
~~Zinc~~	~~1 mg/l~~

~~**Notes:**~~

1. ~~Liquid fraction defined as filtered slurry liquid combined with distilled-water rinsate of solid fraction; concentrations calculated on original liquid-fraction volume.~~

2. ~~Cyanide (Total) and (Wad) to be determined by ASTM D2036-82 A and C.~~

3. ~~ANP = Acid neutralization potential in terms of the mass of equivalent~~ ~~$CaCO_3$~~ ~~available, expressed in mass units per thousand mass units.~~

   ~~APP = Acid-producing potential in terms of the mass of equivalent~~ ~~$CaCO_3$~~ ~~required for neutralization, expressed in mass units per thousand mass units.~~

~~TABLE 3~~

~~De-Watered Tailings-Solids Treatment Criteria~~

~~Parameter~~	~~Allowable Concentration~~
~~Soluble Cyanide (Wad)~~	~~0.5 mg/kg~~
~~Soluble Cyanide (Total)~~	~~2.5 mg/kg~~
~~Cyanide (Total) after extraction of Soluble (Wad) and Soluble (Total) Cyanide~~	~~10.0 mg/kg~~
~~Total Sulfur (Sulfide)~~	~~1.0 g/kg~~
~~ANP > 3 APP~~	~~(See notes)~~
~~By EPA TCLP Method 1311:~~	
~~Arsenic~~	~~5 mg/l~~
~~Barium~~	~~100 mg/l~~
~~Cadmium~~	~~1 mg/l~~
~~Chromium~~	~~5 mg/l~~
~~Copper~~	~~1 mg/l~~
~~Lead~~	~~5 mg/l~~
~~Mercury~~	~~0.2 mg/l~~
~~Selenium~~	~~1 mg/l~~
~~Silver~~	~~5 mg/l~~
~~Zinc~~	~~1 mg/l~~

~~Notes:~~

1. ~~See Appendix A for cyanide analysis method.~~

2. ~~"De-watered" means no free liquid.~~

3. ~~ANP = Acid neutralization potential in terms of the mass of equivalent $CaCO_3$ available, expressed in mass units per thousand mass units.~~

   ~~APP = Acid-producing potential in terms of the mass of equivalent $CaCO_3$ required for neutralization, expressed in mass units per thousand mass units.~~

~~TABLE 4~~

~~Heap-Leach Closure Criteria for Cyanide~~

~~Waste Fraction~~	~~Parameter~~	~~Concentration~~
~~Heap Rinsate~~	~~Cyanide (Wad)~~	~~0.2 mg/l~~
~~(Liquid)~~	~~Cyanide (Total)~~	~~10.0 mg/l~~
~~Spent Ore~~	~~Soluble Cyanide (Wad)~~	~~0.2 mg/kg~~
~~(Solids)~~	~~Soluble Cyanide (Total)~~	~~2.5 mg/kg~~
	~~Cyanide (Total) after extraction of Soluble (Wad) and Soluble (Total) Cyanide~~	~~10.0 mg/kg~~

~~**Note:**~~

~~See Appendix A for the cyanide analysis method applicable to the spent ore.~~

~~APPENDIX A~~

~~ANALYSES OF SPENT ORE AND TAILINGS~~

~~Analysis of the spent ore and tailings shall be performed with the following procedure:~~

~~1. For extraction of Soluble Cyanide (Wad):~~

~~a. Place 500 grams of dry spent ore or tailings in 2.5 liters of de-ionized water at neutral pH in an air-tight, capped container. Select the container size to minimize head space.~~

~~b. Stir mildly for 24 hours at room temperature.~~

~~c. Filter entire slurry from Step (1.b) through No. 42 Whatman paper and immediately analyze an aliquot for Wad cyanide.~~

~~d. Calculate Soluble Cyanide (Wad) as in Step (2.d).~~

~~2. For extraction of Soluble Cyanide (Total):~~

~~a. Place 500 grams of dry spent ore or tailings in 2.5 liters of distilled water; adjust to pH 5 with~~ $\cancel{H_2SO_4}$~~.~~

~~b. Stir mildly for 24 hours at room temperature in an air-tight, capped container with no head space.~~

~~c. Filter the entire slurry from Step (2.b) through a No. 42 Whatman filter paper and analyze an aliquot of filtrate for Soluble Cyanide (Total). Use the remaining solid fraction of the slurry for Cyanide (Total) in Step (3.).~~

~~d. Calculate Soluble Cyanide (Total) as mg CN/Kg of solids:~~

$$\cancel{\text{mg CN/Kg} = \frac{(\text{mg/L CNT in filtrate}) \times 2.5}{0.5}}$$

~~3. For determination of Soluble Cyanide (Wad), use ASTM D2036-82 C.~~

~~4. For determination of Cyanide (Total) after extraction of Soluble Cyanide (Wad) and Soluble Cyanide (Total) in the solid fraction, use ASTM D2036-82 A, with a minimum of 5 grams of the solid fraction remaining from Step (2.).~~

Summary of Record of EQC Discussions of Mining Rules

December 13, 1990

At a work session on December 13, 1990, the Commission and Department discussed a variety of options for regulation of the environmental aspects of large scale gold mining operations in Oregon.

This item was intended to provide an interchange of information between the staff and the Commission and provide a common basis for the development of a regulatory approach for large scale gold mining operations in Oregon. Commissioner Lorenzen expressed his desire that the Commission give the staff clear guidance on the approach to be developed. Commissioner Wessinger noted the need to listen to staff recommendations.

Jerry Turnbaugh, of the Water Quality Division, presented background information to the Commission on mining operation, and the particular issues where decisions will have to be made in the development of the regulatory approach. Commissioner Lorenzen asked about the Department's authority on federal lands and the Department's hazardous waste authority. Michael Huston stated that the State has clear environmental authority on federal lands. Brett McKnight, of the Hazardous and Solid Waste Division, cited the hazardous waste cleanup project at the Umatilla Army Depot as an example of the Department's authority. He also noted that under the federal Resource Conservation and Recovery Act (RCRA), the owner of a facility and the operator are both subject to regulation.

In response to Commission questions on regulatory framework, Director Hansen noted that design and performance standards can be incorporated either in rule or as conditions in permits. Chairman Hutchison asked about preferences for rules as opposed to leaving requirements to be determined by professional judgement of the staff. Dave Barrows, representing the mining industry, indicated that his organization was split on that issue. Jean Cameron, representing Oregon Environmental Council, stated that they always preferred standards in rules along with flexibility for the permit writers to incorporate more stringent requirements where needed. Director Hansen stated that the approaches can be combined -- rules that incorporate design and performance standards, and permits that contain conditions based on the rules, guidelines, and best professional judgement. He also noted that mining wastes are not hazardous waste under the federal definitions, but rules adopted by the Commission change that and regulate processing operations as hazardous waste generators. Brett McKnight indicated that mine tailings may or may not be hazardous wastes. If they are, then the Department would have to site a hazardous waste storage facility at the site.

John Beaulieu and Gary Lynch, representing the Department of Geology and Mineral Industries, discussed the interagency approach to review of mining proposals, and indicated that their legislative package seeks to require applicants to present both an environmental analysis and a socio-economic analysis as part of their applications.

Chairman Hutchison then asked the Commission for an expression of their thinking. Commissioners Lorenzen and Wessinger expressed a preference for moving forward with something as rapidly as possible so that industry knows what is expected. They expressed a preference for rules that are general and not too lengthy or specific. Dave Barrows suggested that something be drafted by the Department and taken to public hearing as soon as possible rather than trying to use an advisory committee to develop a proposal. Jean Cameron urged the Commission to not rush too fast because the issue is too important to do it wrong. Representative Bob Pickard encouraged the Commission to move with purpose. He stated that an advisory committee with a long schedule won't serve the Department well in the budget process.

The Commission discussed concepts of regulating to do away with environmental risk, of requiring use of the best technology being employed on a commercial scale anywhere, and of using a combination of rules and guidelines. The Commission indicated it would provide guidance to the Department during the regular agenda at the Friday meeting.

<u>**December 14, 1990**</u>

During the regular meeting on December 14, 1990, the Commission reflected on the Work Session discussion of the previous day and expressed the following views:

- Proceed to rulemaking hearings as soon as possible on rules to address open pit large scale mining in which chemicals are used for ore processing. (Placer mining will be treated separately.)

- Use an open process including public information meetings in the development of proposed rules (in place of an advisory committee process).

- Develop draft rules sufficient to proceed to hearing by the end of February. Proceed to a rulemaking hearing and complete the rulemaking process within six months.

- Report on progress at the February 1, 1991, meeting and provide an outline of proposed rules.

- Circulate drafts to the Commission for their information as they are developed in order to provide an opportunity for input.

- Use a blended approach involving both rules and guidelines. The rules should not be too detailed, and the guidelines ought to be dynamic but sufficiently precise to send a reasonable and sufficiently predictable message about the regulatory expectations of Oregon.

- Direct the rules toward eliminating risk to the environment.

- Make the rules a combination of performance-based and technology based requirements.

- Require the best technology available anywhere as the starting point. If technology is being used anywhere else commercially, that technology will be the starting point for requirements. Make the rules technology forcing.

- Clearly place the burden on the applicant to show why specific technology or performance standards shouldn't apply or why alternative approaches should be considered equivalent and acceptable.

- Evaluate and consider the relationship to RCRA requirements.

- Assure that the regulatory approach is preventative and that the need for future superfund cleanup is eliminated.

- Consider interagency coordination to the maximum extent practicable to minimize duplication of efforts by applicants and the public.

It was MOVED by Commissioner Wessinger that the Department proceed with development of rules based on the above guidance. The Motion was seconded by Commissioner Lorenzen and unanimously approved.

January 31, 1991

At the work session on January 31, Jerry Turnbaugh reported that the Department was proceeding in accordance with a schedule that called for completing a second draft of proposed rules for gold recovery operations by the end of February. That second draft was already complete. The target is to have a third draft which will be sufficient for distribution for public comment available by March 1. An informal group is being assembled to assist in a focused technical review of the rules on February 21. This group includes people from DEQ's water quality and solid waste programs, the Department of Fish and Wildlife, the Department of Geology and Mineral Industries, and several private sector individuals associated with and knowledgeable in mining processes and activities.

Commissioner Lorenzen complimented Mr. Turnbaugh on his efforts to develop rules to address Commission concerns. Commissioner Wessinger asked for an indication of the future problem areas with regard to the proposed rules. Mr. Turnbaugh responded that the cost of technology that is not typically practiced would be the issue. Examples would be technology to added processing steps to remove and reuse cyanide rather than discharging it with wastewater, and steps to remove acid generating materials to prevent generation of acids in the process.

Chair Hutchison asked what the draft rules would say about open mine pits. Mr. Turnbaugh indicated that these rules do not yet address water quality issues associated with the pit. Reclamation of pit areas is a responsibility of the Dept. of Geology and Mineral Industries. The groundwater section will be looking at groundwater impacts in more detail. The Department will also be looking at the relationship to solid waste and hazardous waste rules. Mr. Turnbaugh also indicated that an effort was being made to mesh closure requirements with the reclamation requirements of the Department of Geology and Mineral Industries.

Commissioner Lorenzen noted that the rules as drafted appropriately apply equally to operations on federal lands as well as operations on private lands.

July 25, 1991

At a work session on July 25, 1991, the Department reported on the status of the rule development process. Public hearings were held on the proposed rules as follows:

May 15, 1991 in Portland
May 17, 1991 in Nyssa
May 20, 1991 in Grants Pass.

The Department reported that comments were received from the following and that testimony was still being summarized and evaluated:

State and Federal Agencies

U.S. Fish and Wildlife Service
Oregon Department of Fish and Wildlife
Oregon Water Resources Department
Department of Geology and Mineral Industries

Mining Interests

Simplot
Horizon Gold
Atlas
Sunshine Mining
Phelps Dodge
Northwest Mining Association
Oregon Mining Council

Environmental Advocacy Groups

Oregon Environmental Council
Wilderness Society
National Wildlife Federation
Northwest Environmental Defense Center
Audubon Society
Native Plants Society
Sierra Club

Economic Development Interests

Mayors and Citizens of Nyssa, Ontario, Jordan Valley, Vale and Adrian

The Department summarized what appeared to be the most significant differences of opinion between the Department and the mining industry as represented by the Oregon Mining Council (OMC) as follows:

1. **End-of-pipe tailings cyanide treatment vs. no treatment or "natural" treatment**

The rules are based on end-of-pipe treatment as a basic pollution prevention method.

OMC comments deleted end-of-pipe treatment in favor of graduated containment of tailings wastes.

2. **Use of technology-based waste treatment criteria vs. application of water quality standards for heaps and tailings**

The rules require treatment of tailings and heaps to "technology-based" criteria, regardless of whether groundwater or surface is likely to be affected.

OMC comments would apply present water-quality standards or prevention of aquatic beneficial uses (only when water is affected) as appropriate regulatory criteria.

3. **Leak-detection and compliance at the heap liner vs. an allowable perimeter of soil contamination**

The rules require a "triple" liner configuration that provides for leak detection in the uppermost liner, with a requirement for repair if leakage exceeds an allowable "de-minimis" rate.

OMC proposes, at maximum, a "double" liner system with a lek detection system and repair if the leak exceeds the gravity flow capacity of the leak detection system.

4. **Positive wildlife exclusion vs. "safe" cyanide level**

The rules require "positive" exclusion (netting, fences, etc.) of wildlife (undefined) from all cyanide-containing waters, on the basis that no appropriate standard for "safety" exists.

OMC proposes that a known safe cyanide level exists (perhaps 50 parts per million) and should be used instead of exclusion.

5. **Long-term vs. short-term post-closure monitoring**

The rules state that the permit may be continued in force for a "nominal" period of 30 years for monitoring purposes.

OMC proposes that the permit be continued up to a maximum of five years after closure.

6. **Remedial actions relative to open pits**

The rules require a closure plan to define remedial/protective measures for the pit, if there is a potential for accumulation of contaminated water.

OMC proposes essentially the same thing but removes references to some items to be considered, such as pit-filling or mining avoidance in certain areas.

The Commission asked questions to clarify points of difference between the Department and OMC. Considerable discussion centered on the applicability of technology-based, BPJ (best professional judgment) criteria for mine waste detoxification versus water-quality-based criteria.
The Commission concluded the work session discussion by requesting staff to:

a. Complete a summary write-up of the hearings comments.

b. Complete a final draft of the proposed rules, based on the comments received and circulate the draft for review prior to the next Commission discussion of the issue.

c. Arrange for an advisory panel consisting of key representatives of the mining industry, environmental groups and the Department to meet with the full Commission during a Work Session to discuss the proposed rules.

The Commission indicated it would then follow the Work Session with specific direction to the Department on the next steps to be taken.

October 10, 1991

At this meeting, the Commission was provided with a package of materials which included the following items:

- Proposed Rules on Chemical Mining (October 10, 1991 Draft).

- Abstract of Technical Comments received during the public comment process.

- Response to Public Comment (significant issues).

- Markup of the rule proposal originally presented for comment at public hearings to show proposed changes.

At the meeting, Lydia Taylor, Administrator of the Water Quality Division, introduced the discussion on the chemical mining rules. She noted that two representatives of the mining industry and two representatives of the environmental community had been asked to make a presentation to the Commission on their views of the proposed chemical mining rules. Each group was advised to limit their presentation to 30 minutes. She also noted that Kent Ashbaker and Jerry Turnbaugh of the Water Quality staff were available to answer questions. She provided the Commission a table summarizing issues as addressed in the original draft of the rules and as addressed in the current draft. Director Hansen noted that representative of the Department of Geology and Mineral Industries and Department of Fish and Wildlife were also present to respond to questions.

Debra Struhsaker, an independent consultant on environmental and regulatory issues for the mining industry and for the Oregon Mining Council, began the presentation to the Commission on behalf of the mining industry. She noted that they would address their concerns with the technical aspects of the proposed regulations. She acknowledged the substantial efforts that had gone into the development of the rules to date. She noted that her experience is quite diverse in terms of the issues she has addressed and the states she has worked in, thus leading to a broad perspective on the issues. She handed out copies of overhead slides that she was using in her presentation.

Ms. Struhsaker made the following points in her presentation:

1. The rules should be performance standards rather than design or "universal" criteria. Regulations must apply to both eastern and western Oregon where climate, terrain, habitat, and hydrologic conditions are different. Universally prescribed design and closure criteria cannot satisfy the needs of Oregon's diverse natural environment. The current rules contain design criteria that are extremely stringent and may be good in some settings but not in others. Clarification of "alternative environmental protective means" is required. Clear guidelines need to be established for evaluating site specific criteria.

2. Hazardous Waste philosophy was used to write the rules and that is not necessary to protect the environment. The rules are inconsistent regarding whether mine waste is hazardous. A technically incorrect approach has been specified on waste classification.

3. Closure requirements are too prescriptive and should be based on site specific conditions. Compliance with environmental performance standards is achievable without requiring low permeability covers in many cases.

4. Proposed wildlife protection measures are redundant. Both detoxification and positive exclusion are required when either will suffice on tailings. The requirements need to mesh with Fish and Wildlife rules. The mortality problems at mining sites has been solved.

5. The wetlands restrictions should be removed.

Bill Schafer, representing the Oregon Mining Council, continued the presentation:

6. Thirty year post closure monitoring is not necessary. The duration of monitoring should be determined on a site specific basis.

7. The limitation of 24 inch hydraulic head in the heap effectively bans valley leach systems.

8. The approach to classification of mine wastes is flawed. EPA says method 1311 is incorrect for mine waste classification; 1312 should be used instead.

9. The proposed acid-potential evaluation provisions are inconsistent with

established practice. Mitigation measures should not be prescriptive.

Ms. Struhsaker closed by reiterating their desire to resolve the outstanding issues prior to rule adoption.

Larry Tuttle, representing Wilderness Society and other conservation organizations, summarized their involvement and concerns regarding mining wastes.. He noted that they liked the first draft of the rules that were submitted to public hearing. Those rules were consistent with the governor's directive. He stated they were less happy with the second draft. They support development of the best standards to give certainty to the industry and to drive technology. He recommended that the Commission direct the Department to reopen the record and potentially hold added hearings. He suggested that the hearings be before the EQC.

Gary Brown, representing Citizens for Responsible Mining in Ontario, suggested that there will be many large scale mining operations in Oregon, not just a few. He provided a package of information for the record which recorded examples of problem mining operations. With respect to the present draft rules, he disagreed with the proposal to drop the triple liner requirement (one clay plus two synthetic) in favor of a double liner system (one clay and one synthetic in contact). He noted that the effects of leaks into the ground after closure was not known. He also noted that the heap retains large quantities of solution, and something is needed under the heaps to protect groundwater in the future. He also noted the need for long term protection through detoxification, that acid mine drainage is still a problem, and that problems should be prevented now and into the future rather than counting on the potential ability to correct them later.

Chair Wessinger then asked for questions from the Commission.

Commissioner Lorenzen asked for identification of a western state that was considered a model of environmental protection for mining wastes. Ms. Struhsaker indicated that Nevada and California were considered to be models. Commissioner Lorenzen asked to be provided with the names of contacts later. He then asked why mining waste should not be treated as hazardous waste. Ms. Struhsaker indicated that the large volumes of low hazard materials makes it difficult. She stated that if a waste tests as hazardous under the 1312 test, then it is treated as hazardous waste.

Chair Wessinger noted that when things get tough economically, environmental costs are easy to cut. He asked if the proposed rules were adequate for monitoring. Larry Tuttle responded that the legislature required third party monitoring to be paid for by the mining operation. In addition, a bond is required for all costs.

Chair Wessinger thanked the panel and asked the Department to come forward and summarize the major changes to the rules and the reasons for the changes. Jerry Turnbaugh summarized as follows:

(1) Mill Tailings/End of Pipe Treatment -- The proposed rules do not set wildlife protection levels, but a 30 ppm WAD maximum technology based limit is specified.

(2) Liners/Leak Detection/Closure -- The original proposal specified a triple liner system and the current draft proposes a double liner system. In response to a question about the reason for the change, Mr. Turnbaugh characterized the double liner system as low leakage and indicated that technical difficulties in effectively engineering and installing the triple liner system caused him to move to the double liner recommendation. In response to questions about leak detection, Mr. Turnbaugh stated that there is not a good leak detection system for use with the double liner system.

(3) A variance provision that was included in the initial draft was removed from the current draft. The Department now believed that variance type situations could be handled in permit drafting without adding the variance provision to the rules.

(4) Guidelines for tanks and vessels in the original draft were eliminated in the current draft. Such facilities were not expected to be extensively used, and could be handled adequately in the plan review process.

Chair Wessinger asked for suggestions on the next steps. Director Hansen suggested that the Commission could go step by step through the rules or it could give some direction to the Department and ask the Department to return. Among other issue that guidance would be welcomed on were whether the Commission wanted redundancy to be required in the level of protection provided, and whether the Department should defer to the Department of Fish and Wildlife on wildlife protection or make its own judgements.

Commissioner Lorenzen indicated that he wanted time to review the matter in light of the discussion before he voiced his reactions and recommendations. Commissioner Squier indicated that before she could form any judgments, she needed additional technical information on the state of the art in monitoring to detect leaks, and the ability to rapidly fix a leak once detected. This was necessary before she could form any judgments regarding the difference between double and triple liners and the need for redundancy.

Chair Wessinger stated that the Commission has expressed the desire for a very stringent rule. He noted that when they are done, they don't want an "Exxon". He suggested that the Department go back and evaluate the discussion and comments and return at the November meeting with a specific recommendation on the issues. At that time, the Commission would provide specific direction for developing the final rule draft. Commissioner Whipple noted that the Commission was not looking for a change in the approach.

November 7, 1991

The Commission convened a work session in Medford to continue the earlier Work Session Discussion of Proposed Rules for Mining Operations using Chemicals to Extract Metals from Ores. No public comment was taken at this work session. Discussion was between the Commission and Department staff.

Director Hansen asked the Commission to give advise that would allow the Department to complete a final draft of the mining rules. He suggested that major issues included other agency roles, extent of monitoring during operations, and the extent of engineered protection including how close proposed rule requirements should be to the Hazardous Waste program requirements.

Lydia Taylor, Administrator of the Water Quality Division, handed out a three column table summarizing the provisions of the rules sent out to public hearing (labeled the 6/14 draft), the rules as presented for discussion at the October 10 work session (the 10/10 draft), and the recommendation of the Department (Recommended).

Jerry Turnbaugh of the Water Quality staff summarized the recommendation on liners as a return to the original 6/14 draft which called for a triple liner system. In response to questions from Commissioner Lorenzen, Mr. Turnbaugh noted that the three liner system is better able to detect leaks, but requires more care to keep from puncturing the liner. He noted that some believe the two liner system is not as likely to leak. He also noted that a leak in the two liner system is not as likely to be detected. Commission members stated that this was one of the key issues to be determined. Director Hansen indicated that this is a judgment call. The question is whether an extra level of opportunity to detect and correct a problem is provided before the environment is affected, or whether one relies more heavily on a cap. The Commission discussed the potential for monitoring and the potential for preventing and detecting leaks.

Commissioner Lorenzen recommended that the rules be drafted to require triple liners, unless another way is proposed to assure an equivalent level of monitoring (leak detection) below the liner system. The Commission members concurred with this suggestion.

The next issue discussed was wildlife protection. The Department recommendation was the same as the 10/10 draft which proposed to rely on the Department of Fish and Wildlife. Mr. Turnbaugh noted that HB 2244 requires the Department of Fish and Wildlife to address wildlife protection measures for mining operations. Commissioner Lorenzen asked what happens if Fish and Wildlife doesn't act. Lydia Taylor responded that the proposed rules require elimination of exposure or positive exclusion.

The Commission agreed that the proposed rules should defer to Fish and Wildlife on the issue of wildlife protection measures.

Commissioner Lorenzen then raised the issue of review of design, construction and operation and indicated he would like to have the rules specify third party review. The Commission discussed options for such review including the reviewer hired by DEQ, the reviewer hired by the mining company subject to approval of DEQ, or the ability of DEQ to remove the reviewer or levy penalties. Director Hansen noted that RCRA requires that an independent engineer oversee construction. Mr. Turnbaugh indicated that the Department had considered third party review of design, but not construction or operation. Commissioner Lorenzen stated that it adds comfort to have an independent professional stake their reputation on the plan.

The Commission agreed that the proposed rules should provide for independent review of design, construction, and operation.

Lydia Taylor indicated that the Department was recommending that the requirements for mill tailings be tightened up. The original draft proposed a performance standard. Now the Department is proposing both a performance standard and two technologies -- removal/recycling of cyanide, and oxidation for greater stability.

The Commission agreed with the Department recommendation on tailings.

On the issue of testing, the Commission agreed with the recommendation to tie to the Hazardous waste requirements for testing to determine if the waste is hazardous, and managing the waste accordingly.

The Commission discussed the issue of seismic instability. Director Hansen noted that the proposal opts for some criteria for siting and assumes that facilities can generally be engineered to meet the site criteria. Lydia Taylor noted that existing groundwater criteria will have to be met. The Commission agreed with the Department recommendation.

On the issue of a variance provision, Lydia Taylor indicated that the variance provision in the original draft was eliminated in favor of an approach that will look at equivalent results in the plan review process. The Commission agreed with the proposal.

With respect to requirements for emergency ponds, Lydia Taylor advised that the requirements for emergency ponds were made less restrictive, and that if the ponds are planned to be used, they must be designed to the same standards as regular process facilities.

The next issue discussed was the monitoring after closure. Chair Wessinger asked how monitoring would be conducted after a mine was closed and the company gone. Mr. Turnbaugh indicated that requirements administered by DOGAMI include a bond to cover chemical processing and reclamation. He believed that monitoring could be covered under the bond. Commissioner Lorenzen indicated his desire to have parent corporations or the majority interest holder in the permittee to sign on to the permit to assure greater protection. Commissioner Whipple suggested the issue may be greater than just DEQ. Lydia Taylor indicated that the

intent of the new legislation was to cover the broader picture. Commissioner Lorenzen said his interest was to have any parent corporations guarantee the post closure obligation.
The consensus of the Commission was sympathy with the desire of greater security from the parent company or companies to the permittee and that this option should be looked into further.

The final issue discussed was the open pit itself. Mr. Turnbaugh indicated that the rules call for assessment and have not been modified. There was no suggestion for modification.

December 13, 1991

At this regular meeting, the Commission considered the Department recommendation to adopt proposed mining rules as presented in Attachment A of the staff report (rule draft dated 12/13/91). The proposed rules require mining operations using cyanide or other toxic chemicals to protect soils, groundwater, surface waters and wildlife from contamination or harm by process solutions and waste waters. The protective measures required by the proposed rules include cyanide recovery and re-use, chemical detoxification of cyanide residues and extensive lining and engineered closure of waste disposal facilities.

The department provided the Commission with a background summary of the proposed rules. Commissioner Lorenzen questioned the use of the term **disposal facility** on page A-10 of the proposed rules and asked that the wording be removed. Lydia Taylor, Administrator, Water Quality Division, responded that the term **disposal facility** would be removed from the proposed rules. Commissioner Lorenzen asked how reporting requirements listed in the rules would be handled. Ms. Taylor replied that reporting requirements would be dealt with on a permit-by-permit basis.

Ivan Urnovitz, Northwest Mining Association, **Mike Filio**, Tek Corporation, Vancouver, B. C., and **John Parks**, Atlas Precious Metals, represented the mining industry in a consolidated presentation.

Mr. Urnovitz expressed concerns regarding the following items:

- The mandatory requirement of a 36-inch clay liner.
- The tailings must be handled as hazardous waste.
- The controls were overly redundant and more requirements were in the rules than needed by the state of Oregon.
- The tests required were inappropriate. Mining wastes should be tested differently than municipal wastes.
- The wetlands requirements were arbitrary.
- The AVR system in regard to the liquid storage criteria was arbitrary and over redundant.

Mr. Filio stated that the rules were overly stringent and had caused the suspension of a negotiation with Atlas

Precious Metals on the Grassy Mountain project. His concerns were as follows:

- The method of reusing and recycling cyanide was not proven.

- That determining the potential of acid-water formation from the tailings added little benefit to the environment and was costly.

- That environmental benefits must justify added costs.

Mr. Parks complimented the staff on their efforts. He stated that he supported 80% of the rule proposals, but indicated that the 20% where disagreement exists cannot be quickly resolved. He stated that the "one size fits all" approach of the rules is not appropriate and results in unnecessary costs. He urged the Commission to take additional time to resolve the issues.

Mr. Urnovitz concluded that the rules would create a rigid, inflexible program with added costs to the mining industry. He said that added expense had not been considered, and that industry proposals met state requirements. Mr. Urnovitz suggested that an impartial review panel be established which would include the Commission chair, mining experts from Nevada or California and DEQ staff.

Larry Tuttle, The Wilderness Society, told the Commission that liner systems for tailings and heaps had been used in other states for a long time. He said that the rules would provide the mining industry the ability to prove that other approaches would provide equal protection. Mr. Tuttle added that early detection systems with triple liners would prevent cyanide from entering the soil. He said what was missing from the rules was a third-party verification of baseline data and that removing heavy metals should be a part of cyanide removal. Mr. Tuttle added that wetlands should not be risked and should not be considered at this meeting. He indicated that hazardous waste rules should apply to the tailings, and that EPA is looking at mining with that approach. He further added that the state would learn if the rules are too strict as mining activities occur. Mr. Tuttle concluded by stating that the rules should be adopted and that although the rules were not perfect, changes could evolve over time; the rules would protect the state and give the mining industry a chance to prove the rules were unnecessary.

Commissioner Squier stated that the term **waste** on page A-7 of the proposed rules was too narrow and needed to be clarified. Commissioner Whipple said that when the rules were being developed, the Commission was pushing the edge in terms of environmental protection. However, she stated, that she had concerns that more responsibility had been placed on the Commission to assure technical feasibility. She suggested that the department research the implications of mining activities and try to use the universities in this endeavor. Commissioner Whipple further added that the department should take the time to make sure the rules are technically feasible and correct. She also noted the risk of finding that the rules aren't stringent enough.

Commissioner Lorenzen expressed his general preference for performance standards rather than design standards but noted that there was no perfect performance measuring system. He expressed a desire for a third party review to examine the following issues to determine whether the proposed rules meet Commission goals:

- The requirements for liners under the heap.

- The recycling of cyanide.

- The treatment and long-term stability of tailing ponds.

He added that an independent opinion was needed on the question of whether the proposed rules were overly protective.

Commissioner Squier asked the department about the reuse of cyanide. Staff responded that reuse minimizes the use of cyanide and reduces the amount used; however, it is cheaper to buy cyanide and dispose of it. Staff further stated that by recycling cyanide the toxicity of the tailings can be reduced. Commissioner Lorenzen asked if there was another methodology in place other than the AVR system. Staff replied that the rules do not require AVR but do support removal and reuse.

Commissioner Castle said that the perception of the process was mostly economic. However, he stated, that this was not the purpose of their review. Commissioner Castle supported the idea of a third-party review but stated that the review should be confined to the technical issues relating to environmental protection. Chairman Wessinger expressed his desire not to use an industry committee but rather to find an individual or company with no ties to either side to evaluate the proposed rules. He further requested that the Department get back to the Commission as soon as possible regarding the steps for an independent review.

Director Hansen questioned the Commission about whether they wanted the third-party evaluation to be in the form of addressing applicable policy questions. He suggested that a review could focus on a review of technical issues in relation to the policy including assessment of the level of certainty that the technical requirements would meet the policy, and the technical feasibility of the requirements.

He further stated that the intent of House Bill 2244 was that rules be developed that were necessary and practical. He stated that the term "necessary" was in relation to protecting the environment and was without regard to cost. The term "practicable" applies to selection of alternatives, were available, to meet the "necessary" requirements.

Commissioner Squier noted that a third-party review would be expensive and would require time. She voiced her opinion that the **alternate methods** wording in the proposed rules allowed the department enough flexibility and favored adopting rules now.

Commissioner Lorenzen suggested that the review focus on narrow technical issues and then questioned if the department had the necessary funds to conduct the review. Commissioner Castle noted that the Department should spend whatever is necessary. Commissioner Lorenzen suggested that the third-party review should address the technical means of achieving the Commission's policies.

Commissioner Whipple, after some discussion and questioning of staff, moved that the Commission direct, with a high degree of specificity, that a third-party review be conducted on the issues of liner systems, removal and reuse of cyanide, and reduction of toxicity of the waste to the greatest degree possible. Commissioner Lorenzen seconded the motion with the understanding that closure of the various ponds, heap leach and tailings facility as well as the possible redundancy of the clay liner thickness was included within the context of the motion.

Director Hansen then summarized the issues to be addressed in relation to the policies: technical feasibility, level of certainty, other technologies.

He then noted that contracting with a third party would be a complex process, and suggested that the matter be further discussed by the Commission through a conference call within the next week.

Commissioner Squier made it clear that she wanted detection and repair of leaks before chemicals escaped into the environment to be reviewed. Chairman Wessinger, Commissioners Castle, Whipple and Lorenzen voted yes; Commissioner Squier voted no.

Water Quality Division Administrator Lydia Taylor then asked if it would be appropriate to defer action on any mining permit applications received pending completion of the third-party review and adoption of rules. The Commission agreed, and Commissioner Lorenzen noted that the Commission could very quickly adopt rules if a permit application was filed.

__December 20, 1991__

A special meeting by a conference call of the Environmental Quality Commission was held on Friday, December 20, 1991, at the Oregon Department of Environmental Quality, Conference Room 3A, 811 S. W. Sixth Avenue, Portland, Oregon. The purpose of the special meeting call was to discuss the Department's draft Request for Proposal (RFP) for technical advice on mining rules.

Commission members present by telephone were Vice Chair Castle, Commissioners Squier, Whipple and Lorenzen. Chair Wessinger, Director Hansen and Larry Knudsen, Assistant Attorney General, and Department staff were present in Conference Room 3A. The conference call began at 9:30 a.m.

At the December 13, 1991, EQC meeting, the Commission asked the Department to initiate a third-party review of liner systems, the removal and reuse of cyanide and the reduction of toxicity of the waste. Additionally, the Department was asked to review the technical means of achieving the Commission's policies. Draft portions of the RFP were forwarded to the Commission prior to the meeting.

Director Hansen indicated the draft RFP addressed the questions asked by the Commission and how those questions could be answered by an independent third party. Director Hansen summarized the pre-bid qualifications, procedures and processes related to the bidding and bidders. He requested that the Commission go through policy statements, issues and methods of answering.

Chair Wessinger asked Director Hansen to go through each issue of the draft RFP paragraph by paragraph. Each issue is discussed below.

Dr. Castle asked the staff for reactions to FAXed material the Commission had received. Director Hansen indicated that the memorandum had just been handed to him. The memorandum, from Mr. Richard Bach of Stoel, Rives, Boley, Jones & Grey, to John Parks, expressed concern with the proposed DEQ policy statements.
Lydia Taylor, Administrator, Water Quality Division, responded to Mr. Bach's preference to the wording "threat of harm" versus "release to the environment." Ms. Taylor said that the term "threat of harm" was too open ended and added that the purpose of the liner is to prevent a release. Commissioner Lorenzen agreed that the purpose of a liner is to keep liquid contained; if the liquid does escape from the liner, then that protective barrier is not working. Additionally, Chair Wessinger agreed with Commissioner Lorenzen's interpretation and stated that environment is the important term.

Commissioner Castle further agreed. He said Department staff correctly interpreted the direction with regard to economics; that is, a technical analysis rather than an economic analysis. Commissioner Castle stated he did not agree that risk had been excluded and that the wording asks for statements of the reviewer on the level of certainty in achieving goals.

Director Hansen said that in regard to Mr. Bach's comments about what was described in the Department's memorandum as a note at the bottom of page 1 and top of page 2 and the definition of a double liner at bottom of page 2, the Department did not object to substitute Oregon Mining Council (OMC) wording if the Commission agreed with the OMC proposed language. Director Hansen indicated that the Department was trying to describe the OMC proposal, not editorialize on it. Further, **Jerry Turnbaugh**, Water Quality Division, indicated that he had no objection to OMC's characterization of the double liner, and that it was a fair statement of what the Department believes the liner will accomplish.

Director Hansen told the Commission that OMC had suggested two additional questions be included under **Method to Answer Question--Address**. He said that the answer to their suggested Question No. 5 was implicit; Question No. 6 was the about the issue of economics which the Commission had rejected.

Commissioner Lorenzen commented on the framing of the question itself. He suggested "Will either or both liner systems meet the stated objective of the

Commission?" Commission Squier agreed with Commissioner Lorenzen. Commissioner Lorenzen stated that an additional question could be answered as a part of Issue No. 4(a): "Is 36 inches as required by Issue 4(a) the appropriate thickness to assure a high probability of achieving the Commission's objective?" He further stated that the requirement of 36 inches would be a high-cost item in some areas and expressed concern about this requirement if it was unnecessary; however, if this requirement was necessary, he had no reservations. Director Hansen indicated that **Method to Answer**, Question No. 4, addressed this issue.

Commissioner Lorenzen agreed as long as that is what Answer No. 4 meant. He further indicated concern about implementing costly regulations that do not provide further benefits; therefore, economics must be implicitly considered.

Commissioner Whipple also expressed concern about economics and redundancies. She said that it should not be difficult to obtain from the answers to the technical questions about a sense of the relative costs involved.

Commissioner Castle stated that the Commission did not want an economic analysis. He added that it was appropriate that the consultant address the issue of redundancy. From that, Commissioner Castle stated, the Commission can make judgments about whether the rules require additional measures that incur added cost but does not further protect the environment. He said that the Commission will not ignore economics when a decision is made.

Director Hansen said that the question as phrased uses the words "materially reduce." He indicated that the intent was to provide a basis for determining if there are environmental benefits to the requirements. Director Hansen referred to letter from Martha Pagel to Representative Schroeder about the idea that the rules were contrary to legislative intent. Ms. Pagel stated in her letter that two terms must be considered when meeting environmental standards: necessary and practicable. She said "necessary" is defined as that which is necessary to meet the standard and protect the environment. In further clarifying Ms. Pagel's letter, Director Hansen said that the policy statement reflects what the Commission believes is necessary to protect the environment. He stated that the question then becomes whether there are alternatives for meeting the standard and that "practicable" is considered when determining the alternative to meet the standard.

Commissioner Castle asked about the procedures to be followed in developing the final RFP. He asked if the Commission was putting the RFP in final form or if they were giving the staff advice to guide development of the final RFP. Director Hansen responded that it was the Commission's choice but the closer the Commission would come to final wording on the policy statements and questions the better. He asked the Commission to clarify that the question on the first policy issue will read: "Will either or both liner systems meet the stated policy objective of the Commission?"

Chair Wessinger asked Commissioner Lorenzen if that wording contained the difference he sought. Commissioner Lorenzen replied that perhaps one liner would meet the stated policy better than the other; maybe both liners would meet the stated policy adequately but that one will meet the policy better. Director Hansen indicated that the **Method to Answer**, Question No. 3, provides for more detail and level of certainty.

The Commission agreed that the question wording for the first policy would read as follows:

> Will either or both liner system meet the stated policy objective of the Commission?

In regard to the second policy issue, Commissioner Whipple said that she believed Mr. Bach's two additional questions (proposed questions 5 and 6) would be answered within the context of how the questions were phrased. Commissioner Squier said she believed industry intended that a difference exist because the term "management practices" was used rather than technology which would allow a broader interpretation. Commissioner Whipple asked if there were other ways to meet the policy and indicated she would not like to delay over the definition of technology. Chair Wessinger asked Department staff about technology as compared with management practices.

Mr. Turnbaugh told the Commission that the rules state that cyanide recovery and reuse are an end-of-pipe treatment technology applied before tailings are released to the impoundment. He said that industry would argue that the tailings pond is a treatment system since some natural degradation occurs and solutions can be recirculated from the tailings pond. He concluded he believed the mining industry was broadening the scope of definition beyond end of pipe and beyond what was intended in the Department's proposed rules.

Director Hansen said the issue to be addressed was whether treatment of the tailings would be required before being released to the tailings pond or whether the tailings pond would be part of the treatment system.

Commissioner Whipple said the policy is aimed at reducing toxicity in the releases to greatest degree practicable through treatment. Director Hansen stated that the Department believes that once the material is in the tailings pond, a greater risk of release to the environment exists; therefore, the Department wanted to reduce the toxicity to the greatest degree practicable before discharging the material to the tailings pond.

Commissioner Whipple asked if the policy addressed long-term impacts of treatment. Director Hansen replied that once the material is discharged to tailings pond, it is difficult to control. Commissioner Lorenzen commented that this issue should be examined by the consultant.

Commissioner Lorenzen asked if a process was discovered in the future to reprocess the tailings pond, would the Department allow material to be discharged to the pond with assurance of containment rather than treatment first. He suggested a possible revision to the policy:

> The Commission establishes as policy that the closure of the heap leach and tailings disposal facilities shall be accomplished by a means that ~~to the greatest extent possible~~ <u>a high degree of probability</u> over the long term will prevent release to the environment of any chemicals contained in the facility.

Commissioner Lorenzen also stated that he would not want the tailings spread over a large area without there being a substantial effort to reduce toxicity. He said that dealing with the tailings was a long-term effort, not just 20 years.

Director Hansen added that the liner system required by the draft rules for a tailing pond is different than under a heap leach pad because of the assumption of lower toxicity due to pretreatment. He added that the Department would look at treatment requirements differently if the liner under the tailings pond was the similar to the liner under the heap leach pad.

Commissioner Squier asked Mr. Turnbaugh about 30 parts per million (ppm) cited under **Issue** in Policy No 3. Mr. Turnbaugh replied that 30 ppm is the "best professional judgment" estimate of achievable level of detoxification that can be achieved with a variety of treatment technologies. Commissioner Squier asked how the Department would respond to a business in Portland that was discharging 35 ppm. She further clarified her question by asking how the Department would view 30 ppm of cyanide in other industrial settings: would that discharge be considered a hazardous waste and require barrelling and labeling?

Mr. Turnbaugh replied that he was uncertain of the answer. He said the Department had intended to require end-of-pipe treatment to reduce the toxicity, which is the purpose of the rules. Consequently, he continued, the Department must decide how much technology should be applied. Mr. Turnbaugh said the Department examined potential technologies and concluded that 30 ppm can be achieved. However, he said, 30 ppm is not intended to be a wildlife protective measure and does not relate to liner design. Cyanide that has been discharged to a pond can be released to the air, and this type of release necessitates modeling to determine human health risk.

Commissioner Whipple indicated her inclination to not expand the policy to include management practices. Director Hansen replied that an additional question could be considered: would a liner system be adequate or would the liner system need to be upgraded to achieve the Commission's policy regarding the release of toxics from the tailings pond. Chair Wessinger replied that he was inclined to agree with current staff recommendation.
Commissioner Squier had two questions regarding end-of-pipe treatment:

1. Is 30 ppm achievable with current technology?

2. Does the Department want to have a policy that allows discharges to the pond and confinement of the pond to protect the environment rather than promotes best achievable technology at the end of pipe?

She indicated that the draft proposal addresses the first question but she did not want to open the second question up for debate; therefore, she agreed with Chair Wessinger. Commissioner Whipple also agreed with the draft proposal. Commissioner Castle stated he had no problem with staff formulation and said that these issues will be addressed if Question Nos. 2 and 4 are adequately answered. Commissioner Lorenzen agreed.

Director Hansen summarized that the suggested Question No. 5 in Mr. Bach's letter would not be included. Mr. Turnbaugh said that he had no problem with Mr. Bach's Question No. 5 but would note that non-use may be a matter of choice rather than technical feasibility.

At this point in the meeting, Commissioner Lorenzen excused himself from the conference call. However, he added that he did have a comment about the policy on page 4, second line, about the reference "...to the greatest extent possible." He suggested the wording to a high degree of probability. Director Hansen replied that the Department was attempting to reflect the Commission's intent. He said that **Method to Answer Question--Address**, No. 3, would partially address this issue. Commissioner Castle said that if Commissioner Lorenzen's questions were adequately answered, would he have concern. Commissioner Lorenzen replied no but believed there may be a problem relating this question to policy. Commissioner Castle suggested the following wording to help meet Commissioner Lorenzen's concerns:

> The Commission establishes as policy that the closure of the heap leach and tailing disposal facilities will prevent release to the environment of toxic chemicals contained in the facility.

He suggested this wording be substituted as policy and the questions would not be changed. Commissioner Lorenzen agreed with Commissioner Castle's suggested wording; Commissioner Squier also agreed.

Commissioner Lorenzen then left the conference call.

Director Hansen Fred suggested that **Method to Answer Question--Address**, No. 2, be changed to read as follows:

2. Do detoxification and covering (evaluated and together separately) materially reduce the likelihood of a release of toxic chemicals to the environment?

Commissioners Castle and Squier agreed.

Director Hansen them presented the proposal requirements. He said a concern had surfaced about one item from discussion with the person Commissioner Castle had suggested. In regard to Proposal Requirement No. 2., if followed, the Department would end up with consultants not in touch with the technologies the Commission wanted evaluated. He said that the idea of independence was important.

Commissioner Castle suggested a change to Proposal Requirement No. 2:

2. Noninvolvement for a minimum of ~~the past~~ five years ~~with the mining industry in general, and specifically~~ with mining companies, mining industry groups, or environmental groups active in working on mining regulations and permitting.

Director Hansen suggested a proposed change made by Larry Tuttle, The Wilderness Society, as follows:

2. A substantial portion of income for a minimum of ~~the past~~ five years ~~with the mining industry in general, and specifically~~ with mining companies, mining industry groups, or environmental groups active in working on mining regulations and permitting.

Chair Wessinger indicated that he was apprehensive that consultants who could perform the job would be disqualified. Director Hansen suggested the following wording:

2. Preference will be given to entities who have had no involvement within the five (5) years. As a bid requirement, one must disclose all contacts or contracts they have had over the past five (5) years for evaluation.

Commissioner Squier indicated that she agreed with that wording, and Commissioner Castle also agreed to the proposed wording.

Ms. Taylor indicated that the Department wanted to allow judgment and that conflict of interest with anyone hired was an important consideration. She said that disclosure was important, and that the Department would ask the applicant to disclose any potential conflict of interest and whether a substantial part of their income over the past five (5) years was derived from the mining industry.

Chair Wessinger, Commissioners Castle, Squier and Whipple agreed.

Director Hansen indicated if the Commission had nothing else to add to the memorandum, the Department will proceed. He added that although this memorandum was not the proposal and that more information must be added to meet requirements, it did contain the essential elements and no formal action was needed.

Commissioner Squier stated that she would like to hear back from staff after proposals are in about the time schedule and cost range. Ms. Taylor replied that she will keep the Commission informed. Chair Wessinger asked that the Commission be sent reports about the progress of the proposal. Director Hansen indicated that he will include the status of the proposal in the Director's Report and keep them advised in interim if anything significant occurs.

Subsequent Actions

On January 7, the Department forwarded a draft to the Commission, labeled a "second draft" of the elements to be included in the RFP for consultant services. A draft of the full RFP (including all of the legally required language, etc.) was prepared. On February 3, 1992, a final draft of the RFP was forwarded to Commission members for review and comment. The transmittal memo noted that there had been numerous contacts from representatives of the mining industry while the Department was developing the final wording of the RFP. The RFP was issued on February 7, 1992.

Following the December 20, 1991, Conference Call meeting, the Department has reported to the Commission at each meeting on the current status of the consultant review process.

Note: This summary is for the most part a reproduction of the Commission approved minutes of the respective meetings. Some additions have been made to enhance readability and clarity.

HLS:l

State of Oregon
Department of Environmental Quality — Memorandum

Date: August 19, 1992

To: Environmental Quality Commission

From: Fred Hansen, Director

Subject: Proposed Chemical Mining Rules

At the meeting on August 7, 1992, the Commission indicated acceptance of the Department recommendation for adoption of the proposed chemical mining rules with changes in the following areas:

- The wording for proposed as Alternative 2 for both the heap leach pad liner [OAR 340-43-065(4) on pages 14-15] and processing chemical pond liner [OAR 340-45-065(5) on pages 15-16] was accepted to replace the 12/13/91 draft wording labeled Alternative 1.

- The Commission directed the Department to develop additional wording to clearly convey the intent that alternative liner systems can be approved provided that the level of environmental protection intended by each component of the liner system specified in the rule (primary liner, leak detection system, secondary liner) is achieved, either within the component or on a cross component basis. This new wording appears as OAR 340-43-065(4)(d) on page 15 and (5)(d) on pages 16-17.

- The wording of the Purpose and Policies [OAR 340-43-006(2)(b) on page 3] and the Guidelines for Disposal of Mill Tailings [OAR 340-43-070(1) on page 18] was modified to allow "destruction" of cyanide in mill tailings as an alternative to removal and reuse.

The attached rule draft (Attachment A dated 8/13/92) displays the changes made to the 8/7/92 draft in response to the Commission direction in the traditional way: new wording is <u>underlined</u>, and deleted wording is ~~[enclosed in brackets and struck through]~~. For easy reference, the wording changes appear on pages 3, 14-17, and 18.

It is recommended that the Commission adopt the proposed chemical mining rules as presented in Attachment A.

August 17, 1992 Markup following
August 7, 1992 EQC Consideration

Attachment A

Note: At its 8/7/92 meeting, the Environmental Quality Commission considered proposed rules dated 8/7/92, and accepted the Department recommendations with some changes as noted in this draft. This 8/17/92 draft deletes the underlining from new text and removes text that was shown struck through in the 8/7/92 draft. It then shows changes made in response to Commission discussions in the following manner:

Underlined text is proposed language to be added to the rule draft as a result of the Commission discussions on 8/7/92.

~~[Bracketed and struck through]~~ text is proposed language to be deleted from the rule draft as a result of the Commission discussions on 8/7/92.

RULES PROPOSAL:

OREGON ADMINISTRATIVE RULES

CHAPTER 340

DIVISION 43

CHEMICAL MINING

OAR 340-43-006	Purpose and Policies
OAR 340-43-011	Definitions
OAR 340-43-016	Permit Required
OAR 340-43-021	Permit Application
OAR 340-43-026	Plans and Specifications
OAR 340-43-031	Design, Construction, Operation and Closure Requirements

Renumbering of some rules and other minor "house keeping" amendments proposed in the 8/7/92 rule draft were accepted by the Commission on 8/7/92.

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

PURPOSE and POLICIES

340-43-006

(1) The purpose of these rules and guidelines is to prevent water pollution and protect the quality of the environment and public health in Oregon, consistent with the policies of ORS 468B.015 and 468B.020, by requiring application of all available and reasonable method for control of wastes and chemicals relative to design, construction, operation, and closure of mining operations which use cyanide or other toxic chemicals to extract metals or metal-bearing minerals from the ore and which produce wastes or wastewaters containing toxic materials.

This section reflects amendments to this rule as proposed in the 8/7/92 draft and accepted by the Commission.

(2) The following policies are established to provide further guidance regarding the level of environmental protection these rules are intended to achieve:

This section [340-43-006(2)] was new language proposed in the 8/7/92 rule draft. It was accepted by the Commission with amendments to (b) reflected below.

(a) Liner, leak detection and leak collection systems (systems) are necessary for heap leach pads, solution ponds, and tailings facilities to assure that any leak will be detected before toxic materials escape from the liner system and are released to the environment. For purposes of these rules, the environment is considered to begin at the bottom of the last liner. These systems shall assure that a leak is found, and that sufficient time is available to allow for the repair of the leak and clean up of any leaked material before there is a release to the environment. Natural conditions, such as depth to groundwater or net rainfall, shall be considered as additional protection but not in lieu of the protection required by the engineered liner system.

(b) The toxicity of mill tailings and the potential for long-term cyanide and toxic metals release from mill tailings shall be reduced to the greatest degree practicable through removal, ~~[and]~~ reuse, <u>or destruction</u> of chemical solutions prior to placement of tailings in the tailings disposal facility.

This paragraph was amended by the Commission to be consistent with the change made in rule 340-43-070 to not require reuse and to allow destruction technology to be used.

(c) The closure of heap leach pads and tailings disposal facilities shall prevent future release to the environment of residual potentially toxic chemicals contained in the facility.

DEFINITIONS

340-43-011

Unless the context requires otherwise, as used in this Division:

(1) "Chemical process mine" means a mining and processing operation for metal-bearing ores that uses chemicals to dissolve metals from ores.

(2) "Department" means the Department of Environmental Quality.

(3) "Guidelines" means this body of rules contained in 340-43-045 through 340-43-100.

(4) "Positive exclusion of wildlife" means the use of such devices as tanks, pipes, fences, netting, covers and heap-leach drip-irrigation emitters or covered emitters.

(5) "Tailings" means the spent ore resulting from the milling and chemical extraction process.

PERMIT REQUIRED

340-43-016

(1) As required by ORS 468B.050, a person proposing to construct a new chemical mining operation, commencing to operate an existing non-permitted operation, or proposing to substantially modify or expand an existing operation shall first apply for, and receive, a permit from the Department. The permit may be an NPDES (National Pollutant Discharge Elimination System) permit if there is a point-source discharge to surface waters or a WPCF (Water Pollution Control Facility)

The Commission accepted the minor clarifying amendment proposed in the 8/7/92 draft for this paragraph.

permit if there is no discharge. Consideration may be given to site-specific conditions such as climate, proximity to water, and type of wastes to establish the final permit type and requirements for the facility.

(2) The permit application shall comply with the requirements of OAR Chapter 340, Divisions 14 and 45 and be accompanied by a report that fully addresses the requirements of this Division.

(3) Prior to issuance of a permit for a chemical process mining activity under this Division, a determination of compliance with statewide planning goals and compatibility with local land use plans must be made. The Department shall determine compliance with Statewide Planning Goals and compatibility with acknowledged comprehensive plans and land use regulations in a manner consistent with its approved State Agency Coordination Program and the rules in OAR Chapter 340, Division 18. In making these determinations, the Department shall consider and may rely on the findings and recommendations made by the project coordinating committee authorized by ORS 517.965 and by the Department of Geology and Mineral Industries pursuant to their State Agency Coordination Program and OAR Chapter 632, Divisions 1 and 37.

The Commission accepted this new paragraph as proposed in the 8/7/92 draft.

PERMIT APPLICATION

340-43-021

(1) The permit application shall fully describe the existing site and environmental conditions, with an analysis of how the proposed operation will affect the site and its environment. The application shall, at a minimum, contain the information specified for the DOGAMI (Department of Geology and Mineral Industries) consolidated application under ORS 517.971 (Section 13, Chapter 735, 1991 Oregon Laws). The Department will also use the information contained in NEPA (National Environmental Policy Act), EA (Environmental Assessment), or EIS (Environmental Impact Statement) documents, if they are required for the

This paragraph reflects clarifying amendments proposed in the 8/7/92 draft and accepted by the Commission.

project, as partial fulfillment of the requirements of this paragraph.

(2) The permit application shall, in addition to the information described in Paragraph (1) above, include the following information, unless the information has been otherwise submitted:

(a) Climate/meteorology characterization, with supporting data;

(b) Soils characterization, with supporting data;

(c) Surface water hydrology study, with supporting data;

(d) Characterization of surface water and groundwater quality;

(e) Inventory of surface water and groundwater beneficial uses;

(f) Hydrogeologic characterization of groundwater, with supporting data;

(g) Geologic engineering, hazards and geotechnical study, with supporting data;

(h) Characterization of mine materials and wastes which include, for example, overburden, waste rock, stockpiled ore, leached ore and tailings. Characterization of mine materials and wastes shall include, but not be limited to the following:

(A) Chemical and mineral analysis related to toxicity;

(B) Determination of the potential for acid water formation;

(C) Determination of the potential for long-term leaching of toxic materials from the wastes;

(i) Characterization of wastewater (quantity and chemical and physical quality) produced by the operation;

(j) Assessment of the potential for acid-water formation from waste disposal facilities, low-grade ore stockpiles, waste rock piles and for surface water or groundwater accumulation in open pits that will remain after mining is ended.

(3) Data submitted by the permit applicant should be based on analysis of the actual materials, when possible, or may be based on estimates from knowledge of similar operations and professional judgment.

PLANS AND SPECIFICATIONS

340-43-026

(1) A person constructing or commencing to operate a chemical process mine or substantially modifying or expanding an existing chemical process mine shall first submit plans and specifications to the Department for construction, operation and maintenance of the facilities intended for treatment, control and disposal of wastes.

(2) The plans shall address all applicable requirements of this Division and shall include, but not be limited to, the following:

Sections (2) and (3) of this rule reflect clarifying amendments proposed by the Department and accepted by the Commission.

(a) A description of the facilities to be constructed, including tanks, pipes and other storage and conveyance means for processing chemicals and solutions and wastewaters;

(b) A management plan for control of surface water;

(c) A management plan for treatment and disposal of excess wastewater, including provisions for reuse and wastewater minimization;

(d) A facility construction plan including, as applicable, the design of low-permeability soil barriers, the type of geosynthetics to be used and a description of their installation methods, the design of wastewater treatment facilities and processes, a quality assurance plan for applicable phases of construction and a listing of construction certification reports to be provided to the Department;

(e) A preliminary closure plan;

(f) A preliminary post-closure monitoring and maintenance plan;

(g) A spill containment and control plan.

(3) The Department shall approve the plans, in writing, before construction of the facilities may be started.

DESIGN, CONSTRUCTION, OPERATION AND CLOSURE REQUIREMENTS

340-43-031

(1) All chemical process and waste disposal facilities and facilities for mixing, distribution, and application of chemicals associated with on-site mining operations; ore preparation and beneficiation facilities; and processed ore disposal facilities shall be designed, constructed, operated and closed in accordance with the guidelines contained in this Division.

(2) Alternative facilities and methods of control of wastes and potential pollutants may be approved by the Department if the permit applicant can demonstrate that the alternate facilities and methods will provide environmental protection that is fully equivalent or better than that achieved by the facilities specified in the guidelines in Sections 43-040 to 43-095 of these rules. The burden of proof of fully equivalent protection lies with the permit applicant. Written approval of any alternative by the Department shall be evidence of

This wording reflects clarifying amendments proposed by the Department and accepted by the Commission.

acceptance as equivalent or better level of environmental protection.

(3) A groundwater monitoring plan shall be submitted to, and be approved by the Department. Monitoring wells shall be installed for detection of groundwater contamination as required by OAR Chapter 340, Division 40, unless the Department concludes in writing that the hydrogeology of the site or other technical information indicates that an adverse impact on groundwater quality is not likely to occur.

This wording reflects a clarifying amendment proposed by the Department and accepted by the Commission.

(4) The Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with these rules.

EXEMPTION FROM STATE PERMIT FOR HAZARDOUS WASTE TREATMENT OR DISPOSAL FACILITIES

340-43-035

(1) The state hazardous waste program requires a permit for the "treatment", "storage" or "disposal" of any "hazardous waste" as identified or listed in OAR Chapter 340, Division 101 from the Department, prior to the treatment and disposal of wastes. Permitting requirements can be found in OAR Chapter 340, Division 105, Hazardous Waste Management.

(2) However, any operation permitted under this Division, which would otherwise require the neutralization or treatment of hazardous waste and would require a permit pursuant to OAR Chapter 340, Division 105, shall be exempt from the requirement to obtain such hazardous waste treatment permit.

(3) All mined materials disposed of under this Division shall pass Oregon's hazardous waste rule criteria or they will be considered a state hazardous waste and must be disposed of accordingly.

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

PURPOSE

340-43-040

(1) This Division establishes criteria for the design, construction, operation and closure of chemical mining operations and supplements the provisions of OAR 340-43-006 through OAR 340-43-035. These criteria are intended to establish the minimum level of environmental protection that is necessary using a combination of performance standards and minimum design criteria. Approval of alternative facilities or methods to achieve an equivalent or better environmental result is allowed as defined in OAR 340-43-031.

This section reflects clarifying amendments proposed by the Department and accepted by the Commission.

(2) Any disapproval of submitted plans or specifications, or imposition of requirements by the Department to improve existing facilities or their operation will be referenced when appropriate, to applicable guidelines or rules.

GENERAL PROVISIONS

340-43-045

(1) Facilities permitted under either a WPCF or NPDES permit shall not discharge wastewater or process solutions to surface water, groundwater or soils, except as expressly allowed by the permit.

(2) Facilities subject to these rules shall not be sited in 100-year floodplains or wetlands. A buffer zone (a minimum of 200 feet wide) shall be established between waste disposal facilities and surface waters.

(3) All chemical conveyances (ditches, troughs, pipes, etc.) shall be equipped with secondary containment and leak detection means for preventing and detecting

release of chemicals to surface water, groundwater or soils.

(4) Acid water accumulation in open pits resulting from the mining operation must be prevented by appropriate mining practices, by measures taken in the closure process, or be treated to control pH and toxicity, for the life of the pit.

(5) Construction of surface impoundment liner systems shall conform generally to the principles and practices described in EPA/600/2-88/052, Lining of Waste Containment and Other Impoundment Facilities, September 1988.

(6) The Department may require the permittee to hire a third-party contractor to perform the functions set forth below. Selection of the contractor shall be subject to Department approval.

(a) Review and evaluate the design and construction specifications of all mined-materials disposal facilities permitted under this Division for functional adequacy and conformance with Department requirements. The Department shall not approve construction of the disposal facilities until the design and construction specifications have been evaluated.

(b) Monitor the course of construction of all mined-materials facilities for compliance with the approved design and construction specifications. The third-party contractor shall regularly document the progress of construction and the Department shall require the permittee to take corrective action if construction does not satisfactorily conform to the approved design and construction specifications.

This paragraph includes a clarifying amendment proposed by the Department and accepted by the Commission.

(c) Provide on-site inspections during ongoing operations, including but not limited to the loading of the heap, to assure protection of the integrity of the liner system and other environmental protection measures.

This paragraph is new language proposed by the Department in the 8/7/92 draft and accepted by the Commission.

CONTROL OF SURFACE WATER RUN-ON AND RUN-OFF

340-43-050

(1) Surface water run-on and run-off shall be controlled such that it will not endanger the facility or become contaminated by contact with process materials or loaded with sediment. The control systems shall be designed to accommodate a 100-year, 24-hour storm event, or any other defined climatic event that is more appropriate to the site, and be placed so as to allow for restoration of the natural drainage network, to the maximum extent practicable, upon facility closure.

(2) All mined materials shall be properly placed and protected from surface water and precipitation so as not to be eroded and contribute sediment to site stormwater run-off or to otherwise contaminate surface water.

PHYSICAL STABILITY OF RETAINING STRUCTURES AND EMPLACED MINE MATERIALS

340-43-055

(1) Permit applicants must demonstrate to the Department that the design of chemical processing facilities and waste disposal facilities is adequate to ensure the stability of all structural components of the facilities during operation, closure and post closure.

(2) Retaining structures, foundations and mine materials emplacements shall be designed by a qualified, registered professional and be constructed for long-term stability under anticipated loading and seismic conditions.

(3) Temporary structures and materials emplacements may, with written approval from the Department, be constructed to a lesser standard if it can be shown that they pose no, or minimal, threat to public safety or the environment.

PROTECTION OF WILDLIFE

340-43-060

(1) Wildlife shall be positively excluded from contact with chemical processing solutions and wastewaters containing chemicals.

(2) The Department may waive the positive exclusion requirement if the Oregon Department of Fish and Wildlife (ODF&W) certifies to the Department that the project is designed such that it will adequately protect wildlife.

GUIDELINES FOR DESIGN, CONSTRUCTION, AND OPERATION OF HEAP-LEACH FACILITIES

340-43-065

(1) This paragraph applies to heap-leach facilities using dedicated, or expanding, pads. Heap-leach facilities using on-off, reusable pads may require variations from these rules; they shall be approved on a case-by-case basis by the Department.

(2) The heap-leach facility (pad and associated ponds, pipes and tanks) shall be sized to prevent flooding of any of its components.

(3) TABLE 1 of this Division establishes minimum capacity-sizing criteria for the leach-pad and ponds. The pad and ponds may be designed to act separately or in conjunction with each other to obtain the required storage volumes. Other design criteria may be used, with Department approval, if local conditions warrant. The best available climatic data shall be used to confirm the critical design storm event and estimate the liquid levels in the system over a full seasonal cycle. The liquid mass balance may include provision for evaporation.

