



Pure Water is more Precious than Gold!

Okanogan Highlands Alliance

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May 30, 2014

Sanjay Barik, Water Quality
Department of Ecology, Central Region
15 W Yakima Ave, Suite 200
Yakima, WA 98902-3452

Re: 2014 Update of Adaptive Management Plan for Water Quality for Buckhorn Mine

Dear Mr. Barik,

On many occasions, the Okanogan Highlands Alliance (OHA) has expressed concerns regarding the water quality problems at the Buckhorn Mine, problems that are still occurring. While we acknowledge that mitigation measures have been and are being installed, to date little quantitative improvement has materialized. Crown Resources/Kinross has failed to implement key actions of the Adaptive Management Plan (AMP) for Water Quality. The Department of Ecology has not followed through with guidance or enforcement policies. Whether the problems have been systemic or caused by variations in interpretation, the result has been a serious lack of action to address the ongoing water quality issues at the mine.

In 30-days, on July 1, 2014, according to the NPDES permit, an approvable update to the AMP is to be submitted to Ecology. Implementation of the AMP is required according to provision S6 of the NPDES permit. This Plan recognizes that water that escapes collection and treatment could negatively impact ground and surface water quality. The original version of the AMP discussed hypothetical impacts and mitigation measures (Sections 1.1, 1.2, 2.1). The AMP no longer needs to ask if mine contaminants are impacting ground and surface water. The answer to that question is known. The AMP must focus on understanding the extent of the problem and what actions should be taken to mitigate the escape of contaminants.

In keeping with OHA's interest in reducing pollutant discharge from the Buckhorn Mine, OHA presents the following attached memorandum for consideration. Our goals are to provide Ecology with well-reasoned analysis of the past approach to adaptive management and to make recommendations for a path forward that will provide quantitative benchmarks toward reducing the unpermitted discharge of pollutants.

Key to the issues that effect water quality is establishment and maintenance of a capture zone surrounding the mine. While water level monitoring can provide important information for understanding the response of groundwater to hydrologic events and local dewatering, its use cannot provide unequivocal evidence that a capture zone has

been established because of the fractured nature of the bedrock at the Buckhorn Mine. Therefore, we have removed adaptive management and reporting actions that rely on groundwater levels as an indication of the integrity of the capture zone (Sections 3 and 4).

OHA respectfully submits that a critical objective of the monitoring program is to determine the nature and extent of any mine-impacted water outside the capture zone (Section 2.2). While OHA believes that this type of analysis was required in the old AMP, clarifying this objective would provide significant improvements in addressing the contamination problems. To determine the extent of impact, additional downgradient and downstream monitoring will be needed.

OHA's AMP actions for water quality and hydrogeologic evaluations in the annual report include identifying locations affected by mining and the associated sources and pathways, analyzing potential effects on aquatic biological resources, identifying all groundwater zones, showing/explaining the zone of influence of each dewatering well, estimating monthly groundwater inflow to the mine, and discussing the movement of water in faults. (Section 3.2.2)

OHA has removed use of the FEFLOW model in characterizing the capture zone because it has not provided realistic predictions in all the years that it has been used. (Section 3.2.2)

OHA added a new AMP action level that follows implementation of mitigation measures: evaluation of the effectiveness of selected mitigation measures. An important part of the AMP process is to evaluate whether the selected remedies have been effective in remediating mine-related effects, yet the original AMP had no requirement to do so. (Section 4.4)

A number of mine-related parameters do not have NPDES permit limits. In these cases, measured concentrations in groundwater and surface water should be compared to background values or water quality standards. More details will be provided in our recommended revisions to the Hydrologic Monitoring Plan. (Section 3.2.2)

As an interested stakeholder of the Buckhorn Mine, please consider the attached recommendations regarding the AMP for water quality and the administration thereof. I respectfully urge Ecology to take further action to prevent long-term degradation of water quality.

Thank you for considering these requests and for your attention to these issues.

Sincerely,

A handwritten signature in black ink, appearing to read "David Kliegman". The signature is written in a cursive, flowing style.

