SUPPORTING DOCUMENT 10

GIANT MINE
ASSESSMENT OF DEEP DISPOSAL
GIANT MINE ARSENIC TRIOXIDE DUST

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1. BACKGROUND

The Giant Mine property, located just north of Yellowknife, Northwest Territories, has been producing gold since 1948. In the Giant Mine ore, the gold is associated with an arsenic-bearing mineral, and the process used to liberate the gold leads to the production of arsenic-rich gases. During the period 1951 to 1999, operators of the Giant Mine captured the arsenic-rich gases in the form of an arsenic trioxide dust. Approximately 237,000 tonnes of the dust was then stored underground in mined-out stopes and purpose-built chambers.

Royal Oak Mines Inc. operated the Giant Mine from 1990 to 1999. When Royal Oak Mines Inc. went out of business, the property was conveyed to the Department of Indian Affairs and Northern Development (DIAND). In December 1999, DIAND sold the Giant Mine to Miramar Giant Mine Ltd. Liability of the Miramar parent group for environmental conditions at the mine was limited to the assets of Miramar Giant Mine Ltd. Through this transaction, the federal government effectively retained responsibility for pre-existing environmental liabilities on the property, including the arsenic trioxide dust.

During 2001, the Department of Indian and Northern Development (DIAND) commissioned a technical advisory group to develop pre-feasibility level plans for the underground arsenic trioxide dust. A report was prepared titled, "Study of Management Alternatives - Giant Mine Arsenic Trioxide Dust", May 2001. The objectives of this study were to select four representative management alternatives, prepare pre-feasibility cost estimates for them, and to analyze the associated environmental, human health, technical and financial risks. The use of representative alternatives was not intended to rule out other options, but it was stated that further work "should be limited to areas that could lead to significant reductions in cost and risk."

One of the areas identified for further work was the use of deep disposal as a dust disposal method. To address this area, the following task was included in the work plan for 2001-2002:

> **Task 4.1.2.3** Assess Deep Disposal. Consider extraction of dust and deep disposal. Carry out pre-feasibility level engineering, cost estimates and risk assessment. Compare to ground freezing alternatives.

This study, "Assessment of Deep Disposal", addresses this task.

2. INTRODUCTION

This study develops the concepts of deep underground burial of the arsenic trioxide dust. New underground dust storage chambers would be excavated deep within the Giant Mine, below the lowest existing workings. Arsenic trioxide dust would be excavated from the current, shallow underground storage areas and transported underground into the new chambers, without being handled on surface.

For a complete description of this deep disposal method, this report must be read in conjunction with the closely related report, *Re-assessment of Mining Methods, Giant Mine Arsenic Trioxide Dust* (Supporting Document 7) , which provides a detailed description and cost estimate for the removal by underground methods of the arsenic dust from all of the current storage areas.

This report, "Assessment of Deep Disposal", provides a detailed description and cost estimate for the construction of the deep new storage chambers, and the process of transferring the arsenic dust into them.

Note: To be consistent with preceding studies, the following distinction between "methods" and "alternatives" has been adopted:

> "The term 'method' was defined as referring to an individual step in the management of the arsenic trioxide dust, and the term 'alternative' was defined as referring to a complete combination of methods that covers all the steps in the project life cycle."

3. SITE VISIT AND INFORMATION SOURCES

A site visit to the Giant Mine was conducted from February 16 to 21, 2002 to interview mining personnel, review old mining plans, and to inspect the underground workings around B208 and B212-214.

Interviews conducted were all informal sessions and included Miramar Mining engineering staff, and three of the locally based Mine Inspectors with years of experience at Giant Mine.

A number of reference reports were obtained and reviewed, relative to the previous work completed on the issue of arsenic dust management. These are listed in the references at the end of this report.

4. DESCRIPTION OF ARSENIC STORAGE CHAMBERS

Approximately 237,000 tonnes of arsenic trioxide dust is stored underground at the Giant Mine in 15 chambers, at depths between 23 and 76m below surface. Five of these chambers are actually old stopes, while the other ten are purpose built chambers. The fifteen chambers are categorized into 4 groups based on their location in plan view, the group names being AR1, AR2, AR3 and AR4. Refer to Figures 1 to 4, three-dimensional views of a model constructed to represent these areas.