~~[Heap Leach Pad Liner Alternative 1]~~

~~[(4) The heap leach pad liner system shall be of triple liner construction with between liner leak detection consisting of:~~

~~(a) An engineered, stable, low permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;~~

~~(b) Continuous flexible membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec);~~

~~(c) A leak detection system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre within ten weeks of leak initiation.]~~

The Commission selected Alternative 2 presented below. Therefore, this wording from the 12/13/91 and 8/7/92 rule drafts is marked to clearly indicate the intended deletion.

~~[Heap Leach Pad Liner Alternative 2]~~

(4) The heap leach pad liner system shall be designed, constructed, and operated to meet the following criteria:

(a) A primary liner consisting, at a minimum, of a continuous flexible-membrane of suitable synthetic material shall be provided. This liner shall function together with the process chemical collection system installed immediately above this liner (see section (8) of this rule) to remove process chemicals from the heap.

(b) A leak detection system shall be installed immediately below the primary liner for the purpose of detecting loss of process solutions by leakage through the primary liner. The leak detection system shall be capable of detecting leakage through the primary liner of 400 gallons/day-acre within ten weeks of leak initiation. The leak detection system shall consist of appropriately sized collection piping placed within a minimum thickness of 12 inches of permeable material

This wording reflects the alternative from the 8/7/92 rule draft for heap leach pad liners that was accepted by the Commission. A new subparagraph (d) is presented below to incorporate the intent discussed by the Commission on 8/7/92.

(minimum permeability of 10^{-2} cm/sec) that is capable of withstanding the anticipated weight of the heap without loss of function.

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the operation of the heap and following closure of the heap is not released to the environment. The Secondary liner shall be of a composite design with a continuous flexible-membrane of suitable synthetic material in direct contact with an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches.

(d) Each liner system component described in paragraphs (4)(a)-(c) above addresses a specific need and purpose with respect to environmental protection. For purposes of evaluating alternative facilities and methods of control under OAR 340-43-031(2), an alternative may be approved if the level of environmetal protection intended by each separate liner system component is achieved either within the individual component or on a cross component basis.

This new language was added based on 8/7/92 Commission discussions to clarify the Commission intent with respect to evaluation of equivalent environmental protection of liner system alternatives proposed by a permit applicant.

~~[Processing Chemical Pond Liner Alternative 1]~~

The Commission selected Alternative 2 presented below. Therefore, this wording from the 12/13/91 and 8/7/92 rule drafts is deleted.

~~[(5) The processing chemical pond liners shall be of triple liner construction with between-liner leak detection consisting of:~~

~~(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;~~

~~(b) Continuous flexible membrane middle and top liners of suitable synthetic material separated by a permeable material (minimum coefficient of permeability of 10^{-2} cm/sec);~~

~~(e) A leak detection system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre, within ten weeks of leak initiation.]~~

~~[Processing Chemical Pond Liner Alternative 2]~~

(5) The processing chemical pond liner system shall be designed, constructed, and operated to meet the following criteria:

This wording reflects the alternative from the 8/7/92 rule draft for processing chemical pond liners that was accepted by the Commission. A new subparagraph (d) is presented below to incorporate the intent discussed by the Commission on 8/7/92.

(a) A primary liner consisting, at a minimum, of a continuous flexible-membrane of suitable synthetic material shall be provided. This liner shall provide for positive containment of processing chemical solutions.

(b) A leak detection system shall be installed immediately below the primary liner for the purpose of detecting loss of process chemical solutions by leakage through the primary liner. The leak detection system shall be capable of detecting leakage through the primary liner of 400 gallons/day-acre within ten weeks of leak initiation. The leak detection system shall consist of appropriately sized collection piping placed within a layer of permeable material (minimum permeability of 10^{-2} cm/sec).

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the use of the pond is not released to the environment. The Secondary liner shall be of a composite design with a continuous flexible-membrane of suitable synthetic material in direct contact with an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches.

(d) Each liner system component described in paragraphs (5)(a)-(c) above addresses a specific need and purpose with respect to environmental protection. For purposes of evaluating alternative facilities and methods of control under OAR 340-

This new language was added based on 8/7/92 Commission discussions to clarify the Commission intent with respect to evalu-

43-031(2), an alternative may be approved if the level of environmetal protection intended by each separate liner system component is achieved either within the individual component or on a cross component basis.

ation of equivalent environmental protection of liner system alternatives proposed by a permit applicant.

(6) Emergency ponds may be constructed as an alternative to larger pregnant and barren ponds. The emergency pond may be constructed to a lesser standard, with the limitation that it is to be used only infrequently and for short periods of time. The Department will specify reporting and use limitations for the ponds in the permit. A between-liner leak detection system is not required for the emergency pond.

(7) The emergency-pond liner shall be of composite construction consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-6} cm/sec) with a minimum thickness of 12 inches, and

(b) A single flexible-membrane synthetic top liner of suitable material.

(8) The heap-leach pad shall be provided with a process chemical collection system above the upper-most liner that will prevent an accumulation of process chemical within the heap greater than 24 inches in depth.

(9) The permittee shall prepare a written operating plan for safe temporary shut-down of the heap-leach facility and train employees in its implementation.

(10) The permittee shall respond to leakage collected by the heap-leach and processing-chemical storage pond leak-collection systems according to the process defined in TABLE 2.

(11) The permittee shall determine the acid-generating potential of the spent ore by acid\base accounting and other appropriate static and dynamic laboratory tests. If the spent ore is shown to be potentially acid generat-

ing under the conditions expected in the heap at closure, the permittee shall submit a plan for acid correction for Department approval prior to loading the heap.

GUIDELINES FOR DISPOSAL OF MILL TAILINGS

340-43-070

(1) Mill tailings shall be treated by cyanide removal, ~~[and]~~ re-use, or destruction prior to disposal to reduce the amount of cyanide introduced into the tailings pond to the lowest practicable level. ~~[Chemical oxidation or other means shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the liquid fraction of the tailings.]~~ The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm.

This rule was amended by the Commission on 8/7/92, following extensive discussion. The amendments allows the permit applicant to select cyanide destruction methodology for reducing the amount of cyanide entering the tailings pond. The amendments also require that the technology selected be designed and operated to achieve the lowest practicable level of cyanide in the tailings pond.

(2) The permittee shall determine the potential for acid-water formation from the tailings by means of acid-base accounting and other suitable laboratory static and dynamic tests. If acid formation can occur, basic materials shall be added to the tailings in the amount of three (3) times the acid formation potential or to give a net neutralization potential of at least 20 tons of $CaCO_3$ per 1000 tons of tailings, whichever is greater, before placing tailings in the disposal facility.

(3) The disposal facility shall be lined with a composite double liner consisting of a flexible-membrane synthetic top liner in tight contact with an engineered, stable, soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) having a minimum thickness of 36 inches.

Construction of the liner shall generally follow the principles and practices contained in EPA/600/2-

88/052, "Lining of Waste Containment and Other Impoundment Facilities, September, 1988.

(4) The disposal facility shall be provided with a leachate collection system above the liner suitable for monitoring, collecting and treating potential acid drainage.

GUIDELINES FOR DISPOSAL OR STORAGE OF WASTEROCK, LOW-GRADE ORE AND OTHER MINED MATERIALS

340-43-075

The permittee shall determine the acid-producing and metals-release potential of the wasterock, low-grade ore or other mined materials by acid/base accounting and other appropriate static and dynamic laboratory tests. If the mined materials are shown to be potentially acid forming, or capable of releasing toxic metals, the permittee shall submit a plan for correction and disposal for Department approval prior to permanently placing the materials.

GUIDELINES FOR HEAP-LEACH AND TAILINGS DISPOSAL FACILITY CLOSURE

340-43-080

(1) The waste disposal facilities shall be closed under these rules in conjunction with the reclamation requirements of DOGAMI (Oregon Department of Geology and Mineral Industries).

(2) An up-dated closure plan and post-closure monitoring and maintenance plan shall be submitted to the Department by the permittee at least 180 days prior to beginning closure operations or making any substantial changes to the operation. The closure plan must be compatible with DOGAMI's reclamation plan and may be part of it.

(3) Chemical conveyances (ditches, troughs, pipes, etc.) not necessary for post-closure monitoring shall be

removed. The secondary containment systems shall be checked before closure for process-chemical contamination, and contaminated soil or other materials, if any, shall be removed to an acceptable disposal facility.

(4) Closure of the heap-leach facility.

(a) The heap shall be detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm.

(b) Following detoxification as defined in (a) above, the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water and air infiltration. The cover should consist, at a minimum, of a low-permeability layer and suitable drainage and soil layers to prevent erosion and damage by animals and to sustain vegetation growth, in accordance with DOGAMI's reclamation rules.

(c) The ponds associated with the heap shall be closed by folding in the synthetic liners and filling and contouring the pits with inert material. Residual sludge may be disposed of in one of the on-site waste disposal facilities, provided it meets the criteria for such wastes in these guidelines. The process chemical collection system of the heap shall be maintained in operative condition so that it can be used to monitor the amount and quality of infiltrated water, if any, draining from the heap.

(5) The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time. Maximum effort shall be made to isolate the tailings from the environment. Construction of the cover shall generally follow the principles and practices contained in <u>EPA/530-SW-89-047, Technical Guidance Document -- Final Covers on Hazardous Waste Landfills and Surface Impoundments</u>.

POST-CLOSURE MONITORING

340-43-085

(1) The Department may continue its permit in force for thirty (30) years after closure of the operation and will include permit requirements for periodic monitoring to determine if release of pollutants is occurring.

(2) Monitoring data will be reviewed regularly by the Department to determine the effectiveness of closure of the disposal facilities. The Department will consult with DOGAMI on release of security funds that would otherwise be needed to correct problems resulting from ineffective closure.

LAND DISPOSAL OF WASTEWATER

340-43-090

(1) To qualify for land disposal of excess wastewater, the permit applicant shall demonstrate to the Department that the process has been designed to minimize the amount of excess wastewater that is produced, through use of water-efficient processes, wastewater treatment and reuse, and reduction by natural evaporation. Excess wastewater that must be released shall be treated and disposed of to land under the conditions specified in the permit.

(2) A disposal plan shall be submitted as part of the permit application that, at a minimum, includes:

(a) Wastewater quantity and quality characterization;

(b) Soils characterization and suitability analysis;

(c) Drainage and run-off characteristics of the site relative to land application of wastewater;

(d) Proximity of the disposal site to groundwater and surface water and potential impact;

(e) Wastewater application schedule and water balance;

(f) Disposal site assimilative capacity determination;

(g) Soils, surface water and groundwater monitoring plan;

(h) Potential impact on wildlife or sensitive plant species.

(3) The Department will evaluate the disposal plan and set site-specific permit conditions for the wastewater discharge.

GUIDELINES FOR OPEN-PIT CLOSURE

340-43-095

(1) Open pits that will be left as a result of the mining operation shall be assessed prior to, and following, mining operations for the potential to contaminate water to the extent that it might not meet water-quality standards due to build-up of acid or toxic metals.

(2) If the Department finds that the potential for water accumulation in the pit(s) exists, the permit applicant shall submit a closure plan for the pit that will address contamination prevention and possible remedial treatment of the water. The closure plan shall, at a minimum, examine the following alternatives:

(a) Avoidance, during mining, of acid-generating materials that can be left in place, rather than being exposed to oxidation and weathering;

(b) Removal from the pit and disposal, during or after the mining operation, of residual acid-generating materials that would otherwise be left exposed to oxidation and weathering;

TABLE 1

Heap-Leach Liquid Storage Criteria

Component	Pregnant-Solution Pond	Barren-Solution Pond
Operating Volume	Minimum necessary to maintain recirculation	Minimum necessary to maintain recirculation
Operational Surge	Anticipated draindown and rinse volume	Anticipated draindown and rinse volume
Climatic Surge	100-yr, 24-hr storm plus 10-yr snowmelt	100-yr, 24-hr storm plus 10-yr snowmelt
Safety Factor	2-ft dry freeboard	2-ft dry freeboard

TABLE 2

Required Responses to Leakage Detected from the Leach Pad and Processing Chemical Storage Ponds

Leakage Category	Response
Zero leakage to 200 gal/day-acre	Notify the Department; increase pumping and monitoring
Leakage from 200 gal/day-acre to 400 gal/day-acre	Change operating practices to reduce leakage
Leakage in excess of 400 gal/day-acre	Repair leaks under Department schedule.

(c) Protective capping in-situ of residual acid-generating materials;

(d) Treatment methods for correcting acidity and toxicity of accumulated water;

(e) Installation of an impermeable liner under ponded water to prevent groundwater contamination;

(f) Backfilling of the pit(s) above the water table to reduce oxidation of residual acid-generating materials.

State of Oregon
Department of Environmental Quality — Memorandum

Date: August 17, 1992

To: Environmental Quality Commission

From: Fred Hansen

Subject: Closure of Open Pits -- Mining Rules

This memo provides some additional information as requested by the Chair in response to Jean Cameron's comments regarding closure of open pits at the August 7, 1992, mining discussion. Below on the left is the wording on this issue from the current rule proposal. Jean's Cameron's comments are on the right. Our comments follow. Then, for your reference, the Department of Geology's rule on "Reclamation and Mine Closure Standards" is reproduced to give you a sense of how our rules fit with theirs. Finally, some information on the financial security (reclamation bond) provisions and consolidated permit process of HB 2244 and Geology's rules is provided.

GUIDELINES FOR OPEN-PIT CLOSURE

340-43-095

(1) Open pits that will be left as a result of the mining operation shall be assessed prior to, and following, mining operations for the potential to contaminate water to the extent that it might not meet water-quality standards due to build-up of acid or toxic metals.

(2) If the Department finds that the potential for water accumulation in the pit(s) exists, the permit applicant shall submit a closure plan for the pit that will address contamination prevention and possible remedial treatment of the water. The closure plan shall, at a minimum, examine the following alternatives:

(a) Avoidance, during mining, of acid-generating materials that can be left in place, rather than being exposed to oxidation and weathering;	Jean supports this option.

(b)	Removal from the pit and disposal, during or after the mining operation, of residual acid-generating materials that would otherwise be left exposed to oxidation and weathering;	Jean recommends deleting this option because it's use would leave an even larger scar on the land and would require removal of acid-generating materials to a disposal facility that would itself require long term maintenance and monitoring in an endless shell game.
(c)	Protective capping in-situ of residual acid-generating materials;	Jean recommends deleting this option because of the potential for failure of a cap, especially on steep slopes.
(d)	Treatment methods for correcting acidity and toxicity of accumulated water;	Jean recommends deleting this option because it requires perpetual treatment with related costs and potential for failure.
(e)	Installation of an impermeable liner under ponded water to prevent groundwater contamination;	Jean recommends deleting this option because of the potential for failure that requires perpetual monitoring and potential remedial action, as well as exclosure from wildlife access.
(f)	Backfilling of the pit(s) above the water table to reduce oxidation of residual acid-generating materials.	Jean supports keeping this option in the rules but amending it to read "Backfilling of pit(s) ~~[above the water table]~~ to the level necessary to ~~[reduce]~~ prevent oxidation of residual acid-generating materials."

The intent of paragraph 2 of this rule was to require evaluation of potential options for control and development of a closure plan in the event water accumulation in the pit is a possibility. While some of these options may seem to have drawbacks, we do not think it is appropriate to eliminate any of them from evaluation and potential use at this stage. With respect to the suggested modification of (f), we would agree that "to the level necessary" is probably better wording than "water table". We also agree with the intent of preventing oxidation, but are not sure that backfilling, by itself, could "prevent" oxidation in all cases. Perhaps wording to the effect of "... to the level necessary to, in conjunction with other appropriate control measures, prevent oxidation..." would accomplish the purpose.

The Department of Geology and Mineral Industries adopted fairly extensive rules in October 1991, in response to HB 2244. Rule OAR 340-37-130, entitled "Reclamation and Mine Closure Standards", reproduced below, gives a sense of their current direction regarding reclamation.

632-37-130 The Department shall require a chemical process mine to comply with reclamation and mine closure standards utilizing the best available, practicable and necessary technology to assure compliance with environmental standards. The reclamation and mine closure standards shall include but not be limited to the following:

(1) Surface reclamation shall assure environmental protection and the protection of human health and safety, as well as livestock, fish and wildlife.

(2) Surface reclamation of a chemical process mine shall require certification of the Department of Fish and Wildlife and the Department of Agriculture that a self-sustaining ecosystem, comparable to undamaged ecosystems in the area, has been established in satisfaction of the permittee's habitat restoration obligations.

(3) Post-closure monitoring shall be required by the Department to insure compliance with decommissioning performance standards.

(4) Revegetation shall be considered successful if it is consistent with the establishment of a self-sustaining ecosystem, comparable to undamaged ecosystems in the area of the mine. Vegetation test plots and chemical/physical soil and subsoil analysis may be required to insure establishment feasibility.

(5) Native species shall be established unless the use of non-native species is justified and approved by the Technical Review Team.

(6) Seedmixes, fertilizer rates and other requirements will be derived from departmental experience and advice from such sources as the Oregon Department of Agriculture, U.S. Soil Conservation Service, Oregon State University Extension Service, the Oregon Department of Transportation, the Bureau of Land Management, the Forest Service, local soil conservation districts and private sector experts.

(7) All final slopes shall be stable, blend into adjacent terrain and be compatible with the establishment of a self-sustaining ecosystem, comparable to undamaged ecosystems in the area of the mine.

(8) Reclaimed highwalls shall not have slopes exceeding 1-1/2 horizontal to 1 vertical (1-1/2:1). The Department may grant exceptions for steeper slopes when the applicant can document that the slopes will be stable and if the steeper slopes:

(a) Blend into the adjacent terrain features;
(b) Existed prior to mining; or
(c) Are consistent with the establishment of a self-sustaining ecosystem, comparable to undamaged ecosystems in the area of the mine.

(9) Fill Slopes shall be 2:1 or flatter unless steeper slopes are approved by the Department. Technical data supporting steeper slope stability may be required by the Department.

(10) In-water slopes to six feet below water level for permanent water impoundments when necessary shall be 3:1. Reasonable alternatives may be approved by the Department when they are consistent with the reclamation plan. For example, safety benches with no more than two feet below water level and five feet wide may be substituted for the slope requirement where the Department determines that sloping is not practical.

(11) Permanent structures may remain if they are part of the approved reclamation plan.

(12) Any standards adopted by rule by a permitting or cooperating agency related to reclamation or closure of a chemical process mine.

(13) Backfilling or partial backfilling of pits shall be required if the Department determines that:

(a) Backfilling is necessary to achieve the reclamation objectives set forth in ORS Chapter 517 or Chapter 735, 1991 Oregon Laws;

(b) Reclamation objectives, including but not limited to compliance with environmental standards, cannot be achieved through mitigation or other reclamation technologies; and

(c) Backfilling is the best available, practicable and necessary technology to assure compliance with environmental standards.

Geology's rules (OAR 632-37-135) also deal with the issue of financial security. The rules require a reclamation bond (or approved alternative security) to be posted prior to the start of any mining operations. The amount of the financial security is to be calculated on the basis of the estimated actual cost of reclamation and closure and shall not be limited. The rules detail factors to be considered in determining the amount of security and provide that the calculation shall also consider environmental protection costs based on a credible accident analysis. The rules require Geology to assess annually the overall cost of reclamation. If changes in the operation or modifications to a permit cause the cost of reclamation to exceed the amount of the financial security currently held by the state, the permittee shall post additional security for the difference. Permits are to be suspended if the permittee fails to post necessary security.

HB 2244 and Geology's rules also provide for a consolidated permit application process. A Reclamation and Closure Plan is required as part of the application. Public notice must be given at various stages of the process, including notice of a consolidated public hearing and opportunity for written comment on the draft permits of all agencies. Therefore, there will be opportunity for review and comment on pit closure and reclamation issues before permits are finally issued.

Finally, existing permit process rules adopted by the Commission allow the Department to initiate modification of a permit at any time due to changing conditions or standards, receipt of additional information, or any other reason pursuant to applicable statutes.

The combination of these provisions would seem to give us reasonable opportunity to deal with pit closure issues as more information becomes available in the future.

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DEQ-101-2/86

State of Oregon
Department of Environmental Quality — Memorandum

Date: August 19, 1992

To: Environmental Quality Commission

From: Fred Hansen, Director

Subject: Proposed Chemical Mining Rules

At the meeting on August 7, 1992, the Commission indicated acceptance of the Department recommendation for adoption of the proposed chemical mining rules with changes in the following areas:

- The wording for proposed as Alternative 2 for both the heap leach pad liner [OAR 340-43-065(4) on pages 14-15] and processing chemical pond liner [OAR 340-45-065(5) on pages 15-16] was accepted to replace the 12/13/91 draft wording labeled Alternative 1.

- The Commission directed the Department to develop additional wording to clearly convey the intent that alternative liner systems can be approved provided that the level of environmental protection intended by each component of the liner system specified in the rule (primary liner, leak detection system, secondary liner) is achieved, either within the component or on a cross component basis. This new wording appears as OAR 340-43-065(4)(d) on page 15 and (5)(d) on pages 16-17.

- The wording of the Purpose and Policies [OAR 340-43-006(2)(b) on page 3] and the Guidelines for Disposal of Mill Tailings [OAR 340-43-070(1) on page 18] was modified to allow "destruction" of cyanide in mill tailings as an alternative to removal and reuse.

The attached rule draft (Attachment A dated 8/13/92) displays the changes made to the 8/7/92 draft in response to the Commission direction in the traditional way: new wording is <u>underlined</u>, and deleted wording is ~~[enclosed in brackets and struck through]~~. For easy reference, the wording changes appear on pages 3, 14-17, and 18.

It is recommended that the Commission adopt the proposed chemical mining rules as presented in Attachment A.

Note: At its 8/7/92 meeting, the Environmental Quality Commission considered proposed rules dated 8/7/92, and accepted the Department recommendations with some changes as noted in this draft. This 8/17/92 draft deletes the underlining from new text and removes text that was shown struck through in the 8/7/92 draft. It then shows changes made in response to Commission discussions in the following manner:

Underlined text is proposed language to be added to the rule draft as a result of the Commission discussions on 8/7/92.

~~[Bracketed and struck through]~~ text is proposed language to be deleted from the rule draft as a result of the Commission discussions on 8/7/92.

RULES PROPOSAL:

OREGON ADMINISTRATIVE RULES

CHAPTER 340

DIVISION 43

CHEMICAL MINING

Renumbering of some rules and other minor "house keeping" amendments proposed in the 8/7/92 rule draft were accepted by the Commission on 8/7/92.

OAR 340-43-035	Exemption from State Permits for Hazardous Waste Treatment or Disposal Facilities

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

OAR 340-43-040	Purpose
OAR 340-43-045	General Provisions
OAR 340-43-050	Control of Surface Water Run-On and Run-Off
OAR 340-43-055	Physical Stability of Retaining Structures and Emplaced Mine Materials
OAR 340-43-060	Protection of Wildlife
OAR 340-43-065	Guidelines for Design, Construction, and Operation of Heap-Leach Facilities
OAR 340-43-070	Guidelines for Disposal of Mill Tailings
OAR 340-43-075	Guidelines for Disposal or Storage of Wasterock, Low-Grade Ore and Other Mined Materials
OAR 340-43-080	Guidelines for Heap-Leach and Tailings Disposal Facility Closure
OAR 340-43-085	Post-Closure Monitoring
OAR 340-43-090	Land Disposal of Wastewater
OAR 340-43-095	Guidelines for Open-Pit Closure

PURPOSE and POLICIES

340-43-006

(1) The purpose of these rules and guidelines is to prevent water pollution and protect the quality of the environment and public health in Oregon, consistent with the policies of ORS 468B.015 and 468B.020, by requiring application of all available and reasonable method for control of wastes and chemicals relative to design, construction, operation, and closure of mining operations which use cyanide or other toxic chemicals to extract metals or metal-bearing minerals from the ore and which produce wastes or wastewaters containing toxic materials.

This section reflects amendments to this rule as proposed in the 8/7/92 draft and accepted by the Commission.

(2) The following policies are established to provide further guidance regarding the level of environmental protection these rules are intended to achieve:

This section [340-43-006(2)] was new language proposed in the 8/7/92 rule draft. It was accepted by the Commission with amendments to (b) reflected below.

(a) Liner, leak detection and leak collection systems (systems) are necessary for heap leach pads, solution ponds, and tailings facilities to assure that any leak will be detected before toxic materials escape from the liner system and are released to the environment. For purposes of these rules, the environment is considered to begin at the bottom of the last liner. These systems shall assure that a leak is found, and that sufficient time is available to allow for the repair of the leak and clean up of any leaked material before there is a release to the environment. Natural conditions, such as depth to groundwater or net rainfall, shall be considered as additional protection but not in lieu of the protection required by the engineered liner system.

(b) The toxicity of mill tailings and the potential for long-term cyanide and toxic metals release from mill tailings shall be reduced to the greatest degree practicable through removal, ~~[and]~~ reuse, or destruction of chemical solutions prior to placement of tailings in the tailings disposal facility.

This paragraph was amended by the Commission to be consistent with the change made in rule 340-43-070 to not require reuse and to allow destruction technology to be used.

(c) The closure of heap leach pads and tailings disposal facilities shall prevent future release to the environment of residual potentially toxic chemicals contained in the facility.

DEFINITIONS

340-43-011

Unless the context requires otherwise, as used in this Division:

(1) "Chemical process mine" means a mining and processing operation for metal-bearing ores that uses chemicals to dissolve metals from ores.

(2) "Department" means the Department of Environmental Quality.

(3) "Guidelines" means this body of rules contained in 340-43-045 through 340-43-100.

(4) "Positive exclusion of wildlife" means the use of such devices as tanks, pipes, fences, netting, covers and heap-leach drip-irrigation emitters or covered emitters.

(5) "Tailings" means the spent ore resulting from the milling and chemical extraction process.

PERMIT REQUIRED

340-43-016

(1) As required by ORS 468B.050, a person proposing to construct a new chemical mining operation, commencing to operate an existing non-permitted operation, or proposing to substantially modify or expand an existing operation shall first apply for, and receive, a permit from the Department. The permit may be an NPDES (National Pollutant Discharge Elimination System) permit if there is a point-source discharge to surface waters or a WPCF (Water Pollution Control Facility)

The Commission accepted the minor clarifying amendment proposed in the 8/7/92 draft for this paragraph.

permit if there is no discharge. Consideration may be given to site-specific conditions such as climate, proximity to water, and type of wastes to establish the final permit type and requirements for the facility.

(2) The permit application shall comply with the requirements of OAR Chapter 340, Divisions 14 and 45 and be accompanied by a report that fully addresses the requirements of this Division.

(3) Prior to issuance of a permit for a chemical process mining activity under this Division, a determination of compliance with statewide planning goals and compatibility with local land use plans must be made. The Department shall determine compliance with Statewide Planning Goals and compatibility with acknowledged comprehensive plans and land use regulations in a manner consistent with its approved State Agency Coordination Program and the rules in OAR Chapter 340, Division 18. In making these determinations, the Department shall consider and may rely on the findings and recommendations made by the project coordinating committee authorized by ORS 517.965 and by the Department of Geology and Mineral Industries pursuant to their State Agency Coordination Program and OAR Chapter 632, Divisions 1 and 37.

The Commission accepted this new paragraph as proposed in the 8/7/92 draft.

PERMIT APPLICATION

340-43-021

(1) The permit application shall fully describe the existing site and environmental conditions, with an analysis of how the proposed operation will affect the site and its environment. The application shall, at a minimum, contain the information specified for the DOGAMI (Department of Geology and Mineral Industries) consolidated application under ORS 517.971 (Section 13, Chapter 735, 1991 Oregon Laws). The Department will also use the information contained in NEPA (National Environmental Policy Act), EA (Environmental Assessment), or EIS (Environmental Impact Statement) documents, if they are required for the

This paragraph reflects clarifying amendments proposed in the 8/7/92 draft and accepted by the Commission.

project, as partial fulfillment of the requirements of this paragraph.

(2) The permit application shall, in addition to the information described in Paragraph (1) above, include the following information, unless the information has been otherwise submitted:

(a) Climate/meteorology characterization, with supporting data;

(b) Soils characterization, with supporting data;

(c) Surface water hydrology study, with supporting data;

(d) Characterization of surface water and groundwater quality;

(e) Inventory of surface water and groundwater beneficial uses;

(f) Hydrogeologic characterization of groundwater, with supporting data;

(g) Geologic engineering, hazards and geotechnical study, with supporting data;

(h) Characterization of mine materials and wastes which include, for example, overburden, waste rock, stockpiled ore, leached ore and tailings. Characterization of mine materials and wastes shall include, but not be limited to the following:

(A) Chemical and mineral analysis related to toxicity;

(B) Determination of the potential for acid water formation;

(C) Determination of the potential for long-term leaching of toxic materials from the wastes;

(i) Characterization of wastewater (quantity and chemical and physical quality) produced by the operation;

(j) Assessment of the potential for acid-water formation from waste disposal facilities, low-grade ore stockpiles, waste rock piles and for surface water or groundwater accumulation in open pits that will remain after mining is ended.

(3) Data submitted by the permit applicant should be based on analysis of the actual materials, when possible, or may be based on estimates from knowledge of similar operations and professional judgment.

PLANS AND SPECIFICATIONS

340-43-026

(1) A person constructing or commencing to operate a chemical process mine or substantially modifying or expanding an existing chemical process mine shall first submit plans and specifications to the Department for construction, operation and maintenance of the facilities intended for treatment, control and disposal of wastes.

(2) The plans shall address all applicable requirements of this Division and shall include, but not be limited to, the following:

Sections (2) and (3) of this rule reflect clarifying amendments proposed by the Department and accepted by the Commission.

(a) A description of the facilities to be constructed, including tanks, pipes and other storage and conveyance means for processing chemicals and solutions and wastewaters;

(b) A management plan for control of surface water;

(c) A management plan for treatment and disposal of excess wastewater, including provisions for reuse and wastewater minimization;

(d) A facility construction plan including, as applicable, the design of low-permeability soil barriers, the type of geosynthetics to be used and a description of their installation methods, the design of wastewater treatment facilities and processes, a quality assurance plan for applicable phases of construction and a listing of construction certification reports to be provided to the Department;

(e) A preliminary closure plan;

(f) A preliminary post-closure monitoring and maintenance plan;

(g) A spill containment and control plan.

(3) The Department shall approve the plans, in writing, before construction of the facilities may be started.

DESIGN, CONSTRUCTION, OPERATION AND CLOSURE REQUIREMENTS

340-43-031

(1) All chemical process and waste disposal facilities and facilities for mixing, distribution, and application of chemicals associated with on-site mining operations; ore preparation and beneficiation facilities; and processed ore disposal facilities shall be designed, constructed, operated and closed in accordance with the guidelines contained in this Division.

(2) Alternative facilities and methods of control of wastes and potential pollutants may be approved by the Department if the permit applicant can demonstrate that the alternate facilities and methods will provide environmental protection that is fully equivalent or better than that achieved by the facilities specified in the guidelines in Sections 43-040 to 43-095 of these rules. The burden of proof of fully equivalent protection lies with the permit applicant. Written approval of any alternative by the Department shall be evidence of

This wording reflects clarifying amendments proposed by the Department and accepted by the Commission.

acceptance as equivalent or better level of environmental protection.

(3) A groundwater monitoring plan shall be submitted to, and be approved by the Department. Monitoring wells shall be installed for detection of groundwater contamination as required by OAR Chapter 340, Division 40, unless the Department concludes in writing that the hydrogeology of the site or other technical information indicates that an adverse impact on groundwater quality is not likely to occur.

This wording reflects a clarifying amendment proposed by the Department and accepted by the Commission.

(4) The Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with these rules.

EXEMPTION FROM STATE PERMIT FOR HAZARDOUS WASTE TREATMENT OR DISPOSAL FACILITIES

340-43-035

(1) The state hazardous waste program requires a permit for the "treatment", "storage" or "disposal" of any "hazardous waste" as identified or listed in OAR Chapter 340, Division 101 from the Department, prior to the treatment and disposal of wastes. Permitting requirements can be found in OAR Chapter 340, Division 105, Hazardous Waste Management.

(2) However, any operation permitted under this Division, which would otherwise require the neutralization or treatment of hazardous waste and would require a permit pursuant to OAR Chapter 340, Division 105, shall be exempt from the requirement to obtain such hazardous waste treatment permit.

(3) All mined materials disposed of under this Division shall pass Oregon's hazardous waste rule criteria or they will be considered a state hazardous waste and must be disposed of accordingly.

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

PURPOSE

340-43-040

(1) This Division establishes criteria for the design, construction, operation and closure of chemical mining operations and supplements the provisions of OAR 340-43-006 through OAR 340-43-035. These criteria are intended to establish the minimum level of environmental protection that is necessary using a combination of performance standards and minimum design criteria. Approval of alternative facilities or methods to achieve an equivalent or better environmental result is allowed as defined in OAR 340-43-031.

This section reflects clarifying amendments proposed by the Department and accepted by the Commission.

(2) Any disapproval of submitted plans or specifications, or imposition of requirements by the Department to improve existing facilities or their operation will be referenced when appropriate, to applicable guidelines or rules.

GENERAL PROVISIONS

340-43-045

(1) Facilities permitted under either a WPCF or NPDES permit shall not discharge wastewater or process solutions to surface water, groundwater or soils, except as expressly allowed by the permit.

(2) Facilities subject to these rules shall not be sited in 100-year floodplains or wetlands. A buffer zone (a minimum of 200 feet wide) shall be established between waste disposal facilities and surface waters.

(3) All chemical conveyances (ditches, troughs, pipes, etc.) shall be equipped with secondary containment and leak detection means for preventing and detecting

release of chemicals to surface water, groundwater or soils.

(4) Acid water accumulation in open pits resulting from the mining operation must be prevented by appropriate mining practices, by measures taken in the closure process, or be treated to control pH and toxicity, for the life of the pit.

(5) Construction of surface impoundment liner systems shall conform generally to the principles and practices described in EPA/600/2-88/052, Lining of Waste Containment and Other Impoundment Facilities, September 1988.

(6) The Department may require the permittee to hire a third-party contractor to perform the functions set forth below. Selection of the contractor shall be subject to Department approval.

(a) Review and evaluate the design and construction specifications of all mined-materials disposal facilities permitted under this Division for functional adequacy and conformance with Department requirements. The Department shall not approve construction of the disposal facilities until the design and construction specifications have been evaluated.

(b) Monitor the course of construction of all mined-materials facilities for compliance with the approved design and construction specifications. The third-party contractor shall regularly document the progress of construction and the Department shall require the permittee to take corrective action if construction does not satisfactorily conform to the approved design and construction specifications.

This paragraph includes a clarifying amendment proposed by the Department and accepted by the Commission.

(c) Provide on-site inspections during ongoing operations, including but not limited to the loading of the heap, to assure protection of the integrity of the liner system and other environmental protection measures.

This paragraph is new language proposed by the Department in the 8/7/92 draft and accepted by the Commission.

CONTROL OF SURFACE WATER RUN-ON AND RUN-OFF

340-43-050

(1) Surface water run-on and run-off shall be controlled such that it will not endanger the facility or become contaminated by contact with process materials or loaded with sediment. The control systems shall be designed to accommodate a 100-year, 24-hour storm event, or any other defined climatic event that is more appropriate to the site, and be placed so as to allow for restoration of the natural drainage network, to the maximum extent practicable, upon facility closure.

(2) All mined materials shall be properly placed and protected from surface water and precipitation so as not to be eroded and contribute sediment to site stormwater run-off or to otherwise contaminate surface water.

PHYSICAL STABILITY OF RETAINING STRUCTURES AND EMPLACED MINE MATERIALS

340-43-055

(1) Permit applicants must demonstrate to the Department that the design of chemical processing facilities and waste disposal facilities is adequate to ensure the stability of all structural components of the facilities during operation, closure and post closure.

(2) Retaining structures, foundations and mine materials emplacements shall be designed by a qualified, registered professional and be constructed for long-term stability under anticipated loading and seismic conditions.

(3) Temporary structures and materials emplacements may, with written approval from the Department, be constructed to a lesser standard if it can be shown that they pose no, or minimal, threat to public safety or the environment.

PROTECTION OF WILDLIFE

340-43-060

(1) Wildlife shall be positively excluded from contact with chemical processing solutions and wastewaters containing chemicals.

(2) The Department may waive the positive exclusion requirement if the Oregon Department of Fish and Wildlife (ODF&W) certifies to the Department that the project is designed such that it will adequately protect wildlife.

GUIDELINES FOR DESIGN, CONSTRUCTION, AND OPERATION OF HEAP-LEACH FACILITIES

340-43-065

(1) This paragraph applies to heap-leach facilities using dedicated, or expanding, pads. Heap-leach facilities using on-off, reusable pads may require variations from these rules; they shall be approved on a case-by-case basis by the Department.

(2) The heap-leach facility (pad and associated ponds, pipes and tanks) shall be sized to prevent flooding of any of its components.

(3) TABLE 1 of this Division establishes minimum capacity-sizing criteria for the leach-pad and ponds. The pad and ponds may be designed to act separately or in conjunction with each other to obtain the required storage volumes. Other design criteria may be used, with Department approval, if local conditions warrant. The best available climatic data shall be used to confirm the critical design storm event and estimate the liquid levels in the system over a full seasonal cycle. The liquid mass balance may include provision for evaporation.

~~[Heap Leach Pad Liner Alternative 1]~~

The Commission selected Alternative 2 presented below. Therefore, this wording from the 12/13/91 and 8/7/92 rule drafts is marked to clearly indicate the intended deletion.

~~[(4) The heap leach pad liner system shall be of triple liner construction with between liner leak detection consisting of:~~

~~(a) An engineered, stable, low permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;~~

~~(b) Continuous flexible membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec);~~

~~(c) A leak detection system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre within ten weeks of leak initiation.]~~

~~[Heap Leach Pad Liner Alternative 2]~~

(4) The heap leach pad liner system shall be designed, constructed, and operated to meet the following criteria:

This wording reflects the alternative from the 8/7/92 rule draft for heap leach pad liners that was accepted by the Commission. A new subparagraph (d) is presented below to incorporate the intent discussed by the Commission on 8/7/92.

(a) A primary liner consisting, at a minimum, of a continuous flexible-membrane of suitable synthetic material shall be provided. This liner shall function together with the process chemical collection system installed immediately above this liner (see section (8) of this rule) to remove process chemicals from the heap.

(b) A leak detection system shall be installed immediately below the primary liner for the purpose of detecting loss of process solutions by leakage through the primary liner. The leak detection system shall be capable of detecting leakage through the primary liner of 400 gallons/day-acre within ten weeks of leak initiation. The leak detection system shall consist of appropriately sized collection piping placed within a minimum thickness of 12 inches of permeable material

(minimum permeability of 10^{-2} cm/sec) that is capable of withstanding the anticipated weight of the heap without loss of function.

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the operation of the heap and following closure of the heap is not released to the environment. The Secondary liner shall be of a composite design with a continuous flexible-membrane of suitable synthetic material in direct contact with an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches.

<u>(d) Each liner system component described in paragraphs (4)(a)-(c) above addresses a specific need and purpose with respect to environmental protection. For purposes of evaluating alternative facilities and methods of control under OAR 340-43-031(2), an alternative may be approved if the level of environmetal protection intended by each separate liner system component is achieved either within the individual component or on a cross component basis.</u>

This new language was added based on 8/7/92 Commission discussions to clarify the Commission intent with respect to evaluation of equivalent environmental protection of liner system alternatives proposed by a permit applicant.

~~[Processing Chemical Pond Liner Alternative 1]~~

The Commission selected Alternative 2 presented below. Therefore, this wording from the 12/13/91 and 8/7/92 rule drafts is deleted.

~~[(5) The processing chemical pond liners shall be of triple liner construction with between liner leak detection consisting of:~~

~~(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;~~

~~(b) Continuous flexible membrane middle and top liners of suitable synthetic material separated by a permeable material (minimum coefficient of permeability of 10^{-2} cm/sec);~~

~~(e) A leak detection system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre, within ten weeks of leak initiation.]~~

~~[Processing Chemical Pond Liner Alternative 2]~~

(5) The processing chemical pond liner system shall be designed, constructed, and operated to meet the following criteria:

This wording reflects the alternative from the 8/7/92 rule draft for processing chemical pond liners that was accepted by the Commission. A new subparagraph (d) is presented below to incorporate the intent discussed by the Commission on 8/7/92.

(a) A primary liner consisting, at a minimum, of a continuous flexible-membrane of suitable synthetic material shall be provided. This liner shall provide for positive containment of processing chemical solutions.

(b) A leak detection system shall be installed immediately below the primary liner for the purpose of detecting loss of process chemical solutions by leakage through the primary liner. The leak detection system shall be capable of detecting leakage through the primary liner of 400 gallons/day-acre within ten weeks of leak initiation. The leak detection system shall consist of appropriately sized collection piping placed within a layer of permeable material (minimum permeability of 10^{-2} cm/sec).

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the use of the pond is not released to the environment. The Secondary liner shall be of a composite design with a continuous flexible-membrane of suitable synthetic material in direct contact with an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches.

<u>(d) Each liner system component described in paragraphs (5)(a)-(c) above addresses a specific need and purpose with respect to environmental protection. For purposes of evaluating alternative facilities and methods of control under OAR 340-</u>

This new language was added based on 8/7/92 Commission discussions to clarify the Commission intent with respect to evalu-

43-031(2), an alternative may be approved if the level of environmetal protection intended by each separate liner system component is achieved either within the individual component or on a cross component basis.

ation of equivalent environmental protection of liner system alternatives proposed by a permit applicant.

(6) Emergency ponds may be constructed as an alternative to larger pregnant and barren ponds. The emergency pond may be constructed to a lesser standard, with the limitation that it is to be used only infrequently and for short periods of time. The Department will specify reporting and use limitations for the ponds in the permit. A between-liner leak detection system is not required for the emergency pond.

(7) The emergency-pond liner shall be of composite construction consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-6} cm/sec) with a minimum thickness of 12 inches, and

(b) A single flexible-membrane synthetic top liner of suitable material.

(8) The heap-leach pad shall be provided with a process chemical collection system above the upper-most liner that will prevent an accumulation of process chemical within the heap greater than 24 inches in depth.

(9) The permittee shall prepare a written operating plan for safe temporary shut-down of the heap-leach facility and train employees in its implementation.

(10) The permittee shall respond to leakage collected by the heap-leach and processing-chemical storage pond leak-collection systems according to the process defined in TABLE 2.

(11) The permittee shall determine the acid-generating potential of the spent ore by acid\base accounting and other appropriate static and dynamic laboratory tests. If the spent ore is shown to be potentially acid generat-

ing under the conditions expected in the heap at closure, the permittee shall submit a plan for acid correction for Department approval prior to loading the heap.

GUIDELINES FOR DISPOSAL OF MILL TAILINGS

340-43-070

(1) Mill tailings shall be treated by cyanide removal, ~~[and]~~ re-use, or destruction prior to disposal to reduce the amount of cyanide introduced into the tailings pond to the lowest practicable level. ~~[Chemical oxidation or other means shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the liquid fraction of the tailings.]~~ The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm.

This rule was amended by the Commission on 8/7/92, following extensive discussion. The amendments allows the permit applicant to select cyanide destruction methodology for reducing the amount of cyanide entering the tailings pond. The amendments also require that the technology selected be designed and operated to achieve the lowest practicable level of cyanide in the tailings pond.

(2) The permittee shall determine the potential for acid-water formation from the tailings by means of acid-base accounting and other suitable laboratory static and dynamic tests. If acid formation can occur, basic materials shall be added to the tailings in the amount of three (3) times the acid formation potential or to give a net neutralization potential of at least 20 tons of $CaCO_3$ per 1000 tons of tailings, whichever is greater, before placing tailings in the disposal facility.

(3) The disposal facility shall be lined with a composite double liner consisting of a flexible-membrane synthetic top liner in tight contact with an engineered, stable, soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) having a minimum thickness of 36 inches.

Construction of the liner shall generally follow the principles and practices contained in EPA/600/2-

88/052, "Lining of Waste Containment and Other Impoundment Facilities, September, 1988.

(4) The disposal facility shall be provided with a leachate collection system above the liner suitable for monitoring, collecting and treating potential acid drainage.

GUIDELINES FOR DISPOSAL OR STORAGE OF WASTEROCK, LOW-GRADE ORE AND OTHER MINED MATERIALS

340-43-075

The permittee shall determine the acid-producing and metals-release potential of the wasterock, low-grade ore or other mined materials by acid/base accounting and other appropriate static and dynamic laboratory tests. If the mined materials are shown to be potentially acid forming, or capable of releasing toxic metals, the permittee shall submit a plan for correction and disposal for Department approval prior to permanently placing the materials.

GUIDELINES FOR HEAP-LEACH AND TAILINGS DISPOSAL FACILITY CLOSURE

340-43-080

(1) The waste disposal facilities shall be closed under these rules in conjunction with the reclamation requirements of DOGAMI (Oregon Department of Geology and Mineral Industries).

(2) An up-dated closure plan and post-closure monitoring and maintenance plan shall be submitted to the Department by the permittee at least 180 days prior to beginning closure operations or making any substantial changes to the operation. The closure plan must be compatible with DOGAMI's reclamation plan and may be part of it.

(3) Chemical conveyances (ditches, troughs, pipes, etc.) not necessary for post-closure monitoring shall be

removed. The secondary containment systems shall be checked before closure for process-chemical contamination, and contaminated soil or other materials, if any, shall be removed to an acceptable disposal facility.

(4) Closure of the heap-leach facility.

(a) The heap shall be detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm.

(b) Following detoxification as defined in (a) above, the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water and air infiltration. The cover should consist, at a minimum, of a low-permeability layer and suitable drainage and soil layers to prevent erosion and damage by animals and to sustain vegetation growth, in accordance with DOGAMI's reclamation rules.

(c) The ponds associated with the heap shall be closed by folding in the synthetic liners and filling and contouring the pits with inert material. Residual sludge may be disposed of in one of the on-site waste disposal facilities, provided it meets the criteria for such wastes in these guidelines. The process chemical collection system of the heap shall be maintained in operative condition so that it can be used to monitor the amount and quality of infiltrated water, if any, draining from the heap.

(5) The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time. Maximum effort shall be made to isolate the tailings from the environment. Construction of the cover shall generally follow the principles and practices contained in <u>EPA/530-SW-89-047, Technical Guidance Document -- Final Covers on Hazardous Waste Landfills and Surface Impoundments</u>.

POST-CLOSURE MONITORING

340-43-085

(1) The Department may continue its permit in force for thirty (30) years after closure of the operation and will include permit requirements for periodic monitoring to determine if release of pollutants is occurring.

(2) Monitoring data will be reviewed regularly by the Department to determine the effectiveness of closure of the disposal facilities. The Department will consult with DOGAMI on release of security funds that would otherwise be needed to correct problems resulting from ineffective closure.

LAND DISPOSAL OF WASTEWATER

340-43-090

(1) To qualify for land disposal of excess wastewater, the permit applicant shall demonstrate to the Department that the process has been designed to minimize the amount of excess wastewater that is produced, through use of water-efficient processes, wastewater treatment and reuse, and reduction by natural evaporation. Excess wastewater that must be released shall be treated and disposed of to land under the conditions specified in the permit.

(2) A disposal plan shall be submitted as part of the permit application that, at a minimum, includes:

(a) Wastewater quantity and quality characterization;

(b) Soils characterization and suitability analysis;

(c) Drainage and run-off characteristics of the site relative to land application of wastewater;

(d) Proximity of the disposal site to groundwater and surface water and potential impact;

(e) Wastewater application schedule and water balance;

(f) Disposal site assimilative capacity determination;

(g) Soils, surface water and groundwater monitoring plan;

(h) Potential impact on wildlife or sensitive plant species.

(3) The Department will evaluate the disposal plan and set site-specific permit conditions for the wastewater discharge.

GUIDELINES FOR OPEN-PIT CLOSURE

340-43-095

(1) Open pits that will be left as a result of the mining operation shall be assessed prior to, and following, mining operations for the potential to contaminate water to the extent that it might not meet water-quality standards due to build-up of acid or toxic metals.

(2) If the Department finds that the potential for water accumulation in the pit(s) exists, the permit applicant shall submit a closure plan for the pit that will address contamination prevention and possible remedial treatment of the water. The closure plan shall, at a minimum, examine the following alternatives:

(a) Avoidance, during mining, of acid-generating materials that can be left in place, rather than being exposed to oxidation and weathering;

(b) Removal from the pit and disposal, during or after the mining operation, of residual acid-generating materials that would otherwise be left exposed to oxidation and weathering;

(c) Protective capping in-situ of residual acid-generating materials;

(d) Treatment methods for correcting acidity and toxicity of accumulated water;

(e) Installation of an impermeable liner under ponded water to prevent groundwater contamination;

(f) Backfilling of the pit(s) above the water table to reduce oxidation of residual acid-generating materials.

TABLE 1

Heap-Leach Liquid Storage Criteria

Component	Pregnant-Solution Pond	Barren-Solution Pond
Operating Volume	Minimum necessary to maintain recirculation	Minimum necessary to maintain recirculation
Operational Surge	Anticipated draindown and rinse volume	Anticipated draindown and rinse volume
Climatic Surge	100-yr, 24-hr storm plus 10-yr snowmelt	100-yr, 24-hr storm plus 10-yr snowmelt
Safety Factor	2-ft dry freeboard	2-ft dry freeboard

TABLE 2

Required Responses to Leakage Detected from the Leach Pad and Processing Chemical Storage Ponds

Leakage Category	Response
Zero leakage to 200 gal/day-acre	Notify the Department; increase pumping and monitoring
Leakage from 200 gal/day-acre to 400 gal/day-acre	Change operating practices to reduce leakage
Leakage in excess of 400 gal/day-acre	Repair leaks under Department schedule.

State of Oregon
Department of Environmental Quality — Memorandum

Date: August 28, 1992

To: Linda McMahan, Commissioner, EQC

From: Kent Ashbaker, Manager
Water Quality, Northwest Region

Subject: Requested Information on Cyanide Interactions

I apologize for being so slow in getting this information to you. With the one who knew where all of this information is, not around anymore and others on vacation, it has taken some time to go through the boxes of mining information and search for the material you requested. I hope that the information is helpful.

Document # 1 includes a page which shows a number of cyanide removal or destruction methods and their ability to remove some basic complexes. In also includes two pages on the AVR process. This is the process which we had proposed for cyanide removal and re-use. The last page on that document has back to back tables. Table 3 shows some of the chemical characteristics or untreated tailings water. Table 4 shows some of the chemical characteristics of AVR treated water. We would have liked to be able to have a table which compared the alkaline chlorination process with the other two, but we couldn't find one.

Document # 2 is an informational memo put out by the State of California.

Document # 3 is an explanation of 7 different cyanide removal processes with some of the chemical reactions.

If you have any specific questions, please let me know and I will try to find an answer for you.

cc: Fred Hansen
Lydia Taylor
Chairman Wessinger
Harold Sawyer

#1

Cyanide Destruction Methods

Method	CN/HCN	Zn/Cd		Cu/N		$Fe(CN)_6^{-3}$	CNS
		metal	complex	metal	complex		
H_2O	yes	yes	yes	part	part	no	no
natural	yes	part	part	no	no	no	part
AVR	yes	yes	yes	yes	yes	yes	part
alk. chlor	yes	yes	yes	yes	yes	no	yes
biodegradation	yes	yes	yes	yes	yes	?	yes
$INCO/SO_2$	yes	yes	yes	no	part	yes	?

The heading "Suitable for Removal of" spans the columns from CN/HCN to CNS.

ACIDIFICATION- VOLATILIZATION-REGENERATION (AVR)

Although the Mills-Crowe AVR process is well-known, it has seen little application in many years, and possibly its use had been completely discontinued until only recently. Hydrogen cyanide (HCN) is extremely volatile and consequently can be readily stripped from solutions by air-sparging, particularly at low pH. The low pH is essential to promote the dissociation of cyanide-metal complexes to form HCN at practical rates. The AVR process consists of acidifying waste cyanide-bearing solutions or slurries to pH 2-3 with H_2SO_4, volatilizing the resulting HCN by intense air stripping and recovering the HCN by absorption in an alkaline solution, i.e., NaOH or $Ca(OH)_2$. The recovered HCN is recycled to the cyanidation circuit. Counter-current towers have been used for both HCN stripping and absorption. Some cyanide containing solids, i.e., CuCN, $Cu_2Fe(CN)_6$, remain in the acidified solution. Dissolved metals, i.e., Cu, Ni and Zn also remain in solution and are precipitated as hydroxides in a subsequent step by neutralization with lime.

The principal AVR reactions are shown by the equations:

Acidification $Ca(CN)_2 + H_2SO_4 \longrightarrow CaSO_4 + 2HCN$

Absorption $2HCN + Ca(OH)_2 \longrightarrow Ca(CN)_2 + 2H_2O$

The AVR process was used by the Hudson Bay Mining and Smelting Company in Flin Flon from 1935 to 1978 to recover cyanide from waste barren solution (16). At that plant 91% of the "regenerable" cyanide was recovered. "Regenerable" cyanide was the amount of cyanide which could be released from the barren solution in a laboratory acidification test.

More recently AMOK Limited at their Cluff Lake mill treated 6,500 tonnes of uranium leach tailings for their gold content using the CIP process (17). An AVR system, operated in the batch mode, was used to recover cyanide from CIP tailings. The acidification step was done by adding H_2SO_4 to pH 3-4 in a vigourously air-agitated tank and the recovery of HCN was carried out in a counter-currently operated absorption tower. Over 90% removal of the cyanide from the CIP tailings slurry was reported.

Staff at CANMET have investigated the AVR process over the past few years. Initially they worked with the standard AVR process but found that air-stripping HCN from the total volume of waste barren solution was unduly expensive (18). Subsequently, their efforts have led to substantial modifications of the process whereby most of the HCN is recovered from acidified waste barren solution as $Ca(CN)_2$ by liming and only a small fraction of HCN needs to be recovered by the more costly air-stripping HCN absorption step (19). The process as demonstrated in the laboratory has been capable of producing final effluents containing less than 1 mg/L total cyanide and below 0.5 mg/L for each of the metals copper, iron, nickel and zinc.

Since 1985, Golconda Minerals has been recovering gold by cyanidation from mill tailings at its Beaconsfield mine in Tasmania. In February 1987, Golconda placed a plant in operation using the AVR process to treat 1200 tonnes/day of tailings pond water (20).

The treatment plant flowsheet is shown in Figure 7. At this plant tailings pond decant is acidified to pH 2-3 with H_2SO_4. The solids formed during acidification are separated by clarification and sand filtration before HCN is air-stripped from solution in counter-currently operated packed towers. Hydrogen cyanide is then absorbed in towers from the air stream in a 10% NaOH solution and the recovered NaCN is recirculated to cyanidation. The barren solution from the aeration columns is sent to carbon columns for the recovery of residual gold and then released. The carbon columns also reduce the residual level of cyanide in the water. Performance data for the treatment plant are presented in Table 10.

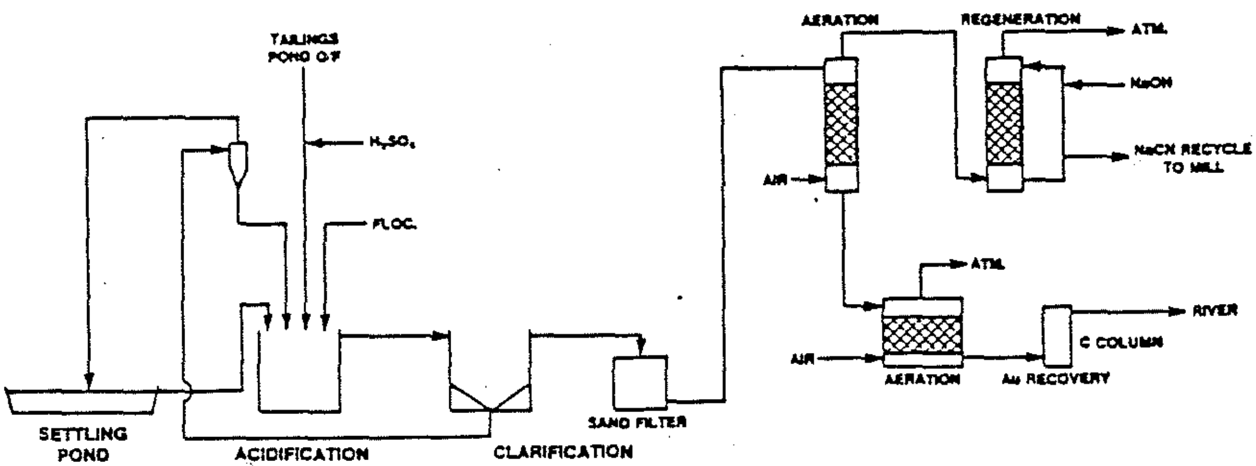

FIGURE 7 GOLCONDA CYANIDE REGENERATION PROCESS

TABLE 10 GOLCONDA TREATMENT PLANT DATA

	Analyses (mg/L)			
	Tailings Pond Decant	Clarified Solution	Aerator Discharge	C Column Discharge
CN_T	200	115	2 - 4	1 - 2
CN_F	10 - 30	110	0.2 - 0.5	0.1 - 0.3
Cu	200	<1	<1	<1
Fe	50 - 100	<1	<1	<1
Ni	1 - 2	<1	<1	<1
Zn	5 - 30	<1	<1	<1
Au	0.08	0.08	0.08	0.01

TABLE 3

CHEMICAL CHARACTERISTICS OF UNTREATED TAILINGS IMPOUNDMENT WATER

Parameter [1,2]	Concentration Range	Average Concentration
Arsenic	------	0.36
Cadmium	------	0.01
Chromium	------	0.01
Cobalt	------	0.21
Copper	2.6 - 2.7	2.6
Iron	------	16.0
Lead	0.08 - 0.20	0.14
Mercury	0.01 - 0.024	0.016
Nickel	------	0.20
Silver	2.0 - 2.1	2.0
Zinc	91.9 - 96.4	93.3
Thiocyanate	30.1 - 36.6	33.6
Total Cyanide	310 - 340	330
Method-C Cyanide	270 - 320	294
Ammonia (as N)	19.0 - 19.6	19.3
pH (in pH units)	10.4 - 10.5	10.4

(1) All concentrations in mg/L, unless otherwise stated.

(2) All values are the result of direct analysis of the samples.

TABLE 4

CHEMICAL CHARACTERISTICS OF THE AVR TREATED WATER

Parameter [1,2]	Concentration Range	Average Concentration
Arsenic	0.01 - 0.02	0.01
Cadmium	0.004 - 0.004	0.004
Chromium	<0.01 - <0.02	<0.02
Cobalt	0.15 - 0.18	0.16
Copper	0.28 - 0.55	0.39
Iron	0.05 - 0.09	0.07
Lead	0.05 - 0.20	0.10
Mercury	0.013 - 0.015	0.014
Nickel	2.05 - 0.10	0.09
Silver	0.5 - 1.1	0.9
Zinc	0.04 - 0.13	0.09
Thiocyanate	27.4 - 36.6	31.3
Total Cyanide	1.3 - 2.3	1.7
Method-C Cyanide	0.7 - 1.6	1.2
Ammonia (as N)	13.8 - 21.3	18.6
Nitrate (as N)	20.0 - 31.4	25.4
Sulfate	1200 - 1600	1450
pH (in pH units)	9.5 - 9.8	------

(1) All concentrations in mg/L, unless otherwise stated.

(2) All values are the result of direct analysis of the samples.

#2

INTERNAL MEMO

TO: O. R. Butterfield
Executive Officer

FROM: Dr. Ranjit S. Gill, E.S. IV

DATE: April 22, 1987

SIGNATURE: Ranjit S. Gill

RECEIVED
AUG 24 1987
Water Quality Division

SUBJECT: CYANIDE REQUIREMENTS FOR CYANIDATION PROCESS WASTES

Regional Board staff are frequently required to issue waste discharge requirements for mining operations that utilize cyanidation process in the recovery of gold and silver. The staff issues the requirements to protect the environment from adverse impact of cyanide-containing wastewater and solid waste.

In the course of working with mining operations that utilize cyanidation process, the Regional Board staff have realized the need to standardize, subject to site specific review, the requirements for the various cyanide compounds and their reaction products in the mine effluent and slurries. I am writing this memo to assist our staff in formulating such requirements. To substantiate the standard requirements proposed later in the text, I offer the following discussion on a) cyanide species encountered in mine effluent; b) environmental fate of cyanides; c) toxicity of cyanides; d) analytical methods of cyanide determination; and e) methods of cyanide destruction.

A. Cyanide Species in Cyanidation Effluents

Cyanide comprises a large class of organic and inorganic chemical compounds with each member containing a cyano group ($C\equiv N$) as part of its molecular structure. Cyanides generally encountered in the cyanidation mine effluents and slurries may be classified into three broad groups:

1) Free Cyanide

Free cyanide is defined as the sum of cyanide anion (CN^-) and hydrogen cyanide gas (HCN). In solution the relationship between CN^- and HCN is highly pH dependent.

$$CN^- + H_2O \longleftrightarrow HCN + OH^-$$

The pKa of HCN, where the concentrations of CN^- and HCN are equal, is at pH 9.367. In solution at pH 11 and above, free cyanide is present as 100% CN^-, and at pH 7 and below, cyanide is present as 100% HCN.

2) Simple Cyanides

Simple cyanides are represented by the formula $A(CN)_x$, where A is an alkali (sodium, potassium, ammonium) or metal, and x, the valence of A, represents the number of cyano groups present in the molecule. Soluble compounds, particularly the alkali cyanides, ionize to release cyanide anions according to the following equation:

$$A(CN)_x \longleftrightarrow A^{+x} + X\ CN^-$$

There is a wide range of solubilities for the simple cyanides which are influenced the most by pH and temperature. The hydrolytic reaction of cyanide ions with water produces hydrocyanic acid according to the following equation:

$$CN^- + H_2O \longleftrightarrow HCN + OH^-$$

Suubsequent behavior then is the same as for HCN.

3) Complex Cyanides

The complex alkali-metallic cyanides can generally be represented by the formula $Ay\ M(CN)_x$, where A is the alkali (sodium, potassium, ammonium). M is the heavy metal (copper, nickel, silver, zinc, Cadmium, ferrous or ferric iron, or others), and x is the number of CN^- groups equal to the valence of A taken y times plus the valence of the heavy metal. The soluble complex cyanides dissociate into complex anions $M\ (CN)_x^-$ rather than the CN^-groups (e.g.):

$$AyM\ (CN)x \longleftrightarrow yA^{+(x)} + (M(CN)_x)^{-yw}$$

W is the oxidation state of A in the original molecule.

The complex anion can then undergo further dissociation releasing CN^-. The hydrolytic reaction of CN^- with water produces HCN. Subsequent behavior would then be the same as for HCN.

Although simple cyanides such as sodium cyanide and potassium cyanide readily dissociate and hydrolize to form CN^- and HCN, the metallocyanide complex anions have a wide range of stabilities. Zinc and Cadmium cyanide complexes dissociate rapidly and nearly completely in dilute solutions, whereas the stability of the copper and nickel metallocyanide anions are pH dependent. Cyanide complexes of iron dissociate very little, but they are subject to rapid and complete photo decomposition which results in release of CN^- in natural light.

The high toxicity of free cyanide is well documented (1, 2, 3, 8), and therefore the Regional Board staff can justify stringent requirements to control its discharge. By comparison, the toxicity of complex cyanides is relatively low. For this reason, on many occasions the dischargers ask the Regional Board staff to waive the requirements for complex cyanides (commonly referred to as total cyanide). The preceding discussion on the dissociation of complex cyanides to free cyanides, however, demonstrates the need for us to issue requirements for complex cyanides present in cyanidation process wastes.

In summary, cyanide in cyanidation process wastes is generally present as free cyanide, simple cyanides and complex cyanides. The simple cyanides and complex cyanides can dissociate to release free cyanide.

We must issue requirements to control discharge of free cyanide, because of its high toxicity, and for complex cyanides, because of their dissociation to free cyanide, to protect the environment.