David Kliegman,
Executive Director

Cc: Charlie McKinney, Water Quality Section Manager

UPDATES TO: ADAPTIVE MANAGEMENT
PLAN FOR WATER QUALITY CHANGES
DUE TO MINING OPERATIONS AT THE
BUCKHORN MINE

**Okanogan Highlands Alliance's Suggested Changes to: Golder
Associates' 2006 Adaptive Management Plan for Water Quality**

Submitted to: Washington State Department of Ecology

30 May 2014

1.0 INTRODUCTION

The revised National Pollution Discharge Elimination System (NPDES) permit (Washington State Department of Ecology, 2014) requires the implementation of Adaptive Management Plans (AMP) for Water Quality and an update of the original AMP (Golder Associates, 2007) by July 1, 2014. The AMPs for water quality include AMP appendices B (Section 2; infiltration gallery), C (water quality changes due to mining operations), D (fine sediment deposition and water quality changes in Marias Creek from the mine access road), F (development rock management), and G (water treatment plant operations and stormwater retention ponds) (Golder Associates, 2007).

This document is submitted to the Washington State Department of Ecology (Ecology) by the Okanogan Highlands Alliance (OHA) as an update of Appendix C of the AMP for water quality (Golder Associates, 2006a). OHA is recommending a number of major changes, which are highlighted in the accompanying cover letter. Our revisions are based on the effectiveness of current monitoring procedures and the last five years of water quality data, as required by the NPDES permit.

1.1 Background

Mining activities at the Buckhorn Mine have had impacts on surface water and groundwater quality. Water quality changes have occurred as a result of contact between water and either development rock or ore, from runoff or infiltration over or through construction fill or surface facilities (industrial stormwater runoff and infiltration), or from leakage from the underground mine workings. Mine-influenced water has escaped collection and treatment and impacted groundwater and surface water quality outside the capture zone.

Water is used during mining for consumptive uses (domestic uses and dust control, for example) and non-consumptive uses (drilling). This water is obtained from dewatering wells or from groundwater that enters the underground mine. Mine-influenced water (stockpile seepage, industrial stormwater, and underground mine water) is collected and treated to meet the numeric effluent limits of the NPDES permit (Ecology, 2014) prior to discharge. Water that is extracted or collected but not used is also treated and released to permitted outfalls or into the underground mine.

To determine the changes in water quality associated with mining, water quality will be monitored during mining, reclamation and post closure at designated surface water and groundwater sampling locations in the monitoring network. The NPDES permit requires that water quality at compliance groundwater and surface water

monitoring locations not exceed numeric compliance limits established in the permit. Mine-contaminated water is not permitted beyond the capture zone established by the NPDES permit.

Interim water quality compliance limits have been established to provide management flexibility for achieving final water quality limits. This adaptive management plan in conjunction with the Hydrologic Monitoring Plan and the Development Rock Management Plan are designed to ensure that benchmarks for attaining full compliance are reached and to provide management actions if they are not.

1.2 Mitigation Measures

General mitigation elements that have been incorporated into the Buckhorn Mine to protect surface water and groundwater quality include:

- Best Management Practices (BMP) for stormwater runoff from the disturbed areas at the Upper and Lower Portals and from other areas that have the potential to release mine-impacted runoff.
- Use of Shotcrete to prevent oxygen migration into potentially acid generating (PAG) rock exposed in the underground mine to improve the quality of the mine water.
- Placement of a synthetic liner below the ore stockpile and most of the development rock stockpile.
- Collection, reuse and treatment of seepage and stormwater drainage from the ore, development rock, and construction stockpiles
- Contain mine water within the capture zone, as identified in the NPDES permit, that surrounds the underground mine and dewatering wells
- Placement of PAG rock below the post-closure water table in the underground mine to prevent oxidation of the rock.
- Operation of a reverse osmosis and ion exchange water treatment plant during operation, mine flooding, and as long as required after mine reclamation and closure.

Additional mitigation measures are listed in Appendix 1.

The Final Supplemental Environmental Impact Statement (SEIS) for Buckhorn Mt. Project (Ecology, 2006) included mitigation measures for water resources designed to address potential water quality effects related to mining activity (See FSEIS, Table S-2; WAT measures relating to water quality). The effectiveness of the mitigation measures for water quality actually implemented at the mine will be evaluated as part of the adaptive management requirements in this document.