Table 1

Giant Mine: Underground Arsenic Storage Area Data

Area	Chamber or Stope	Reported Tonnes t	Calc.Dust Volume @ 1.3 t/m3	Reported Chamber Volume m3	Percent Full %	ApproximateDimensions Height m	Length m	Width m
AR1	B11	5,860	4,508	9,833	46%	22	36	10
	B12	26,243	20,187	25,485	79%	36	61	13
	B14	12,257	9,428	12,006	79%	24	52	12
	Sub-total	**44,360**	**34,123**	**47,324**				
AR2	C9	18,394	14,149	13,337	106%	49	30	12
	C10	9,569	7,361	7,750	95%	49	21	9
	C212	16,946	13,035	18,070	72%	50	46	8
	Sub-total	**44,909**	**34,545**	**39,157**				
AR3	B208	29,364	22,588	22,847	99%	45	45	14
	B230	2,835	2,181	2,294	95%	15	22	6
	B233	11,426	8,789	12,307	71%	44	33	9
	B234	12,048	9,268	12,035	77%	44	33	9
	B235	16,647	12,805	17,896	72%	50	33	11
	B236	16,465	12,666	15,178	83%	44	34	12
	Sub-total	**88,785**	**68,296**	**82,557**				
AR4	B212	32,099	24,691	25,740	96%	50	45	11
	B213	11,723	9,018	9,401	96%	30	25	14
	B214	15,467	11,898	12,403	96%	30	33	14
	Sub-total	**59,289**	**45,607**	**47,544**		Chamber Average Dimensions		
TOTAL	**Combined**	**237,343**	**182,572**	**216,582**	**84%**	38	36	10
	chambers	131,744	56%			Stope Average Dimensions		
	stopes	105,599	44%			41	39	12

Table 1 shows the approximate dimensions of the chambers, and the quantity of dust stored in each.