B. **Environmental Fate of Cyanide**

Limited information is available on the fate of cyanide from cyanidation operations in the environment (soils, waters, tailing dumps, and others). Temperature, pH, sunlight, bacteria, organic and inorganic materials, types of soils, water chemistry, mineral make-up of tailings, permeability of soils, tailings type, and concentration and solubility of cyanide compounds, all have an effect on the ultimate fate of cyanide in the environment. For example, HCN can be removed from solution by volatilization. However, volatilization is generally influenced by pH, temperature, interface area, concentration, and agitation. Degree and rate of HCN volatilization, therefore, varies significantly from site to site.

Similarly, fate of complex cyanides in the cyanidation effluents and slurries varies vastly depending upon the conditions of the associated environment. According to Ford and Smith (14), about 28 elements can form complexes with cyanides to produce about 72 metallocyanide complexes; each exhibits a varying degree of persistence in the environment depending upon whether it is in a solid or an aqueous phase. In an aqueous phase pH, dissolved oxygen concentration, ultraviolet radiation, and availability of other complexing agents affect persistence and mobility. In the solid phase most complexes remain inert. However, complex cyanides in the solid phase can solublize readily as a function of the associated soil and water chemistry. Once in the aqueous phase, the complexed cyanides can migrate with relative ease (5). For example, ferro- and ferri-cyanide when present in the solid phase and shielded from ultraviolet light are stable and relatively nontoxic compounds. However, these anions can solublize and leach readily from their resident sites and reach surface waters (5). Subsequent irradiation by sunlight would result in the production of highly toxic free cyanide. Our staff, therefore, must issue stringent requirements for the soluble fraction of the complex cyanides present in the solid phase of cyanidation tailings.

Environmental concern regarding extremely reactive and toxic free cyanides is easily conceived. The so-called stable and relatively non-toxic complex cyanides should also be of major environmental concern because of their persistence and decomposition to free cyanides. Analytical chemist Pohland remarked, "Metal complexes, on the other hand, decompose slowly with simultaneous appearance of cyanide and cyanate ions. Therefore, pollution of the environment with the so-called `stable' cyanide complexes must be avoided." (6).

Frequently, dischargers ask the Regional Board staff to relax or waive the requirements for cyanide in cyanidation process wastes. They cite natural attenuation as mechanism for elimination of cyanide in the tailings. Natural rate and extent of cyanide attenuation, as described in the preceding discussion, greatly depends on the nature of cyanide compounds present in the cyanidation process waste, type of waste, and the associated environment. For example, if a relatively clear, barren solution containing mostly free cyanide is discharged to a shallow lined pond with provisions for aeration, the free cyanide present will likely degrade to background levels over a period of time. If, however, tailing slurry from a cyanidation process containing a mixture of free, simple and complex cyanides is discharged to an unlined disposal area, the solution contained in the slurry and/or the precipitation percolating through the tailings can, with time, actually end up with higher cyanide concentrations than initially present in the slurry and consequently contaminate ground and surface waters. Such an incidence exists at Noranda Grey Eagle Mine in Region 1. (Personal communication with David Evans, WRCE, Region 1.) The Regional Board staff, therefore, should require accurate knowledge of the fate of cyanide under site specific conditions before making the requirements less stringent than those proposed later in this report.

C. Toxicity of Cyanide

Free cyanide is extremely toxic to most living organisms. The EPA has established 3.5 ug/l (.0035 mg/l) as the ambient water quality criteria for free cyanide to protect aquatic life (1, 8). The U.S. Public Health Service (PHS) has established 0.2 mg CN /l as the acceptable criteria for drinking water supplies (7). In addition to the 0.2 mg CN /l criteria for free cyanide, the PHS set forth an objective to achieve concentrations below 0.01 mg/l in water because proper treatment will reduce cyanide levels to 0.01 mg/l or less (7). The EPA intends to propose 0.154 mg/l as the Human Health Advisory Criteria for free cyanide. (Personal communication with EPA staff, Washington, D.C.).

The toxicity of most complex cyanides to aquatic and terrestrial organisms was considered solely because of the presence of free cyanide derived from ionization, dissociation, and photo decomposition of these cyanide containing compounds. Review of more recent research (4) demonstrates that the so-called non-toxic complex cyanides such as ferri- and ferro-cyanides may also be toxic in the undissociated forms. The 96 hour LC_{50} for Rainbow trout appears to be around 10.0 mg Tot. CN/l. Similarly, recent studies demonstrate that thiocyanate is significantly more toxic to aquatic life than previously suggested (4, 15).

Toxicity of simple and complex cyanides, therefore, is likely because of both the undissociated compounds and their potential to produce free cyanide in the environment. The Regional Board staff, when issuing requirements for complex cyanides, should consider both forms of complex cyanide toxicities.

D. Analytical Methods of Cyanide Determination

The analytical procedures for quantitative determination of cyanide concentrations in liquids, solids, and slurries are currently in a state of flux. The need to determine cyanide species in a wide variety of matrices has resulted in the development of a profusion of methods that are frequently complex and cumbersome to use on a routine and standard basis. Random modifications of analytical procedures has led to mass confusion in interpretation of various test results. Regional Board staff are frequently at a loss to properly identify the cyanide species (free, simple, complex) represented in various studies because of the ambiguities in the analytical procedures used. Obviously, we need to standardize analytical procedures for quantitative determinations of cyanide concentration in cyanidation process wastes.

From an analytical viewpoint, I will describe four methods of cyanide quantification. These are: (1) total cyanide; (2) weak acid dissociable cyanide; (3) cyanide amenable to chlorination; and (4) free cyanide.

- Total cyanide is defined as the amount measured by the reflux mineral acid distillation method and includes complex cyanides, simple cyanides, and free cyanide (gold, cobalt, and platinum complexes are excluded). The most common methodology used for total cyanide determination is an acid reflux/distillation in which a catalytic agent is used to facilitate breakdown of metal cyanide complexes. Hydrogen cyanide liberated by the distillation is collected in an alkaline absorbing solution and is measured depending upon the desired lower limit of detection, by either titration, colorimetry, or specific ion electrodes. Standard Methods 412B (9) and ASTM Method 81 A (10) are applicable to the direct determination of total cyanide in both wastewater and solid waste. Interference by thiocyanate and reduced sulfur compounds and reduced recoveries of noble metal compelxes in the above methods can be alleviated by minor modifications (2). Several investigators (11) have cited difficulties in obtaining representative 0.5 gms solid waste samples required for direct determination of total cyanide in solids by the two methods. This difficulty is easily overcome by increasing the solid waste samples to up to 5 gms (12).

- Weak acid dissociable (WAD) cyanides include free cyanide and free cyanide readily released from simple and complex cyanides under slightly acidic (Ph 4.5) conditions. The method which is now accepted by ASTM as a standard procedure for WAD cyanides is referred to as Method C (10). Method C distillation is carried out with the same equipment and in the same manner as Method A for total cyanide but using acetic acid-sodium acetate solution buffered at pH 4.5 and zinc acetate. Method C recovers cyanides complexed with sodium, potassium, Cadmium, copper, nickel, silver, and zinc. Cyanide is not recovered from ferro, ferri, and cobalt complexes. Thiocyanate interferences do not occur with this method.

- Cyanide amendable to chlorination (CAC) analysis method is based on the difference between total cyanide determination in a sample both before and after chlorination. One portion of the sample is analyzed by ASTM Method A or Standard Method 412B for total cyanide. Another portion is treated with sodium hypochlorite at an alkaline pH for one hour. The chlorine residual is removed and the solution is analyzed by the total cyanide procedure. The alkaline chlorination oxidizes (destroys) all cyanides except the iron complexes. The differences between the two values is reported as CAC.

As compared with WAD cyanide, CAC has two drawbacks: CAC measurements require two sets of analysis; and thiocyanate interferences occur.

- Free cyanide can be determined by either solvent extraction or sparging the HCN from solution and collecting it for later determination. Numerous other methods, primarily research procedures, of measuring free cyanides have also been proposed. They are not applicable or have not been tested for use in monitoring cyanidation mine effluents.

E. Methods of Cyanide Destruction

Numerous treatments (13) are available for cyanide removal from cyanidation process wastes. Of those, three methods are the more commercially important treatment processes. These are 1) natural degradation; 2) alkaline chlorination; and 3) Inco process. I will present a brief discussion of these three methods:

- Natural degradation (lagooning) processes are supposed to detoxify cyanides present in cyanidation process wastes to acceptable levels. Existing practice is to direct the cyanide-containing wastes to a tailings disposal area and let nature take its course. If the disposal area has an adequate retention time, the operation of natural environmental forces can effect some reduction in the cyanide concentration. Environmental forces producing natural degradation are photo decomposition by sunlight, acidification by carbon dioxide in the air, oxidation by oxygen in the air, dilution, and in case of long retention times, biological action. The rate and magnitude of cyanide reduction, as mentioned earlier in the discussion on environmental fate of cyanide, is a function of cyanide species present in the cyanidation process waste, nature of waste, and the associated environment. The half-life of cyanide species present in the waste can vary immensely. Natural degradation in most cases is effective only as pre-treatment to reduce treatment chemical consumption and is generally not sufficient in itself to prevent environment pollution by cyanide.

- Alkaline chlorination is effective in reducing WAD cyanides in barren solutions to 0.05 mg CN/l. The destruction of cyanide can be accomplished by means of chlorine gas, calcium hypochlorite, or sodium hypochlorite. Chlorination is not effective in decomposition of hexacyanoferrates and requires careful control of pH to prevent formulation of highly toxic cyanogen chloride. Another disadvantage of this process is the possibility of forming toxic chlorinated organic compounds. Also, residual excess chlorine can be toxic to aquatic organisms.

o Inco process of cyanide destruction was recently developed by the International Nickel Company of Canada. It is effective in oxidative destruction of cyanide in effluents and slurries (3). It is simple, rapid, effective and relatively inexpensive. Inco's SO_2/air technology is able to remove cyanide in both free and complex forms (including $(Fe(CN)_6{}^{-4})$ to levels around 1 mg/l as CN total, 0.5 mg/l as CN WAD and 0.1 mg/l as CN free. The process works in a continuous mode on either clear water or slurries (commercially successful up to 55% tailings). Removal of the soluble cyanide occurs by two routes, namely;

Oxidation: CN^- (free) $+ SO_2 + O_2 + H_2O \quad CNO^- + H_2SO_4$
CN^- (complexed) $+ SO_2 + O_2 + H_2O \quad CNO + H_2SO_4$

Precipitation: $Fe\ (NC)_6{}^{-4} + 2Cu^+ \quad Cu_2Fe(CN)_6$

Acid produced during CN^- oxidation is neutralized to maintain pH in the operation preferred range of 8-9. Under these conditions, metal ions released by the CN complex are precipitated as hydroxides, i.e., $Ni(OH)_2$, $Cu(OH)_2$, $Zn(OH)_2$, etc. A small amount of Cu may be required to catalize the CN removal. The Inco process removes soluble $Fe\ (CN)_6{}^{-4}$ from the liquid phase and puts it into a very insoluble form, $CuFe(CN)_6$ or $ZnFe(CN)_6$. Inco's solubility data on these compounds indicate that at $pH < 9$ the equilibrium solubility is 0.5 mg/l as CN total. Thus for any given contact with water at $pH < 9$, no more than 0.5 mg/l CN total (assuming extraction of 1 kg heap tailings into 5 kg H_2O) would be extracted from the solid at one time, which if assuming a 10 fold dilution to receiving waters, would result in maximum CN total concentration of 0.05 mg/l.

The advantage of the Inco SO_2 - air method for cyanide removal appears not only in the superior quality of its effluent, but also in the economy when compared with other possible methods such as chlorination or hydrogen peroxide. For example, for a typical gold mill treating 1000 MT ore/day using two pounds NaCN/tonne ore, the cost (chemical and royalty to Inco Corp.) to destroy cyanide by Inco process would be about $0.55/MT ore if SO_2 is used and $1.68/MT ore is $Na_2S_2O_5$ is used. By comparison, alkaline chlorination on the same waste material could cost $1.92/MT ore, and hydrogen peroxide would cost about $4.14/MT ore.

DISCHARGE SPECIFICATIONS

The preceding discussion on cyanide in cyanidation process wastes warrants that the Regional Board staff should issue waste discharge requirements on both the liquid and the solid fractions of the waste. The requirements for the cyanide in liquid fraction are warranted because that cyanide can easily migrate to ground and surface waters. The requirements for the cyanide in solid fraction are needed because the solid material may be washed into surface waters, where its cyanide content can solublize to contaminate the receiving waters, and also because its cyanide content can be leached by precipitation and subsequently carried to ground and surface waters.

Our staff should issue requirements to regulate both the free cyanide and total cyanide contents of liquid and solid fractions of the process wastes. They should regulate the free cyanide content because free cyanide is extremely toxic to aquatic and terrestrial life forms. The staff should regulate total cyanide content because the complex cyanides are toxic in the complex form and may release highly toxic free cyanide in the environment. Also, they should issue requirements to regulate the soluble fraction of the total cyanide present in the solid waste because the soluble fraction is easily leached from the solids and may subsequently contaminate ground and surface waters.

I recommend that the staff should require ASTM Method C (WAD) for the determination of free cyanide because it is less cumbersome to perform than CAC method, and it is not plagued by interferences. Also, Method C most closely represents the methodologies used by EPA and PHS to set free cyanide criteria for protection of aquatic life and drinking water supplies.

For total cyanide determination, I recommend the use of ASTM Method A because at present it is the most widely used method, and it lends itself to simple modifications for elimination of known interferences. Further, for total cyanide determinations in solid waste, I recommend direct digestion of solids because most extraction procedures used to extract total cyanide from solids are not fully effective. The problem in obtaining representative 0.5 gram solid samples for direct digestion can be overcome by increasing sample size to up to 5 grams.

Our staff should allow minor modifications of the ASTM Methods if the modifications are essential to eliminate known interferences and analytical problems because of some unique property of the process waste. The staff, however, should carefully review the proposed modifications to assure that the changes do not alter the integrity of the standard procedures.

For extraction of the soluble fraction of total cyanide content in the solid fraction of slurries, I suggest the following procedure:

1. Sample slurry to get at least 1 L.

2. Filter and wash solids with distilled water.

   (a) first wash with 300 ml, letting all water go through;
   (b) second wash with 300 ml.

3. Take 590 grams of wet cake (this will contain about 500 grams of dry tailings) and put into 2.5 L distilled water; adjust to pH 5 with H_2SO_4.

4. Stir mildly for 24h at room temperature in an air-tight capped container.

5. Filter entire slurry from step 4 tnorugh No. 42 Whatman paper and analyze an aliquot of the filtrate for CN (total).

6. To calculate soluble mg CN/kg solids =

$$\text{mg CN/kg} = \frac{(\text{mg/L CNT in filtrate}) \times 2.5}{0.5}$$

For extraction of the soluble fraction of total cyanide content in the heap leach solid waste omit Steps 1 and 2. Instead, put 500 grams of tailings in 2.5 L distilled water and adjust to pH 5 with H_2SO_4. Then follow Steps 4 through 6.

For extraction of WAD cyanide content in the heap leach process solid waste (tailings), I susggest the following procedure:

1. Take 500 grams of tailings and put into 2.5 L deionized water at neutral pH in an air-tight capped container. Select the container size to minimize head space.

2. Stir mildly for 24 hours at room temperature.

3. Filter entire slurry from Step 2 through No. 42 Whatman paper and immediately analyze an aliquat for CN (WAD).

4. Calculate soluble WAD cyanide as in Step 6 above.

I propose that the cyanide in both the solid and liquid fractions of the cyanidation process wastes should be detoxified prior to discharge to the tailings impoundment. Our staff should disapprove proposals by dischargers to make allowances for natural degradation of cyanide in the impoundment area following discharge as a means of achieving the requirement values, until the dischargers provide both the site specific half-lives of all cyanide species present in the tailings and methods of containing the tailings in the impoundment until cyanide in both the liquid and solid fractions reach the required values.

The cyanide in the process wastes should be considered detoxified if the following limits are met:

Process Waste Fraction	Parameter	Value 1/
Liquid (Barren solution effluent or the liquid fraction of slurries)	i) Total Cyanide	1.0 mg/l
	ii) WAD Cyanide	0.5 mg/l
Solid (Heap leach process tailings or solid fraction of slurries)	i) Soluble WAD 2/ Cyanide	0.5 mg/kg
	ii) Soluble Total Cyanide	2.5 mg/kg
	iii) Total Cyanide After Extraction of Soluble WAD and Total Cyanide	10.0 mg/kg

I propose the above values because they are attainable for most cyanidation process wastes using the best available technology economically attainable (BATEA) for cyanide removal and will best protect the beneficial uses of the Region's ground and surface waters from degradation by cyanide discharges.

We should make the above requirements less stringent only when the dischargers demonstrate by actual test results that such values are impossible to attain using BATEA for cyanide removal because of certain site specific characteristics of the ore and that the elevated values will not affect the beneficial uses of ground and surface water in the discharge influence zone.

1/ Arithmatic mean of laboratory results for samples collected in a period of 15 consecutive days.

2/ Not required for slurries.

1) 'Ambient Water Quality Criteria for Cyanide - 1984'. EPA 440/5-84-028, January 1985. U.S. Environmental Protection Agency, Washington, D.C.

2) 'Cyanide and the Environment'. Proceedings of a conference, Tuscon, Arizona. December, 1984. Volume 1, II.

3) 'Cyanide From Mineral Processing'. Proceedings of a workshop, Salt Lake City, Utah. February 2-3, 1982.

4) Hemig, T.A., and Robert V. Thurston, 1984. 'Physiological and Toxic Effects of Cyanides to Fishes: A Review and Recent Advances.' Conference on Cyanide and the Environment. Tuscon, Arizona. December, 1984.

5) Fuller, W. M. 1978. 'Investigation of Landfill Pollution Attenuation by Soils'. EPA/600/2-78/158. U.S. Environmental Protection Agency, Washington, D.C.

6) Pohlandt, C. 1984. 'The Determination of Cyanides in the Hydrometallurgical Processing of Gold'. Conference on Cyanide and the Environment. Tuscon, Arizona. December, 1984.

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8) 'Ambient Water Quality Criteria for Cyanides'. EPA 440/5-80-037. October 1980. U.S. Environmental Protection Agency.

9) 'Standard Methods for the Examination of Water and Wastewater.' 16th Edition, 1986. PAHA, AWWA, WPCF.

10) 'Standard Test Methods for Cyanides in Water'. ASTM D 2036-81. American Society for Testing and Materials. Philadelphia, PA.

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13) Ingles, J. C., and J. S. Scott. 1981. 'Overview of Cyanide Treatment Methods'. Cyanide in Gold Mining Seminar, Ottawa, Ontario. January, 1981.

14) Ford-Smith, H. M. 1964. 'The Chemistry of Complex Cyanides: A Literature Survey'. London, Her Majesty's Stationary Office.

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#3

AN OVERVIEW OF GOLD MILL EFFLUENT TREATMENT

J.S. Scott

INTRODUCTION

Canada ranks third among the gold producers of the world and obviously, in the words of Robert Service "moiling for gold" is of considerable importance to this country. In Canada, over 80% of the gold is recovered by the process of cyanidation and an unavoidable consequence is the concomitant production of wastes, both liquid and solid. The liquid wastes from these gold mills contain substantial quantities of toxic substances, particularly cyanide and metals, and as a result require careful management before release to the environment.

The historical, but often inadequate method of treating gold mill effluents has been by natural means (natural degradation) in tailings ponds. However, since 1981 there has been not only a great improvement in the understanding of natural systems but there has also been a strong move in Canada to the development and use of chemically-based treatment systems to ensure the discharge of effluents that meet regulatory requirements. A number of different cyanide removal processes are in place in this country and elsewhere. What has been accomplished in so few years is exciting, to the extent that 46 percent of the 50 Canadian gold mills recovering gold by cyanidation, operate chemical treatment systems. The purpose of this paper is to describe the methods currently in place to treat gold mill effluents.

As a number of effective treatment methods are now available, the selection of a process for a specific mill requires careful consideration of: the nature of the effluent to be treated, the capabilities and costs of the alternative treatment methods and the effluent quality requirements imposed by government regulators.

CANADIAN GOLD MINING INDUSTRY

The value of gold production in Canada now tops that of any other metal mined domestically. In 1988, Canadian mines produced 4,106,959 troy ounces of gold valued at 2.22 billion dollars Canadian. Over 80% of this production resulted from mining lode gold deposits, as opposed to placer gold or as a by-product from base metal mining. At the end of 1988 there were 65 gold mills in Canada processing approximately 55,000 tonnes ore/day, some receiving feed from more than one mine. Fifty of these mills used the cyanidation process.

Ore grades ranged from 0.10-0.75 ounces gold/tonne, averaging about 0.25 ounces/tonne. The cost of production per ounce varied considerably, but averaged about $300.00 Canadian. The only provinces or territories void of gold mines are Alberta and Prince Edward Island. Several new gold mines came on stream in 1988 and at least 10 are expected to begin production in 1989.

CONTAMINANTS IN GOLD MILL EFFLUENTS

Gold mills employ a combination of cyanidation and either the Merrill-Crowe (MC) or the Carbon-in-Pulp (CIP) processes for the recovery of gold. In every case gold is first dissolved from its ore by a dilute alkaline cyanide solution according to the following reaction:

$$4Au + 8NaCN + O_2 + 2H_2O \longrightarrow 4NaAu(CN)_2 + 4NaOH$$

The solubilized gold is recovered from clarified solution by precipitation with zinc dust in the Merrill-Crowe process or by absorption directly from leach slurry on activated carbon granules in the CIP process. In the Merrill-Crowe process two cyanide containing waste effluents exit the mill, waste barren solution and washed and repulped leach solids. Whereas, in the CIP process only a single waste stream, the CIP tailings slurry, is discharged from the mill. Another significant difference between these two processes from the point of cyanide release is that in the former considerable barren solution is recirculated to cyanidation to take advantage of its remaining leaching potential, whereas no recirculation takes place in the latter.

Since cyanide is a powerful solvent, but one that is non-selective for gold, a host of objectionable substances simultaneously enter solution in substantial amounts during cyanidation, depending primarily on the mineralogy of the ore treated. These substances appear in waste discharges from mills and are of considerable concern because most are damaging to the environment. As cyanide, both free and complexed, is present in the greatest quantity and is extremely toxic, it is of greatest concern. The metals, copper, iron, nickel and zinc are commonly present as cyanide-metal complexes. Arsenic is often encountered and less commonly antimony and molybdenum, which occur in the Hemlo area gold ores. Thiocyanate (CNS), cyanate (CNO) and ammonia are also frequently present in gold mill effluents. Thiosulphate (S_2O_3) is seldom analyzed for, but it is known to be present in elevated concentrations in effluents from some mills.

The wide range of constituents measured in waste barren solutions is shown in Table 1.

TABLE 1 ANALYSES OF WASTE BARREN SOLUTIONS (MG/L)

CN	50 - 2000	Pb	0 - 0.1
CNS	42 - 1900	Mo	0 - 4.7
S_2O_3	- 856	Ni	0.3 - 35
As	0.0 - 115	Sb	0 - 93
Cu	0.1 - 300	Zn	13 - 740
Fe	0.1 - 100		

Gold mill effluents, unless treated, are extremely hazardous to fish because concentrations as low as 0.05 mg/L free cyanide (HCN and CN^-) are known to kill certain species of fish. Sub-lethal effects are exhibited at even lower concentrations. In many mill effluents the concentrations of other contaminants are also at levels which are acutely toxic to fish. Water quality criterion for cyanide is generally 5µg/L.

GOLD MILL EFFLUENT TREATMENT PROCESSES

Although, over the years numerous methods have been proposed and tested for the destruction or recovery of cyanide, most have not proven successful for treating gold mill effluents. A number of these processes have been described in an earlier Environment Canada report (1). Surprisingly though, a number have passed this test! The processes currently being applied at gold mills are listed in Table 2.

TABLE 2 CYANIDE REMOVAL METHODS AT GOLD MILLS

1. Natural degradation
2. Inco SO_2/air oxidation
3. Hydrogen peroxide oxidation
4. Golden Giant precipitation
5. Alkaline chlorination
6. Homestake biodegradation
7. Acidification-volatilization-regeneration (AVR)

The first 5 processes were applied in Canada in 1988. The biodegradation process is being used only by Homestake Mining at Lead, South Dakota and Golconda Mining operates a cyanide recovery plant, using the AVR process at its mine in Australia. Two additional processes, both developed by Canadian mining companies, i.e., the Con mine iron sulphide and the Noranda SO_2 processes were used until recently in Canada. Except for natural degradation and AVR in a few instances, these methods have all come into use at gold mills since 1981. Canada has been a forerunner in both the development and application of many of these treatment processes. What has been accomplished in only a few years has been challenging and indeed exciting. These processes are used to treat waste barren solutions, mill tailings slurries and ever more frequently tailing pond overflows.

There are no federal limits in Canada for cyanide in mill wastewaters. However, the provinces and territories have limits which are included in mine operating permits. Some examples of the limits for total cyanide (CN_T) and weak-acid dissociable cyanide (CN_{WAD}) for different jurisdictions are shown in Table 3. Weak-acid dissociable cyanide refers to that which is measured by a specific analytical method and includes free cyanide and cyanide-metal complexes less stable than iron cyanides. Total cyanide includes the above forms of cyanide plus iron cyanide.

TABLE 3 CYANIDE LIMITS IN EFFLUENTS (MG/L)

Mine	Location	CNT	CN_{WAD}
Mt. Skukum	Yukon	1.0	0.5
Lupin	NWT	1.0	0.1
Star Lake	Sask.	1.0	
McLelland	Man.	1.0	0.38
Dome	Ont.	2.0	
Kiena	Que.	1.5	0.1
Gordex	N.B.	1.0	
Hope Brook	Nfld.	1.0	0.1

In order to satisfy these requirements, depending on the quantity of cyanide released from a mill, removal efficiencies surpassing 99.9% are often required. Although a demanding target, it has proven to be an attainable one.

NATURAL DEGRADATION

Until only a few years ago natural degradation was the only method used for the treatment of gold mill effluents. Even today, though rapidly losing ground, this historic technique remains the most commonly employed method at Canadian gold mills. Natural degradation involves the removal of cyanide and associated cyanide-metal complexes by naturally occurring processes while mill wastewaters are being retained for extended periods of time in tailing ponds. Cyanide and its associated metal-complexes are removed by a combination of physical, chemical and biological processes which can include: pH depression (by CO_2 absoption from air), volatilization, chemical dissociation, photolysis, precipitation, chemical and biological oxidation, hydrolysis and adsorption. Of these processes, volatilization of hydrogen cyanide (HCN) and chemical dissociation of the cyanide-metal complexes have been shown to be the most important mechanisms in cyanide removal. Dissociation is usually the rate controlling step and is related to the respective stabilities of the cyanide complexes present. When iron cyanide is present, photolysis by ultra-violet radiation (sunlight) is essential for its dissociation. The rate at which natural degradation proceeds is influenced by a number of variables, including: cyanide species and concentrations in solution, species stabilities, pH, temperature, bacteria, sunlight, aeration, and pond conditions, such as, area, depth, turbidity, turbulence, ice cover and retention time.

The principal mechanisms involved in the natural degradation of cyanide are becoming much better understood. Recently staff at Environment Canada's Wastewater Technology Centre, in conjunction with Beak Consultants, have developed a user-friendly predictive mathematical model for a batch-operated natural degradation system. Work is continuing to develop a model for continuous flow-through systems. The model development work has been described in a number of papers (2,3,4). These predictive models will prove valuable in the understanding and designing of natural degradation systems. There is a definite place for such systems either in stand-alone or pre- or post-treatment situations.

Although cyanide removal by natural means is rapid during warmer months it is extremely slow or perhaps non-existent during the late fall and winter months. Consequently, it appears that a stand-alone natural degradation system requires a retention time of 9-10 months since the tailings pond must have the capacity to store water from October through to the following July or August. Advantage should be taken of maximizing tailings pond water recycle in order to reduce the need to store a large volume of mill effluent during the October to July period. Consequently a smaller tailings pond would be required.

Some excellent applications of natural degradation in either stand-alone or pre-treatment situations prior to chemical treatment exist and are described below.

At Echo Bay's Lupin Mine in the NWT only 80 kilometres south of the Arctic Circle, a highly successful natural degradation system is being operated, even though the open water season lasts only 3 months. The mine employs a

2 stage (2 pond) batch-type system. The first pond is continuously filled except when being emptied into the second pond. Most of the cyanide and its associated metals are removed in the first pond by natural degradation, whereas arsenic is removed in the second pond by the addition of ferric sulphate to the batch discharge from the first pond during August. The second pond is previously emptied to receiving waters in July.

A summary of the performance of Lupin's tailing pond system for the period 1985-1988 is given in mg/L Table 4(4).

TABLE 4 LUPIN MINE TAILINGS POND SYSTEM

	Mill Tailings (Solution) (1985-88)	#1 Pond Decant (1986-88)	Final Decant (1986-88)	% Reduction (1986-88)
CN_T	184	7.0	0.17	99.9
CN_{WAD}	138	-	0.04	99.9
As	4.7	1.5	0.29	93.8
Cu	5.0	2.1	0.15	97.0
Ni	0.4	0.2	0.05	87.5
Zn	20.0	1.1	0.11	99.4
pH	11.0	8.5	7.3	

All three gold mines in the Hemlo, Ontario area take considerable advantage of natural degradation by treating tailing pond decants in chemical treatment systems. In all three cases cyanide concentrations in the tailings pond waters increase substantially during the fall and winter months to be followed by rapid decreases in cyanide levels when spring ice break-up occurs. The trend in cyanide concentrations with time in the tailings pond decant waters is shown in Figure 1. Typical cyanide concentrations in the mill discharges to the tailings ponds are in the order of 40-80 mg/L. The three mines are on high water recycle rates from the tailings ponds.

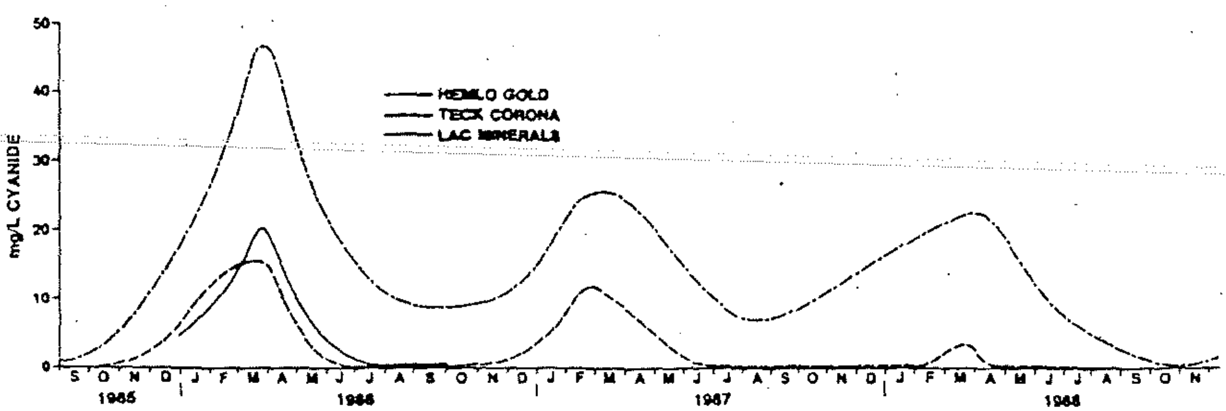

FIGURE 1 EFFECT OF NATURAL DEGRADATION ON CYANIDE IN TAILINGS PONDS

Teck Corona releases treated effluent all year around, whereas the other two mines do not discharge during the winter months. Although each mill has a plant to treat tailings pond overflow, as a result of natural degradation in the tailngs pond it is often unnecessary to operate the cyanide removal stage in order to meet Ontario's guidelines for cyanide of 2 mg/L.

At the Holt McDermott mine near Kirkland Lake, Ontario, an excellent step has been taken towards maximizing the benefits of natural degradation. At this mine the tailings impoundment system has been designed as 2 separate basins with the intention of operating both alternately in the batch mode. Each basin will receive mill discharge for 12 months and then be allowed to remain dormant for the following 9 months while water quality improves naturally to acceptable discharge values before water is released. It is surprising that it has taken this long for the advantage of a two-basin, batch operated tailings impoundment system to be recognized and installed.

CHEMICAL TREATMENT METHODS

In many cases it has not proven possible to depend on sufficient cyanide removal by natural means. Accordingly, a number of chemically-based treatment systems have been installed at Canadian and other gold mills during the past few years. In fact, of the 50 mills in Canada which recovered gold by cyanidation in 1988, 23 (46%) operated treatment plants to destroy cyanide. These plants and the treatment methods employed are listed in Table 5.

TABLE 5 CHEMICAL REMOVAL OF CYANIDE AT CANADIAN GOLD MILLS

Mine	Mill Process	Effluent Treated	CN Removal Process	Remarks
Equity Silver	CIL	MTS	SO_2/Air	
Golden Knight	CIL	MTS	SO_2/Air	
Ketza River	CIP	MTS	SO_2/Air	
Kiena	CIP	MTS	SO_2/Air	
Skyline	MC	MTS	SO_2/Air	
Muscocho	MC	WBS	SO_2/Air	
McLelland	MC	TPO	SO_2/Air	
Skukum Gold	MC	MTS	SO_2/Air	Mill Start-up March/89
Premier Gold	CIL	MTS	SO_2/Air	Mill Start-up April/89
Erg Res.	MC	TPO	SO_2/Air	Mill Start-up March/89
Hope Brook	CIP HEAP	MTS WBS	H_2O_2	
Gordex	HEAP	WBS	H_2O_2	
Mascot	MC	WBS	H_2O_2	
Puffy Lake	MC	WBS	H_2O_2	
Tartan Lake	MC	WBS	H_2O_2	
Con	MC	TPO	H_2O_2	
David Bell	CIP	TPO	H_2O_2	

Detour Lake	CIP	TPO	H_2O_2	
Doyon	CIP	TPO	H_2O_2	
Macassa	CIP	TPO	H_2O_2	H_2O_2 On-Line April/89
Page Williams	CIP	TPO	H_2O_2	
Golden Giant Giant	CIP	TPO	$CuSO_4/FeSO_4$	H_2O_2
Yellowknife	MC	TPO	Chlorination (1988)	H_2O_2 (1989)

MTS - Mill tailings slurry
WBS - Waste barren solution
TPO - Tailings pond overflow

A number of tables in this paper show typical treatment plant performances. These figures indicate the demonstrated capabilities of the various processes when carefully controlled. In some cases considerable divergence has been experienced, when close attention has not been paid to operating the processes, particularly when waste barren solution and tailings slurries are treated directly. Control of the processes would benefit greatly in these cases by the development of reliable on-line sensors of solution quality and automatic control systems.

INCO SO_2/AIR PROCESS

The Inco process for the detoxification of gold mill wastewaters employs a combination of SO_2 and air, typically 2-5% SO_2, in the presence of a copper catalyst. The process involves the oxidation of both free and metal-complexed cyanides (with the exception of iron cyanide) to cyanate at pH 8-10. Sulphur dioxide may be added in the forms of liquid SO_2, sodium bisulphite (Na_2SO_3), sodium metabisulphite ($Na_2S_2O_5$) or SO_2-containing roaster gases. Lime is used to maintain pH. The oxidation of cyanide may be represented by the reaction:

$$CN^- + SO_2 + O_2 + H_2O \longrightarrow CNO^- + H_2SO_4$$

Once free of cyanide, base metals, i.e., copper, nickel and zinc precipitate from solution as hydroxides. Iron cyanide is removed, not by oxidation, but as a copper (or zinc) ferrocyanide precipitate which forms according to the equation:

$$2\ Cu^{2+} + Fe(CN)_6{}^{4-} \longrightarrow Cu_2Fe(CN)_6$$

Copper plays a dual role in the process and must be present in sufficient amounts to act as both a catalyst for the reaction and as a precipitant for any ferrocyanide present.

The Inco process is currently, or within 2-3 months will be applied at 10 gold mills in Cánada (see Table 5). A schematic flowsheet of the most recent installation at Inco's Casa Berardi mine is shown in Figure 2. At this mill modified flotation cells are used for reactors.

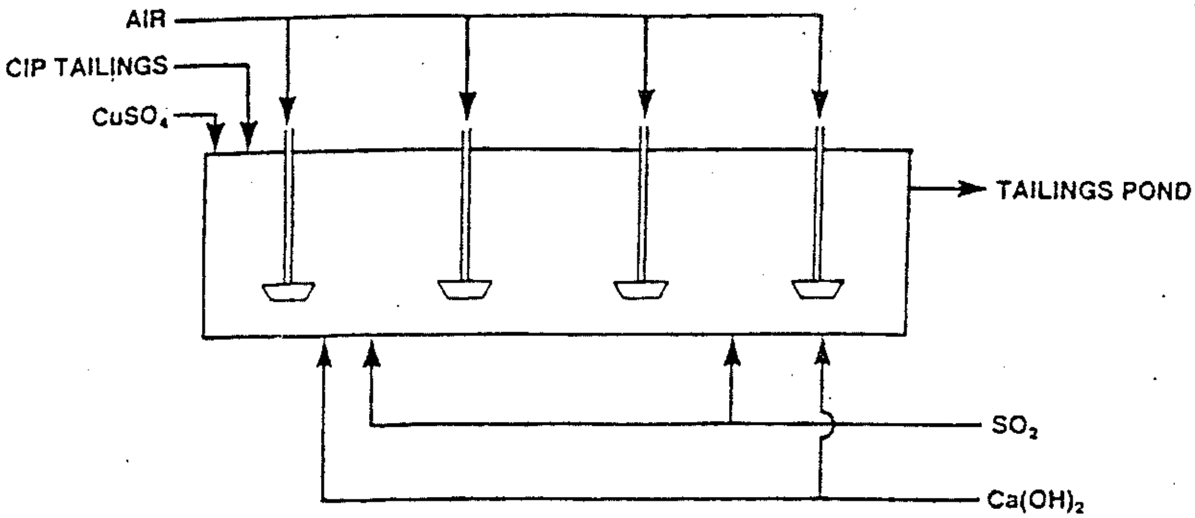

FIGURE 2 CASA BERARDI EFFLUENT TREATMENT SYSTEM

A summary of typical treatment performance at a number of mills using the Inco process is shown in Table 6.

TABLE 6 TYPICAL PERFORMANCE OF SO_2/AIR PROCESS

				Monthly Averages Analyses (mg/L)			Reagents (g/g CN)		
Mill	Stream		pH	CN_T	Cu	Fe	SO_2	Cu	Lime
McBean	Barren bleed	INF	11.5	370	30	20	4.0	0	4.0
		EFF	9.0	0.2	0.7	0.2			
Lynngold	Pond overflow	INF	8.7	100	10.0	2.0	6.0	0.1	8.0
		EFF	9.5	0.6	0.1	0.1			
Colloseum	CIP tails	INF	10.6	375	129	2.2	5.6	0.11	2.9
		EFF	8.7	0.4	1.5	0.2			
Equity Silver	CIP tails	INF	11.0	150	35	2.0	5.4	0.27	0.0
		EFF	9.0	1-5	2-5	0.2			

The target for CN_T in the effluent at Equity Silver is 5 mg/L since the effluent is totally recycled to the mill. The range of values shown are the averages of several months operation.

Reference can be made to numerous papers for further description of the Inco process and its applications (6,7,8).

HYDROGEN PEROXIDE PROCESS

The H_2O_2 process for detoxifying gold mill effluents has experienced remarkable growth since the first system was installed at the OK TEDI mine in Papua New Guinea in 1984 (9). Since that time 20 gold mills are either using the process or will be doing so within the next few months. Twelve of these mills are located in Canada (see Table 5).

Hydrogen peroxide, in the presence of a copper catalyst destroys free and metal-complexed cyanides (but not iron cyanide) by oxidation to cyanate (CNO^-) according to the equations shown below. The metals copper, nickel and zinc in the form of cyanide-metal complexes, once freed by oxidation of cyanide form hydroxide precipitates. Any excess H_2O_2 rapidly decomposes to water and oxygen.

$$CN^- + H_2O_2 \longrightarrow CNO^- + H_2O$$

$$Cu(CN)^{2-}{}_4 + 4H_2O_2 + 2OH^- \longrightarrow Cu(OH)_2 + 4CNO^- + 4H_2O$$

Since iron cyanide is too stable to be oxidized by H_2O_2 it is removed by complexing with copper to form a copper ferrocyanide ($Cu_2Fe(CN)_6$) precipitate, as in the Inco process.

The flowsheet to treat tailings pond overflow at the Con mill in Yellowknife is shown in Figure 3. Hydrogen peroxide does not remove arsenic so a second stage using ferric sulphate is required to precipitate arsenic.

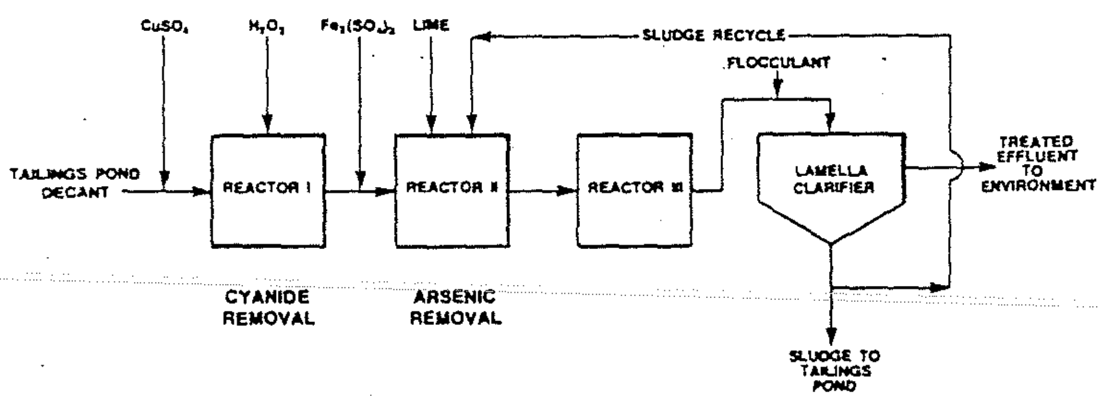

FIGURE 3 CON MINE EFFLUENT TREATMENT PLANT

The flowsheet for the more complex three-stage treatment system at t Hope Brook mine to treat barren solution from a heap leach operation is shown Figure 4. In this plant, following the addition of H_2O_2, sulphuric acid is added to lower the pH of the solution for iron cyanide precipitation. A Degus reagent called TMT 15, the trisodium salt of trimercaptotriazene, is added to complete the precipitation of copper.

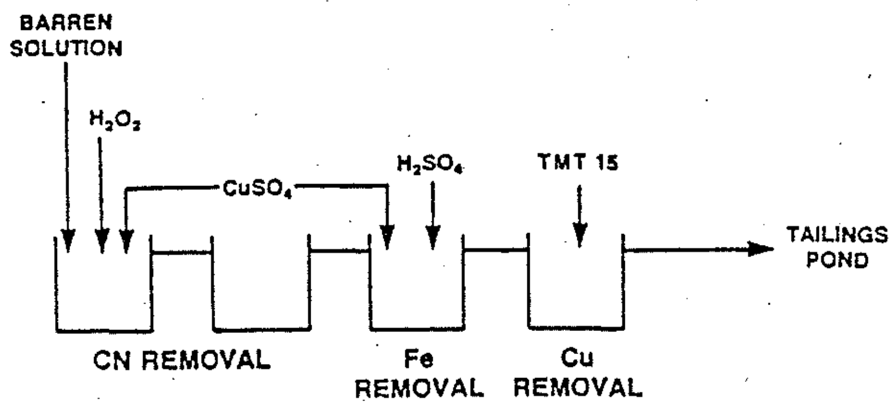

FIGURE 4 HOPE BROOK MINE EFFLUENT TREATMENT PLANT

Typical performance results at three mills using the H_2O_2 process are given in Table 7.

TABLE 7 TYPICAL PERFORMANCE OF H_2O_2 PROCESS

Mill Effluent		Analyses (mg/L) CN_T	As	Cu	Fe	Zn
Con Tailings	INF	3.0	21.0	3.1		
Pond O/F	EFF	0.28	0.33	0.15		
David Bell Tailings	INF	5.45	0.02	0.84	1.29	
Pond O/F(TeckCorona)	EFF	0.55	0.001	0.38	0.56	
Hope Brook Barren	INF	311		99.3	8.1	0.63
Solution	EFF	1.0		0.5	0.3	0.10

Numerous technical papers are available describing the application of the H_2O_2 process to gold mill effluents (10,11).

HEMLO GOLD PROCESS

Since commencing production in 1985 Hemlo Gold has tested a number of processes for treatment of tailings pond water at its Golden Giant Mine. These have included Noranda's patented SO_2 process and the H_2O_2 process. More recent testwork has led to the development and current utilization of a novel process for which Hemlo Gold applied for a patent in 1987. This new process consists of adding a premixed solution of $CuSO_4$ and $FeSO_4$ to the tailings pond decant (11).

The premixed solution is added at a controlled pH of 6-7, following which it is believed that ferrous ion is oxidized immediately to form ferric hydroxide and cupric ion is simultaneously reduced to cuprous, according to the following equation:

$$Cu^{2+} + Fe^{2+} + 3OH^- \longrightarrow Cu^+ + Fe(OH)_3$$

The resulting cuprous ion removes free cyanide as an insoluble cuprous cyanide precipitate. The removal of free cyanide results in the dissociation of copper, nickel and zinc cyanide complexes leading to the removal of further cyanide by cuprous ions. These reactions are represented by the following equations:

$$2\ Cu^+ + 2CN^- \longrightarrow Cu_2(CN)_2$$

$$Cu(CN)_4{}^{2-} \longrightarrow Cu^{2+} + 4CN^-$$

Ferrocyanide precipitates as cupric ferrocyanide by the reaction:

$$2Cu^{2+} + Fe(CN)_6{}^{4-} \longrightarrow Cu_2Fe(CN)_6$$

The heavy metals copper, nickel and zinc, and antimony and molybdenum are co-precipitated from solution with the ferric hydroxide formed upon addition of the $CuSO_4$-$FeSO_4$ solution. Lime is then added to increase the solution pH to 9.5 - 10 to ensure nickel precipitation. Although it is claimed that cyanide can be reduced to acceptable levels by addition of $CuSO_4$-$FeSO_4$ alone, it has been found more economical to finalize cyanide removal in an additional stage by the addition of H_2O_2 at pH 10.

The process flowsheet at the Golden Giant Mill is shown in Figure 5.

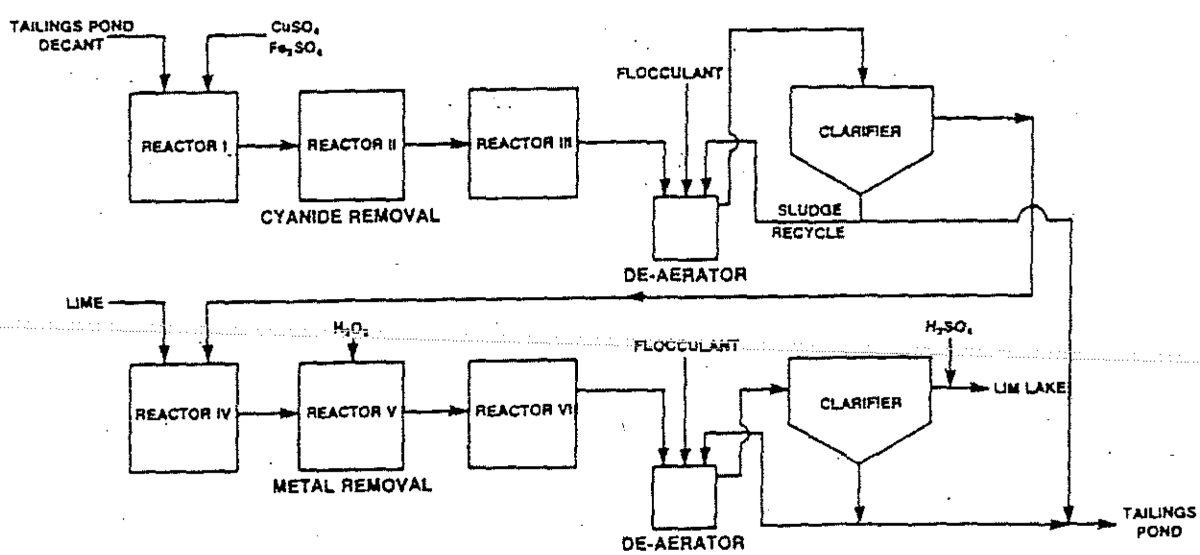

FIGURE 5 EFFLUENT TREATMENT FLOWSHEET AT GOLDEN GIANT MILL

Performance data for the Golden Giant treatment plant is given in Table 8.

TABLE 8 EFFLUENT TREATMENT PLANT AT GOLDEN GIANT MINE

	pH	CN_T	Cu	Fe	Ni	Sb	Mo	CNS
				Analyses (mg/L)				
Influent	9.10	23.20	4.10	5.20	4.80	7.70	1.20	44.40
Effluent	9.81	0.13	0.50	0.11	0.08	1.00	0.20	24.20
% Removal		99.9	87.8	97.9	98.3	87.0	83.3	45.5

A recently presented paper by Hemlo Gold staff (11) highlights several important measures, besides the new treatment process, taken at the Golden Giant mine to increase effluent treatment efficiency and reduce costs. Briefly these are:

- adjusting cyanidation parameters to reduce the dissolution of antimony.
- reducing cyanide additions from 0.95 to 0.36 kg/tonne ore.
- removing substantial amounts of contaminants from the influent to the treatment plant by routing this water through the grinding circuit prior to treatment.
- almost doubling the tailings pond surface area and reducing water depth so as to enhance the effectiveness of natural degradation.

These beneficial moves clearly reflect the management philosophy held by this company and is well captured in their words as: "finding an optimum solution (to water management) requires scrutiny of the conditions at hand with due consideration being given to all aspects of the operation" (12).

ALKALINE CHLORINATION

Alkaline chlorination was the first chemical process applied to the treatment of gold mill effluents in Canada. It had been used at a number of mines (e.g. Scottie, Baker, Carolin, Detour lake, Giant Yellowknife) but has almost fallen into disuse in favour of more effective and less costly methods. Giant Yellowknife, the last Canadian gold mine to use this process will switch to hydrogen peroxide this year. The chief disadvantages of alkaline chlorination are: the inability to remove iron cyanide, the cost and the occurrence of residual chlorine at concentrations toxic to fish, to name just three.

In this process both free and metal-complexed cyanides (except for iron cyanide) are oxidized to cyanate (CNO). Simplified process chemistry is illustrated by the following equations:

$$CN^- + Cl_2 + 2OH^- \longrightarrow CNO^- + 2Cl^- + H_2O$$

$$Zn(CN)_4{}^{2-} + 4Cl_2 + 2(OH)^- \longrightarrow 4CNO^- + 8Cl^- + Zn(OH)_2$$

In an extra stage with the further addition of chlorine and longer retention times it is possible to oxidize cyanate to nitrogen and bicarbonate. Chlorination is the only gold effluent treatment process currently applied in Canada that has this capability, but it has not been necessary to go to the second stage.

The flowsheet used at Giant Yellowknife is shown in Figure 6. Since alkaline chlorination does not remove arsenic, ferric sulphate is added to remove arsenic in the second stage of a two-stage process.

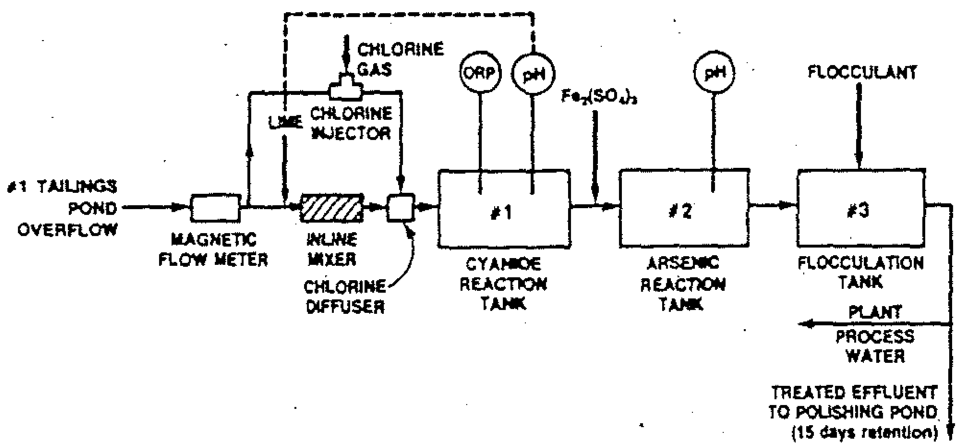

FIGURE 6 EFFLUENT TREATMENT PLANT AT GIANT YELLOWKNIFE MINE

Typical treatment performance data at this plant are given in Table 9.

TABLE 9 GIANT YELLOWKNIFE TREATMENT PLANT (1985)

	Analyses (mg/L)			
	Influent	Effluent	Pond O/F	% Removal
pH	8.5		7.6	
CN_T	7.5	1.3	0.15	98.0
As	12.1		0.14	98.8
Cu	6.7	0.09	0.03	99.6
Fe	0.1	0.1	0.1	
Ni	1.2	0.7	0.17	85.7
Zn	0.1	0.1	0.1	
NH_3			4.9	

The treatment plant at Giant Yellowknife has been described in detail in several papers and the reader is directed to these for further information (13,14).

HOMESTAKE BIODEGRADATION PROCESS

In 1984, Homestake Mining Company brought on stream a biological system for the treatment of its combined mine water and tailings pond decant at a cost of $10,000,000 U.S. (15). This combination of waters allows plant influent temperature to be held at 10-18°C year round, an important feature in maintaining reasonable process kinetics.

Homestake's biodegradation process is carried out in two stages, both of which employ rotating biological contactors. In the first stage cyanide and thiocyanate are removed by biological oxidation to carbon dioxide, sulphate and ammonia and metals are removed concurrently by adsorption by the bacteria. The second stage involves the bacterial nitrification of ammonia, first to nitrite and then to nitrate. The first stage uses indigenous microorganisms that are first acclimatized to increasing cyanide and thiocyanate levels and the second stage employs the usual <u>Nitrosomonas</u> and <u>Nitrobacter</u> bacteria. Metals absorbed by the biofilm of bacteria adhering to the revolving contactors are removed as the biofilm sloughs off. The sludge is removed in a clarifier and dual-media sand filters and disposed of with the mill tailings. The treated effluent is released to a nearby stream.

Forty-eight rotating biological contractors, with 12 foot diameter disks, are used, 24 in each stage, to contact the bacteria with the wastewater and air. Typical performance data for the plant are given in Table 11.

TABLE 11 TYPICAL HOMESTAKE TREATMENT PLANT PERFORMANCE

	Analyses (mg/L)	
	Influent	Effluent
CN_T	3.67	0.33
CN_{WAD}	2.30	0.05
CNS	61.5	0.50
Cu	0.56	0.04
NH_3-N	5.60	0.50

Perhaps the cold weather conditions that exist for a good part of the year has discouraged the use of the biodegradation process in Canada. There is indication that the process is not practical below 10° C.

CYANIDE RECOVERY PROCESSES

The aim of the cyanide removal processes is described so far has been to destroy cyanide. Considerable interest is currently being shown in a number of processes for the recovery of cyanide from gold mill effluents. This section briefly addresses some of these methods. The only plant operating at full scale to recover cyanide is in Tasmania and uses the process of acidification-volatilization-reneutralization (AVR). A second process based on ion-exchange combined with AVR has been tested at pilot plant scale. Interest has also been renewed in the electrolytic recovery of cyanide.

ACIDIFICATION- VOLATILIZATION-REGENERATION (AVR)

Although the Mills-Crowe AVR process is well-known, it has seen little application in many years, and possibly its use had been completely discontinued until only recently. Hydrogen cyanide (HCN) is extremely volatile and consequently can be readily stripped from solutions by air-sparging, particularly at low pH. The low pH is essential to promote the dissociation of cyanide-metal complexes to form HCN at practical rates. The AVR process consists of acidifying waste cyanide-bearing solutions or slurries to pH 2-3 with H_2SO_4, volatilizing the resulting HCN by intense air stripping and recovering the HCN by absorption in an alkaline solution, i.e., NaOH or $Ca(OH)_2$. The recovered HCN is recycled to the cyanidation circuit. Counter-current towers have been used for both HCN stripping and absorption. Some cyanide containing solids, i.e., CuCN, $Cu_2Fe(CN)_6$, remain in the acidified solution. Dissolved metals, i.e., Cu, Ni and Zn also remain in solution and are precipitated as hydroxides in a subsequent step by neutralization with lime.

The principal AVR reactions are shown by the equations:

Acidification $\quad Ca(CN)_2 + H_2SO_4 \longrightarrow CaSO_4 + 2HCN$

Absorption $\quad 2HCN + Ca(OH)_2 \longrightarrow Ca(CN)_2 + 2H_2O$

The AVR process was used by the Hudson Bay Mining and Smelting Company in Flin Flon from 1935 to 1978 to recover cyanide from waste barren solution (16). At that plant 91% of the "regenerable" cyanide was recovered. "Regenerable" cyanide was the amount of cyanide which could be released from the barren solution in a laboratory acidification test.

More recently AMOK Limited at their Cluff Lake mill treated 6,500 tonnes of uranium leach tailings for their gold content using the CIP process (17). An AVR system, operated in the batch mode, was used to recover cyanide from CIP tailings. The acidification step was done by adding H_2SO_4 to pH 3-4 in a vigourously air-agitated tank and the recovery of HCN was carried out in a counter-currently operated absorption tower. Over 90% removal of the cyanide from the CIP tailings slurry was reported.

Staff at CANMET have investigated the AVR process over the past few years. Initially they worked with the standard AVR process but found that air-stripping HCN from the total volume of waste barren solution was unduly expensive (18). Subsequently, their efforts have led to substantial modifications of the process whereby most of the HCN is recovered from acidified waste barren solution as $Ca(CN)_2$ by liming and only a small fraction of HCN needs to be recovered by the more costly air-stripping HCN absorption step (19). The process as demonstrated in the laboratory has been capable of producing final effluents containing less than 1 mg/L total cyanide and below 0.5 mg/L for each of the metals copper, iron, nickel and zinc.

Since 1985, Golconda Minerals has been recovering gold by cyanidation from mill tailings at its Beaconsfield mine in Tasmania. In February 1987, Golconda placed a plant in operation using the AVR process to treat 1200 tonnes/day of tailings pond water (20).

The treatment plant flowsheet is shown in Figure 7. At this plant tailings pond decant is acidified to pH 2-3 with H_2SO_4. The solids formed during acidification are separated by clarification and sand filtration before HCN is air-stripped from solution in counter-currently operated packed towers. Hydrogen cyanide is then absorbed in towers from the air stream in a 10% NaOH solution and the recovered NaCN is recirculated to cyanidation. The barren solution from the aeration columns is sent to carbon columns for the recovery of residual gold and then released. The carbon columns also reduce the residual level of cyanide in the water. Performance data for the treatment plant are presented in Table 10.

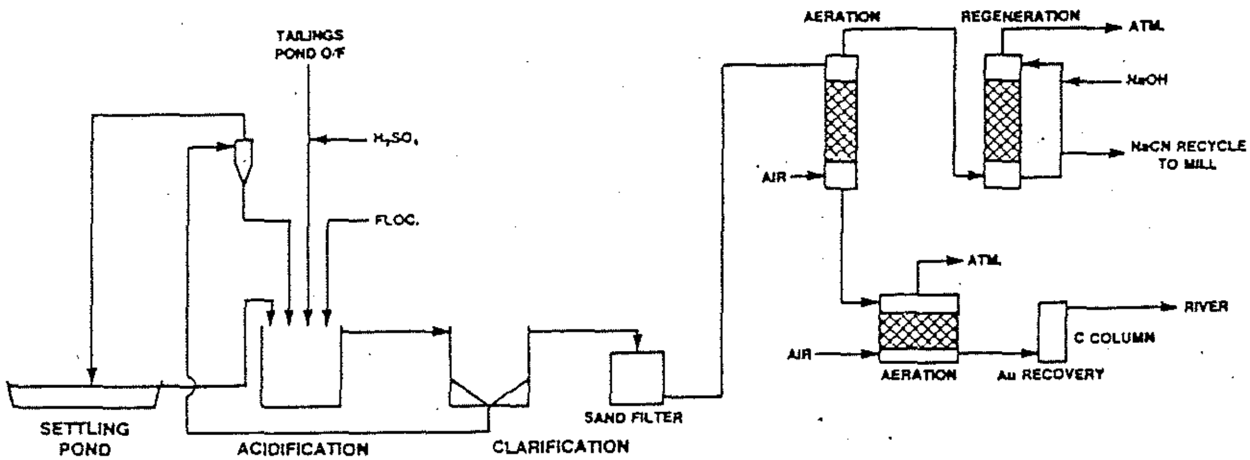

FIGURE 7 GOLCONDA CYANIDE REGENERATION PROCESS

TABLE 10 GOLCONDA TREATMENT PLANT DATA

	Analyses (mg/L)			
	Tailings Pond Decant	Clarified Solution	Aerator Discharge	C Column Discharge
CN_T	200	115	2 - 4	1 - 2
CN_F	10 - 30	110	0.2 - 0.5	0.1 - 0.3
Cu	200	< 1	< 1	< 1
Fe	50 - 100	< 1	< 1	< 1
Ni	1 - 2	< 1	< 1	< 1
Zn	5 - 30	< 1	< 1	< 1
Au	0.08	0.08	0.08	0.01

As an aside from cyanide recovery, but still critical to the efficient operation of the overall process at Beaconsfield is the clarification step following solution acidification. Upon the addition of H_2SO_4, fine and gelatinous precipitates form which are difficult to remove from solution by standard methods. To cope with this problem Golconda has developed an "Inert Particulate Collector Process (IPC)" for which it holds world-wide patent applications. In this process large chemically inert particles are used to collect, with the aid of flocculants, the difficult to settle fine or near colloidal metal-cyanide precipitates. Cyclone separators are used to recycle the inert particles and the fines report in the cyclone overflow and exit the process via a settling pond.

ION EXCHANGE PROCESS

Interest has recently been shown in the recovery of cyanide from gold mill wastewaters by a combination of ion-exchange (IX) and the AVR process. One such process was patented in 1987 by Resource Technology Associates (RTA) of Boulder, Colorado (21). The RTA cyanide regeneration process consists of an ion-exchange step to remove metal-cyanide complexes from barren solution using a weak-base anion exchange resin (typically tertiary amine), concentrating the cyanide by eluting with a calcium hydroxide solution, followed by cyanide volatilization and recovery by the AVR process. In order to remove free cyanide in solution by the ion-exchange resin the cyanide must first be complexed by the addition of copper. The RTA process has been tested at pilot plant scale only.

A second process combining IX-AVR, similar in many respects to the one described above was being marketed by a Canadian company called CY-TECH. In this process metal-cyanide complexes were adsorbed on a strong-base resin. The resin once loaded was eluted with a dilute solution of H_2SO_4. The eluate from ion-exchange was sent to a standard AVR process. CY-TECH piloted the process but the company no longer appears to be actively marketing its system.

ELECTROLYTIC RECOVERY

Orocon, a Canadian company is currently testing an electrolytic process at pilot scale for the recovery of cyanide and metals from gold mill effluents (22).

CONCLUSIONS

Effluents discharged from gold mills using the cyanidation process contain toxic levels of cyanide, metals and often other substances, and consequently, require treatment before release to the environment.

Effluents frequently contain significant amounts of oxidizable substances other than cyanide, i.e., metals in their lower oxidation states, thiosulphate (S_2O_3), and thiocyanate (CNS) that often go unnoticed but which, in oxidation based treatment systems, i.e., chlorine, hydrogen peroxide and sulphur-dioxide, are responsible for higher than expected reagent consumptions.

Natural degradation still continues to be the most common stand-alone method practiced for the treatment of gold mill waste effluents, though rapidly losing ground to chemical processes for this purpose. Its use as a post or pre-treatment system will remain high.

