Memo

To: John Stard

From: Larry Connell

Subject: Arsenic Storage Chamber #15 - Approval of Design by MIS

Date: November 21, 1996

CC: Bryan Macleod, Tim Canam, Brian Penney

Based on our discussions of November 20th, I believe that at a minimum the following data needs to be collected and prepared in a professional format for presentation to the N.W.T. Mine Inspection Service in support of our request for approval of the #15 U/G arsenic storage chamber design:

1) The preparation of a series of drawings showing the geological structures surrounding arsenic storage chambers #12, 14 and 15. The drawings should show the structures in relation to the storage chambers and follow them both to surface and for a minimum of 500 feet (if possible) in each direction. Significant surface features such as Baker Creek and any open pits should be included on the drawings. Suggest cross sections be prepared at 50 foot intervals across the width of the three chambers and once down the center line of each chamber across the length of each chamber. The drawings should show the geological structures as we believe them to be based on best available information derived from mapping of the rock exposed while excavating these chambers, logging of the core obtained from diamond drill holes drilled in the vicinity of the chambers and from surface mapping. The drawings will be instrumental in predicting the most probable flow path(s) for groundwater in the vicinity of the storage chambers.

2) A report from a qualified hydro geologist dealing with the following issues:

- prediction of the most probable flow path(s) for groundwater movement into arsenic storage chamber #15.

- prediction of the most probable flow path(s) for groundwater movement away from arsenic storage chamber #15 under the following conditions:

i) assume that there will be no accumulation of water in the chamber as all groundwater collecting in the bottom of the chamber will be drained into a sump and returned to surface for treatment; and

ii) assume that water will accumulate in the chamber resulting in a hydrostatic pressure.

- prediction of the most probable source for the groundwater entering arsenic storage chamber #15.

- prediction of the rate of flow of groundwater into chamber #15 under different seasonal conditions, i.e. during spring freshet, during summer months, during fall and in the winter months.

3) A report from a qualified geologist describing the geological structure(s) in which chamber #15 is being constructed, detailing any faults, dykes, slips, etc. intercepted by the excavation based on the best available information derived from geological mapping of the rock surfaces exposed during excavation, interpretation of the diamond drill holes drilled in the area and knowledge of the surrounding geological structure;

4) A report from a qualified rock mechanics specialist on the structural integrity of the rock surrounding the storage chamber and an assessment of the stability of the crown pillar and side wall pillars if applicable (i.e. between #14 and #15 chambers).

5) A design for the bulkhead to be installed in the sill drift complete with hydrostatic calculations, assumptions used and the construction specifications. A similar design for the bulkhead to be installed in the crown pillar access drift along with access hatch, delivery and vent piping details.

6) A design for a drain, a sump and pumping system (pump calculations) to positively drain any groundwater that may accumulate in the #15 chamber and to return this contaminated groundwater to the mill for treatment in the mine's effluent treatment plant.

7) A written inspection and monitoring plan for arsenic chamber #15 to be implemented and maintained by mine staff.

The following issues should be considered by mine engineering staff in relation to obtaining approval from MIS for arsenic storage chamber #15:

a) Based on the hydro geologist's prediction of the probable source and flow path(s) for groundwater entering arsenic storage chamber #15, is it feasible to reduce the amount of water entering the chamber by installation of a clay or till blanket on surface to direct surface precipitation away from the chamber.

b) Based on the hydro geologist's prediction of the probable source and flow path(s) for groundwater entering arsenic storage chamber #15, is it feasible to engineer and construct an interception drain using a drift or a series of drilled holes to pick up the groundwater up gradient of the chamber and redirect it to an elevation below and away from the arsenic storage chambers.

I would like to see Royal Oak voluntarily test both of these techniques (assuming we find them to be technically feasible and to be of benefit) in relation to chamber #15. Careful application of these techniques could be used to resolve the same concern for arsenic chamber #12 and #14 at the same time given that chambers #12, 14 and 15 are all grouped in close proximity. This action would demonstrate to the GNWT that Royal Oak can be pro-active, that the company does have regard for environmental protection and help improve our credibility with the regulatory community based in Yellowknife. It will also provide MIS with additional confidence in reaching their decision on approval of the design for chamber #15.