2.0 MONITORING

2.1 Problem Assessment

Contact from mine contaminated runoff, including water in the underground mine, and mined materials have created geochemical changes to surface water or groundwater. Mine water that is affected by blasting and other mine activities has also affected water quality. Discharge of this water, without treatment, will have and has had negative impacts on surface water and groundwater resources in the area. Mitigation measures include collecting and treating this contact water before it is discharged to prevent it from escaping outside the capture zone. The treated effluent quality is closely monitored to ensure effective treatment plant operation and permit compliance. Water quality monitoring locations outside the capture zone will also be closely monitored to determine if contaminants are effectively being captured or if contaminants are escaping capture and causing exceedences of applicable permit limits, pre-mining background conditions, and/or water quality standards. Relevant State of Washington water quality standards are contained in Chapter 173-201A WAC (for surface water quality standards) and Chapter 173-200 WAC (for groundwater quality standards). Pre-mining background water quality for parameters without NPDES permit limits can be found in Golder Associates (2006 a and b), Ecology (2006 and 2014), and Okanogan Highlands Alliance (2013).

2.2 Objective

The goal of the adaptive management program of the Buckhorn Mine is to provide direction for the management of the mine and identify specific actions that can be taken such that full mitigation of impacts can be accomplished.

An updated Hydrologic Monitoring Plan that describes the monitoring that will be carried out to evaluate changes in surface water and groundwater quality is also required by the 2014 NPDES permit.

The objective of the monitoring program is to determine:

- Whether the mine and dewatering wells are maintaining a capture zone by containing seepage from the underground mine, development rock and ore stockpiles, and other mine facilities
- Whether mining activities are impacting groundwater and surface water quality outside the capture zone
- Whether the water treatment plant is adequately treating the water generated during mining activities to meet NPDES permit limits (addressed in a separate Adaptive Management Plan)
- Whether the stormwater BMPs used at the mine site are accomplishing the goal of protecting water resources, and

- If mining activity has adversely affected water quality, the nature and extent of mine-impacted water outside the capture zone.

The results of the monitoring will be used to adapt mining and mine water management activities and mitigation measures so that NPDES permit requirements are attained.

As noted above, the adequacy of the water treatment plant to meet NPDES permit limits is addressed in a separate Adaptive Management Plan. Mine access road impacts on surface water quality in Marias Creek are also addressed in a separate Adaptive Management Plan.

Water quality sampling locations, sampling procedures, and sampling frequency will be consistent with the requirements of the updated Hydrologic Monitoring Plan (Golder Associates, 2014). Crown/Kinross will be responsible for setting up the monitoring equipment, keeping it in operating condition, collecting the samples on a regular basis, and keeping separate back-up records. Crown/Kinross will provide the monitoring results to Ecology in a timely fashion, as required in the NPDES permit.

3.0 REPORTING, DATA ANALYSIS, AND INTERPRETATION OF MONITORING RESULTS

The monitoring data and other information will be used to determine:

- Whether the underground mine and dewatering system collects all seepage from the underground mine, ore and development rock stockpiles, and other mine facilities
- The extent to which the mining operations are affecting surface water and groundwater quality
- Whether surface water or groundwater quality is impacted by stormwater runoff or infiltration, and
- The effectiveness of water quality mitigation measures.

The evaluation of the data will be linked to adaptive management actions listed in Section 4.0.

3.1 Reporting

Reporting of monitoring information will be consistent with the requirements of the NPDES permit for the facility. Some reporting will be more frequent than annually. For example, turbidity reports will be submitted to the US Forest Service monthly, and silt fence performance reporting will occur quarterly. Reporting may be increased to respond to specific water quality concerns.

Annual reports related to water quality, including but not limited to reports for the Development Rock Management Plan, a capture zone evaluation, a shotcrete and grout evaluation, and the Hydrologic Monitoring Plan report, must be completed and submitted at least two weeks prior to the Buckhorn Mine annual meeting.

3.2 Data Analysis and Interpretation

3.2.1 As-Needed Basis

Early and intermediate adaptive management measures and implementation actions discussed in Section 4.0 will require data analysis and interpretation on daily, weekly, monthly or other timeframes. Violations of NPDES permit limits or conditions also require data analysis and interpretation that occur on short timeframes (see Section S3.D).

3.2.2 Annual Basis

Crown/Kinross will complete hydrogeological and geochemical assessments on an annual basis to evaluate any groundwater and surface water quality changes related to mining operations.