Where natural degradation is to be used as stand-alone treatment year round, the system must have a minimum wastewater retention capacity of 9-10 months.

Predictive mathematical models which are in place for batch operated natural degradation systems, and will be developed soon for continuous flow-through systems, should provide a welcome and reliable guide to treatment system design and performance.

The treatment of gold mill effluents by chemical methods began in 1981 in Canada, except for one much earlier exception, and currently 46% of the mills employing cyanidation use one four available chemical treatment methods. Two other methods, not used in Canada but known to be practiced elsewhere, are Homestake Mining's biodegradation process and Golconda's cyanide regeneration process.

The most commonly used chemical treatment processes in Canada are hydrogen peroxide and the Inco SO_2-air. Alkaline chlorination, the first cyanide removal process employed extensively in Canada has been completely replaced by more effective and less costly methods.

Although a variety of effluents including waste barren solutions, mill tailings slurries and tailings pond decants are being treated, there is a trend towards the treatment of tailing pond decants.

In many cases the effluent treatment processes are required to provide 99.9% or greater cyanide removal capabilities and have been able to achieve this.

The removal of copper from gold mill effluents sometimes poses a more serious problem than that of cyanide removal and greater knowledge of the forms in which copper persists in solution is essential to employing more satisfactory methods for its removal.

The extent of the problem created by ammonia in final effluents, methods to both minimize the amount of ammonia entering solutions and to best remove ammonia, if necessary, have yet to be determined, except in the case of Homestake Mining's biodegradation system.

Toxicity of effluents to fish are rarely measured and, consequently, there is still much to learn about the capabilities of the treatment processes to produce effluents which are non-toxic to fish, again with the exception of the Homestake process.

Renewed interest is being shown in the recovery of cyanide from gold mill effluents by the processes of: acidification-volatilization-regeneration, ion-exchange and electrolysis.

Arsenic and antimony when present in gold mill effluents are commonly removed subsequent to cyanide removal by the addition of an iron salt, e.g. ferric sulphate or chloride.

Close supervision must be given to the chemical treatment of gold mill effluents, particularly where waste barren solutions and mill tailings slurries are treated directly. In these instances, process control would benefit immeasurably from the development of reliable on-line sensors and automatic controllers.

Reliable design of site-specific treatment systems requires both careful laboratory, and preferably pilot-plant testing, of representative effluents and system design by experts well-qualified in this field.

Finally, a number of alternative methods are currently available for the treatment of gold mill effluents and the selection of the one most appropriate for a specific mill requires careful consideration: of the nature of the effluent to be treated, the capabilities and costs of the alternative treatment processes and the regulatory limits to be met by the company.

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CHEMICAL PROCESS MINING RULES

LINER SYSTEMS

Many environmental problems have occurred as a result of ineffective liner systems at chemical process mines. Since Oregon's future environment depends on EQC's choice of liner systems, the effectiveness of the chosen liner system is critical. This liner system will be required to protect not only our present environment but also our future environment for hundreds of years. In choosing a liner system, consideration must be given to the following:

1. "Puncturing of the primary liner is the most prevalent problem that occurs on heap leach pads", *TRC Final Report*, page 32.

2. "damage may also result from overstressing the liner with excessive heights of ore", *TRC Final Report*, Page 32.

3. "All liners leak. There's no way you can avoid it. That's why you have a leak detection system." Bruce Humphries, Supervisor, Colorado Mined Land Reclamation Division, *Chronicle* (Omak, WA), June 3, 1992

4. "You cannot build something that will not leak", Andre Duchane, Vice President, Battle Mountain's North American Operation, *Chronicle* (Omak, WA), June 3, 1992

5. "Even a quality installation of a geosynthetic liner will in almost every case result in some occurrence of defects, however minor." *TRC Final Draft*, Page 35.

A review of the preceding comments from industry experts reveals that the OAR 340 Triple-Liner System is the only proposal which will meet EQC's policy objective "that a liner, leak detection and collection system are necessary to assure that any leak will be detected before toxic materials escape from the liner system and are released to the environment." If experts agree that the primary liner will leak, then the secondary protection system must incorporate all forms of safety redundancy in order to back up any failures the primary liner may possess. We should anticipate and build for every eventuality. Protection devices always should be stronger than the entity they are designed to protect.

Since OMC's Proposed Double Liner System obviously fails to meet EQC's policy (emphasized by TRC), it will likely not be discussed as a viable system. However, TRC's Proposed Alternate Candidate Liner System potentially will be discussed regarding the reasons it will not meet EQC's policy statement.

TRC's Proposed Alternate Candidate Liner System places its entire emphasis on the upper system components...namely the primary liner. There is essentially no protection provided for the environment below the leak detection system. Therefore, if a leak is detected, there will only be 12 inches of clay for safety. (It should be noted that the clay base should not be considered a liner, but classified as to the degree of safety it provides...the thicker the clay, the greater the degree of protection). Since "all liners leak", it is essential that the clay safety factor be maximized. In fact, TRC, when discussing the OAR Triple-Liner System, states "The bottom clay liner also provides a safety factor with regard to post-closure operations, in the event that the primary and secondary synthetic liners would be adversely affected due to environmental conditions over the duration of the post closure period." *TRC Final Report*, Page 34.

TRC's lower system component (12 inch clay) will fail to meet EQC's policy statement. Consider:

1. "The occurrence of dessication cracking could result in the clay liner's permeability being in excess of the prescribed, 10^{-7} cm/sec permeability value." *TRC Final Report*, Page 26.

2. "There is no guarantee that dessication cracking can be prevented from occurring in clay liners." *TRC Final Report*, Page 26.

3. "the potential for moisture loss is generally reduced as the liner becomes thicker in depth, since drying of the outer liner surface does not affect the deeper clay particles as much, particularly the further away from the liner's surface and drying influences the deeper clay particles are." *TRC Final Report*, Page 26.

4. "If dessication cracking has been found to occur, and extends through the full profile of the liner, leachate escape (provided the secondary liner (FML) is defective) into the environment may immediately occur."*TRC Final Report*, Page 27.

TRC's Alternate Candidate Liner System provides very little protection because of the lack of a secondary liner system and the existence of a minimal thickness of clay base. Therefore, once a leak is detected, there are no assurances that the leachate will not reach the environment. In other words, the TRC Alternate Candidate Liner System will fail to meet EQC's policy statement.

Additionally, TRC's Level of Certainty Evaluation of the three proposed liner systems is based on value judgments which are too subjective...it allows for industry biased interpretations. For example: TRC gives the Alternate Liner's secondary liner system an average score of 2.00 for performance characteristics. In reality, the score should have been 0 (a failure) since the system does not provide secondary liner which will meet EQC's policy. (It should be noted that the numerals included in the table on page 6 of TRC's Final Report do not correspond to numerals included in Table 2-2, 2-3, 2-4 on page 56.)

Furthermore, TRC's Level of Certainty Evaluation of the OAR Triple-Liner System assigned an average score of 2.00 for the primary liner because the primary liner was considered its weakest component. Should the weakness of the primary liner be of concern, the OAR Triple-Liner System should be adapted accordingly as has been suggested by DEQ staff in their recommendation. Protection ABOVE the primary liner, to strengthen the lining system, should be added. It would be sensible to require installation of a deep sand or finely crushed ore "transition course" between the heaped ore and the primary liner to protect against punctures from accident and vandalism. (Ore should not be heaped directly on the primary HDPE liner!) To limit puncturing from ore slippage, a further increase in the protective stability of the lining system could be achieved through employment of liners with rough textured surfaces.

Another alternative would be to develop a composite primary liner (FML with a variable depth clay layer) to replace the FML primary liner. For an extremely small increase in cost (3%), this alternative would provide the highest level of certainty according to the TRC evaluation method. The OAR Triple-Liner System would overwhelmingly out-score other systems by compiling a total score of 34.00 out of a possible score of 36.00 (Equal Weighting). ***(A word of caution, however:*** one theory postulates that it is reasonable to have a **thin** "sand" cushion between the HDPE and the clay liner. This is because clay in direct contact with HDPE tends to pull the fluid through the HDPE rupture. If you have a void between the two, the surface tension limits flow through the hole. This theory warrants further study should an HDPE/clay composite liner be considered.)

Protection of Oregon's environment must be considered paramount to all other issues. Oregonian's do not want situations similar to Kennecott's Bingham Canyon operation where "Assistant Utah Attorney General Fred Nelson said nature was cleaning up the damaged groundwater on its own and the water should reach safe drinking levels during the next 100 to 200 years." (*Pay Dirt*, April, 1992)

TAILINGS TREATMENT

"Question: Do the requirements for removal and reuse of cyanide materially reduce toxicity and potential for long-term cyanide and toxic metals release from mill tailings?" *Request for Proposals for Technical Advice on Mining Rules*, Feb 7, 1992, Page 5.

"Method to Answer or Address Question: (1) Are removal and reuse technically feasible? (2) Do removal and reuse (evaluated separately) materially reduce the toxicity and potential for long-term cyanide and toxic metals release from the mill tailings? (3) What is the level of certainty you give to the answers provided above? (4) Are there other tailings treatment technologies which will equally, or more effectively achieve the policy of the Commission? *Request for Proposals for Technical Advice on Mining Rules*, Feb 7, 1992, Page 5.

In response to the Feb 7, 1992, directives, TRC states that

1. "Removal and reuse are technically feasible" and has been demonstrated to function. *TRC Final Report*, Page 7

2. "**Removal of cyanide from tailings does materially reduce the cyanide toxicity and potential for long-term release**...Reuse of cyanide does not reduce the cyanide toxicity or potential for long-term cyanide and toxic metals release from mill tailings. **It does reduce the total quantity of cyanide reagent consumed over the life of the operation.**" (Emphasis added) *TRC Final Report*, Page 8.

TRC concludes that "Reuse" is unimportant. However, it was on February 8, 1990, that a truck hauling hydrochloric acid to a mining operation in Nevada, spilled its contents into the John Day River, sterilizing the river and killing 100,000 fish. Contrary to TRC's opinion regarding the reuse of cyanide, "reuse" reduces the number of opportunities for transportation and handling mishaps.

3. "The level of certainty that removal of cyanide materially reduces the toxicity and potential for long-term cyanide release from mill tailings is high." *TRC Final Report*, Page 9.

However, TRC's discussion of tailings treatment has emphasized that chemical oxidation treatments are more appropriate than "remove and reuse" systems because they "offer significant economic advantage, greater operational flexibility, and result in more efficient utilization of resources." *TRC Final Report*, Page 9. ***None of the above "advantages" are within the scope of the questions.***

Additionally, TRC is incorrect regarding their optimism about chemical oxidation treatment processes. Systems which do not provide for cyanide removal **will not** meet EQC's standards. In discussing chemical oxidation systems, TRC failed to comment on the system's Level of Certainty. These systems, no matter what reagent is used, are not technically reliable. Chemical oxidation allows too much variation regarding toxins in the effluent. Examples include:

1. Atlas Precious Metals Gold Bar Mine in Nevada - a bird kill forced Atlas to institute a cyanide neutralization (not removal) process. Their "ferrous sulfate treatment system went on line at 3:30 p.m. on August 29, 1990." (8/31/92 Atlas letter to Nevada Department of Wildlife)

However, Atlas reported an additional 15 avian mortalities during the fourth quarter of 1990. (Mining Operations Wildlife Mortality Form, 4th Qtr 1990 Report)

Additionally, in an EPA document discussing ferrous sulfate treatment of cyanide ponds, Claire Elliot (Environmental Engineer) states "According to Tom DeMull the tailings pond was responsible for the death of 1400 birds in 1987 when they came to rest on the cyanide tainted pond. Since then the facility began to add ferrous sulfate, which forms a less toxic ferro-cyanide complex, and only one bird was killed in 1988. **Although converting free cyanide to a ferro-cyanide complex reduces the toxicity considerably, there is apparent recent research showing that iron complexes with cyanide may be more toxic than previously thought. The solubility, persistence and mobility of iron-cyanide complexes varies as a function of dissolved oxygen concentration, ultraviolet radiation and the presence of other complexing agents."** (emphasis added) *NPDES Compliance Evaluation Inspection Report, Alligator Ridge Mine, Sep 30, 1989*

2. Battle Mountain Fortitude Mine in Nevada - This mine uses the alkaline chlorination process. Reports indicate that the operation is having an extremely difficult time controlling the residual chlorine. For more information, contact Doug Zimmerman, Nevada DEP, (702)-687-4670.

CLOSURE OF HEAP LEACH FACILITIES

Proper closure of mining sites is of extreme importance to the future environmental well-being of the area being impacted. Therefore, it is important that DEQ analyze these proposals relative to their benefits into perpetuity. In discussing detoxification of heap leach facilities, TRC is overly optimistic and probably incorrect when they state:

> "Cyanide degradation and attenuation in a heap can be achieved by individual or combined application of rinsing, chemical treatment, or natural degradation reactions...It is technically feasible to reduce the WAD cyanide levels within the heaps to 0.5 ppm or less through rinse/rest cycles and chemical oxidation, minimizing post-closure toxicity concerns." *TRC Final Report*, Pg 97, 98.

In May, 1990, the Bureau of Land Management and the Montana Department of State Lands prepared an Environmental Assessment (EA) for an expansion proposal at the Pegasus Landusky Mine. This EA contains a section which discusses long-term seepage of cyanidated solutions. The following is an excerpt from this section:

> "After rinsing, not all of the solution within the decommissioned heaps would dewater by gravity drainage. The volume of irrecoverable solution in the heaps would be a function of the degree of saturation within blind-offs, and the specific retention of the material. If the irrecoverable solution in the heaps could be optimistically assumed to be equivalent to the natural moisture content of the pit-run material (4%), the dewatered and the expanded Montana Gulch heap would be expected to retain a minimum of 500 million gallons of cyanidated solution at unknown concentration. The ultimate tonnage for all Landusky heaps would retain more than a billion gallons of solution at unknown concentrations. If the overall concentration of retained solution in the heaped tonnage could be assumed to be diluted by rinsing to 5 percent of the original concentration, or approximately 25 ppm, approximately 240,000 pounds of cyanide would be present in the spent ore heaps at the Landusky Mine. Eventual discharge by long-term seepage through a cyclic succession of precipitation recharge, equilibrium by diffusion, and contaminated discharge could occur. The long-term fate and concentrations of this discharged solution is not definitely established." (May, 1990, *Landusky Mine Environmental Assessment*, Pg 36)

The discussion continues by stating:

> "The retained solution would have the potential to contaminate clean water that infiltrates the heaps...Precipitation infiltration and recharge of the heaps' moisture content would result in eventual discharge of contaminated effluent, as the heaps dewater to specific retention." (May, 1990, *Landusky Mine Environmental Assessment*, Pg 37)

Considering the above documentation, it is obvious that detoxification is insufficient as a means of long term-term protection for the environment and should be accompanied by covering the heap.

CLOSURE OF TAILINGS FACILITIES

When discussing closure of tailing facilities, TRC bases the majority of their evaluation on the detoxification of the cyanide in the tailings impoundment. Discussion concerning the presence of heavy metals in the tailings is generally underemphasized. It is not proposed in the current set of rules to remove the heavy metals; therefore, the urgency to cover the tailings is enhanced.

TRC determined that covering of tailings after detoxification would provide the necessary protection if there is potential for acid mine drainage. It is a known fact that gold and silver are associated with other heavy metals such as lead, mercury, and arsenic. For example, the Atlas Grassy Mountain Project site has high arsenic levels and Horizon's Hope Butte Project site is an old mercury mine. Enclosure of these toxins will be necessary to prevent their further release by natural erosion processes such as wind and rain.

Additionally, coverings over heap and tailings facilities must be composed of highly impenetrable synthetic material. Clay coverings with a vegetative cover have been used for years to reclaim municipal and hazardous waste landfills. The older coverings have invariably leaked. The general reason cited is penetration of the clay covering by roots of the vegetative cover. If the vegetative cover is not provided, the cover erodes away.

Similarly, if the vegetative cover penetrates the cover, there is the chance of heavy metal uptake by the vegetation:

> "Reclamation research has not yet satisfactorily dealt with the problem of root penetration into tailing or other potentially hazardous media. It has been demonstrated that many plant species can accumulate potentially toxic (to animals or humans) concentrations of trace metals with no apparent harmful effects to the plants. The potential concern for physical or biological migration of hazardous substances through soil covers from waste materials to reclaimed surfaces and to the environment at large cannot be generalized....In cases of significant concern, increased cover thickness and/or the use of impermeable barriers can be warranted." (*National Park Service, Environmental Handbook for Cyanide Leaching Projects*, Page 45; June 1986)

Additionally, according to an EPA document on the California

Gulch (Colorado) mine site, "Contaminants have degraded vegetation in pastures downstream, and plant tissues in some cases contained levels of metals toxic to livestock and wildlife." *EPA National Superfund Priorities Sites: Colorado, Dec, 1991.*

'All liners leak,' says Colorado official

SAN LUIS, Colo. – All liners which hold toxic chemicals will eventually leak at some time, those in the know say.

The collections pond liner at Battle Mountain's San Luis mine is no exception.

"All liners leak. There's no way you can avoid it. It's why you have a leak detection system," said Bruce Humphries, supervisor of mineral programs for the Colorado Mined Land Reclamation Division.

"You cannot build something that will not leak," said André Douchane, vice president of Battle Mountain's North American Operations, Denver.

A clay liner probably is the best material to use, because clay is self-bonding and becomes rather impermeable, Douchane said.

The tailings pond at San Luis has a heavy duty plastic liner over 12 inches of clay to contain the tailings, which is an after-product of the process used to separate gold from ore. It contains cyanide.

The plastic liner makes sure if the solution leaks, "it goes through in very, very tiny amounts that it does not oversaturate the clay," Douchane explained.

The solution goes into the tailings pond where some of the water evaporates; what doesn't drains off into a collection pond which recycles the water to be used again in the mining process.

The collections pond is double lined with plastic, with a foot of gravel and drain pipes in between.

The first liner is leaking now, Battle Mountain officials admit.

But none of the water is escaping outside the pond; it is being contained and pumped up a hill to the recycled water tank, company officials said.

Douchane said the company didn't expect the liner to leak, but "nothing in this world is perfect."

The leak isn't considered a very big one by Ron Zumwalt, safety supervisor at San Luis.

He called it "a pinhole leak," and said only about 50 gallons of water a week is leaking through it. The pond collects water from the 120-acre tailings pond.

Leaks do not have to be reported to regulatory agencies until they reach four and a half gallons a minute, Zumwalt said.

If a major leak should crop up down the road after Battle Mountain closes up shop at San Luis, the state would be responsible for clean-up, Humphries said.

"In Colorado law, once we release the operation, they're home free," he said.

But he said Battle Mountain probably would be liable for damages under federal laws. "It can go into a superfund site. That would cost Battle Mountain Gold a lot of money."

A bill which would require a mine to have a post-closure plan for up to 30 years is pending in Congress, Humphries said.

Things may be different in Washington.

If a problem cropped up at Chesaw after mining operations ceased, "I think we would be liable in perpetuity," Douchane said.

Chronicle (Omak, Washington)
Wednesday, June 3, 1992

Parties argue over Bingham Canyon water suit settlement

SALT LAKE CITY, March 23rd (AP) — State attorneys say $12 million offered by Kennecott as compensation for damanging groundwater is a fair settlement, but water district officials contend the amount should be much higher.

During a hearing in federal court Monday, the Salt Lake County Water Conservancy District asked Judge J. Thomas Greene to block the proposed settlement, saying a plume of contaminated water from Kennecott's Bingham Canyon operation caused $200 million damage.

Greene will hear evidence from Kennecott, the state and the water district later this week. Monday's hearing focused mostly on whether the $12 million offer was fair to the public.

Assistant Utah Attorney General Fred Nelson said nature was cleaning up the damaged groundwater on its own and the water should reach safe drinking levels during the next 100 to 200 years.

Pumping the water out of the ground and trying to clean it would leave waste material that would have to be treated and disposed of, he said. Even then, hundreds of years would pass before the water would be completely safe.

Kennecott and the state cut off several sources of the contamination in an effort to solve the groundwater contamination problem, Nelson said.

Kennecott has stopped using evaporation ponds in the Bingham Canyon area known to leach hazardous metals and sulphates into the ground. The company also relined a small Bingham reservoir to prevent leaching the lower level of a large reservoir.

An investigation into groundwater contamination began in 1983 after flood waters washed out evaporation ponds near the mining operation. State engineers worked until 1988 to assess damage to the groundwater, and in 1986 the state sued. The settlement has been under negotiation ever since.

Seventy new wells were drilled and water samples were taken from 200 wells to determine the extent of the groundwater damage.

Nelson acknowledged Monday that the problem is severe, with the water containing minerals at levels hazardous to human health.

Evidence suggests that the properties in the area's soil are neutralizing the contaminated water as years pass, allowing metals to precipitate out of the soil. However, the sulphate level in the water still remains above safe levels for drinking.

The water district maintains the $12 million will not come close to covering the costs of replacing water supplies that are or will be contaminated by the spreading plume.

Is Coeur d'Alene River residue old processing tailings?

From The Wallace Miner
Wallace, Idaho—March 26th

Mineral residue in the Coeur d'Alene River believed to be mine tailings should not be considered hazardous waste, state and federal officials said on March 18th

But to exempt the heavy minerals from protective environmental regulations, it must be proved the residue originated at a mine where ore was extracted, said Mark Masarik of the Environmental Protection Agency.

A mining industry spokesman said tailings are excluded from being labeled a hazardous waste under an amendment to the federal Resource Conservation Recovery Act.

Masarik, hazardous waste section chief with the EPA, said that is true.

"At this point, if the tailings came from extraction, I would agree they are excluded from RCRA," Masarik said.

Millions of dollars in taxpayer money and the completion of major improvement projects along the Coeur d'Alene River are at stake, said Gordon Crow of Council for Mineral Information.

At least 3 projects along the river were scrapped or put on hold in recent weeks after officials learned they may have to treat the residue as hazardous waste.

Such action would dramatically increase project costs, officials said, because the material would have to be hauled to a federally approved dump.

Randy Steger, manager of the RCRA section with the Department of Environmental Quality, agreed mine tailings are exempt under what is known as the Bevill Amendment.

"If it is mine tailings, they are excluded under the Bevill Amendment — I agree wholeheartedly. But whether the sole source (of the residue) is from mine tailings has yet to be determined," Steger said.

But just because the tailings are exempt, Steger said, does not mean the residue does not have to be disposed of carefully.

"From a health risk standpoint, we (DEQ) would still have some concerns," he said.

In Idaho, the DEQ has authority to administer RCRA rules. The state has adopted its own environmental rules, patternd after the federal regulations, related to the treatment of what it considers hazardous waste.

Crow said a management plan is needed to address how the heavy-metal residue extracted from the river bed is dealt with.

"Once the EPA and DEQ draft preliminary guidelines for the handling of mine tailings, the local mining industry, health and environmental representatives will meet to hammer out a local management plant," Crow said.

Core samples taken from below a timework bridge near Rose Lake show lead concentrations of between 40-50 parts per million, said Dave Fields, district design engineer with the Idaho Transporation Department.

The ITD had planned to replace the bridge, but has since put the project on hold due to expenses related to removal of the residue.

The EPA and DEQ set limits at 5 parts per million, Fields said. However, those tests may have shown falsely high concentrations due to the way the samples were tested.

Samples were sent to Boise where further tests are being conducted, Fields said. Results are expected later this week.

Crow applauded Al Murrey of the Coeur d'Alene Basin Project, who is coordinating meetings between local, state and federal officials.

"Al Murrey went right to work and did a terrific job that will eventually benefit all the taxpayers of Idaho," Crow said.

"The process is far from over, but a major understanding has been reached between all groups involved."

Aside from the Rose Lake bridge, Coeur d'Alene River projects impacted by the environmental regulations include boat launch across from the mouth of Anderson Lake and improvements at the Rainy Hill campground.

Of Mines And Men

Nevada researcher wins rock mechanics award

Dr. Amitava Ghosh, who is performing post-doctorate research in the Department of Mining Engineering at the University of Nevada-Reno, has been awarded the prestigious Rocha Award by the International Society for Rock Mechanics for the best rock mechanics dissertation.

Ghosh's paper is entitled "Fractal and Numerical Models of Explosive Rock Fragmentation." The work explores ways to more accurately predict how rock breaks when it is blasted.

Ghosh received his PhD in mining engineering from the University of Arizona and hopes to secure a teaching position after completing his post-doctorate research. Dr. Jack Daemen, chairman of the department at the Reno school, served as Ghosh's major professor and nominated him for the award.

Thursday, July 18, 1991 Ontario Argus
Ontario, Oregon

State, feds want money

PORTLAND (AP) — The state and the federal government are trying to collect $840,000 in damages from a Utah trucking company responsible for the largest chemical spill into a river in Oregon history.

The claim was filed in late May against the Thatcher Transportation Co. for a hydrochloric acid spill Feb. 8, 1990, that killed 100,000 fish in the John Day River.

A Thatcher truck spilled 3,500 gallons of the acid, killing fish for at least 12 miles downstream. The truck was bound for a mining operation in Nevada when it slid off U.S. 395 in snowy conditions and rolled into the John Day's north fork.

Contamination from the spill gradually dissipated but was never cleaned up. It killed juvenile chinook salmon and bull trout in the John Day, a river noted for its wild salmon and trout.

The Oregon Department of Environmental Quality also levied a $6,000 fine against Thatcher. The Oregon Department of Fish and Wildlife and the U.S. Department of Interior intend to use the $840,000 in damages to restore the fisheries damaged by the spill.

"They were not wiped out, but some serious work needs to be done to restore their populations," said Greg Robart of the Department of Fish and Wildlife.

Richard Doty, a spokesman for Thatcher, said the company's insurance carrier is handling the claim.

He said Thatcher acknowledged responsibility for the incident "right at the very beginning — as soon as we determined the truck was ours."

The largest chemical spill previously was in 1983, when a truck under contract to the U.S. Forest Service overturned and dumped about 1,900 gallons of the herbicide Sevin was dumped into Willow Creek near Heppner. The spill also killed about 100,000 fish.

Fish have died in two smaller spills in the past two years in Salem's Mill Creek.

In April 1991, about 2,000 fish died when ammonia-tainted water was allowed to enter a storm drain for about three hours at Deluxe Quality Chekd Ice Cream Co.

Dead fish were found that day along a 2.1-mile stretch of Mill Creek from the discharge site to the stream's confluence with the Willamette River. The state is seeking damages of $1,197.

ENVIRONMENTAL ASSESSMENT

for

Zortman Mining Inc.

Application for Amendment No. 010 to

State Operating Permit No. 00095 and

Federal Plan of Operations M-77779

Landusky Mine Expansion

Sullivan Park Heap Leach Pad

Operating and Reclamation Plan

prepared by

Montana Department of State Lands
and
U.S. Department of the Interior
Bureau of Land Management

Pursuant to the

Montana Environmental Policy Act
and the
National Environmental Policy Act

May 11, 1990

c. Long-Term Seepage of Cyanidated Solution

After rinsing, not all of the solution within the decommissioned heaps would dewater by gravity drainage. The volume of irrecoverable solution in the heaps would be a function of the degree of saturation within blind-offs, and the specific retention of the material. If the irrecoverable solution in the heaps could be optimistically assumed to be equivalent to the natural moisture content of the pit-run material (4 percent), the dewatered Sullivan Park and the expanded Montana Gulch heap would be expected to retain a minimum of 500 million gallons of cyanidated solution at unknown concentration. The ultimate tonnage for all Landusky heaps would retain more than a billion gallons of solution at unknown concentration. If the overall concentration of retained solution in the heaped tonnage could be assumed to be diluted by rinsing to 5 percent of the original concentration, or approximately 25 ppm, approximately 240,000 pounds of cyanide would be present in the spent ore heaps at the Landusky Mine. Eventual discharge by long-term seepage through a cyclic succession of precipitation recharge, equilibration by diffusion, and contaminated discharge could occur. The long-term fate and concentrations of this discharged solution is not definitely established.

It is proposed that all leach pad liners would be punctured to provide drainage of the spent ore heaps after reclamation. A portion of the precipitation that infiltrates the reclaimed heaps would drain through the punctured liners. Successful reclamation and revegetation of spent ore heaps would significantly reduce the amount of water which infiltrates and percolates through the heaps.

Heap infiltration amounts can be estimated using climatological data in Klohn Leonhoff's geotechnical report (May 1989). Annual precipitation in the Zortman/Landusky area is 17.9 inches and evaporation is 40.5 inches (Klohn Leonhoff, May 1989). Net precipitation (precipitation minus evaporation) for each month was calculated based on measured precipitation and evaporation assuming a pan coefficient of 0.72. For months in which evaporation is greater than precipitation, a net precipitation of zero is assumed. Assuming all net precipitation seeps through the reclaimed heaps and no surface runoff occurs, annual seepage would be equal to net precipitation. Because some runoff would occur, actual seepages through the heap would be less than net precipitation. During periods when excess precipitation occurs (evaporation less than precipitation) some portion of the precipitation would infiltrate through the revegetated soil cover and would percolate through the heap. Annual net precipitation volume and average precipitation rates infiltrating through the heap for the existing leach pads, and the proposed Sullivan Park leach pad, in the Landusky mine complex area (Hydrometrics 1990) would be:

Pad	Annual Net Precip. (million gallons)	Average Precipitation Rate (gpm)
Mill Gulch	5.4	10.3
Montana Gulch	7.1	13.7
Sullivan Park	5.5	10.5
TOTAL	18.1	34.5

The retained solution would have the potential to contaminate clean water that infiltrates the heaps. Cyanidated solution in retention and infiltrated water would tend to reach chemical equilibrium by diffusion. This process could take up to six months or longer to reach equilibrium depending on diffusion rates and cyanide concentrations. When fresh water from precipitation or sprinkling flushes the heap, the process of chemical diffusion would begin again until all the cyanide migrates out of the more impermeable zones. Precipitation infiltration and recharge of the heaps' moisture content would result in eventual discharge of contaminated effluent, as the heaps dewater to specific retention. An estimated 5.5 million gallons of precipitation may infiltrate the Rock Creek heap and 2.0 million gallons could recharge the expanded Montana Gulch heap yearly. This would equal an estimated 15 gpm of seepage through these proposed heaps. The majority of this water would flow through the underdrain and exit as surface flow, with a smaller amount entering the groundwater system. Cumulative precipitation through all the Landusky heaps is expected to be 18.1 million gallons annually, resulting in an average seepage rate of 34.5 gpm. Cyanide concentrations in this long-term seepage effluent is dependent on the effectiveness of heap rinsing and degradation of retained solution. Chemical diffusion may be greater during natural infiltration than during heap neutralization because retention times may be longer. Accordingly, discharge concentrations would be higher than concentrations monitored during rinsing.

The impact of long-term cyanide solution seepage from the spent ore heaps is unknown. However, factors which could contribute to significance include: failure of surface reclamation to limit infiltration of precipitation, the concentration of residual cyanide left after a 30-day rinse cycle, and possible plugging of the post-reclamation drain holes.

d. Water Rights

Most water rights for Rock Creek, including adit water, are held by the Square Butte Grazing Association, (SBGA) and Zortman Mining, Inc. (ZMI).

There is a concern that increasing water use for various mining purposes would adversely affect water rights of the area. Water rights disputes are resolved through the Department of Natural Resources and Conservation. A dispute does exist over water rights between ZMI and SBGA that to the best of current knowledge is unresolved. Until resolved, impacts to water rights and resultant water uses can not be quantified. Resolution of water rights disputes is beyond the scope of this EA and the authorities of DSL and BLM.

e. Floodplains

Construction of the Sullivan Park heap would cover about 2,000 linear feet of the Upper Rock Creek drainage, but there are only a few small narrow deposits in this area which may be considered floodplains. Due to the size and quality, their loss is not considered significant.

STATE OF NEVADA
DEPARTMENT OF WILDLIFE
1100 Valley Road
P.O. Box 10678
Reno, Nevada 89520-0022
(702) 688-1500

OB MILLER
ing Governor

WILLIAM A. MOLINI
Director

August 27, 1990

Andrew Scrymgeour
Manager
Gold Bar Mine
P.O. Box 282
Eureka, NV 89316

Dear Mr. Scrymgeour,

This letter is notification that the Gold Bar Mine is not in compliance with the Nevada Department of Wildlife's Industrial Artificial Pond Permit #1866 for the mill tailings pond. During a routine inspection on August 24, 1990, Rory Lamp from our Elko office observed four dead birds (one American avocet and three sandpipers) on Cell #3 of the Gold Bar tailings pond.

During the discussion that followed with yourself, Bill Reich and Dennis Appelhans, it was determined that the free cyanide levels being discharged into the tailings pond were above what the Nevada Department of Wildlife considers lethal for wildlife. You also pointed out the Gold Bar Mine was in the process of installing a ferrous sulfate neutralization circuit to the mill facility. In your estimation, the start up date for the neutralization system would be in approximately two to three weeks. At that time Mr. Lamp indicated that the Gold Bar Mine would be required to come into compliance within 30 days.

Subsequent to that discussion, eight additional mortalities (two mallards, five sandpipers, and one merganser) were reported to Rory Lamp by Bill Reich on August 27, 1990. In light of these additional mortalities, the Nevada Department of Wildlife will require the Gold Bar Mine to take steps to neutralize the cyanide concentrations in the tailings discharge to below lethal levels within two weeks upon receipt of this letter.

On a related matter, during the pond inspection, the netting over the pregnant pond was observed to be in a state of disrepair. Bill Reich indicated that a wind storm the previous week had done the damage and that repairs were being done at that time. He indicated that the repairs would be finished as soon as possible. The Nevada Department of Wildlife would like written notification when the repairs to the netting covers on the pregnant pond have been completed.

I hope the Gold Bar Mine will resolve both of these issues quickly so that legal actions will not be required. If you have any questions, please contact me.

Sincerely,

Duane Erickson

Duane Erickson
Supervising Habitat Biologist
1375 Mountain City Highway
Elko, NV 89801
(702) 738-5332

RL
cc: Habitat Division
Bill Schaffer, Eureka County District Attorney
Richard Branzell, Sr., U.S. Fish & Wildlife Service
Wayne King, District Manager, Shoshone-Eureka Resource Area, BLM
Dale Elliot

Atlas Gold Mining Inc.

GOLD BAR MINE
P.O. BOX 282
EUREKA, NEVADA 89316-0282
(702) 237-5621

RH
9/4/90

August 31, 1990

Rory Lamp
Nevada Department of Wildlife
1375 Mountain City Highway
Elko, NV 89801

RE: Repairs to Wildlife Netting, Atlas Gold Bar Mine Leach Pad.

Dear Mr. Lamp:

This letter is to inform you that repairs to the Gold Bar Mine pregnant pond netting were completed on August 27, 1990.

The ferrous sulfate treatment system went on line at 3:30 p.m. on August 29, 1990. Results of cyanide analyses are pending. I will keep you posted as to these results and how the system is functioning.

If you require additional information, please contact me at the earliest opportunity.

Sincerely,

William J. Reich

William J. Reich
Environmental Coordinator

cc: R.E. Blubaugh
A.H. Scrymgeour
D.J. Appelhans

United States Department of the Interior

TAKE PRIDE IN AMERICA

BUREAU OF LAND MANAGEMENT
Shoshone-Eureka Resource Area
P.O. Box 1420
Battle Mountain, NV 89820

IN REPLY REFER TO:
3809
N64-85-001P
(NV-064.2)

SEP 10 1990

CERTIFIED MAIL: P 468 373 273
Returned Receipt Requested

<u>DECISION</u>

Richard Blubaugh, Vice President	:	Gold Bar Mine
Atlas Corporation	:	Eureka County
370 17 th Street, Suite 3150	:	Nevada
Denver, Colorado 80202		

NOTICE OF NONCOMPLIANCE

The Nevada Department of Wildlife has advised us that Atlas Corporation is in noncompliance with the State of Nevada Industrial Artificial Pond Permit as a result of recent bird mortalities, during the month of August, 1990, associated with Atlas Gold Bar Mine cyanide tailings pond. At least 14 birds were reported to have died in the pond.

As a result of the bird mortalities your operations are in violation of the requirements described in 43 Code of Federal Regulations, Subpart 3809 Surface Management Regulations. Listed below are the violations of the regulations:

1. 43 CFR 3809.1-8 (c) which states, " Upon approval of a plan by the authorized officer, operations shall be conducted in accordance with the approved plan."

2. 43 CFR 3809.3-1(a) states, " Nothing in this subpart (3809) shall be construed to effect a preemption of State laws and regulations relating to the conduct of operations."

3. The subject mortality of waterfowl is a violation of the Migratory Bird Treaty Act. As the permitting agency, the Bureau of Land Management policy is to eliminate mine-related wildlife mortality and therefore can not allow the violation to continue as it constitutes failure to follow the approved plan of operations.

Listed below are necessary actions for Atlas to come into compliance with the submitted Plan of Operations:

1. Reduce immediately the concentrations of cyanide discharged into the Gold Bar Mine open solution ponds to non toxic levels as required by State permit and eliminate toxicity to birds either by free cyanide, WAD cyanide or other industrial pond toxicity problems.

2. Within 10 days from date of receipt of this Notice, Atlas Corporation must submit an amendment to the plan of operations detailing what measures Atlas plans to implement to eliminate bird mortalities. The plan is to specify what measures, time frames, monitoring and notification schedules are to be implemented to eliminate bird mortalities associated with open solution ponds at the Gold Bar Mine.

3. Notify this office immediately of any future bird mortalities at the Gold Bar Mine and submit to this office a weekly bird mortality monitoring report indicating both the number of birds killed and the concentration level of cyanide discharged into open solution ponds at the Gold Bar Mine.

The Bureau will approve or disapprove the amended plan based in part on consultation with other affected agencies. Be advised that detoxification has been proven to be the most effective method in complying with the regulations as compared to other methods such as hazing and netting.

Lack of compliance within the 10 working days period will require the Bureau to take appropriate actions.

You have the right to appeal this decision to the Nevada State Director, Bureau of Land Management, in accordance with 43 CFR 3809.4. If you exercise this right, your appeal must be filed in writing, accompanied by a statement of reasons and any arguments you wish to present, which would justify reversal or modification of this decision. Your appeal must be filed at the Bureau of Land Management, Battle Mountain District, Battle Mountain, Nevada 89820, within 30 days after the date of this decision. This decision will remain in effect during appeal unless a written request for a stay is granted.

W King

Wayne King
For the District Manager

cc:
NV920
Rory Lamp, NDOW
Richard Navarre, USFWS
Paul Lependorfer, NDEP

SEP 27 1990
SHOSHONE-EUREKA RESOURCE AREA

ATLAS CORPORATION
Republic Plaza, 370 Seventeenth Street, Suite 3150
Denver, CO 80202
Telephone: (303) 825-1200 Fax: (303) 892-8808

September 21, 1990

Mr. Wayne King, Manager
Shoshone - Eureka Resource Area
Bureau of Land Management
P.O. Box 1420
Battle Mountain, NV 89820

Re: Gold Bar Mine, Eureka County, NV
3809, N64-85-001P (NV-064.2)

Dear Mr. King:

This is in reply to your letter and Notice of Noncompliance dated September 10, 1990 concerning bird mortalities associated with the Gold Bar Mine tailings pond. As you noted in your letter, the Nevada Department of Wildlife (NDOW) sent a notice to Atlas August 27, 1990 concerning this matter (copy enclosed).

Atlas has been working closely with the NDOW and keeping them, as well as your staff, advised of our progress towards rectifying this situation. A copy of our August 31, 1990 letter to the NDOW is enclosed. As stated in the enclosed correspondence, Atlas had installed a ferrous sulfate treatment component as a part of the refractory circuit addition to the mill process, which is located on patented claims.

Cyanide analysis results from September 4, 1990 indicate the barren slurry discharging into the tailings disposal area contains 7.2 ppm WAD cyanide (Sierra Environmental Monitoring Lab, Sparks, Nevada). Concentrations of free cyanide measured by Gold Bar personnel since September 4, 1990 indicates that concentrations have been below 50 ppm, the guide limit set by the NDOW. Additional WAD analyses are pending.

Atlas maintains a full time hazer to keep waterfowl off of the tailings disposal area. The hazing is accomplished through the use of "banger shells" and a hover-craft. Atlas feels that the combination of the ferrous sulfate system and hazing program will eliminate waterfowl mortalities at the Gold Bar Mine.

Monitoring is accomplished on a full time basis by the hazer during the day shift. Periodic monitoring is accomplished by Gold Bar Mill personnel during the evening and night shifts.

Both the Nevada Department of Wildlife and the BLM will be notified by the end of the next working day of waterfowl mortalities occurring at the Gold Bar Mine. This notification is consistent with State of Nevada Regulations. Atlas will include a waterfowl mortality report as part of its weekly self-monitoring report.

Atlas will conduct WAD cyanide analysis of the tails discharge solution every two weeks. The Gold Bar lab is not equipped to analyze for WAD cyanide. These samples must be sent to an outside laboratory. As such, it is very time consuming to get these samples to the lab and obtain the results.

Atlas sincerely regrets the unanticipated impact on avian wildlife as it relates to the operation of the Gold Bar Mine. Preventive actions were in progress prior to the letter from NDOW. Atlas will continue to work towards the goal of preventing avian wildlife mortalities at the Gold Bar Mine. We believe we can achieve this goal through the procedures outlined in the amended plan.

Please contact me or Bill Reich if you require any additional information concerning this matter.

Sincerely,

Richard E. Blubaugh

Richard E. Blubaugh
Vice President Regulatory
And Environmental Affairs

REB/jlb

cc: R. R. Weaver
M. B. Richings
A. M. Scrymgeour
W. J. Reich

NEVADA DEPARTMENT OF WILDLIFE HABITAT DIVISION (E) FORM 2Bb

MINING OPERATIONS WILDLIFE MORTALITY FORM

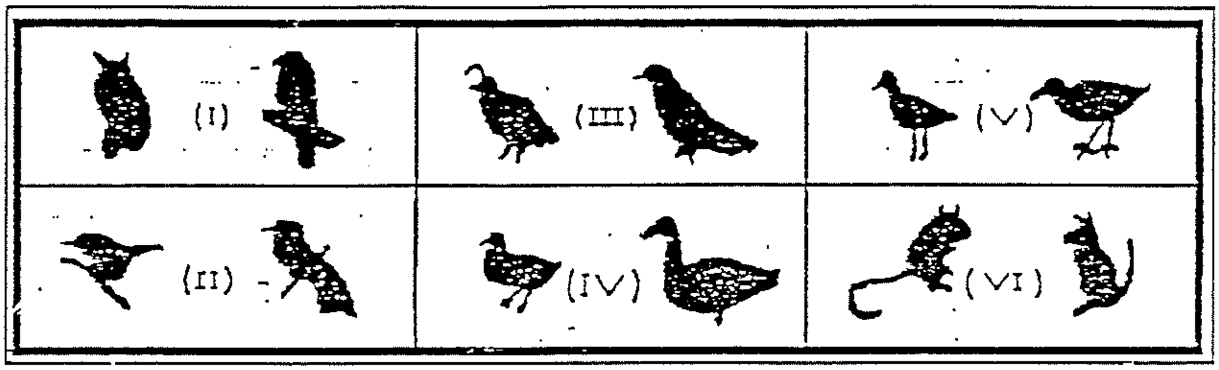
PROJECT TITLE: Atlas Gold Bar mine Permit # 1866

ADDRESS: Box 282 Eureka NV 89316 COUNTY: Eu

REPORT YEAR: 1990 QUARTER: (Check one)

(JAN-MAR)	(APR-JUNE)	(JULY-SEPT)	(OCT-DEC)
			X

WILDLIFE MORTALITY IDENTIFICATION



Please list number and species under category:

EXAMPLE: RAPTOR. 0
SONGBIRD. . . . 1 sparrow, 2 wren
UPLAND. . . . . 1 quail
WATERFOWL . . . 3 mallard, 1 bufflehead, 4 gadwall
SHOREBIRD . . . 0
MAMMAL. . . . . 4 mice, 2 skunk, 2 chipmunk

CYANIDE-RELATED MORTALITIES
NUMBER AND SPECIFIC IDENTIFICATION

RAPTOR (I) . . . .

SONGBIRD (II) . . .

UPLAND (III) . . .

WATERFOWL (IV) . . 6 grebes 3 Ducks

SHOREBIRD (V) . . . 6 Gulls

MAMMAL (VI) . . . .

OTHER . . . .

(Non-Cyanide Mortalities and other remarks on back of form.)

REPORTER: L Groll (Name and Address) DATE 1-3-91

PHONE 237-5621

PLEASE MAIL TO: NEVADA DEPARTMENT OF WILDLIFE
HABITAT SUPERVISOR
REGION II
1375 MT. CITY HIGHWAY
ELKO, NV 89801

The National Park Service

Environmental Handbook for Cyanide Leaching Projects

by MICHAEL D. STANTON
THOMAS A. COLBERT
RICHARD B. TRENHOLME *of* Intermountain Soils, Inc.
Denver, Colorado

under contract to
Radian Corporation
Sacramento, California

for the
Energy, Mining and Minerals Division
National Park Service
United States Department of the Interior

JUNE 1986

distribution of sufficient quantities (depths) of material suitable for a rooting zone for plants. In most instances salvaged native topsoil is the best source of plant growth medium, but there are projects for which the volume of available topsoil is too small to be adequate for reclamation. This is often the situation at older operations where no topsoil was salvaged prior to site development. In some areas the quality of topsoil may not justify its salvage for reclamation. Adequate soil survey information is necessary to assess topsoil quality and availability.

The importance of surface and slope stability in revegetation work cannot be overemphasized. While vegetation cover can be very effective in reducing soil erosion rates, especially due to sheet and wind erosion, it is no less true that the ability to establish any vegetation cover at all can be significantly compromised on unstable or erodible slopes. Susceptibility to erosion of a reclaimed surface is the result of a complex interaction of a number of factors. Some of these factors, notably soil texture, may not be controllable. Other factors can be influenced, most significant of which are length and steepness of slopes. For critical areas and harsh sites, the expense of additional site grading to reduce slope length and steepness is often justified, and can mean the difference between successful vegetation establishment or revegetation failure.

Vegetation cover is generally not as effective in controlling gully erosion. In reclaiming areas where susceptibility to rilling, piping or gullying is a problem, final configuration of surface drainage patterns should be given due attention. These problems tend to occur on certain types of soils, on larger reclaimed areas, in high precipitation or snowmelt areas, and especially on areas having steep slopes. Effective erosion control is critical for reclaimed embankments and tailing ponds where long term integrity of structures must be assured. A thorough discussion on slope stabilization and erosion control is given in Gray and Leiser (1982).

In addition to a stable surface, successful revegetation also depends on the availability of a suitable medium for revegetation. There exist numerous and varied regulatory approaches to this issue.

Decommissioned cyanide heaps and tailing impoundments may require from little or no soil cover to several feet of cover to be sucessfully reclaimed, depending on site conditions. Less than two feet of cover may be of tenuous effectiveness with respect to the long term isolation of waste materials, in cases where such long term isolation is an important concern. In cases where acid formation or toxic trace metals are of concern, increased cover thickness may be warranted. Many ore processing waste materials contain potentially hazardous concentrations of such trace metals as lead, arsenic, cadmium, silver, and others.

Reclamation research has not yet satisfactorily dealt with the problem of root penetration into tailing or other potentially hazardous media. It has been demonstrated that many plant species can accumulate potentially toxic (to animals or humans) concentrations of trace metals with no apparent harmful effects to the plants. The potential concern for physical or biological migration of hazardous substances through soil covers from waste materials to reclaimed surfaces and to the environment at large cannot be generalized, and must be evaluated on a case-by-case basis. In cases of significant concern, increased cover thickness and/or the use of impermeable barriers can be warranted.

Salvaged topsoil is commonly used as a final top layer for reclamation. Research has shown that in many cases as little as six inches of topsoil can significantly enhance revegetation results. The potential benefits of topsoil seem to be diminished to some extent for projects requiring that salvaged topsoil be stockpiled for many years. Research is still being done in this area. Topsoil in reclamation is discussed more thoroughly in Hargis and Redente (1984), Jurinak (1982), McKell (1982), DePuit and Schuman (1983), and U.S. Forest Service (1979).

Prior to reclamation seeding, a suitable seedbed must be prepared. Where slopes are not too

RECEIVED 23 JUL 1990

ENVIRONMENTAL PROTECTION AGENCY

REGION 9

Water Management Division

NPDES Compliance Evaluation Inspection Report

Name of Facility:	Alligator Ridge Mine
Owner:	B.P. Minerals America
Location:	Approximately 40 miles Northwest of Ely, Nevada
NPDES Permit No:	None
Inspection Date:	May 23, 1989

Inspection Participants:

EPA:	Claire Elliott Environmental Engineer
State:	Harry Van Drielen E.M.S. III
B.P. Minerals:	Tom De Mell General Manager

Prepared by:	Claire Elliot
Date:	September 30, 1989

In 1987 Amselco began processing a stockpile of carbonaceous ore. The efficiency of gold recovery from carbonaceous ore by cyanide leaching is reduced by the adsorption of the gold-cyanide complex onto the carbonaceous component of the ore. Therefore, after milling the ore is processed by oxidation to inactivate this component. The oxidized slurry is then vat leached and the gold is recovered through a carbon-in-pulp process. Activated carbon adsorbs the gold and is then strained from the slurry. The slurry is then sent through a thickener to the tailings pond. The tailings pond has a clay liner with an underdrain to a collection sump. Leakage through the tailings pond bottom is collected and pumped back into the tailings pond.

FINDINGS

1. There was no evidence of a discharge to surface water at the time of the inspection. Any drainage from the area would end up in a dry wash which leads to Long Valley. According to a memo in the NDEP files, an ephemeral lake is located in the Valley during periods of heavy precipitation. This lake could be considered a playa lake. Playa lakes are waters of the United States. Therefore any discharge to the wash tributary to this lake would be a discharge to a water of the U.S., and if unauthorized by a NPDES permit it would constitute a violation of the Clean Water Act.

2. The NDEP file on Alligator Ridge contains documentation of four discharges of cyanide containing solutions in the last 6 years. The first took place on February 25th and 26th, 1983. It was an intentional discharge of 100,000-200,000 gallons with a cyanide concentration of 20-38 ppm. The discharge was allowed to occur so that the facility could install a bypass valve. This valve enables the facility to discharge process solution to protect the pond berms in case of high water caused by rain events. The discharge was diluted with well water and the cyanide neutralized with calcium hypochlorite. The facility indicated that they could not determine the distance the discharge achieved. Two discharges are documented as taking place in 1986. One of them, in August, was due to heavy rainfall and apparently caused process water to overflow from the collection pond to the overflow pond,

and from the collection ditches into the stormwater ditches. There is no indication of whether the flowthen made it to the wash which discharges into Long Valley. There was cyanide detected in one monitoring well in September which the facility speculated was caused by this event. The second discharge documented in 1986 was also in August and consisted of 10,800-13,300 gallons of solution containing 365 ppm free cyanide. This discharge was from a tee in the pipe at the Southeast corner of leach pad number 2. No mention was found of where this discharge ended up.

In 1987 a flange in the line carrying solution to the No. 2 leach pad failed allowing 32,000-34,000 gallons of solution containing 365 ppm of free cyanide to discharge. The discharge was treated with hydrogen peroxide and diluted with potable water.

Amselco Minerals Inc. had no NPDES permit, therefore any of these discharges which entered the wash constituted violations of the Clean Water Act.

3. Monitoring of wells which were constructed in the vadose zone detected the existence of a seasonal perched aquifer with fluctuating levels of cyanide. Groundwater monitoring data in NDEP's files indicate contamination below the pregnant solution pond in 1986, and contamination below the pregnant solution collection pond in 1985 and 1986 with cyanide levels as high as 10.4 mg/l as free cyanide.

4. According to Tom DeMull the tailings pond was responsible for the death of 1,400 birds in 1987 when they came to rest on the cyanide tainted pond. Since then the facility began to add ferrous sulfate, which forms a less toxic ferro-cyanide complex, and only one bird was killed in 1988. Although converting free cyanide to a ferro-cyanide complex reduces the toxicity considerably, there is apparently recent research showing that iron complexes with cyanide may be more toxic than previously thought.

   The solubility, persistence and mobility of iron-cyanide complexes varies as a function of dissolved oxygen concentration, ultraviolet radiation and the presence of other complexing agents. Iron-cyanide complexes should be quite soluble

United States
Environmental Protection
Agency

Region VIII

December, 1991

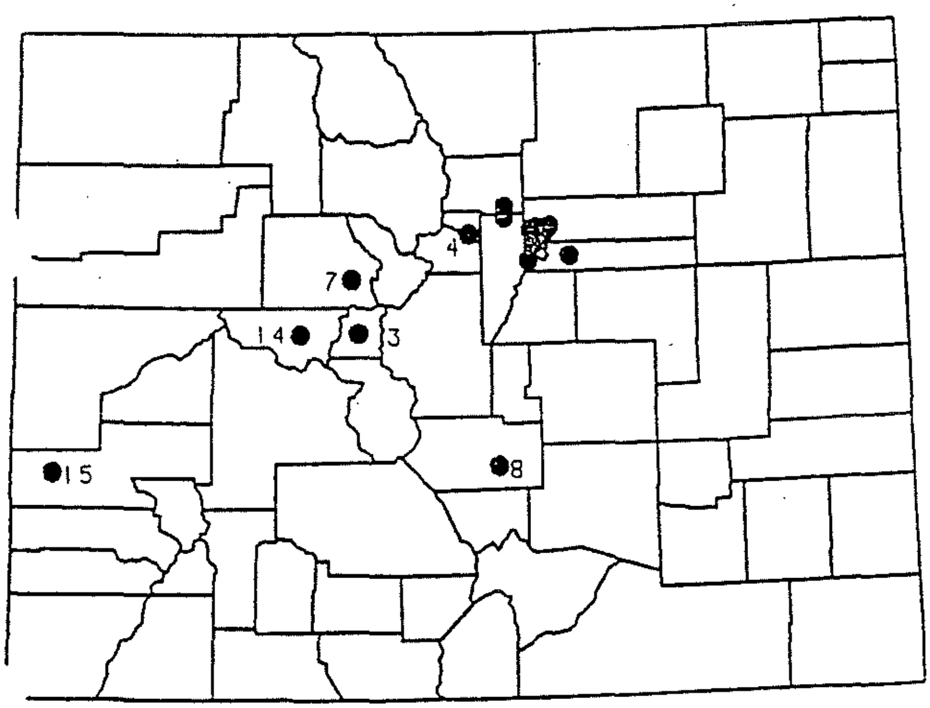
EPA contact -
Gene Taylor
303-293-1640

EPA

National Superfund Priorities List Sites:

Mine Sites

COLORADO



1- Air Force Plant PJKS Property	2- Broderick Wood Products
3- California Gulch	4- Central City-Clear Creek
5- Chemical Sales	6- Denver Radium Site
7- Eagle Mine	8- Lincoln Park
9- Lowry Landfill	10-Marshall Landfill
11-Rocky Flats Plant (USDOE)	12-Rocky Mountain Arsenal
13-Sand Creek Industrial	14-Smuggler Mountain
15-Uravan Uranium (Union Carbide)	16-Woodbury Chemical Co.

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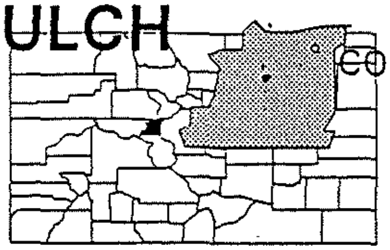
PROGRESS TOWARD CLEANUP AT NPL SITES IN THE STATE OF COLORADO

Site Name	County	NPL*	Date Listed	Initial Response	Site Studies	Remedy Selected	Remedy Design	Cleanup Ongoing	Const. Complete
AIR FORCE PLANT	JEFFERSON	Final	11/21/89	→	→				
BRODERICK WOOD	ADAMS	Final	09/21/84	→	→	→	→	→	
CALIFORNIA GULCH	LAKE	Final	09/08/83	→	→	→	→	→	
CENTRAL CITY-CLEAR CREEK	CLEAR CREEK & GILPIN	Final	09/08/83	→	→	→	→	→	
CHEMICAL SALES	ADAMS & DENVER	Final	08/30/90	→	→	→	→		
DENVER RADIUM	DENVER	Final	09/08/83	→	→	→	→	→	
EAGLE MINE	EAGLE	Final	06/10/86	→	→	→	→	→	
LINCOLN PARK	FREMONT	Final	09/21/84	→	→	→	→	→	
LOWRY LANDFILL	ARAPAHOE	Final	09/21/84	→	→				
MARSHALL LANDFILL	BOULDER	Final	09/08/83	→	→	→	→	→	
ROCKY FLATS PLANT	JEFFERSON	Final	10/04/89	→	→		→	→	
ROCKY MOUNTAIN ARSENAL	ADAMS	Final	07/01/87	→	→	→	→	→	
SAND CREEK INDUSTRIAL	ADAMS	Final	09/08/83	→	→	→	→	→	
SMUGGLER MOUNTAIN	PITKIN	Final	06/01/86	→	→	→	→		
URAVAN URANIUM	MONTROSE	Final	06/10/86		→	→	→	→	
WOODBURY CHEMICAL	ADAMS	Final	09/08/83	→	→	→	→	→	→

*National Priorities List

CALIFORNIA GULCH
COLORADO
EPA ID# COD980717938



EPA REGION 8
CONGRESSIONAL DIST. 05
Lake County
100 miles west of Denver

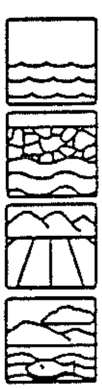
Site Description

The 130-year-old California Gulch site is a mining area covering 16 1/2 square miles of a watershed area that drains along California Gulch to the Arkansas River. Starting in 1859, the area has been mined extensively for gold, lead, silver, copper, zinc, and manganese. California Gulch contains numerous abandoned mines and wastes from mining, milling, and smelting. Miners built the Yak Tunnel to drain water from the mine works and to make mineral exploration and development easier. This tunnel drains hundreds of mines in its 4-mile underground course and discharges a total of 210 tons of various heavy metals each year into California Gulch. Although the tunnel mainly contaminates surface water, heavy metals also have moved through surface water to pollute groundwater and sediments. California Gulch also collects runoff from several other gulches that drain other mine tailings piles and pond wastes. Some of this runoff flows through local town storm drains and city streets. The Arkansas River, which receives water from the California Gulch, has been classified as a recreational resource, and is used heavily for irrigation, livestock watering, public water supply, and fisheries. Approximately 6,000 people live in nearby Leadville and Lake County.

Site Responsibility: This site is being addressed through Federal and potentially responsible parties' actions.

NPL LISTING HISTORY
Proposed Date: 12/30/82
Final Date: 09/08/83

Threats and Contaminants



The primary contaminants of concern affecting surface water, sediments, and groundwater are cadmium, copper, lead, arsenic, mercury, and zinc. The water in several shallow groundwater wells in California Gulch and in some private wells has been shown to exceed EPA drinking water standards for cadmium and zinc. Arsenic, cadmium, and lead exist in waste piles and soils. Adverse effects on the fish population have been observed in the Arkansas River. Contaminants have degraded vegetation in pastures downstream, and plant tissues in some cases contained levels of metals toxic to livestock and wildlife. Water in the main stem of California Gulch is unsafe for drinking. Soil contaminated with lead up to 10,000 ppm occurs in the residential areas of the city. The Colorado Department of Health conducted a heavy metal exposure study in Leadville (April, 1990) and reported that distribution of blood lead levels for children less than 6 years of age at >10, >15, >20 and >25 micrograms/deciliter was 26%, 5.3%, 7.3% and 2%, respectively. Accordingly, EPA has accelerated efforts to complete RI work on populated areas of the site.

Cleanup Approach

This site is being addressed in stages: a remedial action at the Yak Tunnel, and longer term remedial investigation phases focusing on cleanup of the groundwater and surface water and contaminated soils, mine wastes, tailings, and smelter slags in and adjacent to the populated areas of the site.

Response Action Status

Immediate Action: In 1986, EPA emergency workers extended public water supply system lines to residences using private wells. In 1990, the potentially responsible party improved the area storm water drainage system to prevent surface water from coming into contact with mining wastes. This storm water drain system is being upgraded to ensure that the system is effective in times when it is most needed.

Yak Tunnel: In 1988, the EPA selected a remedy to minimize the flow of acid water from the Yak Tunnel and to prevent the uncontrolled release of tunnel drainage to the environment. It features: (1) building a surge pond to capture tunnel drainage and dissipate the effect of surges from the tunnel on the Gulch and River; (2) installing a permanent system to treat the tunnel water before discharging it; (3) installing plugs at three places in the tunnel to stop the uncontrolled discharge of mine drainage; (4) sealing shafts, drill holes, and fractured rock and diverting surface water to reduce the amount of water entering the tunnel; (5) establishing a surface and groundwater monitoring system; and (6) installing a pumping or drainage system to control water levels. Under EPA monitoring, the parties potentially responsible for site contamination are designing the remedies and conducting the cleanup. The parties finished building the surge pond and filter unit in 1989 and currently are designing the permanent treatment plant, which is scheduled for completion in the summer of 1992. All cleanup activities are scheduled for completion by the end of 1993.

Groundwater and Surface Water: EPA began investigation in 1987 of materials contributing contamination on the site. Fullscale studies of surface and groundwater began in 1991 with surface water sampling, streambed sampling, and toxicity testing of the California Gulch and adjacent drainages and the Arkansas River. Installation of 56 additional monitoring wells and piezometers is being done as part of a larger groundwater study.

In 1991 EPA and the PRPs began intensive studies under the following workplans: (1) Demographics surveys, (2) House dust, paint, & gardens, (3) Soils and disturbed materials mapping, (4) Lead/Cadmium/Arsenic mapping, (5) Tailings, (6) Mine waste rock, (7) Tailings, (8) Smelters/building materials, (9) Slag, (10) Metal speciation and (11) Lead bioavailability. Workplans for backround geochemistry studies and cultural resource inventories will occur in 1992.

Environmental Progress

The Surge Pond and temporary filter unit treating surface waterflow in California Gulch have been operational since 1989. The permanent treatment facility is scheduled for completion in the sumnmer of 1992.

Key for revisions to June 14, 1991 Draft: Attachment B-7
Added Text
~~Deleted Text~~

RULES PROPOSAL:

OREGON ADMINISTRATIVE RULES

CHAPTER 340

DIVISION 43

CHEMICAL MINING

~~**MINING OPERATIONS WHICH USE CYANIDE OR OTHER TOXIC CHEMICALS TO EXTRACT METALS OR METAL-BEARING MINERALS FROM ORES**~~

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS ~~SUBJECT TO THESE RULES~~

OAR 340-43-055~~065~~	Physical Stability of Retaining Structures and Emplaced Mine Materials
OAR 340-43-060~~070~~	Protection of Wildlife
~~OAR 340-43-075~~	~~Guidelines for Design and Installation of Vat-Leach Tanks, Vessels and Secondary Containment Systems~~
~~OAR 340-43-080~~	~~Guidelines for Containment and Detection of Releases from Vat-Leach Tanks, Vessels and Secondary Containment Systems~~
~~OAR 340-43-085~~	~~Guidelines for Inspection of Vat-Leach Tanks, Vessels and Secondary Containment Systems~~
OAR 340-43-065~~090~~	Guidelines for Design, Construction, and Operation of Heap-Leach Facilities
OAR 340-43-070~~095~~	Guidelines for Disposal of Mill Tailings
OAR 340-43-075	Guidelines for Disposal or Storage of Wasterock, Low-Grade Ore and Other Mined Materials
OAR 340-43-080~~100~~	Guidelines for Heap-Leach and Tailings Disposal Facility Closure
OAR 340-43-085~~110~~	Post-Closure Monitoring
OAR 340-43-090~~115~~	Land Disposal of Wastewater
OAR 340-43-095~~120~~	Guidelines for Open-Pit Closure

PURPOSE

340-43-005

The purpose of these rules and guidelines is to protect the quality of the environment and public health in Oregon by requiring application of "... all available and reasonable methods...", Oregon Revised Statutes (ORS) 468.710, for control of wastes and chemicals relative to design, construction, operation, and closure of mining operations which use cyanide or other toxic chemicals to extract metals or metal-bearing minerals from the ore ~~or~~ and which produce wastes or wastewaters containing toxic materials.

