680994 1/5
Elk

— VENTILATION + FILL RAISE
— Dry sand or gravel fill V.S. Hydraulic cemented fill.

8 FEB 94

TO: JOHN STOLLERY

FROM: BRAD THIELE

RE: UNDERGROUND MINING - 65 DEGREE ORE

1993 TEST MINING

In 1993, approximately 40 metres of ore drift on the 1570 Level was driven in the HW, adjacent to the ore. The ground was loose blocks of highly altered rock between the ore vein and a strong shear, 2.5 metres away in the HW, which carried muddy clay up to 10 cm thick. As a result, the rock mass over the 2.5 - 3.0 metre span between the ore and the shear would not hold itself up once the drift was excavated. Attempts to drive the heading narrower than the blocky span were unsuccessful, as any opening would cave out to the HW shear. When the shear and ore vein diverged to 3 metres apart requiring timber cap lengths of 4.2 metres, the caps were failing soon after installation. Advance of the drift was achieved by taking 1 metre rounds, installing 10-12 25 mm diameter rebar spiling over the last cap, shotcreting the back sometimes, installing 25cm X 25cm timber caps and later, steel caps. This cost $4000 per metre of advance and was uneconomic.

Prior to backfilling the 2.5m wide X 2.5m high (inside timber) drift with Cemented Rockfill (CRF), a narrow slusher drift was driven 4 metres along strike in the FW of the ore and it required no support. This slusher drift was 1.2m wide X 2m high on average. The waste was taken first and the ore slashed off last and recovered undiluted. This method appeared very promising and would be pursued further in the 1994 test program proposed here.

1994 TEST MINING

Further test mining on the steep dipping (65') ore should compare overhand and underhand methods using a narrow slusher and/or Miniscoop. It could well be that the four combinations of method and equipment should all be applied to optimize mining of the steep ore shoots. The 1994 diamond drilling program will provide ore block definition, intensity and thickness of alteration, identification of shears, etc. which dominate ground stability and therefore dictate mining method options that are applicable to each shoot. For example, the HW shear on 1570 dictates that further test mining in that area would best be done in the FW where a smaller heading can likely be held with little or no support relative to the extensive and expensive steel set support required in the HW.

Backfilling with rockfill becomes more difficult as the equipment downsizes. The use of sand or gravel fills will have to be sourced and evaluated.

The proposed mining methods to be tested include four specific options:

1. Slusher - overhand cut & fill
2. Slusher - underhand cut & fill
3. Miniscoop - overhand cut & fill
4. Miniscoop - underhand cut & fill

1. SLUSHER - OVERHAND CUT & FILL FIG. 1.

The slusher must be narrow to ensure that headings are kept as narrow as possible for ground support reasons. The scraper blade should be 0.7 metre wide or less and should have a passive lip (that is, without aggessive corner bits that rip out unblasted drift floors and walls resulting in oversize headings, dilution and instability). The 1993 test slusher drift on 1570 utilized a 0.76 metre wide scraper with reasonably good results except for the aggressive corner bit digging into the footwall which would have eventually resulted in oversizing and instability of the FW drift. The slusher drift was 1.2 metres wide but was being eroded to 1.5 metres at one point where some spalling was observed.

It can be said that the smaller the heading the more stable it will be and the less support it will require for a given ground condition. This is why I recommend smaller headings in this case. However, in these very small headings, your ability to install ground support is very limited, with shotcrete the most practical. You don't have room to drill for bolting the back and walls and timber is too restrictive, although it can be effective and adequate if only back sprags are required. Slushing through timber post support generally means continuous side boards must be installed. If you backfill with a scraper, the siding has to remain intact to accomodate that function as well. The point is that a small heading must be kept small so the advantage of minimal support is realized.

The 1993 test slusher drift indicated the ore could be left in place in the drift HW until the drift was completed along strike and then all the ore taken at once to minimize dilution on the drift floor. The floor could be shotcreted prior to blasting the ore also, to reduce dilution and ore losses.

A slusher operation does not produce disel fumes, reducing mine ventilating volume requirements. The same 2 stage 60 HP vent fan as used last year is adequate for this year's proposed test mining program.

2. SLUSHER - UNDERHAND CUT & FILL FIG. 2.

The underhand method implies drifting beneath cemented fill and may prove advantageous because of its safety and the greater ease with which backfill can usually be placed, although the backfill would itself be more expensive as it must be cemented.

The excation would not likely be tight filled, but would have intermittent layers of air gap and cemented fill as indicated in Fig. 2.

3. MINISCOOP - OVERHAND CUT & FILL FIG. 3.

The Miniscoop requires a larger heading than could accomodate a small slusher, but the scoop is more versatile and can better be used around corners or to remove the rock farther from the heading face. It requires 4000 cfm of ventilating air flow.
When moving from one ore drift to another, a Miniscoop is mobile whereas a slusher setup must be dismantled and reassembled in its new location.

4. MINISCOOP - UNDERHAND CUT & FILL FIG. 4.

Drifting beneath cemented fill offers safety and greater ease of backfilling usually, as the heading could be driven at greater height. The miniscoop again is more effective around corners or to move the rock to some destination beyond the capabilities of a typical slusher operation. The ventilation requirement remains at 4000 cfm.