Evaluation of the capture zone effectiveness will involve water quality and groundwater/surface water hydrogeologic investigations. Because of the fractured nature of the bedrock at the Buckhorn Mine, an evaluation of the groundwater elevations alone is not sufficient to determine if the capture zone exists or is functioning properly. Water quality monitoring data are the more reliable indicator of the functioning of the mine capture zone. The exceedence of applicable permit limits, pre-mining background concentrations, or water quality standards for mine-related constituents at compliance locations will serve as the primary indicator of whether the capture zone is functioning properly.

Surface water and groundwater quality results will be compared to pre-mining background values, NPDES permit limits, and State of Washington water quality standards and criteria. The following parameters do not have NPDES permit limits, but measured concentrations in streams and groundwater should be compared to pre-mining background values and State of Washington or federal water quality standards and criteria: antimony, cadmium, chromium, fluoride, manganese, mercury, nickel, selenium, silver, thallium, and total suspended solids. Details on analysis and relevant water quality standards and criteria for these parameters are contained in the Hydrologic Monitoring Plan (Golder Associates, updated in 2014). Changes in water quality in monitoring locations downgradient of the mine may indicate that the hydraulic containment system (capture zone) is not fully effective in

containing mine water. Adaptive management will involve improvements in mine or waste management practices, or changes in the mine dewatering system.

As long as monitoring indicates capture zone dysfunction, hydrogeological assessment of groundwater elevations, and the effects of faults on groundwater flow rates and directions, will be conducted to determine groundwater flow paths and to help determine whether dewatering of the underground mine and surrounding rocks has created and is maintaining a capture zone. If a capture zone is not created and maintained, unpermitted discharge of mine water would enter the groundwater system without treatment. The capture zone could be created or improved as part of adaptive management by pumping more from the dewatering wells, adding additional wells, or other improvements in mine water management.

The annual evaluation will include but will not be limited to the following water quality and hydrogeologic analyses.

Water quality evaluations:

- Prepare graphs showing water quality at the surface water and groundwater monitoring locations over time, beginning with pre-mining conditions, and comparing to background concentrations, NPDES permit limits, and applicable water quality standards and criteria.
- Identify locations that have been affected by mining operations.
- Identify probable sources and the pathways for movement of mine-related contaminants to locations found to be affected by mining operations.
- Analyze whether observed changes to stream water quality have the potential to adversely affect aquatic biological resources.

Hydrogeologic evaluations:

- Identify different groundwater aquifers or zones, including groundwater in competent bedrock, shallow groundwater, and any other relevant divisions, throughout the mine site and for each piezometer and monitoring well.
- Prepare graphs showing changes in groundwater levels over time in all piezometers and monitoring wells.
- Evaluate and explain the zone of influence of each dewatering well under low and high groundwater elevation conditions, based on measured groundwater elevations, and plot the zone of influence on water table maps.
- Prepare two water table maps (showing measured groundwater elevations under low and high groundwater conditions) and compare with pre-mining conditions to determine the capture zone for the underground mine and dewatering wells. If groundwater elevations are different in different aquifers or zones, additional maps may be required.

- Estimate the inflow of groundwater to the underground mine monthly, based on actual precipitation, catchment area, estimated infiltration rates, and other relevant measurements. The estimates will be used to ensure that there is adequate treatment and outfall capacity and will be compared to estimates in the FSEIS.
- Evaluate the effect of faults on groundwater flow directions and the performance of the capture zone. Create a map that shows the direction of groundwater flow in the identified faults, and discuss groundwater flow rates in competent bedrock and within faults.

4.0 ADAPTIVE MANAGEMENT ACTIONS

Adaptive Management actions for water quality are required based on the evaluation of monitoring data and other information. Adaptive management actions include four phases: early action, intermediate action, implementation, and evaluation of effectiveness. The adaptive management actions described in this section are designed to reverse mine-related water quality impacts and achieve compliance with NPDES permit requirements. Maintaining and improving water quality is the highest priority for mine water management.

Early actions are aimed at determining whether an exceedence of a permit limit, pre-mining background, or relevant standard is real or related to measurement error. At the level of intermediate action, the issue is known to be real, and a plan for corrective action is created. In the implementation phase, mitigation measures are put in place. The evaluation of effectiveness phase comprises a review of the ability of the implemented mitigation measures to improve water quality. If the measures are found to be ineffective, adaptive management is used to select, implement, and evaluate additional mitigation measures. A timeline for implementation of each type of action is also included. Ecology approval is required for each phase of adaptive management action. The action levels, observations, actions, and products are summarized in Table 1.