~~SCOPE~~

~~340-43-010~~

~~These rules and guidelines apply to mining operations which use chemicals to extract metals or metal-bearing minerals from the ore except for small mineral-extraction operations using froth flotation.~~

~~The rules do not apply to mining and mineral extraction operations which do not use chemical extraction methods. Examples of mining activities to which the rules do not apply are aggregate mines and those placer mines which use only gravity separation methods. Any mining operation, however, that produces waste rock or spent ore that has the potential for forming acidic leachate may be covered by one or more of the provisions of these rules.~~
~~Non-mining operations, such as smelters, are not covered by these rules.~~

DEFINITIONS

340-43-01~~5~~0

Unless the context requires otherwise, as used in ~~these rules~~ this Division:

(1) "Chemical process mine" means a mining and processing operation for metal-bearing ores that uses chemicals to dissolve metals from ores.

(2) ~~(1)~~ "Department" means the Department of Environmental Quality.

(3) ~~(2)~~ "Guidelines" means this body of rules contained in 340-43-04~~5~~0 through 340-43-1~~2~~00.

(4) "Positive exclusion of wildlife" means the use of such devices as tanks, pipes, fences, netting, covers and heap-leach drip-irrigation emitters or covered emitters.

~~(3) "Slurry" means a suspension of ore or waste materials in water.~~

(5) ~~(4)~~ "Tailings" means the spent ore resulting from the milling and chemical extraction process.

PERMIT REQUIRED

340-43-0~~20~~15

(1) A person proposing to construct a new chemical mining operation, commencing to operate an existing non-permitted operation, or proposing to substantially modify or expand an existing operation shall first apply for, and receive, a permit from the Department. The permit may be an NPDES (National Pollutant Discharge Elimination System) permit if there is a point-source discharge to surface waters or a WPCF (Water Pollution Control Facility) permit if there is no discharge. Consideration may be given to site-specific conditions such as climate, proximity to water, and type of wastes to establish the final permit type and requirements for the facility.

(2) The permit application shall comply with the requirements of OAR Chapter 340, Divisions 14 and 45 and be accompanied by a report that fully addresses the requirements of this Division ~~OAR 340, Division 43~~.

PERMIT APPLICATION ~~INFORMATION~~

340-43-02~~5~~0

(1) The permit application shall fully describe the existing site and environmental conditions, with an analysis of how the proposed operation will affect the site and its environment. The Department shall, at a minimum, require the information specified for the DOGAMI consolidated application under Section 13, Chapter 735, 1991 Oregon Laws. The Department will also use the information contained in NEPA (National Environmental Policy Act), EA (Environmental Assessment), or EIS (Environmental Impact Statement) documents, if they are required by the project, as partial fulfillment of the requirements of this paragraph. ~~The Department may accept the information and operating plan required by DOGAMI (Department of Geology and Mineral Industries) under OAR 632, Division 35, or the information contained in a NEPA (National Environmental Protection Act), EA (Environmental Assessment), or EIS (Environmental Impact Study) document as partial fulfillment of the requirements of this paragraph.~~

(2) The permit application shall, in addition to the information ~~required by the application forms,~~ described in Paragraph (1) above, include the following information, unless the information has been otherwise submitted:

~~(a) Site description;~~

~~(b) Site map;~~

(a) ~~(c)~~ Climate/meteorology characterization, with supporting data;

(b) ~~(d)~~ Soils characterization, with supporting data;

(c) ~~(e)~~ Surface water hydrology study, with supporting data;

(d) ~~(f)~~ ~~Surface~~ Characterization of surface water and groundwater quality;

(e) ~~(g)~~ Inventory of surface water and groundwater beneficial uses;

(f) ~~(h)~~ Hydrogeologic characterization of groundwater, with supporting data;

(g) ~~(i)~~ Geologic engineering, hazards and geotechnical study, with supporting data;

(h) ~~(j)~~ Characterization of mine materials and wastes which include, for example, overburden, waste rock, stockpiled ore, leached ore and tailings. Characterization of mine materials and wastes shall include, but not be limited to the following:

(A) Chemical and mineral analysis related to toxicity;

(B) Determination of the potential for acid water ~~generation~~ formation;

(C) Determination of the potential for long-term leaching of toxic materials from the wastes;

(i) ~~(k)~~ Characterization of wastewater (quantity and chemical and physical quality) produced by the operation;

(j)~~(l)~~ Assessment of the potential for ~~residual~~ acid-water formation from waste disposal facilities, low-grade ore stockpiles, waste rock piles and for surface water or groundwater accumulation in open pits that will remain after mining is ended.~~ and accumulation in open pits remaining after mining;~~

~~(m) Any other relevant baseline data.~~

(3) Data submitted by the permit applicant should be based on analysis of the actual materials, when possible, or may be based on estimates from knowledge of similar operations~~,~~ and professional judgment.

PLANS AND SPECIFICATIONS

340-43-0~~30~~25

(1) A person constructing or commencing to operate a chemical process mine or substantially modifying or expanding an existing chemical process mine~~ mining operation which will use cyanide or other toxic chemicals to extract metals or metal-bearing minerals from the ore or which will produce wastes or wastewaters containing toxic materials or substantially modifying or expanding an existing such operation~~ shall first submit plans and specifications to the Department for construction, operation and maintenance of the facilities intended for treatment, control and disposal of~~ potentially toxic~~ wastes.

(2) The Department shall approve the plans, in writing, before construction of the facilities may be started. The plans shall address all applicable requirements of this Division ~~these rules~~ and shall include, but not be limited to, the following:

(a) A description of the facilities to be constructed~~;~~, including tanks, pipes and other storage and conveyance means for processing chemicals and solutions and wastewaters;

(b) A ~~surface water~~ management plan for control of surface water;

(c) A ~~wastewater~~ management plan for treatment and disposal of excess wastewater, including provisions for reuse and wastewater minimization;

(d) A facility construction plan including, as applicable, the design of low-permeability soil barriers, ~~the installation method for geosynthetics,~~ the type of geosynthetics to be used and a description of their installation methods, the design of wastewater treatment facilities and processes, a quality assurance plan for applicable phases of construction and a listing of construction certification reports to be provided to the Department;

(e) A preliminary closure plan;

(f) A preliminary post-closure monitoring and maintenance plan;

(g) A spill containment and control plan.

DESIGN, CONSTRUCTION, OPERATION AND CLOSURE REQUIREMENTS

340-43-03~~5~~0

(1) All chemical process and waste disposal facilities~~,~~ ~~including~~ and facilities for mixing, distribution, and application of chemicals associated with on-site mining operations; ore preparation and beneficiation facilities; and processed ~~waste~~ -ore disposal facilities~~; and tailings disposal facilities~~ shall be designed, constructed, operated and closed in accordance with the guidelines contained in ~~these rules~~ this Division.

(2) A groundwater monitoring plan shall be submitted to, and be approved by the Department. Monitoring wells shall be installed for detection of groundwater contamination as required by ~~OAR 340-40~~ OAR Chapter 340, Division 40, unless the hydrogeology of the site or other technical information indicates that an adverse impact on groundwater quality is not likely to occur.

~~(3) The Department may approve other protective means if the permit applicant can demonstrate that they provide equivalent protection, or the Department may grant a variance from the requirement as provided in OAR 340-43-040.~~

(3) Alternative methods of control of wastes may be acceptable if the permit applicant can demonstrate that the alternate methods will provide fully-equivalent environmental protection. The burden of proof of fully-equivalent protection lies with the permit applicant.

(4) The Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with these rules.

~~GRANTING OF VARIANCES FROM SPECIFIED REQUIREMENTS~~

~~340-32-040~~

~~(1) The Department may, by written variance, waive certain requirements of these rules when size of operation, location, topography, operational procedures, or other site specific conditions indicate that the purpose of these rules can be achieved without strict adherence to the requirements.~~

~~(2) The Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with these rules.~~

EXEMPTION FROM STATE PERMIT~~S~~ FOR HAZARDOUS WASTE TREATMENT OR DISPOSAL FACILITIES

340-43-0435

(1) The state hazardous waste program requires a permit for the "treatment", "storage" or "disposal" of any "hazardous waste" as identified or listed in OAR Chapter 340, Division 101 from the Department, prior to the treatment and disposal of wastes. Permitting requirements can be found in OAR Chapter 340, Division 105, Hazardous Waste Management. ~~The Department may, by written variance, waive certain requirements of these rules when size of operation, location, topography, operational procedures, or other site specific conditions indicate that the purpose of these rules can be achieved without strict adherence to the requirements.~~

(2) However, any operation permitted under ~~these rules~~ this Division, which would otherwise require the neutralization or treatment of hazardous waste and

would require a permit pursuant to OAR ~~340-105~~ Chapter 340, Division 105, shall be exempt from the requirement to obtain such hazardous waste treatment permit.

~~(3) If processing wastes are not treated to the criteria contained in these rules, the permit applicant shall obtain a state hazardous waste treatment and disposal permit.~~

(3) All mined materials disposed of under this Division shall pass Oregon's hazardous waste rule criteria or they will be considered a state hazardous waste and must be disposed of accordingly.

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS ~~SUBJECT TO THESE RULES~~

PURPOSE

340-43-040~~5~~

(1) ~~The guidelines contained in these rules~~ This Division establishes criteria for the design, construction, operation and closure of ~~facilities subject to these rules~~ chemical mining operations and supplements the provisions of ~~paragraphs~~ OAR 340-43-005 through OAR 340-43-~~045~~035.

~~(2) Alternative methods of control of wastes may be acceptable if the permit applicant can demonstrate that the alternate methods will provide fully-equivalent environmental protection. The burden of proof of fully-equivalent protection lies with the permit applicant.~~

~~(3)~~(2) Any disapproval of submitted plans or specifications, or imposition of requirements by the Department to improve existing facilities or their operation will be referenced when appropriate, to applicable guidelines or ~~appropriate sections of these~~ rules.

GENERAL PROVISIONS

340-43-0~~5~~45

(1) Facilities permitted under either a WPCF or NPDES permit shall not discharge ~~inadequately treated~~ wastewater or process solutions to surface water,

groundwater or soils, except as expressly allowed by the permit.

(2) Facilities subject to these rules shall not be sited in 100-year floodplains~~, in~~ or wetlands~~, or on geological features of demonstrated seismic instability~~. A buffer zone (a minimum of 200 feet wide ~~at a minimum~~) shall be established between waste disposal facilities and surface waters.

~~(3) Permit applicants must demonstrate to the Department that the design of ore treatment facilities or waste disposal facilities sited in seismic impact zones or otherwise geologically unstable areas is adequate to ensure the integrity of all structural components of the facilities during operation, closure and post closure.~~

~~(4)~~ (3) All chemical conveyances (ditches, troughs, pipes, etc.) shall be equipped with secondary containment and leak detection means for preventing and detecting release of chemicals to surface water, groundwater or soils.

(~~5)~~ (4) Acid water accumulation in open pits resulting from the mining operation must be prevented by appropriate mining practices, by measures taken in the closure process, or be treated to control pH and toxicity, for the life of the pit.

~~(6)~~ (5) Construction of surface impoundment liner systems shall conform generally to the principles and practices described in EPA/600/2-88/052, Lining of Waste Containment and Other Impoundment Facilities, September 1988.

(6) The Department may require the permittee to hire a third-party contractor to perform the functions set forth below. Selection of the contractor shall be subject to Department approval.

(a) Review and evaluate the design and construction specifications of all mined-materials disposal facilities permitted under this Division for functional adequacy and conformance with Department requirements. The Department shall not approve construction of the disposal facilities until the design and construction specifications have been evaluated.

(b) Monitor the course of construction of all mined-materials disposal facilities for compliance with the approved design and construction specifications. The third-party contractor shall regularly document the progress of construction and the Department shall require the permittee to take corrective action if construction does not satisfactorily conform to the approved design and construction specifications.

CONTROL OF SURFACE WATER RUN-ON AND RUN-OFF

340-43-0~~6~~50

(1) Surface water run-on and run-off shall be controlled such that it will not endanger the facility or become contaminated by contact with process ~~toxic~~ materials or loaded with sediment. The control systems shall be designed to accommodate a 100-year, 24-hour storm event, or any other defined climatic event that is more appropriate to the site, and be placed so as to allow for restoration of the natural drainage network, to the maximum extent practicable, upon facility closure.

(2) All mined materials shall be properly placed and protected from surface water and precipitation so as not to be eroded and contribute sediment to site stormwater run-off or to otherwise contaminate surface water.

PHYSICAL STABILITY OF RETAINING STRUCTURES AND EMPLACED MINE MATERIALS

340-43-0~~6~~55

(1) Permit applicants must demonstrate to the Department that the design of chemical processing facilities and waste disposal facilities is adequate to ensure the stability of all structural components of the facilities during operation, closure and post closure.

~~(1)~~ (2) Retaining structures, foundations and mine materials emplacements shall be designed by a~~n independent,~~ qualified, registered professional and be constructed for long-term stability under anticipated loading and seismic conditions.

~~(2)~~ (3) Temporary structures and materials emplacements may, with written approval from the Department, be constructed to a lesser standard if it can be shown that they pose no, or minimal, threat to public safety or the environment.

PROTECTION OF WILDLIFE

340-43-0~~7~~60

(1) Wildlife shall be positively excluded from contact with chemical processing solutions and wastewaters containing chemicals.

(2) The Department may waive the positive exclusion requirement if the Oregon Department of Fish and Wildlife (ODF&W) certifies to the Department that the project is designed such that it will adequately protect wildlife.

~~(1) Provision shall be made for positive exclusion of wildlife from contact with processing chemicals, contaminated surface waters or wastewaters which are toxic to wildlife. Positive exclusion requires the use of such devices as pipes, fences, netting, covers and heap-leach drip-irrigation emitters.~~

~~(2) Hazing or other non positive protective measures are not acceptable.~~

~~**GUIDELINES FOR DESIGN AND INSTALLATION OF VAT-LEACH TANKS, VESSELS AND SECONDARY CONTAINMENT SYSTEMS**~~

~~**340-43-070**~~

~~(1) Owners or operators of new tank, vessel and secondary containment systems or components must ensure that the foundation, structural support, seams, connections, and pressure controls (if applicable) are adequately designed and that the system has sufficient structural strength, compatibility with the materials to be stored or treated, and corrosion protection so that it will not collapse, rupture, or fail. The owner or operator must obtain a written assessment reviewed and certified by an independent, qualified, registered professional attesting that the system has sufficient structural integrity and is acceptable for the storing and treating of materials.~~

~~This assessment shall include, at a minimum, the following information:~~

~~(a) Design standard(s) according to which the tank(s), vessel(s) and ancillary equipment is or will be constructed;~~

~~(b) Hazardous characteristics of the materials to be handled;~~

~~(c) For new tank systems or components in which the external shell of a metal tank or any external metal component of the tank system is or will be in contact with the soil or with water, a determination by a corrosion expert of:~~

~~(A) Factors affecting the potential for corrosion, including but not limited to:~~

~~(i) Soil moisture content;~~

~~(ii) Soil pH;~~

~~(iii) Soil sulfides level;~~

~~(iv) Soil resistivity;~~

~~(v) Structure to soil potential;~~

~~(vi) Influence of nearby underground metal structures (e.g., piping);~~

~~(vii) Stray electric current;~~

~~(viii) Existing corrosion-protection measures (e.g., coating, cathodic protection);~~

~~(B) The type and degree of external corrosion protection that is needed to ensure the integrity of the tank or vessel system during the use of the system or component, consisting of one or more of the following:~~

~~(i) Corrosion-resistant materials of construction such as special alloys or fiberglass-reinforced plastic;~~

~~(ii) Corrosion-resistant coating (such as epoxy or fiberglass) with cathodic protection (e.g., impressed current or sacrificial anodes);~~

~~(iii) Electrical isolation devices such as insulating joints and flanges.~~

~~(d) For underground tank system components that are likely to be affected by vehicular traffic, a determination of design or operational measures that will protect the tank system against potential damage;~~

~~(e) Design consideration to ensure that:~~

~~(A) Tank and vessel foundations will maintain the load of a full tank or vessel;~~

~~(B) Tank and vessel systems will be anchored to prevent flotation or dislodgement where the system is placed in a saturated zone, or is located within a seismic fault zone;~~

~~(C) Tank and vessel systems will withstand the effect of frost heave.~~

~~(2) The owner or operator of a new tank or vessel system must ensure that proper handling procedures are adhered to in order to prevent damage to the system during installation. Prior to covering, enclosing, or placing a new tank or vessel system or component in use, an independent, qualified professional who is trained and experienced in the proper installation of such systems, shall inspect the system or component for the presence of any of the following items:~~

~~(a) Weld breaks;~~

~~(b) Punctures;~~

~~(c) Scrapes of protective coatings;~~

~~(d) Cracks;~~

~~(e) Corrosion;~~

~~(f) Other structural damage or inadequate construction or installation.~~

~~All discrepancies shall be remedied before the system is covered, enclosed or placed in use.~~

~~(3) New tank or vessel systems or components and piping that are placed underground and backfilled shall be provided with a backfill material that is a noncorrosive, porous, homogenous substance and is carefully installed so that the backfill is placed completely around the system and compacted to ensure that the tank and piping are fully and uniformly supported.~~

~~(4) All new tanks, vessels and ancillary equipment shall be tested for tightness prior to being covered, enclosed or placed in use. If a tank or vessel system is found not to be tight, all repairs necessary to remedy the leak(s) in the system shall be performed prior to the tank or vessel system being covered, enclosed or placed in use.~~

~~(5) Ancillary equipment shall be supported and protected against physical damage and excessive stress due to settlement, vibration, expansion or contraction.~~

~~(6) The owner or operator shall provide the type and degree of corrosion protection necessary, to ensure the integrity of the tank or vessel system during use of the system. The installation of a corrosion protection system that is field fabricated shall be supervised by an independent corrosion expert to ensure proper installation.~~

~~(7) The owner or operator shall obtain and keep on file at the facility written statements by those persons required to certify the design of the tank or vessel system and supervise the installation of the system to attest that the system was properly designed and installed and that repairs, if necessary, were properly performed.~~

~~GUIDELINES FOR CONTAINMENT AND DETECTION OF RELEASES FROM VAT-LEACH TANKS, VESSELS AND SECONDARY CONTAINMENT SYSTEMS~~

~~340-43-080~~

~~(1) In order to prevent the release of toxic materials or wastes to the environment, secondary containment that meets the requirements of this section shall be provided for all new tank or vessel systems or components, prior to their being put into service.~~

~~(2) Secondary containment systems shall be:~~

~~(a) Designed, installed, and operated to prevent any migration of toxic materials or accumulated liquid out of the system to the soil, groundwater, or surface water at any time during the use of the system;~~

~~(b) Capable of detecting and collecting releases and accumulated liquids until the collected material is removed.~~

~~(3) Secondary containment systems shall be at a minimum:~~

~~(a) Constructed or lined with materials that are compatible with the materials to be placed in the system and of sufficient thickness to prevent failure due to pressure gradients (including static head and external hydrological forces), physical contact with the materials to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation (including stresses from nearby vehicular traffic);~~

~~(b) Placed on a foundation or base capable of providing support to the secondary containment system and resistance to pressure gradients above and below the system and capable of preventing failure due to settlement, compression, or uplift;~~

~~(c) Provided with a leak detection system that is designed and operated so that it will detect the failure of either the primary and secondary containment structure or any release of hazardous materials or accumulated liquid in the secondary containment system within 24 hours, or at the earliest practicable time if the existing detection technology or site conditions will not allow detection of a release within 24 hours;~~

~~(d) Sloped or otherwise designed or operated to drain and remove liquids resulting from leaks, spills, or precipitation. Spilled or leaked materials and accumulated precipitation shall be removed from the secondary containment system within 24 hours, or in as timely a manner as is possible to prevent harm to human health or the environment, if removal of the released waste or~~

~~accumulated precipitation cannot be accomplished within 24 hours.~~

~~(4) Secondary containment for tanks or vessels shall include one or more of the following:~~

~~(a) A line (external to the tank);~~

~~(b) A vault;~~

~~(c) A double-walled tank; or~~

~~(d) An equivalent device as approved by the Department.~~

~~(5) In addition to the requirements of paragraphs (2), (3), and (4) of this section, secondary containment systems shall satisfy the following requirements:~~

~~(a) External liner systems shall be:~~

~~(A) Designed or operated to contain 100 percent of the capacity of the largest tank within its boundary;~~

~~(B) Designed or operated to prevent run-on or infiltration of precipitation into the secondary containment system unless the collection system has sufficient excess capacity to contain run-on or infiltration. Such additional capacity shall be sufficient to contain precipitation from a 25-year, 24-hour rainfall event;~~

~~(C) Free of cracks or gaps; and~~

~~(D) Designed and installed to completely surround the tank or vessel and to cover all surrounding earth likely to come into contact with the waste if released from the tank(s) (i.e., capable of preventing lateral as well as vertical migration of the waste).~~

~~(b) Vault systems shall be:~~

~~(A) Designed or operated to contain 100 percent of the capacity of the largest tank or vessel within its boundary;~~

~~(B) Designed or operated to prevent run-on or infiltration of precipitation into the secondary containment system unless the collection system has sufficient excess capacity to contain run-on or infiltration. Such additional capacity shall be sufficient to contain precipitation from a 25-year, 24-hour rainfall event;~~

~~(C) Constructed with chemical-resistant water stops in place at all joints (if any);~~

~~(D) Provided with an impermeable interior coating or lining that is compatible with the stored materials and that will prevent migration of material into the concrete;~~

~~(E) Provided with an exterior moisture barrier or be otherwise designed or operated to prevent migration of moisture into the vault if the vault is subject to hydraulic pressure.~~

~~(c) Double-walled tanks shall be:~~

~~(A) Designed as an integral structure (i.e., an inner tank within an outer shell) so that any release from the inner tank is contained by the outer shell;~~

~~(B) Protected, if constructed of metal, from both corrosion of the primary tank interior and the external surface of the outer shell; and~~

~~(C) Provided with a built-in continuous leak detection system capable of detecting a release within 24 hours or at the earliest practicable time, if the owner or operator can demonstrate to the Department and the Department concurs, that the existing leak detection technology or site conditions will not allow detection of a release within 24 hours.~~

~~(6) Ancillary equipment shall be provided with full secondary containment (e.g., trench, jacketing, double-walled piping) except for:~~

~~(a) Above ground piping (exclusive of flanges, joints, valves, and connections) that are visually inspected for leaks on a daily basis;~~

~~(b) Welded flanges, welded joints, and welded connections that are visually inspected for leaks on a daily basis;~~

~~(c) Sealless or magnetic coupling pumps and sealless valves, that are visually inspected for leaks on a daily basis; and~~

~~(d) Pressurized above ground piping systems with automatic shut-off devices (e.g., excess flow check valves, flow metering shutdown devices, loss of pressure actuated shut-off devices) that are visually inspected for leaks on a daily basis.~~

~~GUIDELINES FOR INSPECTION OF VAT-LEACH TANKS, VESSELS AND SECONDARY CONTAINMENT SYSTEMS~~

~~340-43-085~~

~~(1) The owner or operator shall inspect, at least once each operating day:~~

~~(A) Overfill/spill control equipment (e.g., waste-feed cutoff systems, bypass systems, and drainage systems) to ensure that it is in good working order;~~

~~(B) The above-ground portions of the tank or vessel system, if any, to detect corrosion or releases of waste;~~

~~(C) Data gathered from monitoring equipment and leak-detection equipment (e.g., pressure and temperature gauges, monitoring wells) to ensure that the tank or vessel system is being operated according to its design; and~~

~~(D) The construction materials and the area immediately surrounding the externally accessible portion of the tank system including secondary containment structures (e.g., dikes) to detect erosion or signs of releases of materials (e.g., wet spots, dead vegetation).~~

~~(2) The owner or operator shall inspect cathodic protection systems, if present, according to, at a minimum, the following schedule to ensure that they are functioning properly:~~

~~(a) The proper operation of the cathodic protection system shall be confirmed within six months after initial installation, and annually thereafter;~~

~~(b) All sources of impressed current shall be inspected and/or tested, as appropriate, at least bimonthly (i.e., every other month).~~

~~(3) The owner or operator shall document in the operating record of the facility an inspection of those items in paragraphs (1) and (2) of this section.~~

GUIDELINES FOR DESIGN, CONSTRUCTION, AND OPERATION OF HEAP-LEACH FACILITIES

340-43-<u>065</u>~~090~~

(1) ~~These guidelines apply~~ This paragraph applies ~~generally~~ to heap-leach facilities using dedicated, or expanding, pads. Heap-leach facilities using on-off, reusable pads may require variations from these rules<u>; they</u> ~~that~~ shall be approved <u>on a case-by-case basis</u> by the Department.

(2) The heap-leach facility (pad and associated ponds, pipes and tanks) shall be sized to prevent flooding of any of its components. ~~A limited-use, emergency overflow pond (or tank) constructed to lesser requirements as described in this paragraph may be used in addition to the pregnant-solution pond (or tank) to reduce the required design capacity of the pregnant-solution pond(or tank).~~

(3) TABLE 1 of this Division establishes minimum capacity-sizing criteria <u>for the leach-pad and ponds</u>. The pad <u>and ponds</u>~~, pond and tank components~~ may be designed to act separately or in conjunction with each other to obtain the required storage volumes. <u>Other design criteria may be used, with Department approval, if local conditions warrant.</u> The best available climatic data shall be used to confirm the ~~most appropriate~~ <u>critical</u> design storm event and estimate the liquid levels in the system over a full

seasonal cycle. The liquid mass balance may include provision for evaporation.

(4) The heap-leach pad liner system shall be of triple liner construction with between-liner leak detection consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous ~~full~~ flexible-membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec);

(c) A leak-detection system between the synthetic liners capable of detecting leakage ~~equivalent to free flow from a total hole area of 0.05 square inches per acre of liner~~ of 400 gallons/day-acre within ten ~~one~~ weeks of leak initiation.

(5) The processing-chemical pond liners shall be of triple liner construction with between-liner leak detection consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;

(b) Continuous ~~full~~ flexible-membrane middle and top liners of suitable synthetic material separated by a ~~suitable~~ permeable material (minimum coefficient of permeability of 10^{-2} cm/sec);

(c) A leak detection system between the synthetic liners capable of detecting leakage ~~equivalent to free flow from a total hole area of 0.05 square inches per acre of liner~~ of 400 gallons/day-acre, within ~~one~~ ten weeks of leak initiation.

(6) Emergency ponds may be constructed as an alternative to larger pregnant and barren ponds. The emergency pond may be constructed to a lesser standard, with the limitation that it is to be used only infrequently and for short periods of time. The Department will specify reporting and use limitations

for the ponds in the permit. A between-liner leak detection system is not required for the emergency pond.

(7) The emergency-pond liner shall be of composite construction consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of $10^{\underline{-6}\,\cancel{-7}}$ cm/sec) with a minimum thickness of 12 inches, and

(b) A single ~~full~~ flexible-membrane synthetic top liner of suitable material.

~~(8)~~ (6) The heap-leach pad shall be provided with a process chemical collection system above the upper-most liner that will prevent an accumulation of process chemical within the heap greater than 24 inches in depth.

~~(9)~~ (7) The permittee shall prepare a written operating plan for safe temporary shut-down of the heap-leach facility and train employees in its implementation.

~~(10)~~ (8) The permittee shall respond to leakage collected by the heap-leach and processing-chemical storage pond leak-collection systems according to the process defined in TABLE 2.

~~(10) Leaks detected by the heap-leach and processing-chemical pond leak-detection systems with leak rates in excess of the rate for free flow through 0.05 square inches of hole per acre of liner at the actual liquid depth shall either be repaired at the first opportunity or operations shall be modified such that the leakage is reduced below the specified rate. The Department will set a time schedule for repair with the permittee, if necessary.~~

~~(11)~~ (9) The ~~permit applicant~~ permittee shall determine the acid-generating potential of the spent ore by acid\base accounting and other appropriate static and dynamic laboratory tests. If the spent ore is shown to be potentially acid generating under the conditions expected in the heap at closure, the permittee shall submit a plan for acid correction for Department approval prior to loading the heap.

GUIDELINES FOR DISPOSAL OF MILL TAILINGS

340-43-09~~5~~70

(1) Mill tailings shall be treated by cyanide removal and re-use prior to disposal to reduce the amount of cyanide introduced into the tailings pond. Chemical oxidation or other means shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the liquid fraction of the tailings. The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm. ~~Mill tailings shall be treated prior to disposal to remove or detoxify process chemicals and available toxic metals, and minimize potential formation of acid leachate in the waste disposal facility. The Department places first consideration on use of treatment technologies which will remove toxic metals, cyanide or other process chemicals and acid-generating minerals from the wastestream and use them in a beneficial manner. Second consideration will be given to cyanide oxidation or other "detoxification" treatments which will convert or remove toxic metals and cyanide complexes to reduce overall toxicity.~~

~~(2) The liquid-retention capacity of tailings disposal facilities which receive tailings as a slurry shall be designed to the (applicable) criteria of TABLE 1 to prevent overflow.~~

(3) The permittee shall determine the potential for acid-water formation from the tailings by means of acid-base accounting and other suitable laboratory static and dynamic tests. If acid formation can occur, basic materials shall be added to the tailings in the amount of three (3) times the acid formation potential or to give a net neutralization potential of at least 20 tons of $CaCO_3$ per 1000 tons of tailings, whichever is greater, before placing tailings in the disposal facility.

~~Disposal of non-acid-generating tailings.~~

~~(a) Non-acid-generating tailings should be disposed of as de-watered solids and the disposal area progressively covered, but disposal as a slurry will be considered.~~

~~(b) Tailings disposed of either as a slurry or as de-watered solids, shall meet the criteria of TABLE 2 or 3 of this Division, respectively.~~

~~(c) The disposal facility shall be lined with an engineered, stable, soil/clay liner with a maximum permeability of 10^{-6} cm/sec, having a minimum thickness of 12 inches and shall be provided with a collection system to remove stormwater.~~

(4) The disposal facility shall be lined with a composite double liner consisting of a flexible-membrane synthetic top liner in tight contact with an engineered, stable, soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) having a minimum thickness of 36 inches.

Construction of the liner shall generally follow the principles and practices contained in EPA/600/2-88/052, "Lining of Waste Containment and Other Impoundment Facilities, September, 1988.

~~Disposal of acid-generating tailings.~~

~~(a) Tailings, or waste materials that have been separated from tailings, which contain more than 1.0 g/kg of total sulfide sulfur and are acid generating, shall be disposed of in a separate disposal facility.~~

~~(b) Tailings or waste materials disposed of as a slurry or as de-watered solids shall meet the treatment criteria of TABLE 2 or 3, respectively, except that the sulfur criterion may be exceeded.~~

~~(c) The disposal facility shall be lined with a composite double liner consisting of a full-membrane synthetic top liner in tight contact with an engineered, stable, soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) having a minimum thickness of 36 inches.~~

~~Construction of the liner shall follow the principles and practices contained in EPA/600/2-88/052, "Lining of Waste Containment and Other Impoundment Facilities, September, 1988.~~

~~(d) The disposal facility shall be provided with a leachate collection system above the liner~~

~~suitable for monitoring, collection and treatment of potential acid drainage.~~

~~(e) The permittee shall segregate and place acid-generating and acid-neutralizing tailings in such a manner as to minimize acid~~ <u>water</u> ~~generation~~ <u>formation</u> ~~by maximizing neutralization and exclusion of water and oxygen, according to a Department-approved plan.~~

<u>(5) The disposal facility shall be provided with a leachate collection system above the liner suitable for monitoring, collecting and treating potential acid drainage.</u>

<u>GUIDELINES FOR DISPOSAL OR STORAGE OF WASTEROCK, LOW-GRADE ORE AND OTHER MINED MATERIALS</u>

<u>340-43-075</u>

<u>The permittee shall determine the acid-producing and metals- release potential of the wasterock, low-grade ore or other mined materials by acid/base accounting and other appropriate static and dynamic laboratory tests. If the mined materials are shown to be potentially acid forming, or capable of releasing toxic metals, the permittee shall submit a plan for correction and disposal for Department approval prior to permanently placing the materials.</u>

GUIDELINES FOR HEAP-LEACH AND TAILINGS DISPOSAL FACILITY CLOSURE

340-43-~~1~~0<u>8</u>0

(1) The waste disposal facilities shall be closed under these rules in conjunction with the reclamation requirements of DOGAMI (Oregon Department of Geology and Mineral Industries).

(2) An up-dated closure plan and post-closure monitoring and maintenance plan shall be submitted to the Department by the permittee at least 180 days prior to beginning closure operations or making any substantial changes to the operation. The closure plan must be compatible with DOGAMI's reclamation plan<u> and may be part of it</u>.

(3) Chemical conveyances (ditches, troughs, pipes, etc.) not necessary for post-closure monitoring shall be

removed. The secondary containment systems shall be checked before closure for process-chemical contamination, and contaminated soil or other materials, if any, shall be removed to an acceptable disposal facility.

(4) Closure of the heap-leach facility.

(a) The heap shall be detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm.~~, prior to closure by a combination of rinsing and chemical treatment as, for example, with hydrogen peroxide. Chlorine compounds shall not be used. Statistically-representative samples of the spent ore and the rinse water shall be taken and analyzed for the parameters listed in TABLE 4 of this Division. Residual cyanide levels shall meet the criteria of TABLE 4.~~

(b) Following detoxification as defined in (a) above, the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water and air infiltration. ~~Following detoxification and correction for acid-generation formation potential, if any, the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water infiltration.~~ The cover should consist, at a minimum, of a low-permeability layer ~~to prevent water infiltration~~ and suitable drainage and soil layers to prevent erosion and damage by animals and to sustain vegetation growth, in accordance with DOGAMI's reclamation rules.

(c) The ponds associated with the heap shall be closed by folding in the synthetic liners and filling and contouring the pits with inert material. Residual sludge may be disposed of in one of the on-site waste disposal facilities, provided it meets the criteria for such wastes in these guidelines. ~~removing the residual solid sludge and the synthetic liners and filling in and contouring the pits with inert material. The sludge may be disposed of in one of the on-site waste disposal facilities, with Department approval.~~ The process chemical collection system of the heap shall be maintained in operative condition so that it can be used to monitor the amount and quality of infiltrated water, if any, draining from the heap.

(5) The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time. ~~Closure of the non-acid-generating tailings disposal facility. The facility shall be closed in place by covering the tailings with a composite cover consisting, at a minimum, of a low-permeability layer to minimize water infiltration and suitable soil layers to prevent erosion and damage by animals and to sustain vegetation growth, in accordance with DOGAMI's reclamation rules.~~

~~(6) Closure of the acid-generating tailings disposal facility. The acid-generating tailings disposal facility shall be closed by covering with a composite cover designed to prevent water infiltration and be environmentally stable for an indefinite period of time.~~ Maximum effort shall be made to isolate the tailings from the environment. Construction of the cover shall generally follow the principles and practices contained in EPA/530-SW-89-047, Technical Guidance Document -- Final Covers on Hazardous Waste Landfills and Surface Impoundments.

POST-CLOSURE MONITORING

340-43-085~~110~~

(1) The Department may continue its permit in force for thirty (30) years after closure of the operation and will include permit requirements for periodic monitoring to determine if release of pollutants is occurring.

(2) ~~The facility water-quality permit may be continued in force for a nominal period of thirty years after closure of the operation and would include appropriate requirements for periodic monitoring to determine if release of pollutants is occurring.~~ Monitoring data will ~~would~~ be reviewed regularly by the Department ~~with DOGAMI regularly~~ to determine the effectiveness of closure of the disposal facilities. The Department will consult with DOGAMI on release of

security funds ~~before DOGAMI releases bond funds~~ that would otherwise be needed to correct problems resulting from ineffective closure.

LAND DISPOSAL OF WASTEWATER

340-43-090~~115~~

(1) To qualify for land disposal of excess wastewater, the permit applicant shall demonstrate to the Department that the process has been designed to minimize the amount of excess wastewater that is produced, through use of water-efficient processes, wastewater treatment and reuse, and reduction by natural evaporation. Excess wastewater that must be released shall be treated and disposed of to land under the conditions specified in the permit.

(2) A disposal plan shall be submitted as part of the permit application that, at a minimum, includes:

(a) Wastewater quantity and quality characterization;

(b) Soils characterization and suitability analysis;

(c) Drainage and run-off characteristics of the site relative to land application of wastewater;

(d) Proximity of the disposal site to groundwater and surface water and potential impact;

(e) Wastewater application schedule and water balance;

(f) Disposal site assimilative capacity determination;

(g) Soils, surface water and groundwater monitoring plan;

(h) Potential impact on wildlife or sensitive plant species.

(3) The Department will evaluate the disposal plan and set site-specific permit conditions for the wastewater discharge.

GUIDELINES FOR OPEN-PIT CLOSURE

340-43-095~~120~~

(1) Open pits that will be left as a result of the mining operation shall be assessed prior to, and following, mining operations for the potential to contaminate ~~accumulation of~~ water to the extent that it might not meet water-quality standards due to build-up of acid or toxic metals.

(2) If the Department finds ~~judges~~ that the potential for water accumulation in the pit(s) exists, the permit applicant shall submit a closure plan for the pit that will address contamination prevention and possible remedial treatment of the water. The closure plan shall, at a minimum, examine the following alternatives:

(a) Avoidance, during mining, of acid-generating materials that can be left in place, rather than being exposed to oxidation and weathering;

(b) Removal from the pit and disposal, during or after the mining operation, of residual acid-generating materials that would otherwise be left exposed to oxidation and weathering;

(c) Protective capping in-situ of residual acid-generating materials;

(d) Treatment methods for correcting acidity and toxicity of accumulated water ~~for correcting acidity and toxicity~~;

(e) Installation of an impermeable liner under ponded water to prevent groundwater contamination;

(f) Backfilling of the pit(s) above the water table to reduce oxidation of residual acid-generating materials.

TABLE 1

Heap-Leach Liquid Storage Criteria

Component	Pregnant-Solution Pond	Barren-Solution Pond
Operating Volume	Minimum necessary to maintain recirculation	Minimum necessary to maintain recirculation
Operational Surge	Anticipated draindown and rinse volume	Anticipated draindown and rinse volume
Climatic Surge	100-yr, 24-hr storm plus 10-yr snowmelt	100-yr, 24-hr storm plus 10-yr snowmelt
Safety Factor	2-ft dry freeboard	2-ft dry freeboard

TABLE 2

Required Responses to Leakage Detected from the Leach Pad

Leakage Category	Response
Zero leakage to 200 gal/day-acre	Notify the Department; increase pumping and monitoring
Leakage from 200 gal/day-acre to 400 gal/day-acre	Change operating practices to reduce leakage
Leakage in excess of 400 gal/day-acre	Repair leaks under Department schedule.

~~Tailings Slurry Treatment Criteria~~

~~Parameter~~	~~Allowable Concentration~~
~~Filtered Liquid Fraction:~~	
~~Cyanide (Total)~~	~~10 mg/l~~
~~Cyanide (Wad)~~	~~0.2 mg/l~~
~~Thiocyanate ion~~	~~75 mg/l~~
~~Cyanate ion~~	~~50 mg/l~~
~~Filtered Solid Fraction:~~	
~~Total Sulfur (Sulfide)~~	~~1.0 g/kg~~
~~ANP > 3 APP~~	~~(See Notes)~~
~~Both Liquid and Solid Fractions By EPA TCLP Method 1311:~~	
~~Arsenic~~	~~5 mg/l~~
~~Barium~~	~~100 mg/l~~
~~Cadmium~~	~~1 mg/l~~
~~Chromium~~	~~5 mg/l~~
~~Copper~~	~~1 mg/l~~
~~Lead~~	~~5 mg/l~~
~~Mercury~~	~~0.2 mg/l~~
~~Selenium~~	~~1 mg/l~~
~~Silver~~	~~5 mg/l~~
~~Zinc~~	~~1 mg/l~~

~~**Notes:**~~

~~1. Liquid fraction defined as filtered slurry liquid combined with distilled water rinsate of solid fraction; concentrations calculated on original liquid fraction volume.~~

~~2. Cyanide (Total) and (Wad) to be determined by ASTM D2036-82 A and C.~~

~~3. ANP = Acid neutralization potential in terms of the mass of equivalent $CaCO_3$ available, expressed in mass units per thousand mass units.~~

~~APP = Acid-producing potential in terms of the mass of equivalent $CaCO_3$ required for neutralization, expressed in mass units per thousand mass units.~~

~~TABLE 3~~

~~De-Watered Tailings-Solids Treatment Criteria~~

~~Parameter~~	~~Allowable Concentration~~
~~Soluble Cyanide (Wad)~~	~~0.5 mg/kg~~
~~Soluble Cyanide (Total)~~	~~2.5 mg/kg~~
~~Cyanide (Total) after extraction of Soluble (Wad) and Soluble (Total) Cyanide~~	~~10.0 mg/kg~~
~~Total Sulfur (Sulfide)~~	~~1.0 g/kg~~
~~ANP > 3 APP~~	~~(See notes)~~
~~By EPA TCLP Method 1311:~~	
~~Arsenic~~	~~5 mg/l~~
~~Barium~~	~~100 mg/l~~
~~Cadmium~~	~~1 mg/l~~
~~Chromium~~	~~5 mg/l~~
~~Copper~~	~~1 mg/l~~
~~Lead~~	~~5 mg/l~~
~~Mercury~~	~~0.2 mg/l~~
~~Selenium~~	~~1 mg/l~~
~~Silver~~	~~5 mg/l~~
~~Zinc~~	~~1 mg/l~~

~~Notes:~~

1. ~~See Appendix A for cyanide analysis method.~~

2. ~~"De-watered" means no free liquid.~~

3. ~~ANP = Acid neutralization potential in terms of the mass of equivalent $CaCO_3$ available, expressed in mass units per thousand mass units.~~

   ~~APP = Acid-producing potential in terms of the mass of equivalent $CaCO_3$ required for neutralization, expressed in mass units per thousand mass units.~~

~~TABLE 4~~

~~Heap-Leach Closure Criteria for Cyanide~~

~~Waste Fraction~~	~~Parameter~~	~~Concentration~~
~~Heap Rinsate (Liquid)~~	~~Cyanide (Wad)~~	~~0.2 mg/l~~
	~~Cyanide (Total)~~	~~10.0 mg/l~~
~~Spent Ore (Solids)~~	~~Soluble Cyanide (Wad)~~	~~0.2 mg/kg~~
	~~Soluble Cyanide (Total)~~	~~2.5 mg/kg~~
	~~Cyanide (Total) after extraction of Soluble (Wad) and Soluble (Total) Cyanide~~	~~10.0 mg/kg~~

~~Note:~~

~~See Appendix A for the cyanide analysis method applicable to the spent ore.~~

~~APPENDIX A~~

~~ANALYSES OF SPENT ORE AND TAILINGS~~

~~Analysis of the spent ore and tailings shall be performed with the following procedure:~~

~~1. For extraction of Soluble Cyanide (Wad):~~

~~a. Place 500 grams of dry spent ore or tailings in 2.5 liters of de-ionized water at neutral pH in an air-tight, capped container. Select the container size to minimize head space.~~

~~b. Stir mildly for 24 hours at room temperature.~~

~~c. Filter entire slurry from Step (1.b) through No. 42 Whatman paper and immediately analyze an aliquot for Wad cyanide.~~

~~d. Calculate Soluble Cyanide (Wad) as in Step (2.d).~~

~~2. For extraction of Soluble Cyanide (Total):~~

~~a. Place 500 grams of dry spent ore or tailings in 2.5 liters of distilled water; adjust to pH 5 with~~ $\cancel{H_2SO_4}$~~.~~

~~b. Stir mildly for 24 hours at room temperature in an air-tight, capped container with no head space.~~

~~c. Filter the entire slurry from Step (2.b) through a No. 42 Whatman filter paper and analyze an aliquot of filtrate for Soluble Cyanide (Total). Use the remaining solid fraction of the slurry for Cyanide (Total) in Step (3.).~~

~~d. Calculate Soluble Cyanide (Total) as mg CN/Kg of solids:~~

$$\cancel{\text{mg CN/Kg} = \frac{(\text{mg/L CNT in filtrate}) \times 2.5}{0.5}}$$

~~3. For determination of Soluble Cyanide (Wad), use ASTM D2036-82 C.~~

~~4. For determination of Cyanide (Total) after extraction of Soluble Cyanide (Wad) and Soluble Cyanide (Total) in the solid fraction, use ASTM D2036-82 A, with a minimum of 5 grams of the solid fraction remaining from Step (2.).~~

Summary of Record of EQC Discussions of Mining Rules

December 13, 1990

At a work session on December 13, 1990, the Commission and Department discussed a variety of options for regulation of the environmental aspects of large scale gold mining operations in Oregon.

This item was intended to provide an interchange of information between the staff and the Commission and provide a common basis for the development of a regulatory approach for large scale gold mining operations in Oregon. Commissioner Lorenzen expressed his desire that the Commission give the staff clear guidance on the approach to be developed. Commissioner Wessinger noted the need to listen to staff recommendations.

Jerry Turnbaugh, of the Water Quality Division, presented background information to the Commission on mining operation, and the particular issues where decisions will have to be made in the development of the regulatory approach. Commissioner Lorenzen asked about the Department's authority on federal lands and the Department's hazardous waste authority. Michael Huston stated that the State has clear environmental authority on federal lands. Brett McKnight, of the Hazardous and Solid Waste Division, cited the hazardous waste cleanup project at the Umatilla Army Depot as an example of the Department's authority. He also noted that under the federal Resource Conservation and Recovery Act (RCRA), the owner of a facility and the operator are both subject to regulation.

In response to Commission questions on regulatory framework, Director Hansen noted that design and performance standards can be incorporated either in rule or as conditions in permits. Chairman Hutchison asked about preferences for rules as opposed to leaving requirements to be determined by professional judgement of the staff. Dave Barrows, representing the mining industry, indicated that his organization was split on that issue. Jean Cameron, representing Oregon Environmental Council, stated that they always preferred standards in rules along with flexibility for the permit writers to incorporate more stringent requirements where needed. Director Hansen stated that the approaches can be combined -- rules that incorporate design and performance standards, and permits that contain conditions based on the rules, guidelines, and best professional judgement. He also noted that mining wastes are not hazardous waste under the federal definitions, but rules adopted by the Commission change that and regulate processing operations as hazardous waste generators. Brett McKnight indicated that mine tailings may or may not be hazardous wastes. If they are, then the Department would have to site a hazardous waste storage facility at the site.

John Beaulieu and Gary Lynch, representing the Department of Geology and Mineral Industries, discussed the interagency approach to review of mining proposals, and indicated that their legislative package seeks to require applicants to present both an environmental analysis and a socio-economic analysis as part of their applications.

Chairman Hutchison then asked the Commission for an expression of their thinking. Commissioners Lorenzen and Wessinger expressed a preference for moving forward with something as rapidly as possible so that industry knows what is expected. They expressed a preference for rules that are general and not too lengthy or specific. Dave Barrows suggested that something be drafted by the Department and taken to public hearing as soon as possible rather than trying to use an advisory committee to develop a proposal. Jean Cameron urged the Commission to not rush too fast because the issue is too important to do it wrong. Representative Bob Pickard encouraged the Commission to move with purpose. He stated that an advisory committee with a long schedule won't serve the Department well in the budget process.

The Commission discussed concepts of regulating to do away with environmental risk, of requiring use of the best technology being employed on a commercial scale anywhere, and of using a combination of rules and guidelines. The Commission indicated it would provide guidance to the Department during the regular agenda at the Friday meeting.

<u>**December 14, 1990**</u>

During the regular meeting on December 14, 1990, the Commission reflected on the Work Session discussion of the previous day and expressed the following views:

- Proceed to rulemaking hearings as soon as possible on rules to address open pit large scale mining in which chemicals are used for ore processing. (Placer mining will be treated separately.)

- Use an open process including public information meetings in the development of proposed rules (in place of an advisory committee process).

- Develop draft rules sufficient to proceed to hearing by the end of February. Proceed to a rulemaking hearing and complete the rulemaking process within six months.

- Report on progress at the February 1, 1991, meeting and provide an outline of proposed rules.

- Circulate drafts to the Commission for their information as they are developed in order to provide an opportunity for input.

- Use a blended approach involving both rules and guidelines. The rules should not be too detailed, and the guidelines ought to be dynamic but sufficiently precise to send a reasonable and sufficiently predictable message about the regulatory expectations of Oregon.

- Direct the rules toward eliminating risk to the environment.

- Make the rules a combination of performance-based and technology based requirements.

- Require the best technology available anywhere as the starting point. If technology is being used anywhere else commercially, that technology will be the starting point for requirements. Make the rules technology forcing.

- Clearly place the burden on the applicant to show why specific technology or performance standards shouldn't apply or why alternative approaches should be considered equivalent and acceptable.

- Evaluate and consider the relationship to RCRA requirements.

- Assure that the regulatory approach is preventative and that the need for future superfund cleanup is eliminated.

- Consider interagency coordination to the maximum extent practicable to minimize duplication of efforts by applicants and the public.

It was MOVED by Commissioner Wessinger that the Department proceed with development of rules based on the above guidance. The Motion was seconded by Commissioner Lorenzen and unanimously approved.

January 31, 1991

At the work session on January 31, Jerry Turnbaugh reported that the Department was proceeding in accordance with a schedule that called for completing a second draft of proposed rules for gold recovery operations by the end of February. That second draft was already complete. The target is to have a third draft which will be sufficient for distribution for public comment available by March 1. An informal group is being assembled to assist in a focused technical review of the rules on February 21. This group includes people from DEQ's water quality and solid waste programs, the Department of Fish and Wildlife, the Department of Geology and Mineral Industries, and several private sector individuals associated with and knowledgeable in mining processes and activities.

Commissioner Lorenzen complimented Mr. Turnbaugh on his efforts to develop rules to address Commission concerns. Commissioner Wessinger asked for an indication of the future problem areas with regard to the proposed rules. Mr. Turnbaugh responded that the cost of technology that is not typically practiced would be the issue. Examples would be technology to added processing steps to remove and reuse cyanide rather than discharging it with wastewater, and steps to remove acid generating materials to prevent generation of acids in the process.

Chair Hutchison asked what the draft rules would say about open mine pits. Mr. Turnbaugh indicated that these rules do not yet address water quality issues associated with the pit. Reclamation of pit areas is a responsibility of the Dept. of Geology and Mineral Industries. The groundwater section will be looking at groundwater impacts in more detail. The Department will also be looking at the relationship to solid waste and hazardous waste rules. Mr. Turnbaugh also indicated that an effort was being made to mesh closure requirements with the reclamation requirements of the Department of Geology and Mineral Industries.

Commissioner Lorenzen noted that the rules as drafted appropriately apply equally to operations on federal lands as well as operations on private lands.

July 25, 1991

At a work session on July 25, 1991, the Department reported on the status of the rule development process. Public hearings were held on the proposed rules as follows:

May 15, 1991 in Portland
May 17, 1991 in Nyssa
May 20, 1991 in Grants Pass.

The Department reported that comments were received from the following and that testimony was still being summarized and evaluated:

State and Federal Agencies

U.S. Fish and Wildlife Service
Oregon Department of Fish and Wildlife
Oregon Water Resources Department
Department of Geology and Mineral Industries

Mining Interests

Simplot
Horizon Gold
Atlas
Sunshine Mining
Phelps Dodge
Northwest Mining Association
Oregon Mining Council

Environmental Advocacy Groups

Oregon Environmental Council
Wilderness Society
National Wildlife Federation
Northwest Environmental Defense Center
Audubon Society
Native Plants Society
Sierra Club

Economic Development Interests

Mayors and Citizens of Nyssa, Ontario, Jordan Valley, Vale and Adrian

The Department summarized what appeared to be the most significant differences of opinion between the Department and the mining industry as represented by the Oregon Mining Council (OMC) as follows:

1. **End-of-pipe tailings cyanide treatment vs. no treatment or "natural" treatment**

The rules are based on end-of-pipe treatment as a basic pollution prevention method.

OMC comments deleted end-of-pipe treatment in favor of graduated containment of tailings wastes.

2. **Use of technology-based waste treatment criteria vs. application of water quality standards for heaps and tailings**

   The rules require treatment of tailings and heaps to "technology-based" criteria, regardless of whether groundwater or surface is likely to be affected.

   OMC comments would apply present water-quality standards or prevention of aquatic beneficial uses (only when water is affected) as appropriate regulatory criteria.

3. **Leak-detection and compliance at the heap liner vs. an allowable perimeter of soil contamination**

   The rules require a "triple" liner configuration that provides for leak detection in the uppermost liner, with a requirement for repair if leakage exceeds an allowable "de-minimis" rate.

   OMC proposes, at maximum, a "double" liner system with a lek detection system and repair if the leak exceeds the gravity flow capacity of the leak detection system.

4. **Positive wildlife exclusion vs. "safe" cyanide level**

   The rules require "positive" exclusion (netting, fences, etc.) of wildlife (undefined) from all cyanide-containing waters, on the basis that no appropriate standard for "safety" exists.

   OMC proposes that a known safe cyanide level exists (perhaps 50 parts per million) and should be used instead of exclusion.

5. **Long-term vs. short-term post-closure monitoring**

   The rules state that the permit may be continued in force for a "nominal" period of 30 years for monitoring purposes.

   OMC proposes that the permit be continued up to a maximum of five years after closure.

6. **Remedial actions relative to open pits**

   The rules require a closure plan to define remedial/protective measures for the pit, if there is a potential for accumulation of contaminated water.

   OMC proposes essentially the same thing but removes references to some items to be considered, such as pit-filling or mining avoidance in certain areas.

The Commission asked questions to clarify points of difference between the Department and OMC. Considerable discussion centered on the applicability of technology-based, BPJ (best professional judgment) criteria for mine waste detoxification versus water-quality-based criteria.
The Commission concluded the work session discussion by requesting staff to:

a. Complete a summary write-up of the hearings comments.

b. Complete a final draft of the proposed rules, based on the comments received and circulate the draft for review prior to the next Commission discussion of the issue.

c. Arrange for an advisory panel consisting of key representatives of the mining industry, environmental groups and the Department to meet with the full Commission during a Work Session to discuss the proposed rules.

The Commission indicated it would then follow the Work Session with specific direction to the Department on the next steps to be taken.

<u>October 10, 1991</u>

At this meeting, the Commission was provided with a package of materials which included the following items:

- Proposed Rules on Chemical Mining (October 10, 1991 Draft).

- Abstract of Technical Comments received during the public comment process.

- Response to Public Comment (significant issues).

- Markup of the rule proposal originally presented for comment at public hearings to show proposed changes.

At the meeting, Lydia Taylor, Administrator of the Water Quality Division, introduced the discussion on the chemical mining rules. She noted that two representatives of the mining industry and two representatives of the environmental community had been asked to make a presentation to the Commission on their views of the proposed chemical mining rules. Each group was advised to limit their presentation to 30 minutes. She also noted that Kent Ashbaker and Jerry Turnbaugh of the Water Quality staff were available to answer questions. She provided the Commission a table summarizing issues as addressed in the original draft of the rules and as addressed in the current draft. Director Hansen noted that representative of the Department of Geology and Mineral Industries and Department of Fish and Wildlife were also present to respond to questions.

Debra Struhsaker, an independent consultant on environmental and regulatory issues for the mining industry and for the Oregon Mining Council, began the presentation to the Commission on behalf of the mining industry. She noted that they would address their concerns with the technical aspects of the proposed regulations. She acknowledged the substantial efforts that had gone into the development of the rules to date. She noted that her experience is quite diverse in terms of the issues she has addressed and the states she has worked in, thus leading to a broad perspective on the issues. She handed out copies of overhead slides that she was using in her presentation.

Ms. Struhsaker made the following points in her presentation:

1. The rules should be performance standards rather than design or "universal" criteria. Regulations must apply to both eastern and western Oregon where climate, terrain, habitat, and hydrologic conditions are different. Universally prescribed design and closure criteria cannot satisfy the needs of Oregon's diverse natural environment. The current rules contain design criteria that are extremely stringent and may be good in some settings but not in others. Clarification of "alternative environmental protective means" is required. Clear guidelines need to be established for evaluating site specific criteria.

2. Hazardous Waste philosophy was used to write the rules and that is not necessary to protect the environment. The rules are inconsistent regarding whether mine waste is hazardous. A technically incorrect approach has been specified on waste classification.

3. Closure requirements are too prescriptive and should be based on site specific conditions. Compliance with environmental performance standards is achievable without requiring low permeability covers in many cases.

4. Proposed wildlife protection measures are redundant. Both detoxification and positive exclusion are required when either will suffice on tailings. The requirements need to mesh with Fish and Wildlife rules. The mortality problems at mining sites has been solved.

5. The wetlands restrictions should be removed.

Bill Schafer, representing the Oregon Mining Council, continued the presentation:

6. Thirty year post closure monitoring is not necessary. The duration of monitoring should be determined on a site specific basis.

7. The limitation of 24 inch hydraulic head in the heap effectively bans valley leach systems.

8. The approach to classification of mine wastes is flawed. EPA says method 1311 is incorrect for mine waste classification; 1312 should be used instead.

9. The proposed acid-potential evaluation provisions are inconsistent with

established practice. Mitigation measures should not be prescriptive.

Ms. Struhsaker closed by reiterating their desire to resolve the outstanding issues prior to rule adoption.

Larry Tuttle, representing Wilderness Society and other conservation organizations, summarized their involvement and concerns regarding mining wastes. He noted that they liked the first draft of the rules that were submitted to public hearing. Those rules were consistent with the governor's directive. He stated they were less happy with the second draft. They support development of the best standards to give certainty to the industry and to drive technology. He recommended that the Commission direct the Department to reopen the record and potentially hold added hearings. He suggested that the hearings be before the EQC.

Gary Brown, representing Citizens for Responsible Mining in Ontario, suggested that there will be many large scale mining operations in Oregon, not just a few. He provided a package of information for the record which recorded examples of problem mining operations. With respect to the present draft rules, he disagreed with the proposal to drop the triple liner requirement (one clay plus two synthetic) in favor of a double liner system (one clay and one synthetic in contact). He noted that the effects of leaks into the ground after closure was not known. He also noted that the heap retains large quantities of solution, and something is needed under the heaps to protect groundwater in the future. He also noted the need for long term protection through detoxification, that acid mine drainage is still a problem, and that problems should be prevented now and into the future rather than counting on the potential ability to correct them later.

Chair Wessinger then asked for questions from the Commission.

Commissioner Lorenzen asked for identification of a western state that was considered a model of environmental protection for mining wastes. Ms. Struhsaker indicated that Nevada and California were considered to be models. Commissioner Lorenzen asked to be provided with the names of contacts later. He then asked why mining waste should not be treated as hazardous waste. Ms. Struhsaker indicated that the large volumes of low hazard materials makes it difficult. She stated that if a waste tests as hazardous under the 1312 test, then it is treated as hazardous waste.

Chair Wessinger noted that when things get tough economically, environmental costs are easy to cut. He asked if the proposed rules were adequate for monitoring. Larry Tuttle responded that the legislature required third party monitoring to be paid for by the mining operation. In addition, a bond is required for all costs.

Chair Wessinger thanked the panel and asked the Department to come forward and summarize the major changes to the rules and the reasons for the changes. Jerry Turnbaugh summarized as follows:

(1) Mill Tailings/End of Pipe Treatment -- The proposed rules do not set wildlife protection levels, but a 30 ppm WAD maximum technology based limit is specified.

(2) Liners/Leak Detection/Closure -- The original proposal specified a triple liner system and the current draft proposes a double liner system. In response to a question about the reason for the change, Mr. Turnbaugh characterized the double liner system as low leakage and indicated that technical difficulties in effectively engineering and installing the triple liner system caused him to move to the double liner recommendation. In response to questions about leak detection, Mr. Turnbaugh stated that there is not a good leak detection system for use with the double liner system.

(3) A variance provision that was included in the initial draft was removed from the current draft. The Department now believed that variance type situations could be handled in permit drafting without adding the variance provision to the rules.

(4) Guidelines for tanks and vessels in the original draft were eliminated in the current draft. Such facilities were not expected to be extensively used, and could be handled adequately in the plan review process.

Chair Wessinger asked for suggestions on the next steps. Director Hansen suggested that the Commission could go step by step through the rules or it could give some direction to the Department and ask the Department to return. Among other issue that guidance would be welcomed on were whether the Commission wanted redundancy to be required in the level of protection provided, and whether the Department should defer to the Department of Fish and Wildlife on wildlife protection or make its own judgements.

Commissioner Lorenzen indicated that he wanted time to review the matter in light of the discussion before he voiced his reactions and recommendations. Commissioner Squier indicated that before she could form any judgments, she needed additional technical information on the state of the art in monitoring to detect leaks, and the ability to rapidly fix a leak once detected. This was necessary before she could form any judgments regarding the difference between double and triple liners and the need for redundancy.

Chair Wessinger stated that the Commission has expressed the desire for a very stringent rule. He noted that when they are done, they don't want an "Exxon". He suggested that the Department go back and evaluate the discussion and comments and return at the November meeting with a specific recommendation on the issues. At that time, the Commission would provide specific direction for developing the final rule draft. Commissioner Whipple noted that the Commission was not looking for a change in the approach.

November 7, 1991

The Commission convened a work session in Medford to continue the earlier Work Session Discussion of Proposed Rules for Mining Operations using Chemicals to Extract Metals from Ores. No public comment was taken at this work session. Discussion was between the Commission and Department staff.

Director Hansen asked the Commission to give advise that would allow the Department to complete a final draft of the mining rules. He suggested that major issues included other agency roles, extent of monitoring during operations, and the extent of engineered protection including how close proposed rule requirements should be to the Hazardous Waste program requirements.

Lydia Taylor, Administrator of the Water Quality Division, handed out a three column table summarizing the provisions of the rules sent out to public hearing (labeled the 6/14 draft), the rules as presented for discussion at the October 10 work session (the 10/10 draft), and the recommendation of the Department (Recommended).

Jerry Turnbaugh of the Water Quality staff summarized the recommendation on liners as a return to the original 6/14 draft which called for a triple liner system. In response to questions from Commissioner Lorenzen, Mr. Turnbaugh noted that the three liner system is better able to detect leaks, but requires more care to keep from puncturing the liner. He noted that some believe the two liner system is not as likely to leak. He also noted that a leak in the two liner system is not as likely to be detected. Commission members stated that this was one of the key issues to be determined. Director Hansen indicated that this is a judgment call. The question is whether an extra level of opportunity to detect and correct a problem is provided before the environment is affected, or whether one relies more heavily on a cap. The Commission discussed the potential for monitoring and the potential for preventing and detecting leaks.

Commissioner Lorenzen recommended that the rules be drafted to require triple liners, unless another way is proposed to assure an equivalent level of monitoring (leak detection) below the liner system. The Commission members concurred with this suggestion.

The next issue discussed was wildlife protection. The Department recommendation was the same as the 10/10 draft which proposed to rely on the Department of Fish and Wildlife. Mr. Turnbaugh noted that HB 2244 requires the Department of Fish and Wildlife to address wildlife protection measures for mining operations. Commissioner Lorenzen asked what happens if Fish and Wildlife doesn't act. Lydia Taylor responded that the proposed rules require elimination of exposure or positive exclusion.

The Commission agreed that the proposed rules should defer to Fish and Wildlife on the issue of wildlife protection measures.

Commissioner Lorenzen then raised the issue of review of design, construction and operation and indicated he would like to have the rules specify third party review. The Commission discussed options for such review including the reviewer hired by DEQ, the reviewer hired by the mining company subject to approval of DEQ, or the ability of DEQ to remove the reviewer or levy penalties. Director Hansen noted that RCRA requires that an independent engineer oversee construction. Mr. Turnbaugh indicated that the Department had considered third party review of design, but not construction or operation. Commissioner Lorenzen stated that it adds comfort to have an independent professional stake their reputation on the plan.

The Commission agreed that the proposed rules should provide for independent review of design, construction, and operation.