The 1994 test mining program will be applied to ore shoots as identified by definition drilling to be done during the spring. As a result, figures 5 and 6 are conceptual only, in an effort to portrait the intention in the proposed test mining.

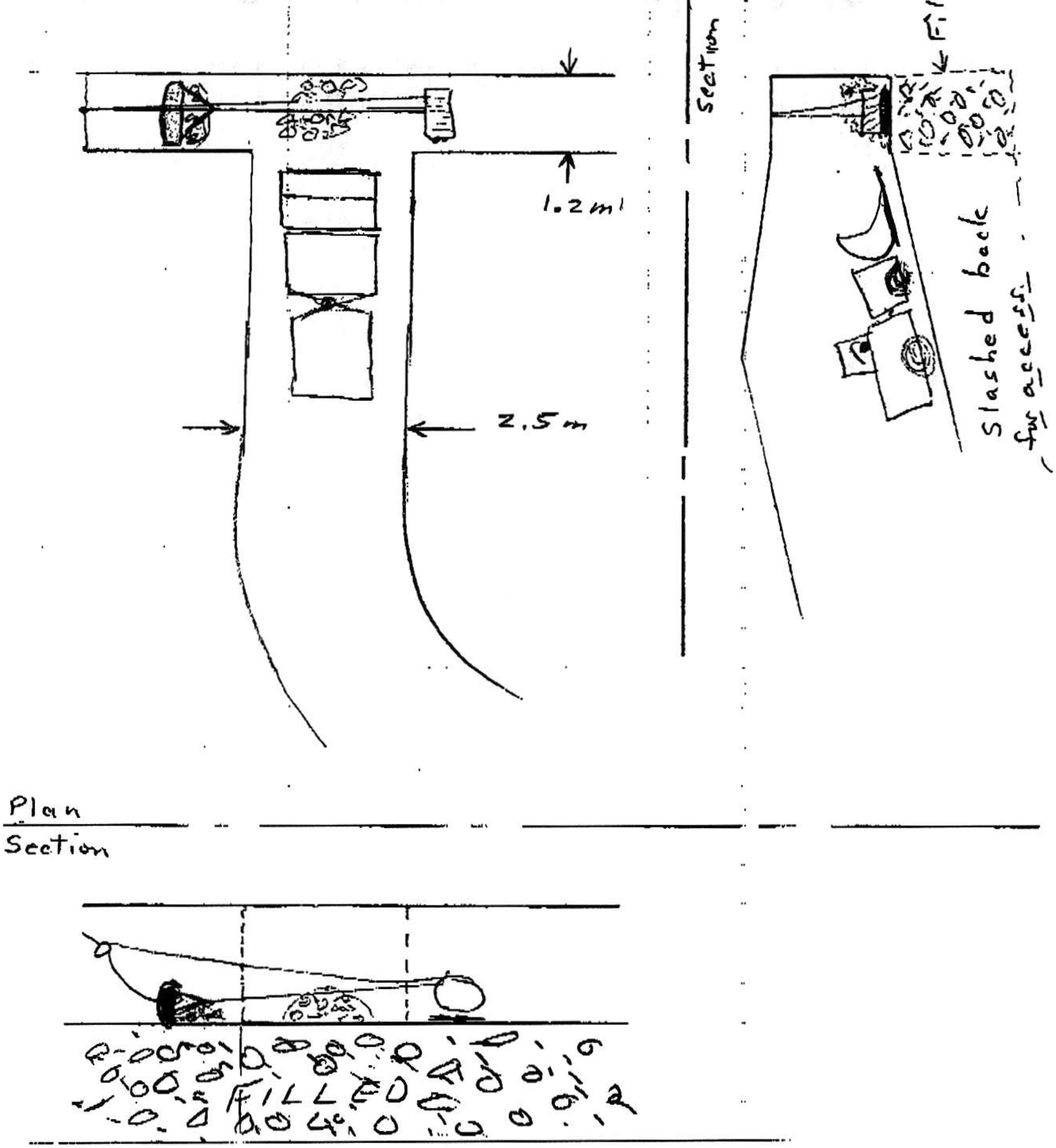
BEYOND THE 1994 TEST MINING PROGRAM

Assuming that a viable mining method for the 65 degree ore is proven, mining beyond 1994 can be expected to resemble Fig. 7.

The existing decline would continue to its economic limit as determined by ore reserves and production levels. Ore zone access would be off the decline and via spiral level access ramps. The spiral level access ramps accomodate ore zone access above and below the main decline; the farther up or down dip you want to access the ore, the greater the length of the spiral level access ramp or the farther into the FW will the pivot be located. Refer to Fig. 8.

If sufficient mining is eventually planned, to warrant a second access, a ventilation/egress raise could be driven at 65 degrees connecting sections of the main decline to depth. It would likely be driven in segments by alimak. It could be 1.8m X 2.4m and extend from surface to 1470 as indicated in Fig. 7. It could be downcast and contain egress ladderways and air, water, dewater, backfill and power lines.

FIG. 1. SLUSHER - OVERHAND CUT & FILL



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SAMPLE
SKETCH ONLY