4.1 Early Action

Early action is triggered when laboratory results are received that indicate the exceedence of background concentrations, permit limits and/or water quality standards at compliance locations. This is an indication that the capture zone is not being adequately maintained or that mine-related contaminants have in some way reached monitoring points.

Early actions include but are not limited to the following:

- Have laboratory notify Kinross/Crown at earliest indication that a sample has exceeded background concentrations, permit limits, or water quality standards.
- Within 24 hours of notification, review data and determine if laboratory error.
- If not laboratory error, notify Ecology, confirm that samples have been held at laboratory, and request an expedited re-run of the sample (within 24 hours).
- If parameter still exceeds or sample is unavailable or outside of recommended hold times, resample monitoring site, in coordination with Ecology, within 48 hours of receipt of new data and submit sample to laboratory for expedited analysis (within 48 hours).
- If parameters still exceed, begin intermediate action.

At the end of the Early Action phase, Crown/Kinross will submit a letter to Ecology. The DMR cover letter for following month will indicate and briefly describe the exceedences.

4.2 Intermediate Action

Exceedence of background concentrations, permit limits, or water quality standards is considered to be indicative of failure of the capture zone or escape of mine-related contaminants, necessitating that intermediate actions will be taken. Agency approval will be required for all actions.

Intermediation actions include but are not limited to the following:

- Within 14 days of confirmation, begin an investigation to determine the source of the exceedence.
- Within 30 days of confirmation, develop a draft plan to evaluate the nature and extent of the exceedence using increased monitoring (in space and time), including additional downgradient and/or downstream monitoring points that will identify the boundaries between impacted and background conditions. The plan will also identify mitigation measures that would best eliminate the source of contamination and the presence of the mine-related contaminants in groundwater and surface water. Provide justification for each mitigation measure selected, estimate time to full recovery or marked improvement in water quality for each measure, and suggest a contractor that can reliably carry out the actions.
- Include a plan for environmental monitoring that will be able to discern changes in water quality resulting from implementation of the selected mitigation measures.
- Review and seek Ecology approval for carrying out action plans. Modify draft plan based on Ecology's input and publish a final plan

- Follow agency enforcement requirements.

The final approved plan for addressing mine-related exceedence will be submitted to Ecology and be made available to the public.

4.3 Implementation

Implementation of the corrective action/mitigation plan will proceed after receiving Ecology approval.

Implementation actions include but are not limited to the following:

- Within seven days of Ecology approval of the Intermediate Action Plan, begin implementation of the selected mitigation measures and the monitoring program.
- Keep careful written documentation of the procedures used for implementation, including photographs, notes, and discussions with Ecology and contractor.
- Notify Ecology at critical junctures in the implementation (e.g., before burial of pipes or materials that will not be easily visible after implementation) and seek inspection and approval.
- Notify Ecology when implementation is complete and seek Ecology inspection and approval for final implementation; inspection will include evaluation of the additional monitoring network to determine its ability to evaluate the effectiveness of the measures.

Crown/Kinross will submit a memo to Ecology that documents the actual procedures used for implementation of the measures and describe any deviations from the plan.

4.4 Evaluation of Effectiveness: Evaluation of the effectiveness of water quality mitigation measures

The water quality mitigation measures that have been taken will be evaluated to determine if the measures have improved water quality. Within 90 days of implementation of the mitigation measures, an evaluation of the effectiveness of the mitigation measures will be conducted.

The evaluation of the effectiveness of water quality mitigation measures will include, at a minimum:

- Reason mitigation measure was implemented, including evidence from water quality monitoring results
- Process for selection of mitigation measures
- Detailed description of the mitigation measures, including literature references or information from other mines that have used the measures

- and found them to be effective in improving water quality, materials used, engineering and bio/geo/chemical mechanisms employed in mitigation
- Implementation schedule
 - An estimate of the expected timing of water quality improvements resulting from implementation of the mitigation measures, based on modeling or estimates of the amount of mine-related contaminants prevented from reaching water resources
 - Monitoring results that demonstrate the effectiveness of the mitigation measures in improving water quality over time
 - Map that shows extent of plume or exceedence before and after implementation of mitigation measures, and
 - If monitoring results do not show that the corrective action/mitigation measures were effective within 90 days, return to Intermediate Action and select alternative mitigation measures.