Lydia Taylor indicated that the Department was recommending that the requirements for mill tailings be tightened up. The original draft proposed a performance standard. Now the Department is proposing both a performance standard and two technologies -- removal/recycling of cyanide, and oxidation for greater stability.

The Commission agreed with the Department recommendation on tailings.

On the issue of testing, the Commission agreed with the recommendation to tie to the Hazardous waste requirements for testing to determine if the waste is hazardous, and managing the waste accordingly.

The Commission discussed the issue of seismic instability. Director Hansen noted that the proposal opts for some criteria for siting and assumes that facilities can generally be engineered to meet the site criteria. Lydia Taylor noted that existing groundwater criteria will have to be met. The Commission agreed with the Department recommendation.

On the issue of a variance provision, Lydia Taylor indicated that the variance provision in the original draft was eliminated in favor of an approach that will look at equivalent results in the plan review process. The Commission agreed with the proposal.

With respect to requirements for emergency ponds, Lydia Taylor advised that the requirements for emergency ponds were made less restrictive, and that if the ponds are planned to be used, they must be designed to the same standards as regular process facilities.

The next issue discussed was the monitoring after closure. Chair Wessinger asked how monitoring would be conducted after a mine was closed and the company gone. Mr. Turnbaugh indicated that requirements administered by DOGAMI include a bond to cover chemical processing and reclamation. He believed that monitoring could be covered under the bond. Commissioner Lorenzen indicated his desire to have parent corporations or the majority interest holder in the permittee to sign on to the permit to assure greater protection. Commissioner Whipple suggested the issue may be greater than just DEQ. Lydia Taylor indicated that the

intent of the new legislation was to cover the broader picture. Commissioner Lorenzen said his interest was to have any parent corporations guarantee the post closure obligation.
The consensus of the Commission was sympathy with the desire of greater security from the parent company or companies to the permittee and that this option should be looked into further.

The final issue discussed was the open pit itself. Mr. Turnbaugh indicated that the rules call for assessment and have not been modified. There was no suggestion for modification.

<u>December 13, 1991</u>

At this regular meeting, the Commission considered the Department recommendation to adopt proposed mining rules as presented in Attachment A of the staff report (rule draft dated 12/13/91). The proposed rules require mining operations using cyanide or other toxic chemicals to protect soils, groundwater, surface waters and wildlife from contamination or harm by process solutions and waste waters. The protective measures required by the proposed rules include cyanide recovery and re-use, chemical detoxification of cyanide residues and extensive lining and engineered closure of waste disposal facilities.

The department provided the Commission with a background summary of the proposed rules. Commissioner Lorenzen questioned the use of the term **disposal facility** on page A-10 of the proposed rules and asked that the wording be removed. Lydia Taylor, Administrator, Water Quality Division, responded that the term **disposal facility** would be removed from the proposed rules. Commissioner Lorenzen asked how reporting requirements listed in the rules would be handled. Ms. Taylor replied that reporting requirements would be dealt with on a permit-by-permit basis.

Ivan Urnovitz, Northwest Mining Association, **Mike Filio**, Tek Corporation, Vancouver, B. C., and **John Parks**, Atlas Precious Metals, represented the mining industry in a consolidated presentation.

Mr. Urnovitz expressed concerns regarding the following items:

- The mandatory requirement of a 36-inch clay liner.

- The tailings must be handled as hazardous waste.

- The controls were overly redundant and more requirements were in the rules than needed by the state of Oregon.

- The tests required were inappropriate. Mining wastes should be tested differently than municipal wastes.

- The wetlands requirements were arbitrary.

- The AVR system in regard to the liquid storage criteria was arbitrary and over redundant.

Mr. Filio stated that the rules were overly stringent and had caused the suspension of a negotiation with Atlas

Precious Metals on the Grassy Mountain project. His concerns were as follows:

- The method of reusing and recycling cyanide was not proven.
- That determining the potential of acid-water formation from the tailings added little benefit to the environment and was costly.
- That environmental benefits must justify added costs.

Mr. Parks complimented the staff on their efforts. He stated that he supported 80% of the rule proposals, but indicated that the 20% where disagreement exists cannot be quickly resolved. He stated that the "one size fits all" approach of the rules is not appropriate and results in unnecessary costs. He urged the Commission to take additional time to resolve the issues.

Mr. Urnovitz concluded that the rules would create a rigid, inflexible program with added costs to the mining industry. He said that added expense had not been considered, and that industry proposals met state requirements. Mr. Urnovitz suggested that an impartial review panel be established which would include the Commission chair, mining experts from Nevada or California and DEQ staff.

Larry Tuttle, The Wilderness Society, told the Commission that liner systems for tailings and heaps had been used in other states for a long time. He said that the rules would provide the mining industry the ability to prove that other approaches would provide equal protection. Mr. Tuttle added that early detection systems with triple liners would prevent cyanide from entering the soil. He said what was missing from the rules was a third-party verification of baseline data and that removing heavy metals should be a part of cyanide removal. Mr. Tuttle added that wetlands should not be risked and should not be considered at this meeting. He indicated that hazardous waste rules should apply to the tailings, and that EPA is looking at mining with that approach. He further added that the state would learn if the rules are too strict as mining activities occur. Mr. Tuttle concluded by stating that the rules should be adopted and that although the rules were not perfect, changes could evolve over time; the rules would protect the state and give the mining industry a chance to prove the rules were unnecessary.

Commissioner Squier stated that the term **waste** on page A-7 of the proposed rules was too narrow and needed to be clarified. Commissioner Whipple said that when the rules were being developed, the Commission was pushing the edge in terms of environmental protection. However, she stated, that she had concerns that more responsibility had been placed on the Commission to assure technical feasibility. She suggested that the department research the implications of mining activities and try to use the universities in this endeavor. Commissioner Whipple further added that the department should take the time to make sure the rules are technically feasible and correct. She also noted the risk of finding that the rules aren't stringent enough.

Commissioner Lorenzen expressed his general preference for performance standards rather than design standards but noted that there was no perfect performance measuring system. He expressed a desire for a third party review to examine the following issues to determine whether the proposed rules meet Commission goals:

- The requirements for liners under the heap.

- The recycling of cyanide.

- The treatment and long-term stability of tailing ponds.

He added that an independent opinion was needed on the question of whether the proposed rules were overly protective.

Commissioner Squier asked the department about the reuse of cyanide. Staff responded that reuse minimizes the use of cyanide and reduces the amount used; however, it is cheaper to buy cyanide and dispose of it. Staff further stated that by recycling cyanide the toxicity of the tailings can be reduced. Commissioner Lorenzen asked if there was another methodology in place other than the AVR system. Staff replied that the rules do not require AVR but do support removal and reuse.

Commissioner Castle said that the perception of the process was mostly economic. However, he stated, that this was not the purpose of their review. Commissioner Castle supported the idea of a third-party review but stated that the review should be confined to the technical issues relating to environmental protection. Chairman Wessinger expressed his desire not to use an industry committee but rather to find an individual or company with no ties to either side to evaluate the proposed rules. He further requested that the Department get back to the Commission as soon as possible regarding the steps for an independent review.

Director Hansen questioned the Commission about whether they wanted the third-party evaluation to be in the form of addressing applicable policy questions. He suggested that a review could focus on a review of technical issues in relation to the policy including assessment of the level of certainty that the technical requirements would meet the policy, and the technical feasibility of the requirements.

He further stated that the intent of House Bill 2244 was that rules be developed that were necessary and practical. He stated that the term "necessary" was in relation to protecting the environment and was without regard to cost. The term "practicable" applies to selection of alternatives, were available, to meet the "necessary" requirements.

Commissioner Squier noted that a third-party review would be expensive and would require time. She voiced her opinion that the **alternate methods** wording in the proposed rules allowed the department enough flexibility and favored adopting rules now.

Commissioner Lorenzen suggested that the review focus on narrow technical issues and then questioned if the department had the necessary funds to conduct the review. Commissioner Castle noted that the Department should spend whatever is necessary. Commissioner Lorenzen suggested that the third-party review should address the technical means of achieving the Commission's policies.

Commissioner Whipple, after some discussion and questioning of staff, moved that the Commission direct, with a high degree of specificity, that a third-party review be conducted on the issues of liner systems, removal and reuse of cyanide, and reduction of toxicity of the waste to the greatest degree possible. Commissioner Lorenzen seconded the motion with the understanding that closure of the various ponds, heap leach and tailings facility as well as the possible redundancy of the clay liner thickness was included within the context of the motion.

Director Hansen then summarized the issues to be addressed in relation to the policies: technical feasibility, level of certainty, other technologies.

He then noted that contracting with a third party would be a complex process, and suggested that the matter be further discussed by the Commission through a conference call within the next week.

Commissioner Squier made it clear that she wanted detection and repair of leaks before chemicals escaped into the environment to be reviewed. Chairman Wessinger, Commissioners Castle, Whipple and Lorenzen voted yes; Commissioner Squier voted no.

Water Quality Division Administrator Lydia Taylor then asked if it would be appropriate to defer action on any mining permit applications received pending completion of the third-party review and adoption of rules. The Commission agreed, and Commissioner Lorenzen noted that the Commission could very quickly adopt rules if a permit application was filed.

December 20, 1991

A special meeting by a conference call of the Environmental Quality Commission was held on Friday, December 20, 1991, at the Oregon Department of Environmental Quality, Conference Room 3A, 811 S. W. Sixth Avenue, Portland, Oregon. The purpose of the special meeting call was to discuss the Department's draft Request for Proposal (RFP) for technical advice on mining rules.

Commission members present by telephone were Vice Chair Castle, Commissioners Squier, Whipple and Lorenzen. Chair Wessinger, Director Hansen and Larry Knudsen, Assistant Attorney General, and Department staff were present in Conference Room 3A. The conference call began at 9:30 a.m.

At the December 13, 1991, EQC meeting, the Commission asked the Department to initiate a third-party review of liner systems, the removal and reuse of cyanide and the reduction of toxicity of the waste. Additionally, the Department was asked to review the technical means of achieving the Commission's policies. Draft portions of the RFP were forwarded to the Commission prior to the meeting.

Director Hansen indicated the draft RFP addressed the questions asked by the Commission and how those questions could be answered by an independent third party. Director Hansen summarized the pre-bid qualifications, procedures and processes related to the bidding and bidders. He requested that the Commission go through policy statements, issues and methods of answering.

Chair Wessinger asked Director Hansen to go through each issue of the draft RFP paragraph by paragraph. Each issue is discussed below.

Dr. Castle asked the staff for reactions to FAXed material the Commission had received. Director Hansen indicated that the memorandum had just been handed to him. The memorandum, from Mr. Richard Bach of Stoel, Rives, Boley, Jones & Grey, to John Parks, expressed concern with the proposed DEQ policy statements.
Lydia Taylor, Administrator, Water Quality Division, responded to Mr. Bach's preference to the wording "threat of harm" versus "release to the environment." Ms. Taylor said that the term "threat of harm" was too open ended and added that the purpose of the liner is to prevent a release. Commissioner Lorenzen agreed that the purpose of a liner is to keep liquid contained; if the liquid does escape from the liner, then that protective barrier is not working. Additionally, Chair Wessinger agreed with Commissioner Lorenzen's interpretation and stated that environment is the important term.

Commissioner Castle further agreed. He said Department staff correctly interpreted the direction with regard to economics; that is, a technical analysis rather than an economic analysis. Commissioner Castle stated he did not agree that risk had been excluded and that the wording asks for statements of the reviewer on the level of certainty in achieving goals.

Director Hansen said that in regard to Mr. Bach's comments about what was described in the Department's memorandum as a note at the bottom of page 1 and top of page 2 and the definition of a double liner at bottom of page 2, the Department did not object to substitute Oregon Mining Council (OMC) wording if the Commission agreed with the OMC proposed language. Director Hansen indicated that the Department was trying to describe the OMC proposal, not editorialize on it. Further, **Jerry Turnbaugh**, Water Quality Division, indicated that he had no objection to OMC's characterization of the double liner, and that it was a fair statement of what the Department believes the liner will accomplish.

Director Hansen told the Commission that OMC had suggested two additional questions be included under **Method to Answer Question--Address**. He said that the answer to their suggested Question No. 5 was implicit; Question No. 6 was the about the issue of economics which the Commission had rejected.

Commissioner Lorenzen commented on the framing of the question itself. He suggested "Will either or both liner systems meet the stated objective of the

Commission?" Commission Squier agreed with Commissioner Lorenzen. Commissioner Lorenzen stated that an additional question could be answered as a part of Issue No. 4(a): "Is 36 inches as required by Issue 4(a) the appropriate thickness to assure a high probability of achieving the Commission's objective?" He further stated that the requirement of 36 inches would be a high-cost item in some areas and expressed concern about this requirement if it was unnecessary; however, if this requirement was necessary, he had no reservations. Director Hansen indicated that **Method to Answer**, Question No. 4, addressed this issue.

Commissioner Lorenzen agreed as long as that is what Answer No. 4 meant. He further indicated concern about implementing costly regulations that do not provide further benefits; therefore, economics must be implicitly considered.

Commissioner Whipple also expressed concern about economics and redundancies. She said that it should not be difficult to obtain from the answers to the technical questions about a sense of the relative costs involved.

Commissioner Castle stated that the Commission did not want an economic analysis. He added that it was appropriate that the consultant address the issue of redundancy. From that, Commissioner Castle stated, the Commission can make judgments about whether the rules require additional measures that incur added cost but does not further protect the environment. He said that the Commission will not ignore economics when a decision is made.

Director Hansen said that the question as phrased uses the words "materially reduce." He indicated that the intent was to provide a basis for determining if there are environmental benefits to the requirements. Director Hansen referred to letter from Martha Pagel to Representative Schroeder about the idea that the rules were contrary to legislative intent. Ms. Pagel stated in her letter that two terms must be considered when meeting environmental standards: necessary and practicable. She said "necessary" is defined as that which is necessary to meet the standard and protect the environment. In further clarifying Ms. Pagel's letter, Director Hansen said that the policy statement reflects what the Commission believes is necessary to protect the environment. He stated that the question then becomes whether there are alternatives for meeting the standard and that "practicable" is considered when determining the alternative to meet the standard.

Commissioner Castle asked about the procedures to be followed in developing the final RFP. He asked if the Commission was putting the RFP in final form or if they were giving the staff advice to guide development of the final RFP. Director Hansen responded that it was the Commission's choice but the closer the Commission would come to final wording on the policy statements and questions the better. He asked the Commission to clarify that the question on the first policy issue will read: "Will either or both liner systems meet the stated policy objective of the Commission?"

Chair Wessinger asked Commissioner Lorenzen if that wording contained the difference he sought. Commissioner Lorenzen replied that perhaps one liner would meet the stated policy better than the other; maybe both liners would meet the stated policy adequately but that one will meet the policy better. Director Hansen indicated that the **Method to Answer**, Question No. 3, provides for more detail and level of certainty.

The Commission agreed that the question wording for the first policy would read as follows:

> Will either or both liner system meet the stated policy objective of the Commission?

In regard to the second policy issue, Commissioner Whipple said that she believed Mr. Bach's two additional questions (proposed questions 5 and 6) would be answered within the context of how the questions were phrased. Commissioner Squier said she believed industry intended that a difference exist because the term "management practices" was used rather than technology which would allow a broader interpretation. Commissioner Whipple asked if there were other ways to meet the policy and indicated she would not like to delay over the definition of technology. Chair Wessinger asked Department staff about technology as compared with management practices.

Mr. Turnbaugh told the Commission that the rules state that cyanide recovery and reuse are an end-of-pipe treatment technology applied before tailings are released to the impoundment. He said that industry would argue that the tailings pond is a treatment system since some natural degradation occurs and solutions can be recirculated from the tailings pond. He concluded he believed the mining industry was broadening the scope of definition beyond end of pipe and beyond what was intended in the Department's proposed rules.

Director Hansen said the issue to be addressed was whether treatment of the tailings would be required before being released to the tailings pond or whether the tailings pond would be part of the treatment system.

Commissioner Whipple said the policy is aimed at reducing toxicity in the releases to greatest degree practicable through treatment. Director Hansen stated that the Department believes that once the material is in the tailings pond, a greater risk of release to the environment exists; therefore, the Department wanted to reduce the toxicity to the greatest degree practicable before discharging the material to the tailings pond.

Commissioner Whipple asked if the policy addressed long-term impacts of treatment. Director Hansen replied that once the material is discharged to tailings pond, it is difficult to control. Commissioner Lorenzen commented that this issue should be examined by the consultant.

Commissioner Lorenzen asked if a process was discovered in the future to reprocess the tailings pond, would the Department allow material to be discharged to the pond with assurance of containment rather than treatment first. He suggested a possible revision to the policy:

> The Commission establishes as policy that the closure of the heap leach and tailings disposal facilities shall be accomplished by a means that ~~to the greatest extent possible~~ <u>a high degree of probability</u> over the long term will prevent release to the environment of any chemicals contained in the facility.

Commissioner Lorenzen also stated that he would not want the tailings spread over a large area without there being a substantial effort to reduce toxicity. He said that dealing with the tailings was a long-term effort, not just 20 years.

Director Hansen added that the liner system required by the draft rules for a tailing pond is different than under a heap leach pad because of the assumption of lower toxicity due to pretreatment. He added that the Department would look at treatment requirements differently if the liner under the tailings pond was the similar to the liner under the heap leach pad.

Commissioner Squier asked Mr. Turnbaugh about 30 parts per million (ppm) cited under **Issue** in Policy No 3. Mr. Turnbaugh replied that 30 ppm is the "best professional judgment" estimate of achievable level of detoxification that can be achieved with a variety of treatment technologies. Commissioner Squier asked how the Department would respond to a business in Portland that was discharging 35 ppm. She further clarified her question by asking how the Department would view 30 ppm of cyanide in other industrial settings: would that discharge be considered a hazardous waste and require barrelling and labeling?

Mr. Turnbaugh replied that he was uncertain of the answer. He said the Department had intended to require end-of-pipe treatment to reduce the toxicity, which is the purpose of the rules. Consequently, he continued, the Department must decide how much technology should be applied. Mr. Turnbaugh said the Department examined potential technologies and concluded that 30 ppm can be achieved. However, he said, 30 ppm is not intended to be a wildlife protective measure and does not relate to liner design. Cyanide that has been discharged to a pond can be released to the air, and this type of release necessitates modeling to determine human health risk.

Commissioner Whipple indicated her inclination to not expand the policy to include management practices. Director Hansen replied that an additional question could be considered: would a liner system be adequate or would the liner system need to be upgraded to achieve the Commission's policy regarding the release of toxics from the tailings pond. Chair Wessinger replied that he was inclined to agree with current staff recommendation.

Commissioner Squier had two questions regarding end-of-pipe treatment:

1. Is 30 ppm achievable with current technology?

2. Does the Department want to have a policy that allows discharges to the pond and confinement of the pond to protect the environment rather than promotes best achievable technology at the end of pipe?

She indicated that the draft proposal addresses the first question but she did not want to open the second question up for debate; therefore, she agreed with Chair Wessinger. Commissioner Whipple also agreed with the draft proposal. Commissioner Castle stated he had no problem with staff formulation and said that these issues will be addressed if Question Nos. 2 and 4 are adequately answered. Commissioner Lorenzen agreed.

Director Hansen summarized that the suggested Question No. 5 in Mr. Bach's letter would not be included. Mr. Turnbaugh said that he had no problem with Mr. Bach's Question No. 5 but would note that non-use may be a matter of choice rather than technical feasibility.

At this point in the meeting, Commissioner Lorenzen excused himself from the conference call. However, he added that he did have a comment about the policy on page 4, second line, about the reference "...to the greatest extent possible." He suggested the wording to a high degree of probability. Director Hansen replied that the Department was attempting to reflect the Commission's intent. He said that **Method to Answer Question--Address**, No. 3, would partially address this issue. Commissioner Castle said that if Commissioner Lorenzen's questions were adequately answered, would he have concern. Commissioner Lorenzen replied no but believed there may be a problem relating this question to policy. Commissioner Castle suggested the following wording to help meet Commissioner Lorenzen's concerns:

> The Commission establishes as policy that the closure of the heap leach and tailing disposal facilities will prevent release to the environment of toxic chemicals contained in the facility.

He suggested this wording be substituted as policy and the questions would not be changed. Commissioner Lorenzen agreed with Commissioner Castle's suggested wording; Commissioner Squier also agreed.

Commissioner Lorenzen then left the conference call.

Director Hansen Fred suggested that **Method to Answer Question--Address**, No. 2, be changed to read as follows:

2. Do detoxification and covering (evaluated and together separately) materially reduce the likelihood of a release of toxic chemicals to the environment?

Commissioners Castle and Squier agreed.

Director Hansen them presented the proposal requirements. He said a concern had surfaced about one item from discussion with the person Commissioner Castle had suggested. In regard to Proposal Requirement No. 2., if followed, the Department would end up with consultants not in touch with the technologies the Commission wanted evaluated. He said that the idea of independence was important.

Commissioner Castle suggested a change to Proposal Requirement No. 2:

2. Noninvolvement for a minimum of ~~the past~~ five years ~~with the mining industry in general, and specifically~~ with mining companies, mining industry groups, or environmental groups active in working on mining regulations and permitting.

Director Hansen suggested a proposed change made by Larry Tuttle, The Wilderness Society, as follows:

2. A substantial portion of income for a minimum of ~~the past~~ five years ~~with the mining industry in general, and specifically~~ with mining companies, mining industry groups, or environmental groups active in working on mining regulations and permitting.

Chair Wessinger indicated that he was apprehensive that consultants who could perform the job would be disqualified. Director Hansen suggested the following wording:

2. Preference will be given to entities who have had no involvement within the five (5) years. As a bid requirement, one must disclose all contacts or contracts they have had over the past five (5) years for evaluation.

Commissioner Squier indicated that she agreed with that wording, and Commissioner Castle also agreed to the proposed wording.

Ms. Taylor indicated that the Department wanted to allow judgment and that conflict of interest with anyone hired was an important consideration. She said that disclosure was important, and that the Department would ask the applicant to disclose any potential conflict of interest and whether a substantial part of their income over the past five (5) years was derived from the mining industry.

Chair Wessinger, Commissioners Castle, Squier and Whipple agreed.

Director Hansen indicated if the Commission had nothing else to add to the memorandum, the Department will proceed. He added that although this memorandum was not the proposal and that more information must be added to meet requirements, it did contain the essential elements and no formal action was needed.

Commissioner Squier stated that she would like to hear back from staff after proposals are in about the time schedule and cost range. Ms. Taylor replied that she will keep the Commission informed. Chair Wessinger asked that the Commission be sent reports about the progress of the proposal. Director Hansen indicated that he will include the status of the proposal in the Director's Report and keep them advised in interim if anything significant occurs.

Subsequent Actions

On January 7, the Department forwarded a draft to the Commission, labeled a "second draft" of the elements to be included in the RFP for consultant services. A draft of the full RFP (including all of the legally required language, etc.) was prepared. On February 3, 1992, a final draft of the RFP was forwarded to Commission members for review and comment. The transmittal memo noted that there had been numerous contacts from representatives of the mining industry while the Department was developing the final wording of the RFP. The RFP was issued on February 7, 1992.

Following the December 20, 1991, Conference Call meeting, the Department has reported to the Commission at each meeting on the current status of the consultant review process.

Note: This summary is for the most part a reproduction of the Commission approved minutes of the respective meetings. Some additions have been made to enhance readability and clarity.

HLS:l

Note: At a telephone conference meeting on September 1, 1992, the Environmental Quality Commission adopted the following **new** rules.

RULES PROPOSAL:

OREGON ADMINISTRATIVE RULES

CHAPTER 340

DIVISION 43

CHEMICAL MINING

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

OAR 340-43-060	Protection of Wildlife
OAR 340-43-065	Guidelines for Design, Construction, and Operation of Heap-Leach Facilities
OAR 340-43-070	Guidelines for Disposal of Mill Tailings
OAR 340-43-075	Guidelines for Disposal or Storage of Wasterock, Low-Grade Ore and Other Mined Materials
OAR 340-43-080	Guidelines for Heap-Leach and Tailings Disposal Facility Closure
OAR 340-43-085	Post-Closure Monitoring
OAR 340-43-090	Land Disposal of Wastewater
OAR 340-43-095	Guidelines for Open-Pit Closure

PURPOSE and POLICIES

340-43-006

(1) The purpose of these rules and guidelines is to prevent water pollution and protect the quality of the environment and public health in Oregon, consistent with the policies of ORS 468B.015 and 468B.020, by requiring application of all available and reasonable method for control of wastes and chemicals relative to design, construction, operation, and closure of mining operations which use cyanide or other toxic chemicals to extract metals or metal-bearing minerals from the ore and which produce wastes or wastewaters containing toxic materials.

(2) The following policies are established to provide further guidance regarding the level of environmental protection these rules are intended to achieve:

(a) Liner, leak detection and leak collection systems (systems) are necessary for heap leach pads, solution ponds, and tailings facilities to assure that any leak will be detected before toxic materials escape from the liner system and are released to the environment. For purposes of these rules, the environment is considered to begin at the bottom of the last liner. These systems shall assure that a leak is found, and that sufficient time is available to allow for the repair of the leak and clean up of any leaked material before there is a release to the environment. Natural conditions, such as depth to groundwater or net rainfall, shall be considered as additional protection but not in lieu of the protection required by the engineered liner system.

(b) The toxicity of mill tailings and the potential for long-term cyanide and toxic metals release from mill tailings shall be reduced to the greatest degree practicable through removal, reuse, or destruction of chemical solutions prior to placement of tailings in the tailings disposal facility.

(c) The closure of heap leach pads and tailings disposal facilities shall prevent future release to the environment of residual potentially toxic chemicals contained in the facility.

DEFINITIONS

340-43-011

Unless the context requires otherwise, as used in this Division:

(1) "Chemical process mine" means a mining and processing operation for metal-bearing ores that uses chemicals to dissolve metals from ores.

(2) "Department" means the Department of Environmental Quality.

(3) "Guidelines" means this body of rules contained in 340-43-045 through 340-43-100.

(4) "Positive exclusion of wildlife" means the use of such devices as tanks, pipes, fences, netting, covers and heap-leach drip-irrigation emitters or covered emitters.

(5) "Tailings" means the spent ore resulting from the milling and chemical extraction process.

PERMIT REQUIRED

340-43-016

(1) As required by ORS 468B.050, a person proposing to construct a new chemical mining operation, commencing to operate an existing non-permitted operation, or proposing to substantially modify or expand an existing operation shall first apply for, and receive, a permit from the Department. The permit may be an NPDES (National Pollutant Discharge Elimination System) permit if there is a point-source discharge to surface waters or a WPCF (Water Pollution Control Facility) permit if there is no discharge. Consideration may be given to site-specific conditions such as climate, proximity to water, and type of wastes to establish the final permit type and requirements for the facility.

(2) The permit application shall comply with the requirements of OAR Chapter 340, Divisions 14 and 45 and be accompanied by a report that fully addresses the requirements of this Division.

(3) Prior to issuance of a permit for a chemical process mining activity under this Division, a determination of compliance with statewide planning goals and compatibility with local land use plans must be made. The Department shall determine compliance with Statewide Planning Goals and compatibility with acknowledged comprehensive plans and land use regulations in a manner consistent with its approved State Agency Coordination Program and the rules in OAR Chapter 340, Division 18. In making these determinations, the Department shall consider and may rely on the findings and recommendations made by the project coordinating committee authorized by ORS 517.965 and by the Department of Geology and Mineral Industries pursuant to their State Agency Coordination Program and OAR Chapter 632, Divisions 1 and 37.

PERMIT APPLICATION

340-43-021

(1) The permit application shall fully describe the existing site and environmental conditions, with an analysis of how the proposed operation will affect the site and its environment. The application shall, at a minimum, contain the information specified for the DOGAMI (Department of Geology and Mineral Industries) consolidated application under ORS 517.971 (Section 13, Chapter 735, 1991 Oregon Laws). The Department will also use the information contained in NEPA (National Environmental Policy Act), EA (Environmental Assessment), or EIS (Environmental Impact Statement) documents, if they are required for the project, as partial fulfillment of the requirements of this paragraph.

(2) The permit application shall, in addition to the information described in Paragraph (1) above, include the following information, unless the information has been otherwise submitted:

(a) Climate/meteorology characterization, with supporting data;

(b) Soils characterization, with supporting data;

(c) Surface water hydrology study, with supporting data;

(d) Characterization of surface water and groundwater quality;

(e) Inventory of surface water and groundwater beneficial uses;

(f) Hydrogeologic characterization of groundwater, with supporting data;

(g) Geologic engineering, hazards and geotechnical study, with supporting data;

(h) Characterization of mine materials and wastes which include, for example, overburden, waste rock, stockpiled ore, leached ore and tailings. Characterization of mine materials and wastes shall include, but not be limited to the following:

(A) Chemical and mineral analysis related to toxicity;

(B) Determination of the potential for acid water formation;

(C) Determination of the potential for long-term leaching of toxic materials from the wastes;

(i) Characterization of wastewater (quantity and chemical and physical quality) produced by the operation;

(j) Assessment of the potential for acid-water formation from waste disposal facilities, low-grade ore stockpiles, waste rock piles and for surface water or groundwater accumulation in open pits that will remain after mining is ended.

(3) Data submitted by the permit applicant should be based on analysis of the actual materials, when possible, or may be based on estimates from knowledge of similar operations and professional judgment.

PLANS AND SPECIFICATIONS

340-43-026

(1) A person constructing or commencing to operate a chemical process mine or substantially modifying or expanding an existing chemical process mine shall first submit plans and specifications to the Department for construction, operation and maintenance of the facilities intended for treatment, control and disposal of wastes.

(2) The plans shall address all applicable requirements of this Division and shall include, but not be limited to, the following:

(a) A description of the facilities to be constructed, including tanks, pipes and other storage and conveyance means for processing chemicals and solutions and wastewaters;

(b) A management plan for control of surface water;

(c) A management plan for treatment and disposal of excess wastewater, including provisions for reuse and wastewater minimization;

(d) A facility construction plan including, as applicable, the design of low-permeability soil barriers, the type of geosynthetics to be used and a description of their installation methods, the design of wastewater treatment facilities and processes, a quality assurance plan for applicable phases of construction and a listing of construction certification reports to be provided to the Department;

(e) A preliminary closure plan;

(f) A preliminary post-closure monitoring and maintenance plan;

(g) A spill containment and control plan.

(3) The Department shall approve the plans, in writing, before construction of the facilities may be started.

DESIGN, CONSTRUCTION, OPERATION AND CLOSURE REQUIREMENTS

340-43-031

(1) All chemical process and waste disposal facilities and facilities for mixing, distribution, and application of chemicals associated with on-site mining operations; ore preparation and beneficiation facilities; and processed ore disposal facilities shall be designed, constructed, operated and closed in accordance with the guidelines contained in this Division.

(2) Alternative facilities and methods of control of wastes and potential pollutants may be approved by the Department if the permit applicant can demonstrate that the alternate facilities and methods will provide environmental protection that is fully equivalent or better than that achieved by the facilities specified in the guidelines in Sections 43-040 to 43-095 of these rules. The burden of proof of fully equivalent protection lies with the permit applicant. Written approval of any alternative by the Department shall be evidence of acceptance as equivalent or better level of environmental protection.

(3) A groundwater monitoring plan shall be submitted to, and be approved by the Department. Monitoring wells shall be installed for detection of groundwater contamination as required by OAR Chapter 340, Division 40, unless the Department concludes in writing that the hydrogeology of the site or other technical information indicates that an adverse impact on groundwater quality is not likely to occur.

(4) The Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with these rules.

EXEMPTION FROM STATE PERMIT FOR HAZARDOUS WASTE TREATMENT OR DISPOSAL FACILITIES

340-43-035

(1) The state hazardous waste program requires a permit for the "treatment", "storage" or "disposal" of any "hazardous waste" as identified or listed in OAR Chapter 340, Division 101 from the Department, prior to the treatment and disposal of wastes. Permitting requirements can be found in OAR Chapter 340, Division 105, Hazardous Waste Management.

(2) However, any operation permitted under this Division, which would otherwise require the neutralization or treatment of hazardous waste and would require a permit pursuant to OAR Chapter 340, Division 105, shall be exempt from the requirement to obtain such hazardous waste treatment permit.

(3) All mined materials disposed of under this Division shall pass Oregon's hazardous waste rule criteria or they will be considered a state hazardous waste and must be disposed of accordingly.

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

PURPOSE

340-43-040

(1) This Division establishes criteria for the design, construction, operation and closure of chemical mining operations and supplements the provisions of OAR 340-43-006 through OAR 340-43-035. These criteria are intended to establish the minimum level of environmental protection that is necessary using a combination of performance standards and minimum design criteria. Approval of alternative facilities or methods to achieve an equivalent or better environmental result is allowed as defined in OAR 340-43-031.

Total Costs to DEQ	$25,300
EPA Assistance sought by DEQ (75% of $15,000 of ICMA Costs)	$11,250

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(2) Any disapproval of submitted plans or specifications, or imposition of requirements by the Department to improve existing facilities or their operation will be referenced when appropriate, to applicable guidelines or rules.

GENERAL PROVISIONS

340-43-045

(1) Facilities permitted under either a WPCF or NPDES permit shall not discharge wastewater or process solutions to surface water, groundwater or soils, except as expressly allowed by the permit.

(2) Facilities subject to these rules shall not be sited in 100-year floodplains or wetlands. A buffer zone (a minimum of 200 feet wide) shall be established between waste disposal facilities and surface waters.

(3) All chemical conveyances (ditches, troughs, pipes, etc.) shall be equipped with secondary containment and leak detection means for preventing and detecting release of chemicals to surface water, groundwater or soils.

(4) Acid water accumulation in open pits resulting from the mining operation must be prevented by appropriate mining practices, by measures taken in the closure process, or be treated to control pH and toxicity, for the life of the pit.

(5) Construction of surface impoundment liner systems shall conform generally to the principles and practices described in EPA/600/2-88/052, Lining of Waste Containment and Other Impoundment Facilities, September 1988.

(6) The Department may require the permittee to hire a third-party contractor to perform the functions set forth below. Selection of the contractor shall be subject to Department approval.

   (a) Review and evaluate the design and construction specifications of all mined-materials disposal facilities permitted under this Division for functional adequacy and conformance with Department requirements. The Department shall not approve construction of the disposal facilities until the design and construction specifications have been evaluated.

   (b) Monitor the course of construction of all mined-materials facilities for compliance with the approved design and construction specifications. The third-party contractor shall regularly document the progress of construction and the Department shall require the permittee to take corrective action if construction does not satisfactorily conform to the approved design and construction specifications.

(c) Provide on-site inspections during ongoing operations, including but not limited to the loading of the heap, to assure protection of the integrity of the liner system and other environmental protection measures.

CONTROL OF SURFACE WATER RUN-ON AND RUN-OFF

340-43-050

(1) Surface water run-on and run-off shall be controlled such that it will not endanger the facility or become contaminated by contact with process materials or loaded with sediment. The control systems shall be designed to accommodate a 100-year, 24-hour storm event, or any other defined climatic event that is more appropriate to the site, and be placed so as to allow for restoration of the natural drainage network, to the maximum extent practicable, upon facility closure.

(2) All mined materials shall be properly placed and protected from surface water and precipitation so as not to be eroded and contribute sediment to site stormwater run-off or to otherwise contaminate surface water.

PHYSICAL STABILITY OF RETAINING STRUCTURES AND EMPLACED MINE MATERIALS

340-43-055

(1) Permit applicants must demonstrate to the Department that the design of chemical processing facilities and waste disposal facilities is adequate to ensure the stability of all structural components of the facilities during operation, closure and post closure.

(2) Retaining structures, foundations and mine materials emplacements shall be designed by a qualified, registered professional and be constructed for long-term stability under anticipated loading and seismic conditions.

(3) Temporary structures and materials emplacements may, with written approval from the Department, be constructed to a lesser standard if it can be shown that they pose no, or minimal, threat to public safety or the environment.

PROTECTION OF WILDLIFE

340-43-060

(1) Wildlife shall be positively excluded from contact with chemical processing solutions and wastewaters containing chemicals.

(2) The Department may waive the positive exclusion requirement if the Oregon Department of Fish and Wildlife (ODF&W) certifies to the Department that the project is designed such that it will adequately protect wildlife.

GUIDELINES FOR DESIGN, CONSTRUCTION, AND OPERATION OF HEAP-LEACH FACILITIES

340-43-065

(1) This paragraph applies to heap-leach facilities using dedicated, or expanding, pads. Heap-leach facilities using on-off, reusable pads may require variations from these rules; they shall be approved on a case-by-case basis by the Department.

(2) The heap-leach facility (pad and associated ponds, pipes and tanks) shall be sized to prevent flooding of any of its components.

(3) TABLE 1 of this Division establishes minimum capacity-sizing criteria for the leach-pad and ponds. The pad and ponds may be designed to act separately or in conjunction with each other to obtain the required storage volumes. Other design criteria may be used, with Department approval, if local conditions warrant. The best available climatic data shall be used to confirm the critical design storm event and estimate the liquid levels in the system over a full seasonal cycle. The liquid mass balance may include provision for evaporation.

(4) The heap leach pad liner system shall be designed, constructed, and operated to meet the following criteria:

   (a) A primary liner consisting, at a minimum, of a continuous flexible-membrane of suitable synthetic material shall be provided. This liner shall function together with the process chemical collection system installed immediately above this liner (see section (8) of this rule) to remove process chemicals from the heap.

   (b) A leak detection system shall be installed immediately below the primary liner for the purpose of detecting loss of process solutions by leakage through the primary liner. The leak detection system shall be capable of detecting leakage through the primary liner of 400 gallons/day-acre within ten weeks of leak initiation. The leak detection system shall consist of appropriately sized collection piping placed within a minimum thickness of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec) that is capable of withstanding the anticipated weight of the heap without loss of function.

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the operation of the heap and following closure of the heap is not released to the environment. The Secondary liner shall be of a composite design with a continuous flexible-membrane of suitable synthetic material in direct contact with an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches.

(d) Each liner system component described in paragraphs (4)(a)-(c) above addresses a specific need and purpose with respect to environmental protection. For purposes of evaluating alternative facilities and methods of control under OAR 340-43-031(2), an alternative may be approved if the level of environmetal protection intended by each separate liner system component is achieved either within the individual component or on a cross component basis.

(5) The processing chemical pond liner system shall be designed, constructed, and operated to meet the following criteria:

(a) A primary liner consisting, at a minimum, of a continuous flexible-membrane of suitable synthetic material shall be provided. This liner shall provide for positive containment of processing chemical solutions.

(b) A leak detection system shall be installed immediately below the primary liner for the purpose of detecting loss of process chemical solutions by leakage through the primary liner. The leak detection system shall be capable of detecting leakage through the primary liner of 400 gallons/day-acre within ten weeks of leak initiation. The leak detection system shall consist of appropriately sized collection piping placed within a layer of permeable material (minimum permeability of 10^{-2} cm/sec).

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the use of the pond is not released to the environment. The Secondary liner shall be of a composite design with a continuous flexible-membrane of suitable synthetic material in direct contact with an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches.

(d) Each liner system component described in paragraphs (5)(a)-(c) above addresses a specific need and purpose with respect to environmental protection. For purposes of evaluating alternative facilities and methods of control under OAR 340-43-031(2), an alternative may be approved if the level of environmetal protection intended by each separate liner system component is achieved either within the individual component or on a cross component basis.

(6) Emergency ponds may be constructed as an alternative to larger pregnant and barren ponds. The emergency pond may be constructed to a lesser standard, with the limitation that it is to be used only infrequently and for short periods of time. The Department will specify reporting and use limitations for the ponds in the permit. A between-liner leak detection system is not required for the emergency pond.

(7) The emergency-pond liner shall be of composite construction consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-6}cm/sec) with a minimum thickness of 12 inches, and

(b) A single flexible-membrane synthetic top liner of suitable material.

(8) The heap-leach pad shall be provided with a process chemical collection system above the upper-most liner that will prevent an accumulation of process chemical within the heap greater than 24 inches in depth.

(9) The permittee shall prepare a written operating plan for safe temporary shut-down of the heap-leach facility and train employees in its implementation.

(10) The permittee shall respond to leakage collected by the heap-leach and processing-chemical storage pond leak-collection systems according to the process defined in TABLE 2.

(11) The permittee shall determine the acid-generating potential of the spent ore by acid\base accounting and other appropriate static and dynamic laboratory tests. If the spent ore is shown to be potentially acid generating under the conditions expected in the heap at closure, the permittee shall submit a plan for acid correction for Department approval prior to loading the heap.

GUIDELINES FOR DISPOSAL OF MILL TAILINGS

340-43-070

(1) Mill tailings shall be treated by cyanide removal, re-use, or destruction prior to disposal to reduce the amount of cyanide introduced into the tailings pond to the lowest practicable level. The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-

acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm.

(2) The permittee shall determine the potential for acid-water formation from the tailings by means of acid-base accounting and other suitable laboratory static and dynamic tests. If acid formation can occur, basic materials shall be added to the tailings in the amount of three (3) times the acid formation potential or to give a net neutralization potential of at least 20 tons of $CaCO_3$ per 1000 tons of tailings, whichever is greater, before placing tailings in the disposal facility.

(3) The disposal facility shall be lined with a composite double liner consisting of a flexible-membrane synthetic top liner in tight contact with an engineered, stable, soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) having a minimum thickness of 36 inches.

Construction of the liner shall generally follow the principles and practices contained in EPA/600/2-88/052, "Lining of Waste Containment and Other Impoundment Facilities, September, 1988.

(4) The disposal facility shall be provided with a leachate collection system above the liner suitable for monitoring, collecting and treating potential acid drainage.

GUIDELINES FOR DISPOSAL OR STORAGE OF WASTEROCK, LOW-GRADE ORE AND OTHER MINED MATERIALS

340-43-075

The permittee shall determine the acid-producing and metals-release potential of the wasterock, low-grade ore or other mined materials by acid/base accounting and other appropriate static and dynamic laboratory tests. If the mined materials are shown to be potentially acid forming, or capable of releasing toxic metals, the permittee shall submit a plan for correction and disposal for Department approval prior to permanently placing the materials.

GUIDELINES FOR HEAP-LEACH AND TAILINGS DISPOSAL FACILITY CLOSURE

340-43-080

(1) The waste disposal facilities shall be closed under these rules in conjunction with the reclamation requirements of DOGAMI (Oregon Department of Geology and Mineral Industries).

(2) An up-dated closure plan and post-closure monitoring and maintenance plan shall be submitted to the Department by the permittee at least 180 days prior to beginning closure operations or making any substantial changes to the operation. The closure plan must be compatible with DOGAMI's reclamation plan and may be part of it.

(3) Chemical conveyances (ditches, troughs, pipes, etc.) not necessary for post-closure monitoring shall be removed. The secondary containment systems shall be checked before closure for process-chemical contamination, and contaminated soil or other materials, if any, shall be removed to an acceptable disposal facility.

(4) Closure of the heap-leach facility.

(a) The heap shall be detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm.

(b) Following detoxification as defined in (a) above, the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water and air infiltration. The cover should consist, at a minimum, of a low-permeability layer and suitable drainage and soil layers to prevent erosion and damage by animals and to sustain vegetation growth, in accordance with DOGAMI's reclamation rules.

(c) The ponds associated with the heap shall be closed by folding in the synthetic liners and filling and contouring the pits with inert material. Residual sludge may be disposed of in one of the on-site waste disposal facilities, provided it meets the criteria for such wastes in these guidelines. The process chemical collection system of the heap shall be maintained in operative condition so that it can be used to monitor the amount and quality of infiltrated water, if any, draining from the heap.

(5) The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time. Maximum effort shall be made to isolate the tailings from the environment. Construction of the cover shall generally follow the principles and practices contained in EPA/530-SW-89-047, Technical Guidance Document -- Final Covers on Hazardous Waste Landfills and Surface Impoundments.

POST-CLOSURE MONITORING

340-43-085

(1) The Department may continue its permit in force for thirty (30) years after closure of the operation and will include permit requirements for periodic monitoring to determine if release of pollutants is occurring.

(2) Monitoring data will be reviewed regularly by the Department to determine the effectiveness of closure of the disposal facilities. The Department will consult with DOGAMI on release of security funds that would otherwise be needed to correct problems resulting from ineffective closure.

LAND DISPOSAL OF WASTEWATER

340-43-090

(1) To qualify for land disposal of excess wastewater, the permit applicant shall demonstrate to the Department that the process has been designed to minimize the amount of excess wastewater that is produced, through use of water-efficient processes, wastewater treatment and reuse, and reduction by natural evaporation. Excess wastewater that must be released shall be treated and disposed of to land under the conditions specified in the permit.

(2) A disposal plan shall be submitted as part of the permit application that, at a minimum, includes:

(a) Wastewater quantity and quality characterization;

(b) Soils characterization and suitability analysis;

(c) Drainage and run-off characteristics of the site relative to land application of wastewater;

(d) Proximity of the disposal site to groundwater and surface water and potential impact;

(e) Wastewater application schedule and water balance;

(f) Disposal site assimilative capacity determination;

(g) Soils, surface water and groundwater monitoring plan;

(h) Potential impact on wildlife or sensitive plant species.

(3) The Department will evaluate the disposal plan and set site-specific permit conditions for the wastewater discharge.

GUIDELINES FOR OPEN-PIT CLOSURE

340-43-095

(1) Open pits that will be left as a result of the mining operation shall be assessed prior to, and following, mining operations for the potential to contaminate water to the extent that it might not meet water-quality standards due to build-up of acid or toxic metals.

(2) If the Department finds that the potential for water accumulation in the pit(s) exists, the permit applicant shall submit a closure plan for the pit that will address contamination prevention and possible remedial treatment of the water. The closure plan shall, at a minimum, examine the following alternatives:

(a) Avoidance, during mining, of acid-generating materials that can be left in place, rather than being exposed to oxidation and weathering;

(b) Removal from the pit and disposal, during or after the mining operation, of residual acid-generating materials that would otherwise be left exposed to oxidation and weathering;

(c) Protective capping in-situ of residual acid-generating materials;

(d) Treatment methods for correcting acidity and toxicity of accumulated water;

(e) Installation of an impermeable liner under ponded water to prevent groundwater contamination;

(f) Backfilling of the pit(s) to the level necessary to, in conjunction with other appropriate control measures, prevent oxidation of residual acid-generating materials.

TABLE 1

Heap-Leach Liquid Storage Criteria

Component	Pregnant-Solution Pond	Barren-Solution Pond
Operating Volume	Minimum necessary to maintain recirculation	Minimum necessary to maintain recirculation
Operational Surge	Anticipated draindown and rinse volume	Anticipated draindown and rinse volume
Climatic Surge	100-yr, 24-hr storm plus 10-yr snowmelt	100-yr, 24-hr storm plus 10-yr snowmelt
Safety Factor	2-ft dry freeboard	2-ft dry freeboard

TABLE 2

Required Responses to Leakage Detected from the Leach Pad and Processing Chemical Storage Ponds

Leakage Category	Response
Zero leakage to 200 gal/day-acre	Notify the Department; increase pumping and monitoring
Leakage from 200 gal/day-acre to 400 gal/day-acre	Change operating practices to reduce leakage
Leakage in excess of 400 gal/day-acre	Repair leaks under Department schedule.

Attachment A

Note: At a telephone conference meeting on September 1, 1992, the Environmental Quality Commission adopted the following new rules.

RULES PROPOSAL:

OREGON ADMINISTRATIVE RULES

CHAPTER 340

DIVISION 43

CHEMICAL MINING

OAR 340-43-006	Purpose and Policies
OAR 340-43-011	Definitions
OAR 340-43-016	Permit Required
OAR 340-43-021	Permit Application
OAR 340-43-026	Plans and Specifications
OAR 340-43-031	Design, Construction, Operation and Closure Requirements
OAR 340-43-035	Exemption from State Permits for Hazardous Waste Treatment or Disposal Facilities

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

OAR 340-43-040	Purpose
OAR 340-43-045	General Provisions
OAR 340-43-050	Control of Surface Water Run-On and Run-Off
OAR 340-43-055	Physical Stability of Retaining Structures and Emplaced Mine Materials

OAR 340-43-060	Protection of Wildlife
OAR 340-43-065	Guidelines for Design, Construction, and Operation of Heap-Leach Facilities
OAR 340-43-070	Guidelines for Disposal of Mill Tailings
OAR 340-43-075	Guidelines for Disposal or Storage of Wasterock, Low-Grade Ore and Other Mined Materials
OAR 340-43-080	Guidelines for Heap-Leach and Tailings Disposal Facility Closure
OAR 340-43-085	Post-Closure Monitoring
OAR 340-43-090	Land Disposal of Wastewater
OAR 340-43-095	Guidelines for Open-Pit Closure

PURPOSE and POLICIES

340-43-006

(1) The purpose of these rules and guidelines is to prevent water pollution and protect the quality of the environment and public health in Oregon, consistent with the policies of ORS 468B.015 and 468B.020, by requiring application of all available and reasonable method for control of wastes and chemicals relative to design, construction, operation, and closure of mining operations which use cyanide or other toxic chemicals to extract metals or metal-bearing minerals from the ore and which produce wastes or wastewaters containing toxic materials.

(2) The following policies are established to provide further guidance regarding the level of environmental protection these rules are intended to achieve:

(a) Liner, leak detection and leak collection systems (systems) are necessary for heap leach pads, solution ponds, and tailings facilities to assure that any leak will be detected before toxic materials escape from the liner system and are released to the environment. For purposes of these rules, the environment is considered to begin at the bottom of the last liner. These systems shall assure that a leak is found, and that sufficient time is available to allow for the repair of the leak and clean up of any leaked material before there is a release to the environment. Natural conditions, such as depth to groundwater or net rainfall, shall be considered as additional protection but not in lieu of the protection required by the engineered liner system.

(b) The toxicity of mill tailings and the potential for long-term cyanide and toxic metals release from mill tailings shall be reduced to the greatest degree practicable through removal, reuse, or destruction of chemical solutions prior to placement of tailings in the tailings disposal facility.

(c) The closure of heap leach pads and tailings disposal facilities shall prevent future release to the environment of residual potentially toxic chemicals contained in the facility.

DEFINITIONS

340-43-011

Unless the context requires otherwise, as used in this Division:

(1) "Chemical process mine" means a mining and processing operation for metal-bearing ores that uses chemicals to dissolve metals from ores.

(2) "Department" means the Department of Environmental Quality.

(3) "Guidelines" means this body of rules contained in 340-43-045 through 340-43-100.

(4) "Positive exclusion of wildlife" means the use of such devices as tanks, pipes, fences, netting, covers and heap-leach drip-irrigation emitters or covered emitters.

(5) "Tailings" means the spent ore resulting from the milling and chemical extraction process.

PERMIT REQUIRED

340-43-016

(1) As required by ORS 468B.050, a person proposing to construct a new chemical mining operation, commencing to operate an existing non-permitted operation, or proposing to substantially modify or expand an existing operation shall first apply for, and receive, a permit from the Department. The permit may be an NPDES (National Pollutant Discharge Elimination System) permit if there is a point-source discharge to surface waters or a WPCF (Water Pollution Control Facility) permit if there is no discharge. Consideration may be given to site-specific conditions such as climate, proximity to water, and type of wastes to establish the final permit type and requirements for the facility.

(2) The permit application shall comply with the requirements of OAR Chapter 340, Divisions 14 and 45 and be accompanied by a report that fully addresses the requirements of this Division.

(3) Prior to issuance of a permit for a chemical process mining activity under this Division, a determination of compliance with statewide planning goals and compatibility with local land use plans must be made. The Department shall determine compliance with Statewide Planning Goals and compatibility with acknowledged comprehensive plans and land use regulations in a manner consistent with its approved State Agency Coordination Program and the rules in OAR Chapter 340, Division 18. In making these determinations, the Department shall consider and may rely on the findings and recommendations made by the project coordinating committee authorized by ORS 517.965 and by the Department of Geology and Mineral Industries pursuant to their State Agency Coordination Program and OAR Chapter 632, Divisions 1 and 37.

PERMIT APPLICATION

340-43-021

(1) The permit application shall fully describe the existing site and environmental conditions, with an analysis of how the proposed operation will affect the site and its environment. The application shall, at a minimum, contain the information specified for the DOGAMI (Department of Geology and Mineral Industries) consolidated application under ORS 517.971 (Section 13, Chapter 735, 1991 Oregon Laws). The Department will also use the information contained in NEPA (National Environmental Policy Act), EA (Environmental Assessment), or EIS (Environmental Impact Statement) documents, if they are required for the project, as partial fulfillment of the requirements of this paragraph.

(2) The permit application shall, in addition to the information described in Paragraph (1) above, include the following information, unless the information has been otherwise submitted:

(a) Climate/meteorology characterization, with supporting data;

(b) Soils characterization, with supporting data;

(c) Surface water hydrology study, with supporting data;

(d) Characterization of surface water and groundwater quality;

(e) Inventory of surface water and groundwater beneficial uses;

(f) Hydrogeologic characterization of groundwater, with supporting data;

(g) Geologic engineering, hazards and geotechnical study, with supporting data;

(h) Characterization of mine materials and wastes which include, for example, overburden, waste rock, stockpiled ore, leached ore and tailings. Characterization of mine materials and wastes shall include, but not be limited to the following:

(A) Chemical and mineral analysis related to toxicity;

(B) Determination of the potential for acid water formation;

(C) Determination of the potential for long-term leaching of toxic materials from the wastes;

(i) Characterization of wastewater (quantity and chemical and physical quality) produced by the operation;

(j) Assessment of the potential for acid-water formation from waste disposal facilities, low-grade ore stockpiles, waste rock piles and for surface water or groundwater accumulation in open pits that will remain after mining is ended.

(3) Data submitted by the permit applicant should be based on analysis of the actual materials, when possible, or may be based on estimates from knowledge of similar operations and professional judgment.

PLANS AND SPECIFICATIONS

340-43-026

(1) A person constructing or commencing to operate a chemical process mine or substantially modifying or expanding an existing chemical process mine shall first submit plans and specifications to the Department for construction, operation and maintenance of the facilities intended for treatment, control and disposal of wastes.

(2) The plans shall address all applicable requirements of this Division and shall include, but not be limited to, the following:

(a) A description of the facilities to be constructed, including tanks, pipes and other storage and conveyance means for processing chemicals and solutions and wastewaters;

(b) A management plan for control of surface water;

(c) A management plan for treatment and disposal of excess wastewater, including provisions for reuse and wastewater minimization;

(d) A facility construction plan including, as applicable, the design of low-permeability soil barriers, the type of geosynthetics to be used and a description of their installation methods, the design of wastewater treatment facilities and processes, a quality assurance plan for applicable phases of construction and a listing of construction certification reports to be provided to the Department;

(e) A preliminary closure plan;

(f) A preliminary post-closure monitoring and maintenance plan;

(g) A spill containment and control plan.

(3) The Department shall approve the plans, in writing, before construction of the facilities may be started.

DESIGN, CONSTRUCTION, OPERATION AND CLOSURE REQUIREMENTS

340-43-031

(1) All chemical process and waste disposal facilities and facilities for mixing, distribution, and application of chemicals associated with on-site mining operations; ore preparation and beneficiation facilities; and processed ore disposal facilities shall be designed, constructed, operated and closed in accordance with the guidelines contained in this Division.

(2) Alternative facilities and methods of control of wastes and potential pollutants may be approved by the Department if the permit applicant can demonstrate that the alternate facilities and methods will provide environmental protection that is fully equivalent or better than that achieved by the facilities specified in the guidelines in Sections 43-040 to 43-095 of these rules. The burden of proof of fully equivalent protection lies with the permit applicant. Written approval of any alternative by the Department shall be evidence of acceptance as equivalent or better level of environmental protection.

(3) A groundwater monitoring plan shall be submitted to, and be approved by the Department. Monitoring wells shall be installed for detection of groundwater contamination as required by OAR Chapter 340, Division 40, unless the Department concludes in writing that the hydrogeology of the site or other technical information indicates that an adverse impact on groundwater quality is not likely to occur.

(4) The Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with these rules.

EXEMPTION FROM STATE PERMIT FOR HAZARDOUS WASTE TREATMENT OR DISPOSAL FACILITIES

340-43-035

(1) The state hazardous waste program requires a permit for the "treatment", "storage" or "disposal" of any "hazardous waste" as identified or listed in OAR Chapter 340, Division 101 from the Department, prior to the treatment and disposal of wastes. Permitting requirements can be found in OAR Chapter 340, Division 105, Hazardous Waste Management.

(2) However, any operation permitted under this Division, which would otherwise require the neutralization or treatment of hazardous waste and would require a permit pursuant to OAR Chapter 340, Division 105, shall be exempt from the requirement to obtain such hazardous waste treatment permit.

(3) All mined materials disposed of under this Division shall pass Oregon's hazardous waste rule criteria or they will be considered a state hazardous waste and must be disposed of accordingly.

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

PURPOSE

340-43-040

(1) This Division establishes criteria for the design, construction, operation and closure of chemical mining operations and supplements the provisions of OAR 340-43-006 through OAR 340-43-035. These criteria are intended to establish the minimum level of environmental protection that is necessary using a combination of performance standards and minimum design criteria. Approval of alternative facilities or methods to achieve an equivalent or better environmental result is allowed as defined in OAR 340-43-031.

(2) Any disapproval of submitted plans or specifications, or imposition of requirements by the Department to improve existing facilities or their operation will be referenced when appropriate, to applicable guidelines or rules.

GENERAL PROVISIONS

340-43-045

(1) Facilities permitted under either a WPCF or NPDES permit shall not discharge wastewater or process solutions to surface water, groundwater or soils, except as expressly allowed by the permit.

(2) Facilities subject to these rules shall not be sited in 100-year floodplains or wetlands. A buffer zone (a minimum of 200 feet wide) shall be established between waste disposal facilities and surface waters.

(3) All chemical conveyances (ditches, troughs, pipes, etc.) shall be equipped with secondary containment and leak detection means for preventing and detecting release of chemicals to surface water, groundwater or soils.

(4) Acid water accumulation in open pits resulting from the mining operation must be prevented by appropriate mining practices, by measures taken in the closure process, or be treated to control pH and toxicity, for the life of the pit.

(5) Construction of surface impoundment liner systems shall conform generally to the principles and practices described in EPA/600/2-88/052, Lining of Waste Containment and Other Impoundment Facilities, September 1988.

(6) The Department may require the permittee to hire a third-party contractor to perform the functions set forth below. Selection of the contractor shall be subject to Department approval.

   (a) Review and evaluate the design and construction specifications of all mined-materials disposal facilities permitted under this Division for functional adequacy and conformance with Department requirements. The Department shall not approve construction of the disposal facilities until the design and construction specifications have been evaluated.

   (b) Monitor the course of construction of all mined-materials facilities for compliance with the approved design and construction specifications. The third-party contractor shall regularly document the progress of construction and the Department shall require the permittee to take corrective action if construction does not satisfactorily conform to the approved design and construction specifications.

(c) Provide on-site inspections during ongoing operations, including but not limited to the loading of the heap, to assure protection of the integrity of the liner system and other environmental protection measures.

CONTROL OF SURFACE WATER RUN-ON AND RUN-OFF

340-43-050

(1) Surface water run-on and run-off shall be controlled such that it will not endanger the facility or become contaminated by contact with process materials or loaded with sediment. The control systems shall be designed to accommodate a 100-year, 24-hour storm event, or any other defined climatic event that is more appropriate to the site, and be placed so as to allow for restoration of the natural drainage network, to the maximum extent practicable, upon facility closure.

(2) All mined materials shall be properly placed and protected from surface water and precipitation so as not to be eroded and contribute sediment to site stormwater run-off or to otherwise contaminate surface water.

PHYSICAL STABILITY OF RETAINING STRUCTURES AND EMPLACED MINE MATERIALS

340-43-055

(1) Permit applicants must demonstrate to the Department that the design of chemical processing facilities and waste disposal facilities is adequate to ensure the stability of all structural components of the facilities during operation, closure and post closure.

(2) Retaining structures, foundations and mine materials emplacements shall be designed by a qualified, registered professional and be constructed for long-term stability under anticipated loading and seismic conditions.

(3) Temporary structures and materials emplacements may, with written approval from the Department, be constructed to a lesser standard if it can be shown that they pose no, or minimal, threat to public safety or the environment.

PROTECTION OF WILDLIFE

340-43-060

(1) Wildlife shall be positively excluded from contact with chemical processing solutions and wastewaters containing chemicals.

(2) The Department may waive the positive exclusion requirement if the Oregon Department of Fish and Wildlife (ODF&W) certifies to the Department that the project is designed such that it will adequately protect wildlife.

GUIDELINES FOR DESIGN, CONSTRUCTION, AND OPERATION OF HEAP-LEACH FACILITIES

340-43-065

(1) This paragraph applies to heap-leach facilities using dedicated, or expanding, pads. Heap-leach facilities using on-off, reusable pads may require variations from these rules; they shall be approved on a case-by-case basis by the Department.

(2) The heap-leach facility (pad and associated ponds, pipes and tanks) shall be sized to prevent flooding of any of its components.

(3) TABLE 1 of this Division establishes minimum capacity-sizing criteria for the leach-pad and ponds. The pad and ponds may be designed to act separately or in conjunction with each other to obtain the required storage volumes. Other design criteria may be used, with Department approval, if local conditions warrant. The best available climatic data shall be used to confirm the critical design storm event and estimate the liquid levels in the system over a full seasonal cycle. The liquid mass balance may include provision for evaporation.

(4) The heap leach pad liner system shall be designed, constructed, and operated to meet the following criteria:

(a) A primary liner consisting, at a minimum, of a continuous flexible-membrane of suitable synthetic material shall be provided. This liner shall function together with the process chemical collection system installed immediately above this liner (see section (8) of this rule) to remove process chemicals from the heap.

(b) A leak detection system shall be installed immediately below the primary liner for the purpose of detecting loss of process solutions by leakage through the primary liner. The leak detection system shall be capable of detecting leakage through the primary liner of 400 gallons/day-acre within ten weeks of leak initiation. The leak detection system shall consist of appropriately sized collection piping placed within a minimum thickness of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec) that is capable of withstanding the anticipated weight of the heap without loss of function.

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the operation of the heap and following closure of the heap is not released to the environment. The Secondary liner shall be of a composite design with a continuous flexible-membrane of suitable synthetic material in direct contact with an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches.

(d) Each liner system component described in paragraphs (4)(a)-(c) above addresses a specific need and purpose with respect to environmental protection. For purposes of evaluating alternative facilities and methods of control under OAR 340-43-031(2), an alternative may be approved if the level of environmetal protection intended by each separate liner system component is achieved either within the individual component or on a cross component basis.

(5) The processing chemical pond liner system shall be designed, constructed, and operated to meet the following criteria:

(a) A primary liner consisting, at a minimum, of a continuous flexible-membrane of suitable synthetic material shall be provided. This liner shall provide for positive containment of processing chemical solutions.

(b) A leak detection system shall be installed immediately below the primary liner for the purpose of detecting loss of process chemical solutions by leakage through the primary liner. The leak detection system shall be capable of detecting leakage through the primary liner of 400 gallons/day-acre within ten weeks of leak initiation. The leak detection system shall consist of appropriately sized collection piping placed within a layer of permeable material (minimum permeability of 10^{-2} cm/sec).

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the use of the pond is not released to the environment. The Secondary liner shall be of a composite design with a continuous flexible-membrane of suitable synthetic material in direct contact with an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches.

(d) Each liner system component described in paragraphs (5)(a)-(c) above addresses a specific need and purpose with respect to environmental protection. For purposes of evaluating alternative facilities and methods of control under OAR 340-43-031(2), an alternative may be approved if the level of environmetal protection intended by each separate liner system component is achieved either within the individual component or on a cross component basis.

(6) Emergency ponds may be constructed as an alternative to larger pregnant and barren ponds. The emergency pond may be constructed to a lesser standard, with the limitation that it is to be used only infrequently and for short periods of time. The Department will specify reporting and use limitations for the ponds in the permit. A between-liner leak detection system is not required for the emergency pond.

(7) The emergency-pond liner shall be of composite construction consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-6}cm/sec) with a minimum thickness of 12 inches, and

(b) A single flexible-membrane synthetic top liner of suitable material.