Crown/Kinross will submit a report to Ecology on the effectiveness of mitigation measures, using monitoring data, and describe next steps. The report will be included as an appendix in the Annual AMP Report.

5.0 REFERENCES

Golder Associates Inc., 2006a. Buckhorn Mt. Project – Adaptive Management Plan for Water Quality Changes Due to Mining Operations. Technical Memorandum. To: Kevin Eppers, Kinross Gold USA, Inc. From: Adrienne Yang, P.E. and David Banton, L. Hg. November 15.

Golder Associates Inc., 2006b. Buckhorn Mt. Project. Engineering Report Addressing WAC 173-240. Washington Department of Ecology, 2005. Draft Supplemental Environmental Impact Study. Buckhorn Mountain Project.

Golder Associates Inc., 2007. Buckhorn Mt. Project Adaptive Management Plan. Submitted to: Crown Resources and Kinross Gold USA, Inc. June 25 and appendices.

Golder Associates Inc., 2014. Buckhorn Mine Hydrologic Monitoring Plan - Update. To be prepared for Crown Resources Corporation and Kinross Gold USA, Inc.

Okanogan Highlands Alliance, 2013. Buckhorn Mine draft NPDES Permit No. WA0052434 comments. Submitted to Cindy Huwe, Washington State Department of Ecology, Water Quality. October 21.

Washington State Department of Ecology (Ecology), 2006. Buckhorn Mountain Project. Final Supplemental Environmental Impact Statement.

Washington State Department of Ecology (Ecology), 2014. National Pollutant Discharge Elimination System Waste Discharge Permit No. WA0052434.

LIST OF TABLES

Table C1. Adaptive Management Action Levels, Observations, Actions, and Products.

Table C1. Adaptive Management Action Levels, Observations, and Actions

Action Level	Observations/Basis	Actions and Timeline	Product
Early Action	Concentrations of mine-related contaminants exceed background concentrations, permit limits, or water quality standards at compliance locations	<ul style="list-style-type: none"> • Have laboratory notify Kinross/Crown at earliest indication that a sample has exceeded background concentrations, permit limits, or water quality standards. • Within 24 hours of notification, review data and determine if laboratory error. • If not laboratory error, notify Ecology, confirm that samples have been held at laboratory, and request an expedited re-run of the sample (within 24 hours). • If parameter still exceeds or sample is unavailable or outside of recommended hold times, resample monitoring site, in coordination with Ecology, within 48 hours of receipt of new data and submit sample to laboratory for expedited analysis (48 hours). • If parameters still exceed, begin intermediate action. 	Letter to Ecology describing observation and process used to evaluate exceedence; DMR cover for following month letter that indicates exceedences.
Intermediate Action	Exceedence of background concentrations, permit limits, or water quality standards is found to be related to failure of the capture zone or escape of mine-related contaminants	<ul style="list-style-type: none"> • Within 14 days of confirmation, begin an investigation to determine the source of the exceedence. • Within 30 days of confirmation, develop a draft plan to evaluate the nature and extent of the exceedence using increased monitoring (in space and time), including additional downgradient and/or downstream monitoring points that will identify the boundaries between impacted and background conditions. The plan will also identify mitigation measures that would best eliminate the source of contamination and the presence of the mine-related contaminants in groundwater and surface water. Provide justification for each mitigation measure selected, estimate time to full recovery or marked improvement in water quality for each measure, and suggest a contractor that can reliably carry out the actions. • Include a plan for environmental monitoring that will be 	Final approved, publicly available, plan for addressing mine-related exceedence.