(8) The heap-leach pad shall be provided with a process chemical collection system above the upper-most liner that will prevent an accumulation of process chemical within the heap greater than 24 inches in depth.

(9) The permittee shall prepare a written operating plan for safe temporary shut-down of the heap-leach facility and train employees in its implementation.

(10) The permittee shall respond to leakage collected by the heap-leach and processing-chemical storage pond leak-collection systems according to the process defined in TABLE 2.

(11) The permittee shall determine the acid-generating potential of the spent ore by acid\base accounting and other appropriate static and dynamic laboratory tests. If the spent ore is shown to be potentially acid generating under the conditions expected in the heap at closure, the permittee shall submit a plan for acid correction for Department approval prior to loading the heap.

GUIDELINES FOR DISPOSAL OF MILL TAILINGS

340-43-070

(1) Mill tailings shall be treated by cyanide removal, re-use, or destruction prior to disposal to reduce the amount of cyanide introduced into the tailings pond to the lowest practicable level. The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-

acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm.

(2) The permittee shall determine the potential for acid-water formation from the tailings by means of acid-base accounting and other suitable laboratory static and dynamic tests. If acid formation can occur, basic materials shall be added to the tailings in the amount of three (3) times the acid formation potential or to give a net neutralization potential of at least 20 tons of $CaCO_3$ per 1000 tons of tailings, whichever is greater, before placing tailings in the disposal facility.

(3) The disposal facility shall be lined with a composite double liner consisting of a flexible-membrane synthetic top liner in tight contact with an engineered, stable, soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) having a minimum thickness of 36 inches.

Construction of the liner shall generally follow the principles and practices contained in EPA/600/2-88/052, "Lining of Waste Containment and Other Impoundment Facilities, September, 1988.

(4) The disposal facility shall be provided with a leachate collection system above the liner suitable for monitoring, collecting and treating potential acid drainage.

GUIDELINES FOR DISPOSAL OR STORAGE OF WASTEROCK, LOW-GRADE ORE AND OTHER MINED MATERIALS

340-43-075

The permittee shall determine the acid-producing and metals-release potential of the wasterock, low-grade ore or other mined materials by acid/base accounting and other appropriate static and dynamic laboratory tests. If the mined materials are shown to be potentially acid forming, or capable of releasing toxic metals, the permittee shall submit a plan for correction and disposal for Department approval prior to permanently placing the materials.

GUIDELINES FOR HEAP-LEACH AND TAILINGS DISPOSAL FACILITY CLOSURE

340-43-080

(1) The waste disposal facilities shall be closed under these rules in conjunction with the reclamation requirements of DOGAMI (Oregon Department of Geology and Mineral Industries).

(2) An up-dated closure plan and post-closure monitoring and maintenance plan shall be submitted to the Department by the permittee at least 180 days prior to beginning closure operations or making any substantial changes to the operation. The closure plan must be compatible with DOGAMI's reclamation plan and may be part of it.

(3) Chemical conveyances (ditches, troughs, pipes, etc.) not necessary for post-closure monitoring shall be removed. The secondary containment systems shall be checked before closure for process-chemical contamination, and contaminated soil or other materials, if any, shall be removed to an acceptable disposal facility.

(4) Closure of the heap-leach facility.

(a) The heap shall be detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm.

(b) Following detoxification as defined in (a) above, the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water and air infiltration. The cover should consist, at a minimum, of a low-permeability layer and suitable drainage and soil layers to prevent erosion and damage by animals and to sustain vegetation growth, in accordance with DOGAMI's reclamation rules.

(c) The ponds associated with the heap shall be closed by folding in the synthetic liners and filling and contouring the pits with inert material. Residual sludge may be disposed of in one of the on-site waste disposal facilities, provided it meets the criteria for such wastes in these guidelines. The process chemical collection system of the heap shall be maintained in operative condition so that it can be used to monitor the amount and quality of infiltrated water, if any, draining from the heap.

(5) The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time. Maximum effort shall be made to isolate the tailings from the environment. Construction of the cover shall generally follow the principles and practices contained in EPA/530-SW-89-047, Technical Guidance Document -- Final Covers on Hazardous Waste Landfills and Surface Impoundments.

POST-CLOSURE MONITORING

340-43-085

(1) The Department may continue its permit in force for thirty (30) years after closure of the operation and will include permit requirements for periodic monitoring to determine if release of pollutants is occurring.

(2) Monitoring data will be reviewed regularly by the Department to determine the effectiveness of closure of the disposal facilities. The Department will consult with DOGAMI on release of security funds that would otherwise be needed to correct problems resulting from ineffective closure.

LAND DISPOSAL OF WASTEWATER

340-43-090

(1) To qualify for land disposal of excess wastewater, the permit applicant shall demonstrate to the Department that the process has been designed to minimize the amount of excess wastewater that is produced, through use of water-efficient processes, wastewater treatment and reuse, and reduction by natural evaporation. Excess wastewater that must be released shall be treated and disposed of to land under the conditions specified in the permit.

(2) A disposal plan shall be submitted as part of the permit application that, at a minimum, includes:

   (a) Wastewater quantity and quality characterization;

   (b) Soils characterization and suitability analysis;

   (c) Drainage and run-off characteristics of the site relative to land application of wastewater;

   (d) Proximity of the disposal site to groundwater and surface water and potential impact;

   (e) Wastewater application schedule and water balance;

   (f) Disposal site assimilative capacity determination;

   (g) Soils, surface water and groundwater monitoring plan;

(h) Potential impact on wildlife or sensitive plant species.

(3) The Department will evaluate the disposal plan and set site-specific permit conditions for the wastewater discharge.

GUIDELINES FOR OPEN-PIT CLOSURE

340-43-095

(1) Open pits that will be left as a result of the mining operation shall be assessed prior to, and following, mining operations for the potential to contaminate water to the extent that it might not meet water-quality standards due to build-up of acid or toxic metals.

(2) If the Department finds that the potential for water accumulation in the pit(s) exists, the permit applicant shall submit a closure plan for the pit that will address contamination prevention and possible remedial treatment of the water. The closure plan shall, at a minimum, examine the following alternatives:

(a) Avoidance, during mining, of acid-generating materials that can be left in place, rather than being exposed to oxidation and weathering;

(b) Removal from the pit and disposal, during or after the mining operation, of residual acid-generating materials that would otherwise be left exposed to oxidation and weathering;

(c) Protective capping in-situ of residual acid-generating materials;

(d) Treatment methods for correcting acidity and toxicity of accumulated water;

(e) Installation of an impermeable liner under ponded water to prevent groundwater contamination;

(f) Backfilling of the pit(s) to the level necessary to, in conjunction with other appropriate control measures, prevent oxidation of residual acid-generating materials.

TABLE 1

Heap-Leach Liquid Storage Criteria

Component	Pregnant-Solution Pond	Barren-Solution Pond
Operating Volume	Minimum necessary to maintain recirculation	Minimum necessary to maintain recirculation
Operational Surge	Anticipated draindown and rinse volume	Anticipated draindown and rinse volume
Climatic Surge	100-yr, 24-hr storm plus 10-yr snowmelt	100-yr, 24-hr storm plus 10-yr snowmelt
Safety Factor	2-ft dry freeboard	2-ft dry freeboard

TABLE 2

Required Responses to Leakage Detected from the Leach Pad and Processing Chemical Storage Ponds

Leakage Category	Response
Zero leakage to 200 gal/day-acre	Notify the Department; increase pumping and monitoring
Leakage from 200 gal/day-acre to 400 gal/day-acre	Change operating practices to reduce leakage
Leakage in excess of 400 gal/day-acre	Repair leaks under Department schedule.

State of Oregon
Department of Environmental Quality
Memorandum

Date: August 19, 1992

To: Environmental Quality Commission

From: Fred Hansen, Director

Subject: Proposed Chemical Mining Rules

At the meeting on August 7, 1992, the Commission indicated acceptance of the Department recommendation for adoption of the proposed chemical mining rules with changes in the following areas:

- The wording for proposed as Alternative 2 for both the heap leach pad liner [OAR 340-43-065(4) on pages 14-15] and processing chemical pond liner [OAR 340-45-065(5) on pages 15-16] was accepted to replace the 12/13/91 draft wording labeled Alternative 1.

- The Commission directed the Department to develop additional wording to clearly convey the intent that alternative liner systems can be approved provided that the level of environmental protection intended by each component of the liner system specified in the rule (primary liner, leak detection system, secondary liner) is achieved, either within the component or on a cross component basis. This new wording appears as OAR 340-43-065(4)(d) on page 15 and (5)(d) on pages 16-17.

- The wording of the Purpose and Policies [OAR 340-43-006(2)(b) on page 3] and the Guidelines for Disposal of Mill Tailings [OAR 340-43-070(1) on page 18] was modified to allow "destruction" of cyanide in mill tailings as an alternative to removal and reuse.

The attached rule draft (Attachment A dated 8/13/92) displays the changes made to the 8/7/92 draft in response to the Commission direction in the traditional way: new wording is <u>underlined</u>, and deleted wording is ~~[enclosed in brackets and struck through]~~. For easy reference, the wording changes appear on pages 3, 14-17, and 18.

It is recommended that the Commission adopt the proposed chemical mining rules as presented in Attachment A.

Note: At its 8/7/92 meeting, the Environmental Quality Commission considered proposed rules dated 8/7/92, and accepted the Department recommendations with some changes as noted in this draft. This 8/17/92 draft deletes the underlining from new text and removes text that was shown struck through in the 8/7/92 draft. It then shows changes made in response to Commission discussions in the following manner:

> Underlined text is proposed language to be added to the rule draft as a result of the Commission discussions on 8/7/92.
>
> ~~[Bracketed and struck through]~~ text is proposed language to be deleted from the rule draft as a result of the Commission discussions on 8/7/92.

RULES PROPOSAL:

OREGON ADMINISTRATIVE RULES

CHAPTER 340

DIVISION 43

CHEMICAL MINING

OAR 340-43-006	Purpose and Policies
OAR 340-43-011	Definitions
OAR 340-43-016	Permit Required
OAR 340-43-021	Permit Application
OAR 340-43-026	Plans and Specifications
OAR 340-43-031	Design, Construction, Operation and Closure Requirements

Renumbering of some rules and other minor "house keeping" amendments proposed in the 8/7/92 rule draft were accepted by the Commission on 8/7/92.

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

PURPOSE and POLICIES

340-43-006

(1) The purpose of these rules and guidelines is to prevent water pollution and protect the quality of the environment and public health in Oregon, consistent with the policies of ORS 468B.015 and 468B.020, by requiring application of all available and reasonable method for control of wastes and chemicals relative to design, construction, operation, and closure of mining operations which use cyanide or other toxic chemicals to extract metals or metal-bearing minerals from the ore and which produce wastes or wastewaters containing toxic materials.

This section reflects amendments to this rule as proposed in the 8/7/92 draft and accepted by the Commission.

(2) The following policies are established to provide further guidance regarding the level of environmental protection these rules are intended to achieve:

This section [340-43-006(2)] was new language proposed in the 8/7/92 rule draft. It was accepted by the Commission with amendments to (b) reflected below.

(a) Liner, leak detection and leak collection systems (systems) are necessary for heap leach pads, solution ponds, and tailings facilities to assure that any leak will be detected before toxic materials escape from the liner system and are released to the environment. For purposes of these rules, the environment is considered to begin at the bottom of the last liner. These systems shall assure that a leak is found, and that sufficient time is available to allow for the repair of the leak and clean up of any leaked material before there is a release to the environment. Natural conditions, such as depth to groundwater or net rainfall, shall be considered as additional protection but not in lieu of the protection required by the engineered liner system.

(b) The toxicity of mill tailings and the potential for long-term cyanide and toxic metals release from mill tailings shall be reduced to the greatest degree practicable through removal, ~~[and]~~ reuse, <u>or destruction</u> of chemical solutions prior to placement of tailings in the tailings disposal facility.

This paragraph was amended by the Commission to be consistent with the change made in rule 340-43-070 to not require reuse and to allow destruction technology to be used.

(c) The closure of heap leach pads and tailings disposal facilities shall prevent future release to the environment of residual potentially toxic chemicals contained in the facility.

DEFINITIONS

340-43-011

Unless the context requires otherwise, as used in this Division:

(1) "Chemical process mine" means a mining and processing operation for metal-bearing ores that uses chemicals to dissolve metals from ores.

(2) "Department" means the Department of Environmental Quality.

(3) "Guidelines" means this body of rules contained in 340-43-045 through 340-43-100.

(4) "Positive exclusion of wildlife" means the use of such devices as tanks, pipes, fences, netting, covers and heap-leach drip-irrigation emitters or covered emitters.

(5) "Tailings" means the spent ore resulting from the milling and chemical extraction process.

PERMIT REQUIRED

340-43-016

(1) As required by ORS 468B.050, a person proposing to construct a new chemical mining operation, commencing to operate an existing non-permitted operation, or proposing to substantially modify or expand an existing operation shall first apply for, and receive, a permit from the Department. The permit may be an NPDES (National Pollutant Discharge Elimination System) permit if there is a point-source discharge to surface waters or a WPCF (Water Pollution Control Facility)

The Commission accepted the minor clarifying amendment proposed in the 8/7/92 draft for this paragraph.

permit if there is no discharge. Consideration may be given to site-specific conditions such as climate, proximity to water, and type of wastes to establish the final permit type and requirements for the facility.

(2) The permit application shall comply with the requirements of OAR Chapter 340, Divisions 14 and 45 and be accompanied by a report that fully addresses the requirements of this Division.

(3) Prior to issuance of a permit for a chemical process mining activity under this Division, a determination of compliance with statewide planning goals and compatibility with local land use plans must be made. The Department shall determine compliance with Statewide Planning Goals and compatibility with acknowledged comprehensive plans and land use regulations in a manner consistent with its approved State Agency Coordination Program and the rules in OAR Chapter 340, Division 18. In making these determinations, the Department shall consider and may rely on the findings and recommendations made by the project coordinating committee authorized by ORS 517.965 and by the Department of Geology and Mineral Industries pursuant to their State Agency Coordination Program and OAR Chapter 632, Divisions 1 and 37.

The Commission accepted this new paragraph as proposed in the 8/7/92 draft.

PERMIT APPLICATION

340-43-021

(1) The permit application shall fully describe the existing site and environmental conditions, with an analysis of how the proposed operation will affect the site and its environment. The application shall, at a minimum, contain the information specified for the DOGAMI (Department of Geology and Mineral Industries) consolidated application under ORS 517.971 (Section 13, Chapter 735, 1991 Oregon Laws). The Department will also use the information contained in NEPA (National Environmental Policy Act), EA (Environmental Assessment), or EIS (Environmental Impact Statement) documents, if they are required for the

This paragraph reflects clarifying amendments proposed in the 8/7/92 draft and accepted by the Commission.

project, as partial fulfillment of the requirements of this paragraph.

(2) The permit application shall, in addition to the information described in Paragraph (1) above, include the following information, unless the information has been otherwise submitted:

(a) Climate/meteorology characterization, with supporting data;

(b) Soils characterization, with supporting data;

(c) Surface water hydrology study, with supporting data;

(d) Characterization of surface water and groundwater quality;

(e) Inventory of surface water and groundwater beneficial uses;

(f) Hydrogeologic characterization of groundwater, with supporting data;

(g) Geologic engineering, hazards and geotechnical study, with supporting data;

(h) Characterization of mine materials and wastes which include, for example, overburden, waste rock, stockpiled ore, leached ore and tailings. Characterization of mine materials and wastes shall include, but not be limited to the following:

(A) Chemical and mineral analysis related to toxicity;

(B) Determination of the potential for acid water formation;

(C) Determination of the potential for long-term leaching of toxic materials from the wastes;

(i) Characterization of wastewater (quantity and chemical and physical quality) produced by the operation;

(j) Assessment of the potential for acid-water formation from waste disposal facilities, low-grade ore stockpiles, waste rock piles and for surface water or groundwater accumulation in open pits that will remain after mining is ended.

(3) Data submitted by the permit applicant should be based on analysis of the actual materials, when possible, or may be based on estimates from knowledge of similar operations and professional judgment.

PLANS AND SPECIFICATIONS

340-43-026

(1) A person constructing or commencing to operate a chemical process mine or substantially modifying or expanding an existing chemical process mine shall first submit plans and specifications to the Department for construction, operation and maintenance of the facilities intended for treatment, control and disposal of wastes.

(2) The plans shall address all applicable requirements of this Division and shall include, but not be limited to, the following:

Sections (2) and (3) of this rule reflect clarifying amendments proposed by the Department and accepted by the Commission.

(a) A description of the facilities to be constructed, including tanks, pipes and other storage and conveyance means for processing chemicals and solutions and wastewaters;

(b) A management plan for control of surface water;

(c) A management plan for treatment and disposal of excess wastewater, including provisions for reuse and wastewater minimization;

(d) A facility construction plan including, as applicable, the design of low-permeability soil barriers, the type of geosynthetics to be used and a description of their installation methods, the design of wastewater treatment facilities and processes, a quality assurance plan for applicable phases of construction and a listing of construction certification reports to be provided to the Department;

(e) A preliminary closure plan;

(f) A preliminary post-closure monitoring and maintenance plan;

(g) A spill containment and control plan.

(3) The Department shall approve the plans, in writing, before construction of the facilities may be started.

DESIGN, CONSTRUCTION, OPERATION AND CLOSURE REQUIREMENTS

340-43-031

(1) All chemical process and waste disposal facilities and facilities for mixing, distribution, and application of chemicals associated with on-site mining operations; ore preparation and beneficiation facilities; and processed ore disposal facilities shall be designed, constructed, operated and closed in accordance with the guidelines contained in this Division.

(2) Alternative facilities and methods of control of wastes and potential pollutants may be approved by the Department if the permit applicant can demonstrate that the alternate facilities and methods will provide environmental protection that is fully equivalent or better than that achieved by the facilities specified in the guidelines in Sections 43-040 to 43-095 of these rules. The burden of proof of fully equivalent protection lies with the permit applicant. Written approval of any alternative by the Department shall be evidence of

This wording reflects clarifying amendments proposed by the Department and accepted by the Commission.

acceptance as equivalent or better level of environmental protection.

(3) A groundwater monitoring plan shall be submitted to, and be approved by the Department. Monitoring wells shall be installed for detection of groundwater contamination as required by OAR Chapter 340, Division 40, unless the Department concludes in writing that the hydrogeology of the site or other technical information indicates that an adverse impact on groundwater quality is not likely to occur.

This wording reflects a clarifying amendment proposed by the Department and accepted by the Commission.

(4) The Department may, in accordance with a written compliance schedule, grant reasonable time for existing facilities to comply with these rules.

EXEMPTION FROM STATE PERMIT FOR HAZARDOUS WASTE TREATMENT OR DISPOSAL FACILITIES

340-43-035

(1) The state hazardous waste program requires a permit for the "treatment", "storage" or "disposal" of any "hazardous waste" as identified or listed in OAR Chapter 340, Division 101 from the Department, prior to the treatment and disposal of wastes. Permitting requirements can be found in OAR Chapter 340, Division 105, Hazardous Waste Management.

(2) However, any operation permitted under this Division, which would otherwise require the neutralization or treatment of hazardous waste and would require a permit pursuant to OAR Chapter 340, Division 105, shall be exempt from the requirement to obtain such hazardous waste treatment permit.

(3) All mined materials disposed of under this Division shall pass Oregon's hazardous waste rule criteria or they will be considered a state hazardous waste and must be disposed of accordingly.

GUIDELINES FOR THE DESIGN, CONSTRUCTION, OPERATION AND CLOSURE OF CHEMICAL MINING OPERATIONS

PURPOSE

340-43-040

(1) This Division establishes criteria for the design, construction, operation and closure of chemical mining operations and supplements the provisions of OAR 340-43-006 through OAR 340-43-035. These criteria are intended to establish the minimum level of environmental protection that is necessary using a combination of performance standards and minimum design criteria. Approval of alternative facilities or methods to achieve an equivalent or better environmental result is allowed as defined in OAR 340-43-031.

This section reflects clarifying amendments proposed by the Department and accepted by the Commission.

(2) Any disapproval of submitted plans or specifications, or imposition of requirements by the Department to improve existing facilities or their operation will be referenced when appropriate, to applicable guidelines or rules.

GENERAL PROVISIONS

340-43-045

(1) Facilities permitted under either a WPCF or NPDES permit shall not discharge wastewater or process solutions to surface water, groundwater or soils, except as expressly allowed by the permit.

(2) Facilities subject to these rules shall not be sited in 100-year floodplains or wetlands. A buffer zone (a minimum of 200 feet wide) shall be established between waste disposal facilities and surface waters.

(3) All chemical conveyances (ditches, troughs, pipes, etc.) shall be equipped with secondary containment and leak detection means for preventing and detecting

release of chemicals to surface water, groundwater or soils.

(4) Acid water accumulation in open pits resulting from the mining operation must be prevented by appropriate mining practices, by measures taken in the closure process, or be treated to control pH and toxicity, for the life of the pit.

(5) Construction of surface impoundment liner systems shall conform generally to the principles and practices described in EPA/600/2-88/052, Lining of Waste Containment and Other Impoundment Facilities, September 1988.

(6) The Department may require the permittee to hire a third-party contractor to perform the functions set forth below. Selection of the contractor shall be subject to Department approval.

(a) Review and evaluate the design and construction specifications of all mined-materials disposal facilities permitted under this Division for functional adequacy and conformance with Department requirements. The Department shall not approve construction of the disposal facilities until the design and construction specifications have been evaluated.

(b) Monitor the course of construction of all mined-materials facilities for compliance with the approved design and construction specifications. The third-party contractor shall regularly document the progress of construction and the Department shall require the permittee to take corrective action if construction does not satisfactorily conform to the approved design and construction specifications.

This paragraph includes a clarifying amendment proposed by the Department and accepted by the Commission.

(c) Provide on-site inspections during ongoing operations, including but not limited to the loading of the heap, to assure protection of the integrity of the liner system and other environmental protection measures.

This paragraph is new language proposed by the Department in the 8/7/92 draft and accepted by the Commission.

CONTROL OF SURFACE WATER RUN-ON AND RUN-OFF

340-43-050

(1) Surface water run-on and run-off shall be controlled such that it will not endanger the facility or become contaminated by contact with process materials or loaded with sediment. The control systems shall be designed to accommodate a 100-year, 24-hour storm event, or any other defined climatic event that is more appropriate to the site, and be placed so as to allow for restoration of the natural drainage network, to the maximum extent practicable, upon facility closure.

(2) All mined materials shall be properly placed and protected from surface water and precipitation so as not to be eroded and contribute sediment to site stormwater run-off or to otherwise contaminate surface water.

PHYSICAL STABILITY OF RETAINING STRUCTURES AND EMPLACED MINE MATERIALS

340-43-055

(1) Permit applicants must demonstrate to the Department that the design of chemical processing facilities and waste disposal facilities is adequate to ensure the stability of all structural components of the facilities during operation, closure and post closure.

(2) Retaining structures, foundations and mine materials emplacements shall be designed by a qualified, registered professional and be constructed for long-term stability under anticipated loading and seismic conditions.

(3) Temporary structures and materials emplacements may, with written approval from the Department, be constructed to a lesser standard if it can be shown that they pose no, or minimal, threat to public safety or the environment.

PROTECTION OF WILDLIFE

340-43-060

(1) Wildlife shall be positively excluded from contact with chemical processing solutions and wastewaters containing chemicals.

(2) The Department may waive the positive exclusion requirement if the Oregon Department of Fish and Wildlife (ODF&W) certifies to the Department that the project is designed such that it will adequately protect wildlife.

GUIDELINES FOR DESIGN, CONSTRUCTION, AND OPERATION OF HEAP-LEACH FACILITIES

340-43-065

(1) This paragraph applies to heap-leach facilities using dedicated, or expanding, pads. Heap-leach facilities using on-off, reusable pads may require variations from these rules; they shall be approved on a case-by-case basis by the Department.

(2) The heap-leach facility (pad and associated ponds, pipes and tanks) shall be sized to prevent flooding of any of its components.

(3) TABLE 1 of this Division establishes minimum capacity-sizing criteria for the leach-pad and ponds. The pad and ponds may be designed to act separately or in conjunction with each other to obtain the required storage volumes. Other design criteria may be used, with Department approval, if local conditions warrant. The best available climatic data shall be used to confirm the critical design storm event and estimate the liquid levels in the system over a full seasonal cycle. The liquid mass balance may include provision for evaporation.

~~[Heap Leach Pad Liner Alternative 1]~~

The Commission selected Alternative 2 presented below. Therefore, this wording from the 12/13/91 and 8/7/92 rule drafts is marked to clearly indicate the intended deletion.

~~[(4) The heap leach pad liner system shall be of triple liner construction with between-liner leak detection consisting of:~~

~~(a) An engineered, stable, low permeability soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;~~

~~(b) Continuous flexible-membrane middle and top liners of suitable synthetic material separated by a minimum of 12 inches of permeable material (minimum permeability of 10^{-2} cm/sec);~~

~~(c) A leak detection system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre within ten weeks of leak initiation.]~~

~~[Heap Leach Pad Liner Alternative 2]~~

(4) The heap leach pad liner system shall be designed, constructed, and operated to meet the following criteria:

This wording reflects the alternative from the 8/7/92 rule draft for heap leach pad liners that was accepted by the Commission. A new subparagraph (d) is presented below to incorporate the intent discussed by the Commission on 8/7/92.

(a) A primary liner consisting, at a minimum, of a continuous flexible-membrane of suitable synthetic material shall be provided. This liner shall function together with the process chemical collection system installed immediately above this liner (see section (8) of this rule) to remove process chemicals from the heap.

(b) A leak detection system shall be installed immediately below the primary liner for the purpose of detecting loss of process solutions by leakage through the primary liner. The leak detection system shall be capable of detecting leakage through the primary liner of 400 gallons/day-acre within ten weeks of leak initiation. The leak detection system shall consist of appropriately sized collection piping placed within a minimum thickness of 12 inches of permeable material

(minimum permeability of 10^{-2} cm/sec) that is capable of withstanding the anticipated weight of the heap without loss of function.

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the operation of the heap and following closure of the heap is not released to the environment. The Secondary liner shall be of a composite design with a continuous flexible-membrane of suitable synthetic material in direct contact with an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches.

(d) Each liner system component described in paragraphs (4)(a)-(c) above addresses a specific need and purpose with respect to environmental protection. For purposes of evaluating alternative facilities and methods of control under OAR 340-43-031(2), an alternative may be approved if the level of environmetal protection intended by each separate liner system component is achieved either within the individual component or on a cross component basis.

This new language was added based on 8/7/92 Commission discussions to clarify the Commission intent with respect to evaluation of equivalent environmental protection of liner system alternatives proposed by a permit applicant.

~~[Processing Chemical Pond Liner Alternative 1]~~

~~[(5) The processing chemical pond liners shall be of triple liner construction with between-liner leak detection consisting of:~~

~~(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches;~~

~~(b) Continuous flexible-membrane middle and top liners of suitable synthetic material separated by a permeable material (minimum coefficient of permeability of 10^{-2} cm/sec);~~

The Commission selected Alternative 2 presented below. Therefore, this wording from the 12/13/91 and 8/7/92 rule drafts is deleted.

~~(c) A leak detection system between the synthetic liners capable of detecting leakage of 400 gallons/day-acre, within ten weeks of leak initiation.]~~

~~[Processing Chemical Pond Liner Alternative 2]~~

(5) The processing chemical pond liner system shall be designed, constructed, and operated to meet the following criteria:

This wording reflects the alternative from the 8/7/92 rule draft for processing chemical pond liners that was accepted by the Commission. A new subparagraph (d) is presented below to incorporate the intent discussed by the Commission on 8/7/92.

(a) A primary liner consisting, at a minimum, of a continuous flexible-membrane of suitable synthetic material shall be provided. This liner shall provide for positive containment of processing chemical solutions.

(b) A leak detection system shall be installed immediately below the primary liner for the purpose of detecting loss of process chemical solutions by leakage through the primary liner. The leak detection system shall be capable of detecting leakage through the primary liner of 400 gallons/day-acre within ten weeks of leak initiation. The leak detection system shall consist of appropriately sized collection piping placed within a layer of permeable material (minimum permeability of 10^{-2} cm/sec).

(c) A secondary liner shall be placed below the leak detection system to provide assurance that any leakage through the primary liner during the use of the pond is not released to the environment. The Secondary liner shall be of a composite design with a continuous flexible-membrane of suitable synthetic material in direct contact with an engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-7} cm/sec) with a minimum thickness of 36 inches.

(d) <u>Each liner system component described in paragraphs (5)(a)-(c) above addresses a specific need and purpose with respect to environmental protection. For purposes of evaluating alternative facilities and methods of control under OAR 340-</u>

This new language was added based on 8/7/92 Commission discussions to clarify the Commission intent with respect to evalu-

43-031(2), an alternative may be approved if the level of environmetal protection intended by each separate liner system component is achieved either within the individual component or on a cross component basis.

ation of equivalent environmental protection of liner system alternatives proposed by a permit applicant.

(6) Emergency ponds may be constructed as an alternative to larger pregnant and barren ponds. The emergency pond may be constructed to a lesser standard, with the limitation that it is to be used only infrequently and for short periods of time. The Department will specify reporting and use limitations for the ponds in the permit. A between-liner leak detection system is not required for the emergency pond.

(7) The emergency-pond liner shall be of composite construction consisting of:

(a) An engineered, stable, low permeability soil/clay bottom liner (maximum permeability of 10^{-6} cm/sec) with a minimum thickness of 12 inches, and

(b) A single flexible-membrane synthetic top liner of suitable material.

(8) The heap-leach pad shall be provided with a process chemical collection system above the upper-most liner that will prevent an accumulation of process chemical within the heap greater than 24 inches in depth.

(9) The permittee shall prepare a written operating plan for safe temporary shut-down of the heap-leach facility and train employees in its implementation.

(10) The permittee shall respond to leakage collected by the heap-leach and processing-chemical storage pond leak-collection systems according to the process defined in TABLE 2.

(11) The permittee shall determine the acid-generating potential of the spent ore by acid\base accounting and other appropriate static and dynamic laboratory tests. If the spent ore is shown to be potentially acid generat-

ing under the conditions expected in the heap at closure, the permittee shall submit a plan for acid correction for Department approval prior to loading the heap.

GUIDELINES FOR DISPOSAL OF MILL TAILINGS

340-43-070

(1) Mill tailings shall be treated by cyanide removal, ~~[and]~~ re-use, or destruction prior to disposal to reduce the amount of cyanide introduced into the tailings pond to the lowest practicable level. ~~[Chemical oxidation or other means shall be additionally used, if necessary, prior to disposal to reduce the WAD cyanide level in the liquid fraction of the tailings.]~~ The permittee shall conduct laboratory column tests on mill tailings to determine the lowest practicable concentration to which the WAD cyanide (weak-acid dissociable cyanide as measured by ASTM Method D2036-82 C) can be reduced. In no event, shall the permitted WAD cyanide concentration in the liquid fraction of the tailings be greater than 30 ppm.

This rule was amended by the Commission on 8/7/92, following extensive discussion. The amendments allows the permit applicant to select cyanide destruction methodology for reducing the amount of cyanide entering the tailings pond. The amendments also require that the technology selected be designed and operated to achieve the lowest practicable level of cyanide in the tailings pond.

(2) The permittee shall determine the potential for acid-water formation from the tailings by means of acid-base accounting and other suitable laboratory static and dynamic tests. If acid formation can occur, basic materials shall be added to the tailings in the amount of three (3) times the acid formation potential or to give a net neutralization potential of at least 20 tons of $CaCO_3$ per 1000 tons of tailings, whichever is greater, before placing tailings in the disposal facility.

(3) The disposal facility shall be lined with a composite double liner consisting of a flexible-membrane synthetic top liner in tight contact with an engineered, stable, soil/clay bottom liner (maximum coefficient of permeability of 10^{-7} cm/sec) having a minimum thickness of 36 inches.

Construction of the liner shall generally follow the principles and practices contained in EPA/600/2-

88/052, "Lining of Waste Containment and Other Impoundment Facilities, September, 1988.

(4) The disposal facility shall be provided with a leachate collection system above the liner suitable for monitoring, collecting and treating potential acid drainage.

GUIDELINES FOR DISPOSAL OR STORAGE OF WASTEROCK, LOW-GRADE ORE AND OTHER MINED MATERIALS

340-43-075

The permittee shall determine the acid-producing and metals-release potential of the wasterock, low-grade ore or other mined materials by acid/base accounting and other appropriate static and dynamic laboratory tests. If the mined materials are shown to be potentially acid forming, or capable of releasing toxic metals, the permittee shall submit a plan for correction and disposal for Department approval prior to permanently placing the materials.

GUIDELINES FOR HEAP-LEACH AND TAILINGS DISPOSAL FACILITY CLOSURE

340-43-080

(1) The waste disposal facilities shall be closed under these rules in conjunction with the reclamation requirements of DOGAMI (Oregon Department of Geology and Mineral Industries).

(2) An up-dated closure plan and post-closure monitoring and maintenance plan shall be submitted to the Department by the permittee at least 180 days prior to beginning closure operations or making any substantial changes to the operation. The closure plan must be compatible with DOGAMI's reclamation plan and may be part of it.

(3) Chemical conveyances (ditches, troughs, pipes, etc.) not necessary for post-closure monitoring shall be

removed. The secondary containment systems shall be checked before closure for process-chemical contamination, and contaminated soil or other materials, if any, shall be removed to an acceptable disposal facility.

(4) Closure of the heap-leach facility.

(a) The heap shall be detoxified over a suitable period of time prior to closure, using rinse/rest cycles of rinsing and chemical oxidation, if necessary. The WAD cyanide concentration in the rinsate shall be no greater than 0.2 ppm.

(b) Following detoxification as defined in (a) above, the heap shall be closed in place on the pad by covering the heap with a cover designed to prevent water and air infiltration. The cover should consist, at a minimum, of a low-permeability layer and suitable drainage and soil layers to prevent erosion and damage by animals and to sustain vegetation growth, in accordance with DOGAMI's reclamation rules.

(c) The ponds associated with the heap shall be closed by folding in the synthetic liners and filling and contouring the pits with inert material. Residual sludge may be disposed of in one of the on-site waste disposal facilities, provided it meets the criteria for such wastes in these guidelines. The process chemical collection system of the heap shall be maintained in operative condition so that it can be used to monitor the amount and quality of infiltrated water, if any, draining from the heap.

(5) The tailings disposal facility shall be closed by covering with a composite cover designed to prevent water and air infiltration and be environmentally stable for an indefinite period of time. Maximum effort shall be made to isolate the tailings from the environment. Construction of the cover shall generally follow the principles and practices contained in <u>EPA/530-SW-89-047, Technical Guidance Document -- Final Covers on Hazardous Waste Landfills and Surface Impoundments</u>.

POST-CLOSURE MONITORING

340-43-085

(1) The Department may continue its permit in force for thirty (30) years after closure of the operation and will include permit requirements for periodic monitoring to determine if release of pollutants is occurring.

(2) Monitoring data will be reviewed regularly by the Department to determine the effectiveness of closure of the disposal facilities. The Department will consult with DOGAMI on release of security funds that would otherwise be needed to correct problems resulting from ineffective closure.

LAND DISPOSAL OF WASTEWATER

340-43-090

(1) To qualify for land disposal of excess wastewater, the permit applicant shall demonstrate to the Department that the process has been designed to minimize the amount of excess wastewater that is produced, through use of water-efficient processes, wastewater treatment and reuse, and reduction by natural evaporation. Excess wastewater that must be released shall be treated and disposed of to land under the conditions specified in the permit.

(2) A disposal plan shall be submitted as part of the permit application that, at a minimum, includes:

(a) Wastewater quantity and quality characterization;

(b) Soils characterization and suitability analysis;

(c) Drainage and run-off characteristics of the site relative to land application of wastewater;

(d) Proximity of the disposal site to groundwater and surface water and potential impact;

(e) Wastewater application schedule and water balance;

(f) Disposal site assimilative capacity determination;

(g) Soils, surface water and groundwater monitoring plan;

(h) Potential impact on wildlife or sensitive plant species.

(3) The Department will evaluate the disposal plan and set site-specific permit conditions for the wastewater discharge.

GUIDELINES FOR OPEN-PIT CLOSURE

340-43-095

(1) Open pits that will be left as a result of the mining operation shall be assessed prior to, and following, mining operations for the potential to contaminate water to the extent that it might not meet water-quality standards due to build-up of acid or toxic metals.

(2) If the Department finds that the potential for water accumulation in the pit(s) exists, the permit applicant shall submit a closure plan for the pit that will address contamination prevention and possible remedial treatment of the water. The closure plan shall, at a minimum, examine the following alternatives:

(a) Avoidance, during mining, of acid-generating materials that can be left in place, rather than being exposed to oxidation and weathering;

(b) Removal from the pit and disposal, during or after the mining operation, of residual acid-generating materials that would otherwise be left exposed to oxidation and weathering;

(c) Protective capping in-situ of residual acid-generating materials;

(d) Treatment methods for correcting acidity and toxicity of accumulated water;

(e) Installation of an impermeable liner under ponded water to prevent groundwater contamination;

(f) Backfilling of the pit(s) above the water table to reduce oxidation of residual acid-generating materials.

TABLE 1

Heap-Leach Liquid Storage Criteria

Component	Pregnant-Solution Pond	Barren-Solution Pond
Operating Volume	Minimum necessary to maintain recirculation	Minimum necessary to maintain recirculation
Operational Surge	Anticipated draindown and rinse volume	Anticipated draindown and rinse volume
Climatic Surge	100-yr, 24-hr storm plus 10-yr snowmelt	100-yr, 24-hr storm plus 10-yr snowmelt
Safety Factor	2-ft dry freeboard	2-ft dry freeboard

TABLE 2

Required Responses to Leakage Detected from the Leach Pad and Processing Chemical Storage Ponds

Leakage Category	Response
Zero leakage to 200 gal/day-acre	Notify the Department; increase pumping and monitoring
Leakage from 200 gal/day-acre to 400 gal/day-acre	Change operating practices to reduce leakage
Leakage in excess of 400 gal/day-acre	Repair leaks under Department schedule.

OREGON MINING COUNCIL
200 Century Tower, 1201 S.W. 12th Avenue
Portland, Oregon 97205
(503) 227-5591

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY

OFFICE OF THE DIRECTOR

August 27, 1992

Mr. William Wessinger, Chair
Environmental Quality Commission
121 SW Salmon, Suite 1100
Portland, Oregon 97204

Dear Mr. Wessinger:

I feel it is important to respond to recent references related to cyanide impacts at the Landusky Mine in Montana and the Summitville Mine in Colorado. Both of these operations utilize "valley-fill" heap leach designs. As you are aware, the proposed Chemical Mining Rules require the operator, ". . . prevent an accumulation of process chemical within the heap greater than 24 inches in depth.", OAR 340-43-065 (8). Neither of these operations could be permitted in Oregon as solutions typically accumulate in a valley-fill heap in the order of tens of feet.

The long term fate of residual cyanide in the heaps of potential operations in Oregon has also repeatedly been raised as a concern. The reference identified to support this concern has been the Environmental Assessment (EA) for the Landusky Mine Expansion in Montana (May 11, 1990). Subsequent to the release of this EA, a research project was commissioned which included a study of the fate of cyanide at this facility. A final report titled "Cyanide Degradation and Decommissioning of Spent Heap-Leach Ore at the Landusky Mine" was issued on December 28, 1990. Its authors concluded that natural degradation of residual cyanide will bring the facility into compliance with regulatory standards for cyanide within 6 to 10 years.

Again, I must caution that these comparisons of valley-fill heaps and potential Oregon operations are largely misleading and inappropriate.

Sincerely,

John C. Parks

John C. Parks-Chair
Oregon Mining Council

cc: Dr. Emery Castle
Mr. Henry Lorenzen
Ms. Carol Whipple
Ms. Linda R. McMahan
Mr. Frederic Hansen
Mr. Harold L. Sawyer

Concerned Citizens For Responsible Mining

• P.O. Box 957 • Ontario, Oregon 97914 •

Bill Wessinger

August 28, 1992

William Wessinger
121 S.W. Salmon
Suite 1100
Portland, Oregon 97204

Dear Chair Wessinger,

The intent of this correspondence is to express our support of language revisions recently incorporated into the draft of the proposed DEQ chemical mining rules. We encourage adoption of standards which package flexibility with strong environmental protection: the revised rules provide that benefit.

Thank you for your consideration.

Sincerely,

Carolyn Brown

Carolyn Brown
CCRM

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
AUG 1 1992
OFFICE OF THE DIRECTOR

State of Oregon
Department of Environmental Quality — Memorandum

Date: August 28, 1992

To: Linda McMahan, Commissioner, EQC

From: Kent Ashbaker, Manager
Water Quality, Northwest Region

Subject: Requested Information on Cyanide Interactions

I apologize for being so slow in getting this information to you. With the one who knew where all of this information is, not around anymore and others on vacation, it has taken some time to go through the boxes of mining information and search for the material you requested. I hope that the information is helpful.

Document # 1 includes a page which shows a number of cyanide removal or destruction methods and their ability to remove some basic complexes. In also includes two pages on the AVR process. This is the process which we had proposed for cyanide removal and re-use. The last page on that document has back to back tables. Table 3 shows some of the chemical characteristics of untreated tailings water. Table 4 shows some of the chemical characteristics of AVR treated water. We would have liked to be able to have a table which compared the alkaline chlorination process with the other two, but we couldn't find one.

Document # 2 is an informational memo put out by the State of California.

Document # 3 is an explanation of 7 different cyanide removal processes with some of the chemical reactions.

If you have any specific questions, please let me know and I will try to find an answer for you.

cc: Fred Hansen
Lydia Taylor
Chairman Wessinger
Harold Sawyer

#1

Cyanide Destruction Methods

	Suitable for Removal of						
Method	CN/HCN	Zn/Cd		Cu/N		$Fe(CN)_6^{-3}$	CNS
		metal	complex	metal	complex		
H_2O	yes	yes	yes	part	part	no	no
natural	yes	part	part	no	no	no	part
AVR	yes	yes	yes	yes	yes	yes	part
alk. chlor	yes	yes	yes	yes	yes	no	yes
biodegradation	yes	yes	yes	yes	yes	?	yes
$INCO/SO_2$	yes	yes	yes	no	part	yes	?

ACIDIFICATION- VOLATILIZATION-REGENERATION (AVR)

Although the Mills-Crowe AVR process is well-known, it has seen little application in many years, and possibly its use had been completely discontinued until only recently. Hydrogen cyanide (HCN) is extremely volatile and consequently can be readily stripped from solutions by air-sparging, particularly at low pH. The low pH is essential to promote the dissociation of cyanide-metal complexes to form HCN at practical rates. The AVR process consists of acidifying waste cyanide-bearing solutions or slurries to pH 2-3 with H_2SO_4, volatilizing the resulting HCN by intense air stripping and recovering the HCN by absorption in an alkaline solution, i.e., NaOH or $Ca(OH)_2$. The recovered HCN is recycled to the cyanidation circuit. Counter-current towers have been used for both HCN stripping and absorption. Some cyanide containing solids, i.e., CuCN, $Cu_2Fe(CN)_6$, remain in the acidified solution. Dissolved metals, i.e., Cu, Ni and Zn also remain in solution and are precipitated as hydroxides in a subsequent step by neutralization with lime.

The principal AVR reactions are shown by the equations:

Acidification $\quad Ca(CN)_2 + H_2SO_4 \longrightarrow CaSO_4 + 2HCN$

Absorption $\quad 2HCN + Ca(OH)_2 \longrightarrow Ca(CN)_2 + 2H_2O$

The AVR process was used by the Hudson Bay Mining and Smelting Company in Flin Flon from 1935 to 1978 to recover cyanide from waste barren solution (16). At that plant 91% of the "regenerable" cyanide was recovered. "Regenerable" cyanide was the amount of cyanide which could be released from the barren solution in a laboratory acidification test.

More recently AMOK Limited at their Cluff Lake mill treated 6,500 tonnes of uranium leach tailings for their gold content using the CIP process (17). An AVR system, operated in the batch mode, was used to recover cyanide from CIP tailings. The acidification step was done by adding H_2SO_4 to pH 3-4 in a vigourously air-agitated tank and the recovery of HCN was carried out in a counter-currently operated absorption tower. Over 90% removal of the cyanide from the CIP tailings slurry was reported.

Staff at CANMET have investigated the AVR process over the past few years. Initially they worked with the standard AVR process but found that air-stripping HCN from the total volume of waste barren solution was unduly expensive (18). Subsequently, their efforts have led to substantial modifications of the process whereby most of the HCN is recovered from acidified waste barren solution as $Ca(CN)_2$ by liming and only a small fraction of HCN needs to be recovered by the more costly air-stripping HCN absorption step (19). The process as demonstrated in the laboratory has been capable of producing final effluents containing less than 1 mg/L total cyanide and below 0.5 mg/L for each of the metals copper, iron, nickel and zinc.

Since 1985, Golconda Minerals has been recovering gold by cyanidation from mill tailings at its Beaconsfield mine in Tasmania. In February 1987, Golconda placed a plant in operation using the AVR process to treat 1200 tonnes/day of tailings pond water (20).

The treatment plant flowsheet is shown in Figure 7. At this plant tailings pond decant is acidified to pH 2-3 with H_2SO_4. The solids formed during acidification are separated by clarification and sand filtration before HCN is air-stripped from solution in counter-currently operated packed towers. Hydrogen cyanide is then absorbed in towers from the air stream in a 10% NaOH solution and the recovered NaCN is recirculated to cyanidation. The barren solution from the aeration columns is sent to carbon columns for the recovery of residual gold and then released. The carbon columns also reduce the residual level of cyanide in the water. Performance data for the treatment plant are presented in Table 10.

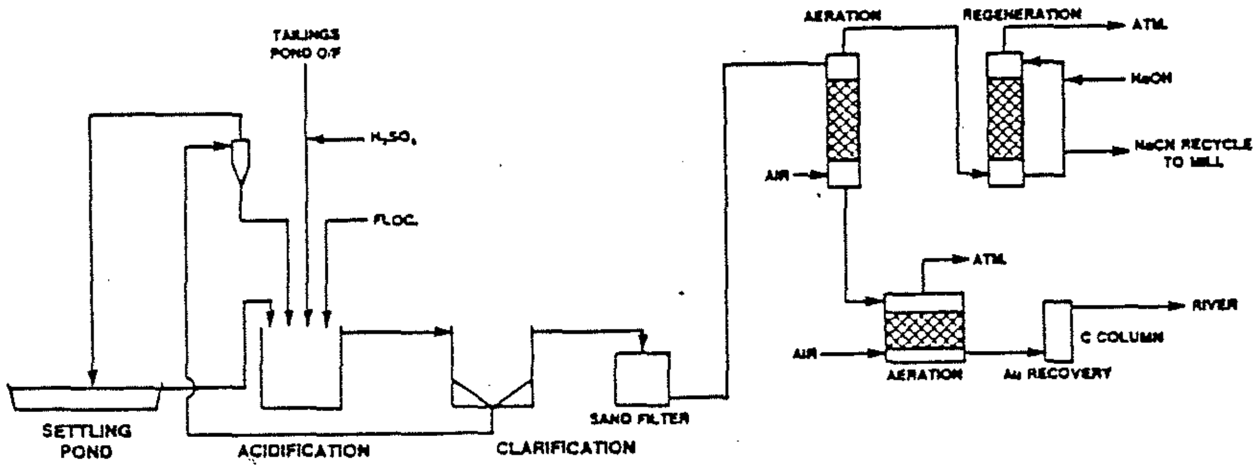

FIGURE 7 GOLCONDA CYANIDE REGENERATION PROCESS

TABLE 10 GOLCONDA TREATMENT PLANT DATA

	Analyses (mg/L)			
	Tailings Pond Decant	Clarified Solution	Aerator Discharge	C Column Discharge
CN_T	200	115	2 - 4	1 - 2
CN_F	10 - 30	110	0.2 - 0.5	0.1 - 0.3
Cu	200	< 1	< 1	< 1
Fe	50 - 100	< 1	< 1	< 1
Ni	1 - 2	< 1	< 1	< 1
Zn	5 - 30	< 1	< 1	< 1
Au	0.08	0.08	0.08	0.01

TABLE 3

CHEMICAL CHARACTERISTICS OF UNTREATED TAILINGS IMPOUNDMENT WATER

Parameter [1,2]	Concentration Range	Average Concentration
Arsenic	------	0.36
Cadmium	------	0.01
Chromium	------	0.01
Cobalt	------	0.21
Copper	2.6 - 2.7	2.6
Iron	------	16.0
Lead	0.08 - 0.20	0.14
Mercury	0.01 - 0.024	0.016
Nickel	------	0.20
Silver	2.0 - 2.1	2.0
Zinc	91.9 - 96.4	93.3
Thiocyanate	30.1 - 36.6	33.6
Total Cyanide	310 - 340	330
Method-C Cyanide	270 - 320	294
Ammonia (as N)	19.0 - 19.6	19.3
pH (in pH units)	10.4 - 10.5	10.4

(1) All concentrations in mg/L, unless otherwise stated.

(2) All values are the result of direct analysis of the samples.

TABLE 4

CHEMICAL CHARACTERISTICS OF THE AVR TREATED WATER

Parameter [1,2]	Concentration Range	Average Concentration
Arsenic	0.01 - 0.02	0.01
Cadmium	0.004 - 0.004	0.004
Chromium	<0.01 - <0.02	<0.02
Cobalt	0.15 - 0.18	0.16
Copper	0.28 - 0.55	0.39
Iron	0.05 - 0.09	0.07
Lead	0.05 - 0.20	0.10
Mercury	0.013 - 0.015	0.014
Nickel	2.05 - 0.10	0.09
Silver	0.5 - 1.1	0.9
Zinc	0.04 - 0.13	0.09
Thiocyanate	27.4 - 36.6	31.3
Total Cyanide	1.3 - 2.3	1.7
Method-C Cyanide	0.7 - 1.6	1.2
Ammonia (as N)	13.8 - 21.3	18.6
Nitrate (as N)	20.0 - 31.4	25.4
Sulfate	1200 - 1600	1450
pH (in pH units)	9.5 - 9.8	------

(1) All concentrations in mg/L, unless otherwise stated.

(2) All values are the result of direct analysis of the samples.

INTERNAL MEMO

TO: O. R. Butterfield
Executive Officer

FROM: Dr. Ranjit S. Gill, E.S. IV

RECEIVED AUG 24 1987 Water Quality Division

DATE: April 22, 1987

SIGNATURE: Ranjit S. Gill

SUBJECT: CYANIDE REQUIREMENTS FOR CYANIDATION PROCESS WASTES

Regional Board staff are frequently required to issue waste discharge requirements for mining operations that utilize cyanidation process in the recovery of gold and silver. The staff issues the requirements to protect the environment from adverse impact of cyanide-containing wastewater and solid waste.

In the course of working with mining operations that utilize cyanidation process, the Regional Board staff have realized the need to standardize, subject to site specific review, the requirements for the various cyanide compounds and their reaction products in the mine effluent and slurries. I am writing this memo to assist our staff in formulating such requirements. To substantiate the standard requirements proposed later in the text, I offer the following discussion on a) cyanide species encountered in mine effluent; b) environmental fate of cyanides; c) toxicity of cyanides; d) analytical methods of cyanide determination; and e) methods of cyanide destruction.

A. Cyanide Species in Cyanidation Effluents

Cyanide comprises a large class of organic and inorganic chemical compounds with each member containing a cyano group ($C \equiv N$) as part of its molecular structure. Cyanides generally encountered in the cyanidation mine effluents and slurries may be classified into three broad groups:

1) Free Cyanide

Free cyanide is defined as the sum of cyanide anion (CN^-) and hydrogen cyanide gas (HCN). In solution the relationship between CN^- and HCN is highly pH dependent.

$$CN^- + H_2O \longleftrightarrow HCN + OH^-$$

The pKa of HCN, where the concentrations of CN^- and HCN are equal, is at pH 9.367. In solution at pH 11 and above, free cyanide is present as 100% CN^-, and at pH 7 and below, cyanide is present as 100% HCN.

2) Simple Cyanides

Simple cyanides are represented by the formula $A(CN)_x$, where A is an alkali (sodium, potassium, ammonium) or metal, and x, the valence of A, represents the number of cyano groups present in the molecule. Soluble compounds, particularly the alkali cyanides, ionize to release cyanide anions according to the following equation:

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$$A(CN)_X \longleftrightarrow A^{+X} + X\ CN^-$$

There is a wide range of solubilities for the simple cyanides which are influenced the most by pH and temperature. The hydrolytic reaction of cyanide ions with water produces hydrocyanic acid according to the following equation:

$$CN^- + H_2O \longleftrightarrow HCN + OH^-$$

Suubsequent behavior then is the same as for HCN.

3) Complex Cyanides

The complex alkali-metallic cyanides can generally be represented by the formula Ay $M(CN)_X$, where A is the alkali (sodium, potassium, ammonium). M is the heavy metal (copper, nickel, silver, zinc, Cadmium, ferrous or ferric iron, or others), and x is the number of CN^- groups equal to the valence of A taken y times plus the valence of the heavy metal. The soluble complex cyanides dissociate into complex anions M $(CN)_X^-$ rather than the CN^-groups (e.g.):

$$AyM\ (CN)x \longleftrightarrow yA^{+(x)} \quad + (M(CN)_X)^{-yw}$$

W is the oxidation state of A in the original molecule.

The complex anion can then undergo further dissociation releasing CN^-. The hydrolytic reaction of CN^- with water produces HCN. Subsequent behavior would then be the same as for HCN.

Although simple cyanides such as sodium cyanide and potassium cyanide readily dissociate and hydrolize to form CN^- and HCN, the metallocyanide complex anions have a wide range of stabilities. Zinc and Cadmium cyanide complexes dissociate rapidly and nearly completely in dilute solutions, whereas the stability of the copper and nickel metallocyanide anions are pH dependent. Cyanide complexes of iron dissociate very little, but they are subject to rapid and complete photo decomposition which results in release of CN^- in natural light.

The high toxicity of free cyanide is well documented (1, 2, 3, 8), and therefore the Regional Board staff can justify stringent requirements to control its discharge. By comparison, the toxicity of complex cyanides is relatively low. For this reason, on many occasions the dischargers ask the Regional Board staff to waive the requirements for complex cyanides (commonly referred to as total cyanide). The preceding discussion on the dissociation of complex cyanides to free cyanides, however, demonstrates the need for us to issue requirements for complex cyanides present in cyanidation process wastes.

In summary, cyanide in cyanidation process wastes is generally present as free cyanide, simple cyanides and complex cyanides. The simple cyanides and complex cyanides can dissociate to release free cyanide.

We must issue requirements to control discharge of free cyanide, because of its high toxicity, and for complex cyanides, because of their dissociation to free cyanide, to protect the environment.

B. **Environmental Fate of Cyanide**

Limited information is available on the fate of cyanide from cyanidation operations in the environment (soils, waters, tailing dumps, and others). Temperature, pH, sunlight, bacteria, organic and inorganic materials, types of soils, water chemistry, mineral make-up of tailings, permeability of soils, tailings type, and concentration and solubility of cyanide compounds, all have an effect on the ultimate fate of cyanide in the environment. For example, HCN can be removed from solution by volatilization. However, volatilization is generally influenced by pH, temperature, interface area, concentration, and agitation. Degree and rate of HCN volatilization, therefore, varies significantly from site to site.

Similarly, fate of complex cyanides in the cyanidation effluents and slurries varies vastly depending upon the conditions of the associated environment. According to Ford and Smith (14), about 28 elements can form complexes with cyanides to produce about 72 metallocyanide complexes; each exhibits a varying degree of persistence in the environment depending upon whether it is in a solid or an aqueous phase. In an aqueous phase pH, dissolved oxygen concentration, ultra-violet radiation, and availability of other complexing agents affect persistence and mobility. In the solid phase most complexes remain inert. However, complex cyanides in the solid phase can solublize readily as a function of the associated soil and water chemistry. Once in the aqueous phase, the complexed cyanides can migrate with relative ease (5). For example, ferro- and ferri-cyanide when present in the solid phase and shielded from ultraviolet light are stable and relatively nontoxic compounds. However, these anions can solublize and leach readily from their resident sites and reach surface waters (5). Subsequent irradiation by sunlight would result in the production of highly toxic free cyanide. Our staff, therefore, must issue stringent requirements for the soluble fraction of the complex cyanides present in the solid phase of cyanidation tailings.

Environmental concern regarding extremely reactive and toxic free cyanides is easily conceived. The so-called stable and relatively non-toxic complex cyanides should also be of major environmental concern because of their persistence and decomposition to free cyanides. Analytical chemist Pohland remarked, "Metal complexes, on the other hand, decompose slowly with simultaneous appearance of cyanide and cyanate ions. Therefore, pollution of the environment with the so-called `stable' cyanide complexes must be avoided." (6).

Frequently, dischargers ask the Regional Board staff to relax or waive the requirements for cyanide in cyanidation process wastes. They cite natural attenuation as mechanism for elimination of cyanide in the tailings. Natural rate and extent of cyanide attenuation, as described in the preceding discussion, greatly depends on the nature of cyanide compounds present in the cyanidation process waste, type of waste, and the associated environment. For example, if a relatively clear, barren solution containing mostly free cyanide is discharged to a shallow lined pond with provisions for aeration, the free cyanide present will likely degrade to background levels over a period of time. If, however, tailing slurry from a cyanidation process containing a mixture of free, simple and complex cyanides is discharged to an unlined disposal area, the solution contained in the slurry and/or the precipitation percolating through the tailings can, with time, actually end up with higher cyanide concentrations than initially present in the slurry and consequently contaminate ground and surface waters. Such an incidence exists at Noranda Grey Eagle Mine in Region 1. (Personal communication with David Evans, WRCE, Region 1.) The Regional Board staff, therefore, should require accurate knowledge of the fate of cyanide under site specific conditions before making the requirements less stringent than those proposed later in this report.

C. Toxicity of Cyanide

Free cyanide is extremely toxic to most living organisms. The EPA has established 3.5 ug/l (.0035 mg/l) as the ambient water quality criteria for free cyanide to protect aquatic life (1, 8). The U.S. Public Health Service (PHS) has established 0.2 mg CN /l as the acceptable criteria for drinking water supplies (7). In addition to the 0.2 mg CN /l criteria for free cyanide, the PHS set forth an objective to achieve concentrations below 0.01 mg/l in water because proper treatment will reduce cyanide levels to 0.01 mg/l or less (7). The EPA intends to propose 0.154 mg/l as the Human Health Advisory Criteria for free cyanide. (Personal communication with EPA staff, Washington, D.C.).

The toxicity of most complex cyanides to aquatic and terrestrial organisms was considered solely because of the presence of free cyanide derived from ionization, dissociation, and photo decomposition of these cyanide containing compounds. Review of more recent research (4) demonstrates that the so-called non-toxic complex cyanides such as ferri- and ferro-cyanides may also be toxic in the undissociated forms. The 96 hour LC_{50} for Rainbow trout appears to be around 10.0 mg Tot. CN/l. Similarly, recent studies demonstrate that thiocyanate is significantly more toxic to aquatic life than previously suggested (4, 15).

Toxicity of simple and complex cyanides, therefore, is likely because of both the undissociated compounds and their potential to produce free cyanide in the environment. The Regional Board staff, when issuing requirements for complex cyanides, should consider both forms of complex cyanide toxicities.

D. Analytical Methods of Cyanide Determination

The analytical procedures for quantitative determination of cyanide concentrations in liquids, solids, and slurries are currently in a state of flux. The need to determine cyanide species in a wide variety of matrices has resulted in the development of a profusion of methods that are frequently complex and cumbersome to use on a routine and standard basis. Random modifications of analytical procedures has led to mass confusion in interpretation of various test results. Regional Board staff are frequently at a loss to properly identify the cyanide species (free, simple, complex) represented in various studies because of the ambiguities in the analytical procedures used. Obviously, we need to standardize analytical procedures for quantitative determinations of cyanide concentration in cyanidation process wastes.

From an analytical viewpoint, I will describe four methods of cyanide quantification. These are: (1) total cyanide; (2) weak acid dissociable cyanide; (3) cyanide amenable to chlorination; and (4) free cyanide.

- o Total cyanide is defined as the amount measured by the reflux mineral acid distillation method and includes complex cyanides, simple cyanides, and free cyanide (gold, cobalt, and platinum complexes are excluded). The most common methodology used for total cyanide determination is an acid reflux/distillation in which a catalytic agent is used to facilitate breakdown of metal cyanide complexes. Hydrogen cyanide liberated by the distillation is collected in an alkaline absorbing solution and is measured depending upon the desired lower limit of detection, by either titration, colorimetry, or specific ion electrodes. Standard Methods 412B (9) and ASTM Method 81 A (10) are applicable to the direct determination of total cyanide in both wastewater and solid waste. Interference by thiocyanate and reduced sulfur compounds and reduced recoveries of noble metal compelxes in the above methods can be alleviated by minor modifications (2). Several investigators (11) have cited difficulties in obtaining representative 0.5 gms solid waste samples required for direct determination of total cyanide in solids by the two methods. This difficulty is easily overcome by increasing the solid waste samples to up to 5 gms (12).

- o Weak acid dissociable (WAD) cyanides include free cyanide and free cyanide readily released from simple and complex cyanides under slightly acidic (Ph 4.5) conditions. The method which is now accepted by ASTM as a standard procedure for WAD cyanides is referred to as Method C (10). Method C distillation is carried out with the same equipment and in the same manner as Method A for total cyanide but using acetic acid-sodium acetate solution buffered at pH 4.5 and zinc acetate. Method C recovers cyanides complexed with sodium, potassium, Cadmium, copper, nickel, silver, and zinc. Cyanide is not recovered from ferro, ferri, and cobalt complexes. Thiocyanate interferences do not occur with this method.

- o Cyanide amendable to chlorination (CAC) analysis method is based on the difference between total cyanide determination in a sample both before and after chlorination. One portion of the sample is analyzed by ASTM Method A or Standard Method 412B for total cyanide. Another portion is treated with sodium hypochlorite at an alkaline pH for one hour. The chlorine residual is removed and the solution is analyzed by the total cyanide procedure. The alkaline chlorination oxidizes (destroys) all cyanides except the iron complexes. The differences between the two values is reported as CAC.

As compared with WAD cyanide, CAC has two drawbacks: CAC measurements require two sets of analysis; and thiocyanate interferences occur.

- Free cyanide can be determined by either solvent extraction or sparging the HCN from solution and collecting it for later determination. Numerous other methods, primarily research procedures, of measuring free cyanides have also been proposed. They are not applicable or have not been tested for use in monitoring cyanidation mine effluents.

E. Methods of Cyanide Destruction

Numerous treatments (13) are available for cyanide removal from cyanidation process wastes. Of those, three methods are the more commercially important treatment processes. These are 1) natural degradation; 2) alkaline chlorination; and 3) Inco process. I will present a brief discussion of these three methods:

- Natural degradation (lagooning) processes are supposed to detoxify cyanides present in cyanidation process wastes to acceptable levels. Existing practice is to direct the cyanide-containing wastes to a tailings disposal area and let nature take its course. If the disposal area has an adequate retention time, the operation of natural environmental forces can effect some reduction in the cyanide concentration. Environmental forces producing natural degradation are photo decomposition by sunlight, acidification by carbon dioxide in the air, oxidation by oxygen in the air, dilution, and in case of long retention times, biological action. The rate and magnitude of cyanide reduction, as mentioned earlier in the discussion on environmental fate of cyanide, is a function of cyanide species present in the cyanidation process waste, nature of waste, and the associated environment. The half-life of cyanide species present in the waste can vary immensely. Natural degradation in most cases is effective only as pre-treatment to reduce treatment chemical consumption and is generally not sufficient in itself to prevent environment pollution by cyanide.

- Alkaline chlorination is effective in reducing WAD cyanides in barren solutions to 0.05 mg CN/l. The destruction of cyanide can be accomplished by means of chlorine gas, calcium hypochlorite, or sodium hypochlorite. Chlorination is not effective in decomposition of hexacyanoferrates and requires careful control of pH to prevent formulation of highly toxic cyanogen chloride. Another disadvantage of this process is the possibility of forming toxic chlorinated organic compounds. Also, residual excess chlorine can be toxic to aquatic organisms.