Action Level	Observations/Basis	Actions and Timeline	Product
		<p>able to discern changes in water quality resulting from implementation of the selected mitigation measures.</p> <ul style="list-style-type: none"> • Review and seek Ecology approval for carrying out action plans. Modify draft plan based on Ecology's input and publish a final plan. • Follow agency enforcement requirements. 	
Implementation	Ecology approval of final mitigation/corrective action plan.	<ul style="list-style-type: none"> • Within seven days of Ecology approval of the Intermediate Action Plan, begin implementation of the selected mitigation measures and the monitoring program. • Keep careful written documentation of the procedures used for implementation, including photographs, notes, and discussions with Ecology and contractor. • Notify Ecology at critical junctures in the implementation (e.g., before burial of pipes or materials that will not be easily visible after implementation) and seek inspection and approval. • Notify Ecology when implementation is complete and seek Ecology inspection and approval for final implementation; inspection will include evaluation of the additional monitoring network to determine its ability to evaluate the effectiveness of the measures. 	Memo to Ecology that documents actual procedures used for implementation of measures and any deviations from plan.

Action Level	Observations/Basis	Actions and Timeline	Product
Evaluation of Effectiveness	Implemented mitigation/corrective action measures have been in place for 90 days.	<p>Within 90 days of implementation of the mitigation measures, conduct an evaluation of the effectiveness of water quality mitigation measures, including, at a minimum:</p> <ul style="list-style-type: none"> • Reason mitigation measure was implemented, including evidence from water quality monitoring results • Process for selection of mitigation measure • Detailed description of the mitigation measures, including literature references or information from other mines that have used the measures and found them to be effective in improving water quality, materials used, engineering and bio/geo/chemical mechanisms employed in mitigation • Implementation schedule • An estimate of the expected timing of water quality improvements resulting from implementation of the mitigation measures, based on modeling or estimates of the amount of mine-related contaminants prevented from reaching water resources by the mitigation measures in improving water quality over time • Monitoring results that demonstrate the degree of effectiveness of the mitigation measures in terms of improving water quality over time • Map that shows extent of plume or exceedence before and after implementation of mitigation measures • If monitoring results do not show that the corrective action/mitigation measures were effective within 90 days, return to Intermediate Action and select alternative mitigation measures. 	Report to Ecology on effectiveness of mitigation measures, using monitoring data, and a description of next steps. Include report as appendix in Annual AMP Report.

APPENDIX 1. POSSIBLE MITIGATION MEASURES

Possible mitigation actions and approaches that could improve water quality include but are not limited to:

1. Implement trigger levels for mine-related contaminants that do not have NPDES permit limits. Trigger levels would be concentrations above pre-mining background levels but lower than water quality standards that would trigger early adaptive management actions.
2. Improve best management practices (BMPs). Modifications to BMPs are effective in improving water quality and can be readily implemented in a short time frame.
3. Store only treated mine water in the underground mine.
4. Implement a plan approved by Ecology to identify sources of contamination, the extent of the plume outside the capture zone, and the method of capture. This will include: establishing additional monitoring wells outside the capture zone, tracer testing and using piezometers to identify sources, accelerated dewatering of wells and sumps and establishing additional dewatering wells in areas identified as sources or downgradient of sources.
5. Modify the operation of the dewatering wells. Well pumping rates can be increased as required to maintain the capture zone. Additional wells can be readily installed. These actions can be implemented within a very short (days) to short (weeks) time frame and are effective in containing seepage.
6. Modify the mine plan to limit dewatering during the mining of the deepest part of Gold Bowl. Crown/Kinross will evaluate the mine plan on a regular basis during mining. This approach to mine water management is readily implementable.
7. Shotcrete PAG zones. Shotcreting is a known and accepted technology in the civil engineering and mining field and is demonstrated to reduce mine inflows and thus limit the entry of poor-quality water to the underground mine. Shotcrete application is intended to minimize air and moisture penetration into zones of all PAG wall rock including ore headings, thereby minimizing the potential for sulfide oxidation and the onset of acidification. In addition, use of shotcrete should reduce the amount of interaction between reactive rock in the DRZ and mine wall runoff/seepage, thereby reducing transport of sulfide oxidation products. Shotcrete further is an alkaline material, potentially providing buffering capacity. Shotcrete can be rapidly implemented using on-site equipment.
8. Modify blasting practices to minimize explosive use. Crown/Kinross should continually review blasting practices to limit explosive use as part of regular operations.
9. Evaluate passive treatment approaches. Bench and/or pilot scale tests are required to confirm effectiveness.
10. Extend operation of the water treatment plant during and after mine flooding.
11. Improve storage options for mine-influenced water that do not result in contamination escaping from the underground mine and the capture zone.