- Inco process of cyanide destruction was recently developed by the International Nickel Company of Canada. It is effective in oxidative destruction of cyanide in effluents and slurries (3). It is simple, rapid, effective and relatively inexpensive. Inco's SO_2/air technology is able to remove cyanide in both free and complex forms (including $(Fe(CN)_6^{-4})$ to levels around 1 mg/l as CN total, 0.5 mg/l as CN WAD and 0.1 mg/l as CN free. The process works in a continuous mode on either clear water or slurries (commercially successful up to 55% tailings). Removal of the soluble cyanide occurs by two routes, namely;

  Oxidation: CN^- (free) + $SO_2 + O_2 + H_2O$ $CNO^- + H_2SO_4$
  CN^- (complexed) + $SO_2 + O_2 + H_2O$ $CNO^- + H_2SO_4$

  Precipitation: $Fe\ (NC)_6^{-4} + 2Cu^{+}$ $Cu_2Fe(CN)_6$

  Acid produced during CN^- oxidation is neutralized to maintain pH in the operation preferred range of 8-9. Under these conditions, metal ions released by the CN complex are precipitated as hydroxides, i.e., $Ni(OH)_2$, $Cu(OH)_2$, $Zn(OH)_2$, etc. A small amount of Cu may be required to catalize the CN removal. The Inco process removes soluble $Fe\ (CN)_6^{-4}$ from the liquid phase and puts it into a very insoluble form, $CuFe(CN)_6$ or $ZnFe(CN)_6$. Inco's solubility data on these compounds indicate that at pH$<$9 the equilibrium solubility is 0.5 mg/l as CN total. Thus for any given contact with water at pH$<$9, no more than 0.5 mg/l CN total (assuming extraction of 1 kg heap tailings into 5 kg H_2O) would be extracted from the solid at one time, which if assuming a 10 fold dilution to receiving waters, would result in maximum CN total concentration of 0.05 mg/l.

The advantage of the Inco SO_2 - air method for cyanide removal appears not only in the superior quality of its effluent, but also in the economy when compared with other possible methods such as chlorination or hydrogen peroxide. For example, for a typical gold mill treating 1000 MT ore/day using two pounds NaCN/tonne ore, the cost (chemical and royalty to Inco Corp.) to destroy cyanide by Inco process would be about $0.55/MT ore if SO_2 is used and $1.68/MT ore is $Na_2S_2O_5$ is used. By comparison, alkaline chlorination on the same waste material could cost $1.92/MT ore, and hydrogen peroxide would cost about $4.14/MT ore.

DISCHARGE SPECIFICATIONS

The preceding discussion on cyanide in cyanidation process wastes warrants that the Regional Board staff should issue waste discharge requirements on both the liquid and the solid fractions of the waste. The requirements for the cyanide in liquid fraction are warranted because that cyanide can easily migrate to ground and surface waters. The requirements for the cyanide in solid fraction are needed because the solid material may be washed into surface waters, where its cyanide content can solublize to contaminate the receiving waters, and also because its cyanide content can be leached by precipitation and subsequently carried to ground and surface waters.

Our staff should issue requirements to regulate both the free cyanide and total cyanide contents of liquid and solid fractions of the process wastes. They should regulate the free cyanide content because free cyanide is extremely toxic to aquatic and terrestrial life forms. The staff should regulate total cyanide content because the complex cyanides are toxic in the complex form and may release highly toxic free cyanide in the environment. Also, they should issue requirements to regulate the soluble fraction of the total cyanide present in the solid waste because the soluble fraction is easily leached from the solids and may subsequently contaminate ground and surface waters.

I recommend that the staff should require ASTM Method C (WAD) for the determination of free cyanide because it is less cumbersome to perform than CAC method, and it is not plagued by interferences. Also, Method C most closely represents the methodologies used by EPA and PHS to set free cyanide criteria for protection of aquatic life and drinking water supplies.

For total cyanide determination, I recommend the use of ASTM Method A because at present it is the most widely used method, and it lends itself to simple modifications for elimination of known interferences. Further, for total cyanide determinations in solid waste, I recommend direct digestion of solids because most extraction procedures used to extract total cyanide from solids are not fully effective. The problem in obtaining representative 0.5 gram solid samples for direct digestion can be overcome by increasing sample size to up to 5 grams.

Our staff should allow minor modifications of the ASTM Methods if the modifications are essential to eliminate known interferences and analytical problems because of some unique property of the process waste. The staff, however, should carefully review the proposed modifications to assure that the changes do not alter the integrity of the standard procedures.

For extraction of the soluble fraction of total cyanide content in the solid fraction of slurries, I suggest the following procedure:

1. Sample slurry to get at least 1 L.

2. Filter and wash solids with distilled water.

   (a) first wash with 300 ml, letting all water go through;
   (b) second wash with 300 ml.

3. Take 590 grams of wet cake (this will contain about 500 grams of dry tailings) and put into 2.5 L distilled water; adjust to pH 5 with H_2SO_4.

4. Stir mildly for 24h at room temperature in an air-tight capped container.

5. Filter entire slurry from step 4 tnorugh No. 42 Whatman paper and analyze an aliquot of the filtrate for CN (total).

6. To calculate soluble mg CN/kg solids =

$$\text{mg CN/kg} = \frac{(\text{mg/L CNT in filtrate}) \times 2.5}{0.5}$$

For extraction of the soluble fraction of total cyanide content in the heap leach solid waste omit Steps 1 and 2. Instead, put 500 grams of tailings in 2.5 L distilled water and adjust to pH 5 with H_2SO_4. Then follow Steps 4 through 6.

For extraction of WAD cyanide content in the heap leach process solid waste (tailings), I susggest the following procedure:

1. Take 500 grams of tailings and put into 2.5 L deionized water at neutral pH in an air-tight capped container. Select the container size to minimize head space.

2. Stir mildly for 24 hours at room temperature.

3. Filter entire slurry from Step 2 through No. 42 Whatman paper and immediately analyze an aliquat for CN (WAD).

4. Calculate soluble WAD cyanide as in Step 6 above.

I propose that the cyanide in both the solid and liquid fractions of the cyanidation process wastes should be detoxified prior to discharge to the tailings impoundment. Our staff should disapprove proposals by dischargers to make allowances for natural degradation of cyanide in the impoundment area following discharge as a means of achieving the requirement values, until the dischargers provide both the site specific half-lives of all cyanide species present in the tailings and methods of containing the tailings in the impoundment until cyanide in both the liquid and solid fractions reach the required values.

The cyanide in the process wastes should be considered detoxified if the following limits are met:

Process Waste Fraction	Parameter	Value[1/]
Liquid (Barren solution effluent or the liquid fraction of slurries)	i) Total Cyanide ii) WAD Cyanide	1.0 mg/l 0.5 mg/l
Solid (Heap leach process tailings or solid fraction of slurries)	i) Soluble WAD[2/] Cyanide ii) Soluble Total Cyanide iii) Total Cyanide After Extraction of Soluble WAD and Total Cyanide	0.5 mg/kg 2.5 mg/kg 10.0 mg/kg

I propose the above values because they are attainable for most cyanidation process wastes using the best available technology economically attainable (BATEA) for cyanide removal and will best protect the beneficial uses of the Region's ground and surface waters from degradation by cyanide discharges.

We should make the above requirements less stringent only when the dischargers demonstrate by actual test results that such values are impossible to attain using BATEA for cyanide removal because of certain site specific characteristics of the ore and that the elevated values will not affect the beneficial uses of ground and surface water in the discharge influence zone.

1/ Arithmatic mean of laboratory results for samples collected in a period of 15 consecutive days.

2/ Not required for slurries.

1) 'Ambient Water Quality Criteria for Cyanide - 1984'. EPA 440/5-84-028, January 1985. U.S. Environmental Protection Agency, Washington, D.C.

2) 'Cyanide and the Environment'. Proceedings of a conference, Tuscon, Arizona. December, 1984. Volume 1, II.

3) 'Cyanide From Mineral Processing'. Proceedings of a workshop, Salt Lake City, Utah. February 2-3, 1982.

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#5

AN OVERVIEW OF GOLD MILL EFFLUENT TREATMENT

J.S. Scott

INTRODUCTION

Canada ranks third among the gold producers of the world and obviously, in the words of Robert Service "moiling for gold" is of considerable importance to this country. In Canada, over 80% of the gold is recovered by the process of cyanidation and an unavoidable consequence is the concomitant production of wastes, both liquid and solid. The liquid wastes from these gold mills contain substantial quantities of toxic substances, particularly cyanide and metals, and as a result require careful management before release to the environment.

The historical, but often inadequate method of treating gold mill effluents has been by natural means (natural degradation) in tailings ponds. However, since 1981 there has been not only a great improvement in the understanding of natural systems but there has also been a strong move in Canada to the development and use of chemically-based treatment systems to ensure the discharge of effluents that meet regulatory requirements. A number of different cyanide removal processes are in place in this country and elsewhere. What has been accomplished in so few years is exciting, to the extent that 46 percent of the 50 Canadian gold mills recovering gold by cyanidation, operate chemical treatment systems. The purpose of this paper is to describe the methods currently in place to treat gold mill effluents.

As a number of effective treatment methods are now available, the selection of a process for a specific mill requires careful consideration of: the nature of the effluent to be treated, the capabilities and costs of the alternative treatment methods and the effluent quality requirements imposed by government regulators.

CANADIAN GOLD MINING INDUSTRY

The value of gold production in Canada now tops that of any other metal mined domestically. In 1988, Canadian mines produced 4,106,959 troy ounces of gold valued at 2.22 billion dollars Canadian. Over 80% of this production resulted from mining lode gold deposits, as opposed to placer gold or as a by-product from base metal mining. At the end of 1988 there were 65 gold mills in Canada processing approximately 55,000 tonnes ore/day, some receiving feed from more than one mine. Fifty of these mills used the cyanidation process.

Ore grades ranged from 0.10-0.75 ounces gold/tonne, averaging about 0.25 ounces/tonne. The cost of production per ounce varied considerably, but averaged about $300.00 Canadian. The only provinces or territories void of gold mines are Alberta and Prince Edward Island. Several new gold mines came on stream in 1988 and at least 10 are expected to begin production in 1989.

CONTAMINANTS IN GOLD MILL EFFLUENTS

Gold mills employ a combination of cyanidation and either the Merrill-Crowe (MC) or the Carbon-in-Pulp (CIP) processes for the recovery of gold. In every case gold is first dissolved from its ore by a dilute alkaline cyanide solution according to the following reaction:

$$4Au + 8NaCN + O_2 + 2H_2O \longrightarrow 4NaAu(CN)_2 + 4NaOH$$

The solubilized gold is recovered from clarified solution by precipitation with zinc dust in the Merrill-Crowe process or by absorption directly from leach slurry on activated carbon granules in the CIP process. In the Merrill-Crowe process two cyanide containing waste effluents exit the mill, waste barren solution and washed and repulped leach solids. Whereas, in the CIP process only a single waste stream, the CIP tailings slurry, is discharged from the mill. Another significant difference between these two processes from the point of cyanide release is that in the former considerable barren solution is recirculated to cyanidation to take advantage of its remaining leaching potential, whereas no recirculation takes place in the latter.

Since cyanide is a powerful solvent, but one that is non-selective for gold, a host of objectionable substances simultaneously enter solution in substantial amounts during cyanidation, depending primarily on the mineralogy of the ore treated. These substances appear in waste discharges from mills and are of considerable concern because most are damaging to the environment. As cyanide, both free and complexed, is present in the greatest quantity and is extremely toxic, it is of greatest concern. The metals, copper, iron, nickel and zinc are commonly present as cyanide-metal complexes. Arsenic is often encountered and less commonly antimony and molybdenum, which occur in the Hemlo area gold ores. Thiocyanate (CNS), cyanate (CNO) and ammonia are also frequently present in gold mill effluents. Thiosulphate (S_2O_3) is seldom analyzed for, but it is known to be present in elevated concentrations in effluents from some mills.

The wide range of constituents measured in waste barren solutions is shown in Table 1.

TABLE 1 ANALYSES OF WASTE BARREN SOLUTIONS (MG/L)

CN	50 - 2000	Pb	0 - 0.1
CNS	42 - 1900	Mo	0 - 4.7
S_2O_3	- 856	Ni	0.3 - 35
As	0.0 - 115	Sb	0 - 93
Cu	0.1 - 300	Zn	13 - 740
Fe	0.1 - 100		

Gold mill effluents, unless treated, are extremely hazardous to fish because concentrations as low as 0.05 mg/L free cyanide (HCN and CN^-) are known to kill certain species of fish. Sub-lethal effects are exhibited at even lower concentrations. In many mill effluents the concentrations of other contaminants are also at levels which are acutely toxic to fish. Water quality criterion for cyanide is generally 5µg/L.

GOLD MILL EFFLUENT TREATMENT PROCESSES

Although, over the years numerous methods have been proposed and tested for the destruction or recovery of cyanide, most have not proven successful for treating gold mill effluents. A number of these processes have been described in an earlier Environment Canada report (1). Surprisingly though, a number have passed this test! The processes currently being applied at gold mills are listed in Table 2.

TABLE 2 CYANIDE REMOVAL METHODS AT GOLD MILLS

1. Natural degradation
2. Inco SO_2/air oxidation
3. Hydrogen peroxide oxidation
4. Golden Giant precipitation
5. Alkaline chlorination
6. Homestake biodegradation
7. Acidification-volatilization-regeneration (AVR)

The first 5 processes were applied in Canada in 1988. The biodegradation process is being used only by Homestake Mining at Lead, South Dakota and Golconda Mining operates a cyanide recovery plant, using the AVR process at its mine in Australia. Two additional processes, both developed by Canadian mining companies, i.e., the Con mine iron sulphide and the Noranda SO_2 processes were used until recently in Canada. Except for natural degradation and AVR in a few instances, these methods have all come into use at gold mills since 1981. Canada has been a forerunner in both the development and application of many of these treatment processes. What has been accomplished in only a few years has been challenging and indeed exciting. These processes are used to treat waste barren solutions, mill tailings slurries and ever more frequently tailing pond overflows.

There are no federal limits in Canada for cyanide in mill wastewaters. However, the provinces and territories have limits which are included in mine operating permits. Some examples of the limits for total cyanide (CN_T) and weak-acid dissociable cyanide (CN_{WAD}) for different jurisdictions are shown in Table 3. Weak-acid dissociable cyanide refers to that which is measured by a specific analytical method and includes free cyanide and cyanide-metal complexes less stable than iron cyanides. Total cyanide includes the above forms of cyanide plus iron cyanide.

TABLE 3 CYANIDE LIMITS IN EFFLUENTS (MG/L)

Mine	Location	CNT	CN_{WAD}
Mt. Skukum	Yukon	1.0	0.5
Lupin	NWT	1.0	0.1
Star Lake	Sask.	1.0	
McLelland	Man.	1.0	0.38
Dome	Ont.	2.0	
Kiena	Que.	1.5	0.1
Gordex	N.B.	1.0	
Hope Brook	Nfld.	1.0	0.1

In order to satisfy these requirements, depending on the quantity of cyanide released from a mill, removal efficiencies surpassing 99.9% are often required. Although a demanding target, it has proven to be an attainable one.

NATURAL DEGRADATION

Until only a few years ago natural degradation was the only method used for the treatment of gold mill effluents. Even today, though rapidly losing ground, this historic technique remains the most commonly employed method at Canadian gold mills. Natural degradation involves the removal of cyanide and associated cyanide-metal complexes by naturally occurring processes while mill wastewaters are being retained for extended periods of time in tailing ponds. Cyanide and its associated metal-complexes are removed by a combination of physical, chemical and biological processes which can include: pH depression (by CO_2 absoption from air), volatilization, chemical dissociation, photolysis, precipitation, chemical and biological oxidation, hydrolysis and adsorption. Of these processes, volatilization of hydrogen cyanide (HCN) and chemical dissociation of the cyanide-metal complexes have been shown to be the most important mechanisms in cyanide removal. Dissociation is usually the rate controlling step and is related to the respective stabilities of the cyanide complexes present. When iron cyanide is present, photolysis by ultra-violet radiation (sunlight) is essential for its dissociation. The rate at which natural degradation proceeds is influenced by a number of variables, including: cyanide species and concentrations in solution, species stabilities, pH, temperature, bacteria, sunlight, aeration, and pond conditions, such as, area, depth, turbidity, turbulence, ice cover and retention time.

The principal mechanisms involved in the natural degradation of cyanide are becoming much better understood. Recently staff at Environment Canada's Wastewater Technology Centre, in conjunction with Beak Consultants, have developed a user-friendly predictive mathematical model for a batch-operated natural degradation system. Work is continuing to develop a model for continuous flow-through systems. The model development work has been described in a number of papers (2,3,4). These predictive models will prove valuable in the understanding and designing of natural degradation systems. There is a definite place for such systems either in stand-alone or pre- or post-treatment situations.

Although cyanide removal by natural means is rapid during warmer months it is extremely slow or perhaps non-existent during the late fall and winter months. Consequently, it appears that a stand-alone natural degradation system requires a retention time of 9-10 months since the tailings pond must have the capacity to store water from October through to the following July or August. Advantage should be taken of maximizing tailings pond water recycle in order to reduce the need to store a large volume of mill effluent during the October to July period. Consequently a smaller tailings pond would be required.

Some excellent applications of natural degradation in either stand-alone or pre-treatment situations prior to chemical treatment exist and are described below.

At Echo Bay's Lupin Mine in the NWT only 80 kilometres south of the Arctic Circle, a highly successful natural degradation system is being operated, even though the open water season lasts only 3 months. The mine employs a

2 stage (2 pond) batch-type system. The first pond is continuously filled except when being emptied into the second pond. Most of the cyanide and its associated metals are removed in the first pond by natural degradation, whereas arsenic is removed in the second pond by the addition of ferric sulphate to the batch discharge from the first pond during August. The second pond is previously emptied to receiving waters in July.

A summary of the performance of Lupin's tailing pond system for the period 1985-1988 is given in mg/L Table 4(4).

TABLE 4 LUPIN MINE TAILINGS POND SYSTEM

	Mill Tailings (Solution) (1985-88)	#1 Pond Decant (1986-88)	Final Decant (1986-88)	% Reduction (1986-88)
CN_T	184	7.0	0.17	99.9
CN_{WAD}	138	-	0.04	99.9
As	4.7	1.5	0.29	93.8
Cu	5.0	2.1	0.15	97.0
Ni	0.4	0.2	0.05	87.5
Zn	20.0	1.1	0.11	99.4
pH	11.0	8.5	7.3	

All three gold mines in the Hemlo, Ontario area take considerable advantage of natural degradation by treating tailing pond decants in chemical treatment systems. In all three cases cyanide concentrations in the tailings pond waters increase substantially during the fall and winter months to be followed by rapid decreases in cyanide levels when spring ice break-up occurs. The trend in cyanide concentrations with time in the tailings pond decant waters is shown in Figure 1. Typical cyanide concentrations in the mill discharges to the tailings ponds are in the order of 40-80 mg/L. The three mines are on high water recycle rates from the tailings ponds.

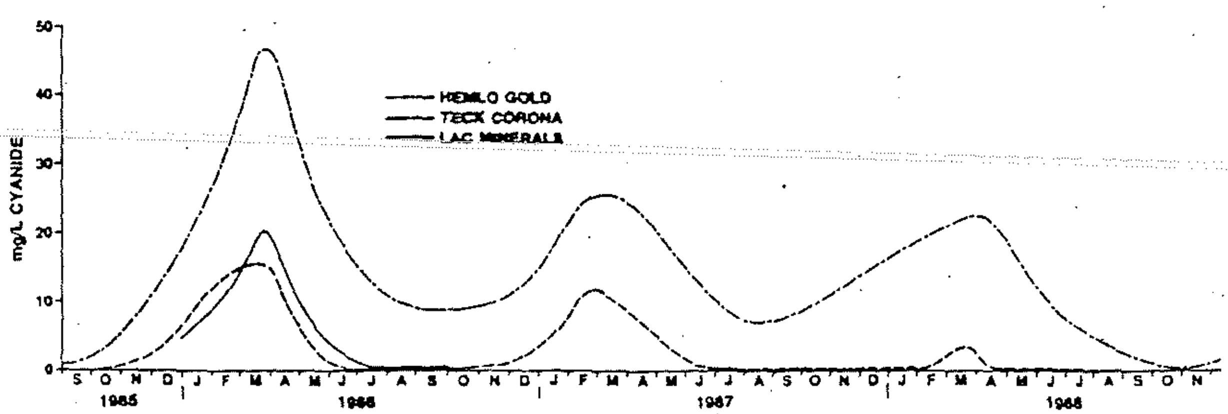

FIGURE 1 EFFECT OF NATURAL DEGRADATION ON CYANIDE IN TAILINGS PONDS

Teck Corona releases treated effluent all year around, whereas the other two mines do not discharge during the winter months. Although each mill has a plant to treat tailings pond overflow, as a result of natural degradation in the tailngs pond it is often unnecessary to operate the cyanide removal stage in order to meet Ontario's guidelines for cyanide of 2 mg/L.

At the Holt McDermott mine near Kirkland Lake, Ontario, an excellent step has been taken towards maximizing the benefits of natural degradation. At this mine the tailings impoundment system has been designed as 2 separate basins with the intention of operating both alternately in the batch mode. Each basin will receive mill discharge for 12 months and then be allowed to remain dormant for the following 9 months while water quality improves naturally to acceptable discharge values before water is released. It is surprising that it has taken this long for the advantage of a two-basin, batch operated tailings impoundment system to be recognized and installed.

CHEMICAL TREATMENT METHODS

In many cases it has not proven possible to depend on sufficient cyanide removal by natural means. Accordingly, a number of chemically-based treatment systems have been installed at Canadian and other gold mills during the past few years. In fact, of the 50 mills in Canada which recovered gold by cyanidation in 1988, 23 (46%) operated treatment plants to destroy cyanide. These plants and the treatment methods employed are listed in Table 5.

TABLE 5 CHEMICAL REMOVAL OF CYANIDE AT CANADIAN GOLD MILLS

Mine	Mill Process	Effluent Treated	CN Removal Process	Remarks
Equity Silver	CIL	MTS	SO_2/Air	
Golden Knight	CIL	MTS	SO_2/Air	
Ketza River	CIP	MTS	SO_2/Air	
Kiena	CIP	MTS	SO_2/Air	
Skyline	MC	MTS	SO_2/Air	
Muscocho	MC	WBS	SO_2/Air	
McLelland	MC	TPO	SO_2/Air	
Skukum Gold	MC	MTS	SO_2/Air	Mill Start-up March/89
Premier Gold	CIL	MTS	SO_2/Air	Mill Start-up April/89
Erg Res.	MC	TPO	SO_2/Air	Mill Start-up March/89
Hope Brook	CIP HEAP	MTS WBS	H_2O_2	
Gordex	HEAP	WBS	H_2O_2	
Mascot	MC	WBS	H_2O_2	
Puffy Lake	MC	WBS	H_2O_2	
Tartan Lake	MC	WBS	H_2O_2	
Con	MC	TPO	H_2O_2	
David Bell	CIP	TPO	H_2O_2	

Detour Lake	CIP	TPO	H_2O_2	
Doyon	CIP	TPO	H_2O_2	
Macassa	CIP	TPO	H_2O_2	H_2O_2 On-Line April/89
Page Williams	CIP	TPO	H_2O_2	
Golden Giant	CIP	TPO	$CuSO_4/FeSO_4$	H_2O_2
Giant Yellowknife	MC	TPO	Chlorination (1988)	H_2O_2 (1989)

MTS - Mill tailings slurry
WBS - Waste barren solution
TPO - Tailings pond overflow

A number of tables in this paper show typical treatment plant performances. These figures indicate the demonstrated capabilities of the various processes when carefully controlled. In some cases considerable divergence has been experienced, when close attention has not been paid to operating the processes, particularly when waste barren solution and tailings slurries are treated directly. Control of the processes would benefit greatly in these cases by the development of reliable on-line sensors of solution quality and automatic control systems.

INCO SO_2/AIR PROCESS

The Inco process for the detoxification of gold mill wastewaters employs a combination of SO_2 and air, typically 2-5% SO_2, in the presence of a copper catalyst. The process involves the oxidation of both free and metal-complexed cyanides (with the exception of iron cyanide) to cyanate at pH 8-10. Sulphur dioxide may be added in the forms of liquid SO_2, sodium bisulphite (Na_2SO_3), sodium metabisulphite ($Na_2S_2O_5$) or SO_2-containing roaster gases. Lime is used to maintain pH. The oxidation of cyanide may be represented by the reaction:

$$CN^- + SO_2 + O_2 + H_2O \longrightarrow CNO^- + H_2SO_4$$

Once free of cyanide, base metals, i.e., copper, nickel and zinc precipitate from solution as hydroxides. Iron cyanide is removed, not by oxidation, but as a copper (or zinc) ferrocyanide precipitate which forms according to the equation:

$$2\ Cu^{2+} + Fe(CN)_6{}^{4-} \longrightarrow Cu_2Fe(CN)_6$$

Copper plays a dual role in the process and must be present in sufficient amounts to act as both a catalyst for the reaction and as a precipitant for any ferrocyanide present.

The Inco process is currently, or within 2-3 months will be applied at 10 gold mills in Canada (see Table 5). A schematic flowsheet of the most recent installation at Inco's Casa Berardi mine is shown in Figure 2. At this mill modified flotation cells are used for reactors.

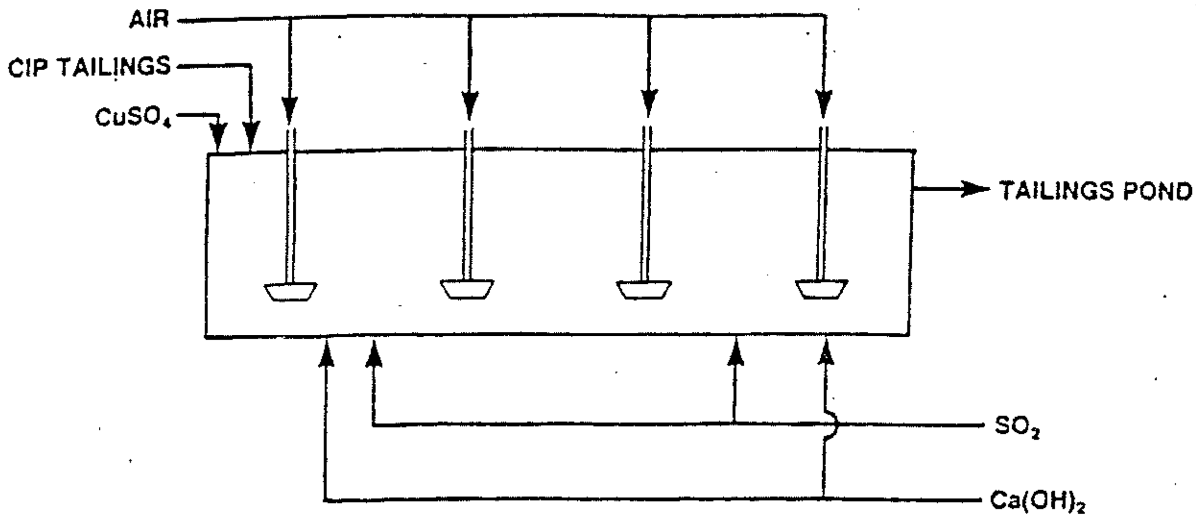

FIGURE 2 CASA BERARDI EFFLUENT TREATMENT SYSTEM

A summary of typical treatment performance at a number of mills using the Inco process is shown in Table 6.

TABLE 6 TYPICAL PERFORMANCE OF SO_2/AIR PROCESS

				Monthly Averages Analyses (mg/L)			Reagents (g/g CN)		
Mill	Stream		pH	CN_T	Cu	Fe	SO_2	Cu	Lime
McBean	Barren	INF	11.5	370	30	20	4.0	0	4.0
	bleed	EFF	9.0	0.2	0.7	0.2			
Lynngold	Pond	INF	8.7	100	10.0	2.0	6.0	0.1	8.0
	overflow	EFF	9.5	0.6	0.1	0.1			
Colloseum	CIP	INF	10.6	375	129	2.2	5.6	0.11	2.9
	tails	EFF	8.7	0.4	1.5	0.2			
Equity	CIP	INF	11.0	150	35	2.0	5.4	0.27	0.0
Silver	tails	EFF	9.0	1-5	2-5	0.2			

The target for CN_T in the effluent at Equity Silver is 5 mg/L since the effluent is totally recycled to the mill. The range of values shown are the averages of several months operation.

Reference can be made to numerous papers for further description of the Inco process and its applications (6,7,8).

HYDROGEN PEROXIDE PROCESS

The H_2O_2 process for detoxifying gold mill effluents has experienced remarkable growth since the first system was installed at the OK TEDI mine in Papua New Guinea in 1984 (9). Since that time 20 gold mills are either using the process or will be doing so within the next few months. Twelve of these mills are located in Canada (see Table 5).

Hydrogen peroxide, in the presence of a copper catalyst destroys free and metal-complexed cyanides (but not iron cyanide) by oxidation to cyanate (CNO^-) according to the equations shown below. The metals copper, nickel and zinc in the form of cyanide-metal complexes, once freed by oxidation of cyanide form hydroxide precipitates. Any excess H_2O_2 rapidly decomposes to water and oxygen.

$$CN^- + H_2O_2 \longrightarrow CNO^- + H_2O$$

$$Cu(CN)^{2-}{}_4 + 4H_2O_2 + 2OH^- \longrightarrow Cu(OH)_2 + 4CNO^- + 4H_2O$$

Since iron cyanide is too stable to be oxidized by H_2O_2 it is removed by complexing with copper to form a copper ferrocyanide ($Cu_2Fe(CN)_6$) precipitate, as in the Inco process.

The flowsheet to treat tailings pond overflow at the Con mill in Yellowknife is shown in Figure 3. Hydrogen peroxide does not remove arsenic so a second stage using ferric sulphate is required to precipitate arsenic.

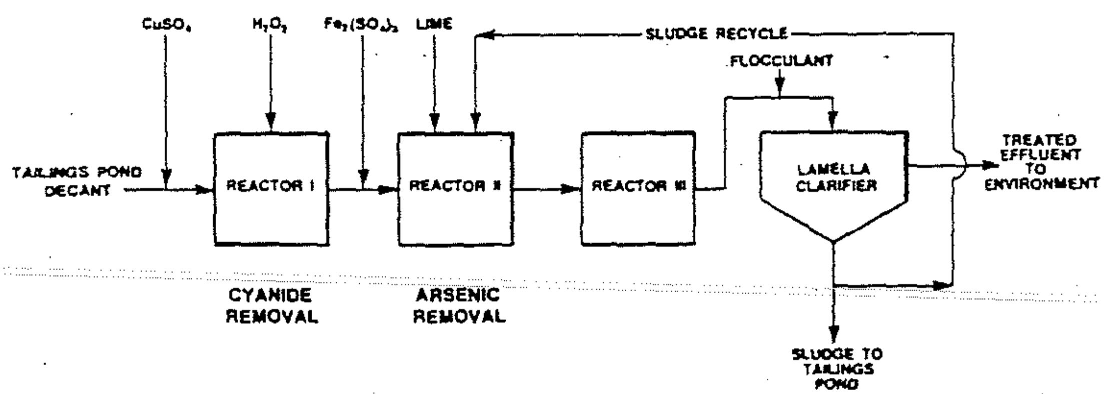

FIGURE 3 CON MINE EFFLUENT TREATMENT PLANT

The flowsheet for the more complex three-stage treatment system at t Hope Brook mine to treat barren solution from a heap leach operation is shown Figure 4. In this plant, following the addition of H_2O_2, sulphuric acid is added to lower the pH of the solution for iron cyanide precipitation. A Degus reagent called TMT 15, the trisodium salt of trimercaptotriazene, is added to complete the precipitation of copper.

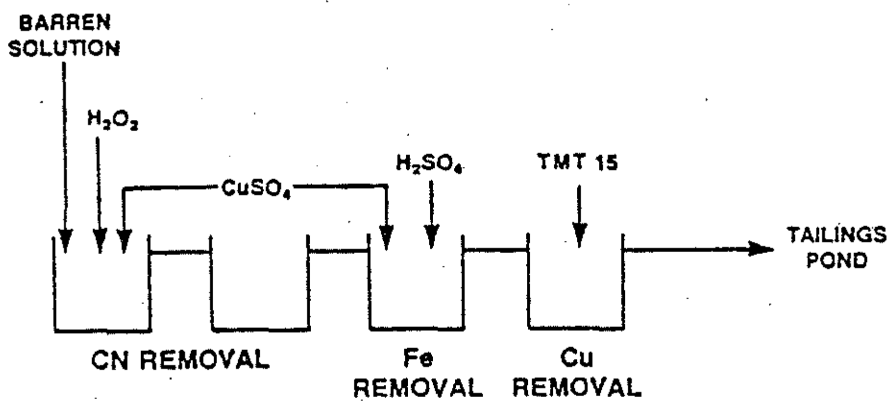

FIGURE 4 HOPE BROOK MINE EFFLUENT TREATMENT PLANT

Typical performance results at three mills using the H_2O_2 process are given in Table 7.

TABLE 7 TYPICAL PERFORMANCE OF H_2O_2 PROCESS

Mill Effluent		Analyses (mg/L) CN_T	As	Cu	Fe	Zn
Con Tailings	INF	3.0	21.0	3.1		
Pond O/F	EFF	0.28	0.33	0.15		
David Bell Tailings	INF	5.45	0.02	0.84	1.29	
Pond O/F(TeckCorona)	EFF	0.55	0.001	0.38	0.56	
Hope Brook Barren	INF	311		99.3	8.1	0.63
Solution	EFF	1.0		0.5	0.3	0.10

Numerous technical papers are available describing the application of the H_2O_2 process to gold mill effluents (10,11).

HEMLO GOLD PROCESS

Since commencing production in 1985 Hemlo Gold has tested a number of processes for treatment of tailings pond water at its Golden Giant Mine. These have included Noranda's patented SO_2 process and the H_2O_2 process. More recent testwork has led to the development and current utilization of a novel process for which Hemlo Gold applied for a patent in 1987. This new process consists of adding a premixed solution of $CuSO_4$ and $FeSO_4$ to the tailings pond decant (11).

The premixed solution is added at a controlled pH of 6-7, following which it is believed that ferrous ion is oxidized immediately to form ferric hydroxide and cupric ion is simultaneously reduced to cuprous, according to the following equation:

$$Cu^{2+} + Fe^{2+} + 3OH^- \longrightarrow Cu^+ + Fe(OH)_3$$

The resulting cuprous ion removes free cyanide as an insoluble cuprous cyanide precipitate. The removal of free cyanide results in the dissociation of copper, nickel and zinc cyanide complexes leading to the removal of further cyanide by cuprous ions. These reactions are represented by the following equations:

$$2\ Cu^+ + 2CN^- \longrightarrow Cu_2(CN)_2$$

$$Cu(CN)_4{}^{2-} \longrightarrow Cu^{2+} + 4CN^-$$

Ferrocyanide precipitates as cupric ferrocyanide by the reaction:

$$2Cu^{2+} + Fe(CN)_6{}^{4-} \longrightarrow Cu_2Fe(CN)_6$$

The heavy metals copper, nickel and zinc, and antimony and molybdenum are co-precipitated from solution with the ferric hydroxide formed upon addition of the $CuSO_4$-$FeSO_4$ solution. Lime is then added to increase the solution pH to 9.5 - 10 to ensure nickel precipitation. Although it is claimed that cyanide can be reduced to acceptable levels by addition of $CuSO_4$-$FeSO_4$ alone, it has been found more economical to finalize cyanide removal in an additional stage by the addition of H_2O_2 at pH 10.

The process flowsheet at the Golden Giant Mill is shown in Figure 5.

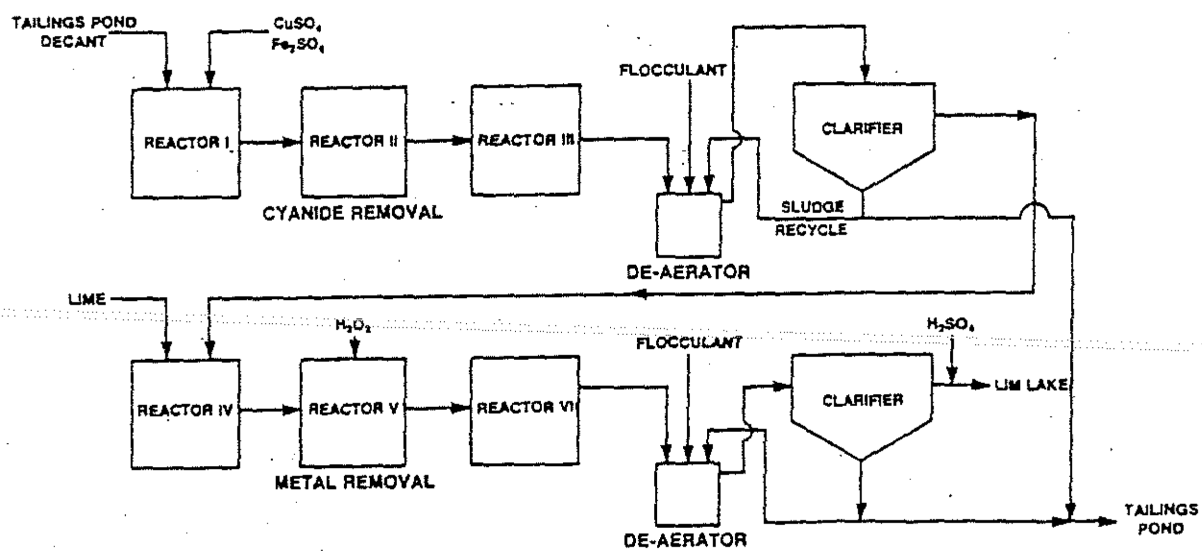

FIGURE 5 EFFLUENT TREATMENT FLOWSHEET AT GOLDEN GIANT MILL

Performance data for the Golden Giant treatment plant is given in Table 8.

TABLE 8 EFFLUENT TREATMENT PLANT AT GOLDEN GIANT MINE

	Analyses (mg/L)							
	pH	CN_T	Cu	Fe	Ni	Sb	Mo	CNS
Influent	9.10	23.20	4.10	5.20	4.80	7.70	1.20	44.40
Effluent	9.81	0.13	0.50	0.11	0.08	1.00	0.20	24.20
% Removal		99.9	87.8	97.9	98.3	87.0	83.3	45.5

A recently presented paper by Hemlo Gold staff (11) highlights several important measures, besides the new treatment process, taken at the Golden Giant mine to increase effluent treatment efficiency and reduce costs. Briefly these are:

- adjusting cyanidation parameters to reduce the dissolution of antimony.
- reducing cyanide additions from 0.95 to 0.36 kg/tonne ore.
- removing substantial amounts of contaminants from the influent to the treatment plant by routing this water through the grinding circuit prior to treatment.
- almost doubling the tailings pond surface area and reducing water depth so as to enhance the effectiveness of natural degradation.

These beneficial moves clearly reflect the management philosophy held by this company and is well captured in their words as: "finding an optimum solution (to water management) requires scrutiny of the conditions at hand with due consideration being given to all aspects of the operation" (12).

ALKALINE CHLORINATION

Alkaline chlorination was the first chemical process applied to the treatment of gold mill effluents in Canada. It had been used at a number of mines (e.g. Scottie, Baker, Carolin, Detour lake, Giant Yellowknife) but has almost fallen into disuse in favour of more effective and less costly methods. Giant Yellowknife, the last Canadian gold mine to use this process will switch to hydrogen peroxide this year. The chief disadvantages of alkaline chlorination are: the inability to remove iron cyanide, the cost and the occurrence of residual chlorine at concentrations toxic to fish, to name just three.

In this process both free and metal-complexed cyanides (except for iron cyanide) are oxidized to cyanate (CNO). Simplified process chemistry is illustrated by the following equations:

$$CN^- + Cl_2 + 2OH^- \longrightarrow CNO^- + 2Cl^- + H_2O$$

$$Zn(CN)_4{}^{2-} + 4Cl_2 + 2(OH)^- \longrightarrow 4CNO^- + 8Cl^- + Zn(OH)_2$$

In an extra stage with the further addition of chlorine and longer retention times it is possible to oxidize cyanate to nitrogen and bicarbonate. Chlorination is the only gold effluent treatment process currently applied in Canada that has this capability, but it has not been necessary to go to the second stage.

The flowsheet used at Giant Yellowknife is shown in Figure 6. Since alkaline chlorination does not remove arsenic, ferric sulphate is added to remove arsenic in the second stage of a two-stage process.

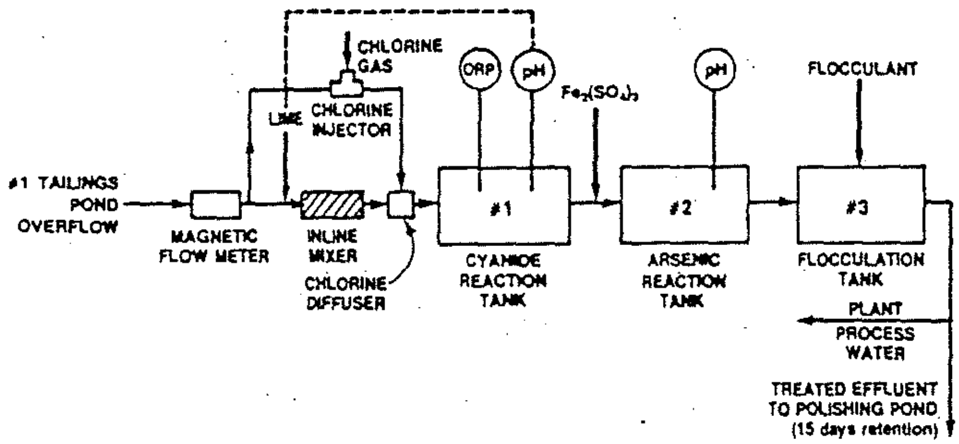

FIGURE 6 EFFLUENT TREATMENT PLANT AT GIANT YELLOWKNIFE MINE

Typical treatment performance data at this plant are given in Table 9.

TABLE 9 GIANT YELLOWKNIFE TREATMENT PLANT (1985)

	Analyses (mg/L)			
	Influent	Effluent	Pond O/F	% Removal
pH	8.5		7.6	
CN_T	7.5	1.3	0.15	98.0
As	12.1		0.14	98.8
Cu	6.7	0.09	0.03	99.6
Fe	0.1	0.1	0.1	
Ni	1.2	0.7	0.17	85.7
Zn	0.1	0.1	0.1	
NH_3			4.9	

The treatment plant at Giant Yellowknife has been described in detail in several papers and the reader is directed to these for further information (13,14).

HOMESTAKE BIODEGRADATION PROCESS

In 1984, Homestake Mining Company brought on stream a biological system for the treatment of its combined mine water and tailings pond decant at a cost of $10,000,000 U.S. (15). This combination of waters allows plant influent temperature to be held at 10-18°C year round, an important feature in maintaining reasonable process kinetics.

Homestake's biodegradation process is carried out in two stages, both of which employ rotating biological contactors. In the first stage cyanide and thiocyanate are removed by biological oxidation to carbon dioxide, sulphate and ammonia and metals are removed concurrently by adsorption by the bacteria. The second stage involves the bacterial nitrification of ammonia, first to nitrite and then to nitrate. The first stage uses indigenous microorganisms that are first acclimatized to increasing cyanide and thiocyanate levels and the second stage employs the usual Nitrosomonas and Nitrobacter bacteria. Metals absorbed by the biofilm of bacteria adhering to the revolving contactors are removed as the biofilm sloughs off. The sludge is removed in a clarifier and dual-media sand filters and disposed of with the mill tailings. The treated effluent is released to a nearby stream.

Forty-eight rotating biological contractors, with 12 foot diameter disks, are used, 24 in each stage, to contact the bacteria with the wastewater and air. Typical performance data for the plant are given in Table 11.

TABLE 11 TYPICAL HOMESTAKE TREATMENT PLANT PERFORMANCE

	Analyses (mg/L)	
	Influent	Effluent
CN_T	3.67	0.33
CN_{WAD}	2.30	0.05
CNS	61.5	0.50
Cu	0.56	0.04
NH_3-N	5.60	0.50

Perhaps the cold weather conditions that exist for a good part of the year has discouraged the use of the biodegradation process in Canada. There is indication that the process is not practical below 10° C.

CYANIDE RECOVERY PROCESSES

The aim of the cyanide removal processes is described so far has been to destroy cyanide. Considerable interest is currently being shown in a number of processes for the recovery of cyanide from gold mill effluents. This section briefly addresses some of these methods. The only plant operating at full scale to recover cyanide is in Tasmania and uses the process of acidification-volatilization-reneutralization (AVR). A second process based on ion-exchange combined with AVR has been tested at pilot plant scale. Interest has also been renewed in the electrolytic recovery of cyanide.

ACIDIFICATION- VOLATILIZATION-REGENERATION (AVR)

Although the Mills-Crowe AVR process is well-known, it has seen little application in many years, and possibly its use had been completely discontinued until only recently. Hydrogen cyanide (HCN) is extremely volatile and consequently can be readily stripped from solutions by air-sparging, particularly at low pH. The low pH is essential to promote the dissociation of cyanide-metal complexes to form HCN at practical rates. The AVR process consists of acidifying waste cyanide-bearing solutions or slurries to pH 2-3 with H_2SO_4, volatilizing the resulting HCN by intense air stripping and recovering the HCN by absorption in an alkaline solution, i.e., NaOH or $Ca(OH)_2$. The recovered HCN is recycled to the cyanidation circuit. Counter-current towers have been used for both HCN stripping and absorption. Some cyanide containing solids, i.e., CuCN, $Cu_2Fe(CN)_6$, remain in the acidified solution. Dissolved metals, i.e., Cu, Ni and Zn also remain in solution and are precipitated as hydroxides in a subsequent step by neutralization with lime.

The principal AVR reactions are shown by the equations:

Acidification $Ca(CN)_2 + H_2SO_4 \longrightarrow CaSO_4 + 2HCN$

Absorption $2HCN + Ca(OH)_2 \longrightarrow Ca(CN)_2 + 2H_2O$

The AVR process was used by the Hudson Bay Mining and Smelting Company in Flin Flon from 1935 to 1978 to recover cyanide from waste barren solution (16). At that plant 91% of the "regenerable" cyanide was recovered. "Regenerable" cyanide was the amount of cyanide which could be released from the barren solution in a laboratory acidification test.

More recently AMOK Limited at their Cluff Lake mill treated 6,500 tonnes of uranium leach tailings for their gold content using the CIP process (17). An AVR system, operated in the batch mode, was used to recover cyanide from CIP tailings. The acidification step was done by adding H_2SO_4 to pH 3-4 in a vigourously air-agitated tank and the recovery of HCN was carried out in a counter-currently operated absorption tower. Over 90% removal of the cyanide from the CIP tailings slurry was reported.

Staff at CANMET have investigated the AVR process over the past few years. Initially they worked with the standard AVR process but found that air-stripping HCN from the total volume of waste barren solution was unduly expensive (18). Subsequently, their efforts have led to substantial modifications of the process whereby most of the HCN is recovered from acidified waste barren solution as $Ca(CN)_2$ by liming and only a small fraction of HCN needs to be recovered by the more costly air-stripping HCN absorption step (19). The process as demonstrated in the laboratory has been capable of producing final effluents containing less than 1 mg/L total cyanide and below 0.5 mg/L for each of the metals copper, iron, nickel and zinc.

Since 1985, Golconda Minerals has been recovering gold by cyanidation from mill tailings at its Beaconsfield mine in Tasmania. In February 1987, Golconda placed a plant in operation using the AVR process to treat 1200 tonnes/day of tailings pond water (20).

The treatment plant flowsheet is shown in Figure 7. At this plant tailings pond decant is acidified to pH 2-3 with H_2SO_4. The solids formed during acidification are separated by clarification and sand filtration before HCN is air-stripped from solution in counter-currently operated packed towers. Hydrogen cyanide is then absorbed in towers from the air stream in a 10% NaOH solution and the recovered NaCN is recirculated to cyanidation. The barren solution from the aeration columns is sent to carbon columns for the recovery of residual gold and then released. The carbon columns also reduce the residual level of cyanide in the water. Performance data for the treatment plant are presented in Table 10.

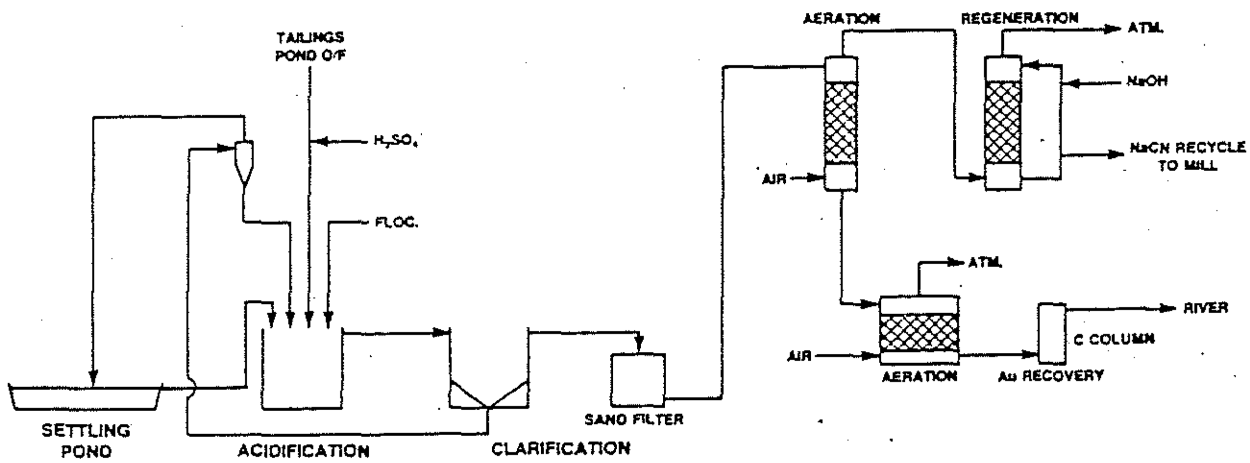

FIGURE 7 GOLCONDA CYANIDE REGENERATION PROCESS

TABLE 10 GOLCONDA TREATMENT PLANT DATA

	Analyses (mg/L)			
	Tailings Pond Decant	Clarified Solution	Aerator Discharge	C Column Discharge
CN_T	200	115	2 - 4	1 - 2
CN_F	10 - 30	110	0.2 - 0.5	0.1 - 0.3
Cu	200	<1	< 1	< 1
Fe	50 - 100	< 1	< 1	< 1
Ni	1 - 2	< 1	< 1	< 1
Zn	5 - 30	< 1	< 1	< 1
Au	0.08	0.08	0.08	0.01

As an aside from cyanide recovery, but still critical to the efficient operation of the overall process at Beaconsfield is the clarification step following solution acidification. Upon the addition of H_2SO_4, fine and gelatinous precipitates form which are difficult to remove from solution by standard methods. To cope with this problem Golconda has developed an "Inert Particulate Collector Process (IPC)" for which it holds world-wide patent applications. In this process large chemically inert particles are used to collect, with the aid of flocculants, the difficult to settle fine or near colloidal metal-cyanide precipitates. Cyclone separators are used to recycle the inert particles and the fines report in the cyclone overflow and exit the process via a settling pond.

ION EXCHANGE PROCESS

Interest has recently been shown in the recovery of cyanide from gold mill wastewaters by a combination of ion-exchange (IX) and the AVR process. One such process was patented in 1987 by Resource Technology Associates (RTA) of Boulder, Colorado (21). The RTA cyanide regeneration process consists of an ion-exchange step to remove metal-cyanide complexes from barren solution using a weak-base anion exchange resin (typically tertiary amine), concentrating the cyanide by eluting with a calcium hydroxide solution, followed by cyanide volatilization and recovery by the AVR process. In order to remove free cyanide in solution by the ion-exchange resin the cyanide must first be complexed by the addition of copper. The RTA process has been tested at pilot plant scale only.

A second process combining IX-AVR, similar in many respects to the one described above was being marketed by a Canadian company called CY-TECH. In this process metal-cyanide complexes were adsorbed on a strong-base resin. The resin once loaded was eluted with a dilute solution of H_2SO_4. The eluate from ion-exchange was sent to a standard AVR process. CY-TECH piloted the process but the company no longer appears to be actively marketing its system.

ELECTROLYTIC RECOVERY

Orocon, a Canadian company is currently testing an electrolytic process at pilot scale for the recovery of cyanide and metals from gold mill effluents (22).

CONCLUSIONS

Effluents discharged from gold mills using the cyanidation process contain toxic levels of cyanide, metals and often other substances, and consequently, require treatment before release to the environment.

Effluents frequently contain significant amounts of oxidizable substances other than cyanide, i.e., metals in their lower oxidation states, thiosulphate (S_2O_3), and thiocyanate (CNS) that often go unnoticed but which, in oxidation based treatment systems, i.e., chlorine, hydrogen peroxide and sulphur-dioxide, are responsible for higher than expected reagent consumptions.

Natural degradation still continues to be the most common stand-alone method practiced for the treatment of gold mill waste effluents, though rapidly losing ground to chemical processes for this purpose. Its use as a post or pre-treatment system will remain high.

Where natural degradation is to be used as stand-alone treatment year round, the system must have a minimum wastewater retention capacity of 9-10 months.

Predictive mathematical models which are in place for batch operated natural degradation systems, and will be developed soon for continuous flow-through systems, should provide a welcome and reliable guide to treatment system design and performance.

The treatment of gold mill effluents by chemical methods began in 1981 in Canada, except for one much earlier exception, and currently 46% of the mills employing cyanidation use one four available chemical treatment methods. Two other methods, not used in Canada but known to be practiced elsewhere, are Homestake Mining's biodegradation process and Golconda's cyanide regeneration process.

The most commonly used chemical treatment processes in Canada are hydrogen peroxide and the Inco SO_2-air. Alkaline chlorination, the first cyanide removal process employed extensively in Canada has been completely replaced by more effective and less costly methods.

Although a variety of effluents including waste barren solutions, mill tailings slurries and tailings pond decants are being treated, there is a trend towards the treatment of tailing pond decants.

In many cases the effluent treatment processes are required to provide 99.9% or greater cyanide removal capabilities and have been able to achieve this.

The removal of copper from gold mill effluents sometimes poses a more serious problem than that of cyanide removal and greater knowledge of the forms in which copper persists in solution is essential to employing more satisfactory methods for its removal.

The extent of the problem created by ammonia in final effluents, methods to both minimize the amount of ammonia entering solutions and to best remove ammonia, if necessary, have yet to be determined, except in the case of Homestake Mining's biodegradation system.

Toxicity of effluents to fish are rarely measured and, consequently, there is still much to learn about the capabilities of the treatment processes to produce effluents which are non-toxic to fish, again with the exception of the Homestake process.

Renewed interest is being shown in the recovery of cyanide from gold mill effluents by the processes of: acidification-volatilization-regeneration, ion-exchange and electrolysis.

Arsenic and antimony when present in gold mill effluents are commonly removed subsequent to cyanide removal by the addition of an iron salt, e.g. ferric sulphate or chloride.

Close supervision must be given to the chemical treatment of gold mill effluents, particularly where waste barren solutions and mill tailings slurries are treated directly. In these instances, process control would benefit immeasurably from the development of reliable on-line sensors and automatic controllers.

Reliable design of site-specific treatment systems requires both careful laboratory, and preferably pilot-plant testing, of representative effluents and system design by experts well-qualified in this field.

Finally, a number of alternative methods are currently available for the treatment of gold mill effluents and the selection of the one most appropriate for a specific mill requires careful consideration: of the nature of the effluent to be treated, the capabilities and costs of the alternative treatment processes and the regulatory limits to be met by the company.

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Hal

OREGON MINING COUNCIL

200 Century Tower, 1201 S.W. 12th Avenue
Portland, Oregon 97205
(503) 227-5591

State of Oregon
DEPARTMENT OF ENVIRONMENTAL QUALITY
AUG 21 1992
OFFICE OF THE DIRECTOR

August 21, 1992

Mr. William Wessinger, Chair
Environmental Quality Commission
121 SW Salmon, Suite 1100
Portland, Oregon 97204

Re: Chemical Mining Rules

Dear Mr. Wessinger:

The Oregon Mining Council ("OMC") thanks the Environmental Quality Commission and the Department of Environmental Quality for the opportunity to comment on the proposed chemical process mining rules, which are now in near-final form. The improvements in those rules made as a result of the day-long hearing on August 7, though limited, are of great importance to the mining industry. However, OMC feels that the rules are still needlessly rigid and unjustifiably redundant. We hope that further drastic improvements will be made as DEQ gains experience with chemical process mines.

OMC welcomed the Commission's decision to delete the requirement to reuse cyanide because it was well founded and necessary. In its response to the TRC report, DEQ staff "fully agrees" that reuse will not lower the toxicity of mine tailings and spent ore in comparison to chemical destruction of the sodium cyanide compounds. DEQ contradicted itself by testifying on August 7 that tailings with destroyed cyanide could be more toxic than tailings with removed cyanide. Those testifying (including a mineral economist and an engineer) cautioned that they were not experts in tailings chemistry, yet their hunches were given great weight by the Commission. The DEQ's testimony conflicted directly with the opinion of TRC, Inc., the Commission's contract expert, and with the opinion of experts contributing to OMC's testimony. OMC urges the Commission to stick with its decision based on scientific analysis.

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The revision that the Commission has requested to allow more flexibility in the design of alternate liner systems is also important to OMC members. Given the high cost of liner systems, mining companies will be motivated to design liner systems that can be implemented at lower cost than the liners specified in the proposed rules while still satisfying Commission policies. However, the flexibility in the liner system rules will be illusory unless alternative liners researched and designed by qualified experts are ultimately approved by DEQ staff.

OMC remains very concerned that the TRC liner proposal may not be adopted as an approved alternative. The TRC liner is as fully researched and described as the triple liner proposed by staff. TRC found that its alternative liner fully satisfied Commission policies. If DEQ staff will not accept the thoughtful recommendations of its own expert consultants, OMC members are justifiably concerned that the considerable efforts they may spend designing better liner systems will be spent in vain. OMC urges the Commission to closely monitor the implementation of the liner rules to assure that the intended flexibility becomes a reality.

OMC members are extremely disappointed with Commission's approval of the requirement to enclose all heap leach pads and tailings facilities as hazardous waste even if the spent ore and tailings are not hazardous. It was remarkable that the experts hired by DEQ to analyze these issues were not invited to the hearing to defend their recommendations! Instead, individuals who admitted their lack of expertise in chemistry were invited to speculate on the long-term chemical behavior of mine tailings. Not surprisingly, these witnesses expressed uncertainty about the long-term chemistry of the tailings. On the basis of that uncertainty, the Commission concluded that hazardous waste-type enclosures were warranted. In OMC's view, this is an illogical approach to rulemaking, leading to unreasonable and unnecessary regulatory requirements.

Cautious regulation based on scientific uncertainty is an acknowledged technique to prevent environmental harm. That is not the same as cautious regulation based on uncertainty which stems from lack of expertise. Recognized experts have testified and are prepared to defend the proposition that spent ore and tailings chemistry can be predicted with certainty. Rocks that contain no acid-forming components will not form acid. After careful consideration, TRC concluded with a high degree of certainty that hazardous waste enclosures are not necessary for non-toxic and non-acid-forming rock materials. In the face of such testimony by experts, it is shocking that public policy was based instead on the speculations of non-experts.

If any OMC members still believe they have economically viable projects in Oregon, they will likely seek approval of alternative closure systems under proposed OAR 340-43-031(2), which allows DEQ to approve alternative facilities that provide environmental protection equivalent to that provided by the other rule requirements. Approval will be sought based upon a detailed factual record on the chemistry of the spent ore and tailings for each project. If an applicant can demonstrate with certainty that its mine tailings will be non-toxic and non-acid-forming, OMC expects that the DEQ will approve alternative closure designs. Again, OMC urges the Commission to monitor such proceedings closely to assure that apparent flexibility in the rules is not arbitrarily ignored.

Finally, OMC urges the Commission to steer clear of land use regulations in the guise of water quality rules. The Commission has been urged by environmental groups to require back-filling of open pits. Many of those environmental groups have openly announced that their true desire is to ban chemical process mining in Oregon, not merely to regulate the effects of mining. The current rules already allow the DEQ to consider backfilling as necessary to control water quality in the pit. Backfilling should receive no greater weight for that purpose than any other technological remedy. In passing the new Oregon chemical process mining statute in 1991 (HB 2244), the Oregon legislature specifically considered and rejected the proposition that backfilling of open pits should be required, except where "reclamation objectives *** cannot be achieved through other mitigation activities." ORS 517.956(3)(d). The Commission should not exceed this statutory standard, which was based on months of negotiation between the Governor's office, industry representatives, environmental groups and legislators.

In summary, though OMC appreciates the modest improvements made in the chemical process mining rules to date, OMC regrets that the rules remain unnecessarily redundant and rigid. OMC only asked for fair consideration of the technical merits of the rules. In its conference call establishing the goals for review of the proposed rules by an independent consultant, the Commission expressed concern that the rules might require expensive facilities or procedures that produce no material improvement in the protection of the environment from pollution. After careful consideration, DEQ's consultant, TRC, reached firm conclusions that several of the requirements of the proposed rules provided no material improvement in environmental protection. DEQ staff urged the Commission to ignore the consultant's conclusions, despite the absence of any scientific testimony to the contrary and despite the loss of Mr. Turnbaugh, the only staff member to have studied the technical aspects of chemical mining. OMC feels that valuable professional input has been wasted without explanation and that the resulting rules are unnecessarily rigid as a result.

TRC was obviously outraged at the treatment of its work by DEQ staff, as evidenced by TRC's letter to Commissioner Lorenzen dated August 5, 1992. TRC concluded that the proposed regulations were based on DEQ's desire to ban chemical process mining in Oregon, rather than to regulate its environmental effects. TRC's conclusion is consistent with the position taken by DEQ staff in the initial workshop with the Commission on April 17, 1990. There Director Hansen asked "Do we want this type of a process in Oregon?" and later answered his own question by saying "You do understand our bias, which is we'd just as soon see these [chemical process mines] all knocked in the head." Unfortunately, it appears that staff's hostility to chemical process mining has resulted in rules that may have the effect of precluding any further exploration efforts in Oregon.

We must acknowledge that our cities and all so-called "clean" industries are built primarily from minerals that come from open pit mines. OMC members would happily concentrate on large high-grade metal deposits that could be mined by selective underground methods. But such deposits are extremely rare and would not support the mineral demands of our society. OMC feels the environmentally responsible route for our society, which uses more minerals per capita than any other, is to mine the minerals we use "in our own back yards," where we can control the environmental effects. Otherwise we will be obtaining such minerals from third-world countries where they may be mined by state-owned or indigenous mining companies that lack the capital or the technology to mine with modern and environmentally sound methods. The atrocious environmental record of the former Soviet Union, which was more technologically advanced than most foreign mineral suppliers, should cause us to question the wisdom of prohibiting mining in our own state. Unfortunately for world ecology, foreign countries currently supply the vast majority of metals used in U.S. industry.

Think globally, permit mining locally.

Sincerely,

John Parks/ vjg

John Parks, Chair
Oregon Mining Council

cc: Dr. Emery Castle
Mr. Henry Lorenzen
Ms. Carol Whipple
Ms. Linda R. McMahan
Mr. Frederic J. Hansen
Mr. Harold L. Sawyer

Notice

Special Telephone Conference Call Meeting

ENVIRONMENTAL QUALITY COMMISSION

Tuesady, September 1, 1992
8:30 a.m.

The Commission will meet by telephone conference call for the purpose of taking final action to adopt proposed rules on chemical mining. The public may attend the conference call at the following location:

Conference Room 3a
Department of Environmental Quality Offices
811 S. W. 6th Avenue
Portland, Oregon 97204