Figure 1: Area AR#1, Looks Southwest

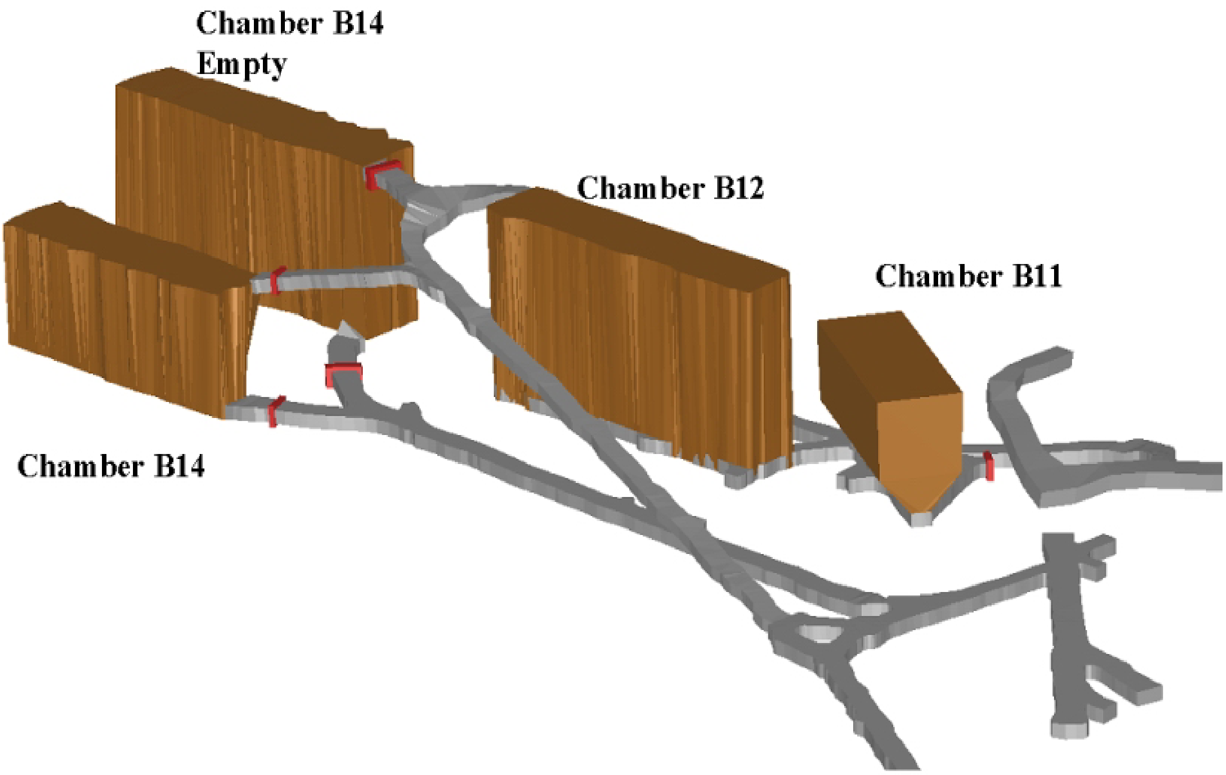
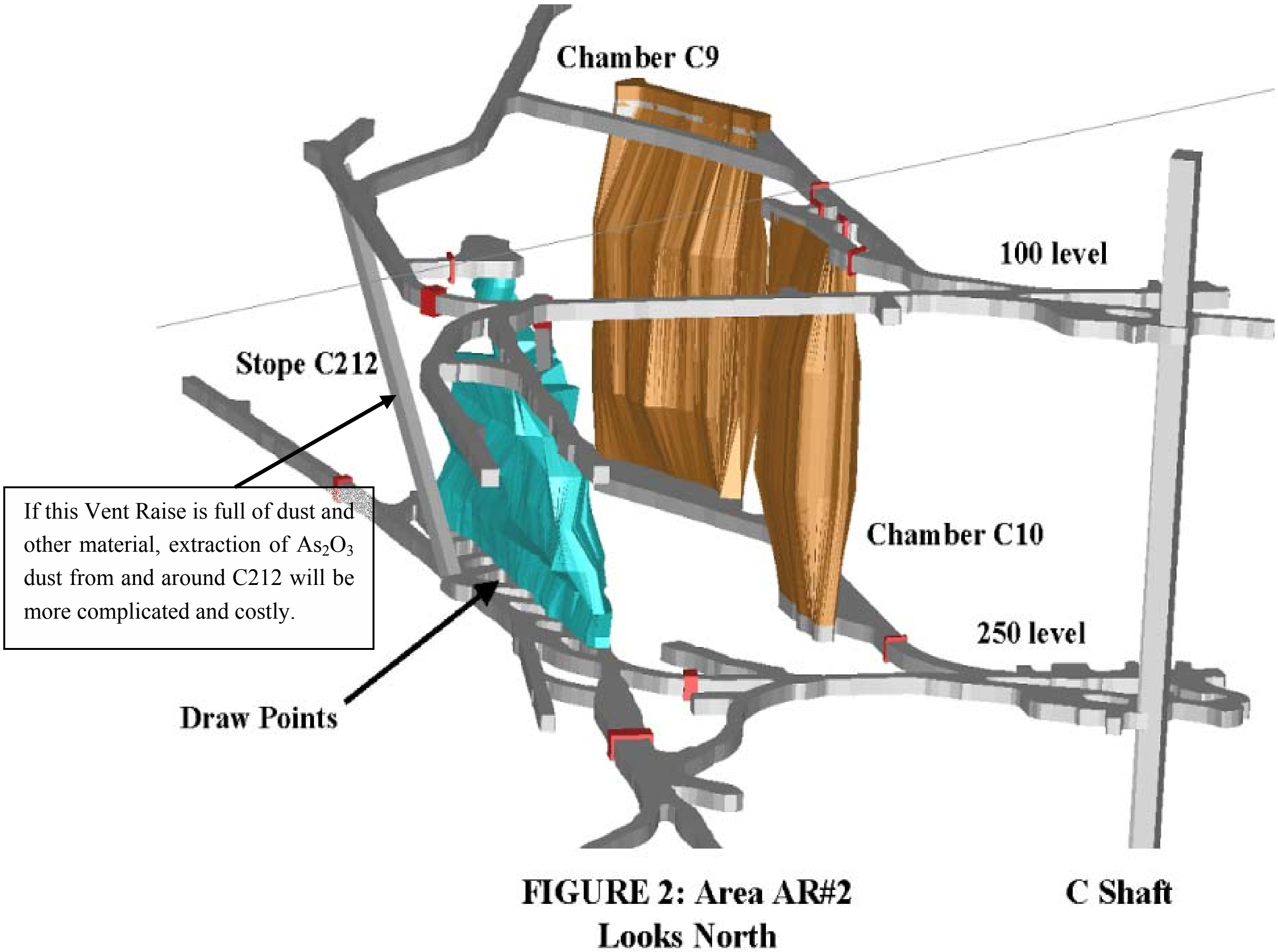


**FIGURE 1: Area AR#1
Looks Southwest**

Area AR#1

These chambers have flat bottoms and were apparently mined using remote equipment. Extraction of arsenic dust from these areas should be more straightforward as the geometry is simpler. The only concerns that have to be overcome are the possibility of a mud rush, the remote mucking distance and machines bogging down in slimes.

Figure 2: AR#2, Looks North



Area AR#2

This group of storage areas have narrow bottoms broken up with multiple draw points and were apparently mined using non-remote equipment. As a stope, C212 has much simpler geometry than B208 and B212-8 (see Figure 4), but if the vent raise beside C212 is full of dust mixed with other material, extraction will be more complex and costly. Concerns that have to be overcome are the complex geometry at the stope bottoms in the area of the old draw points.

Figure 3: Area AR#3, Looks Northeast

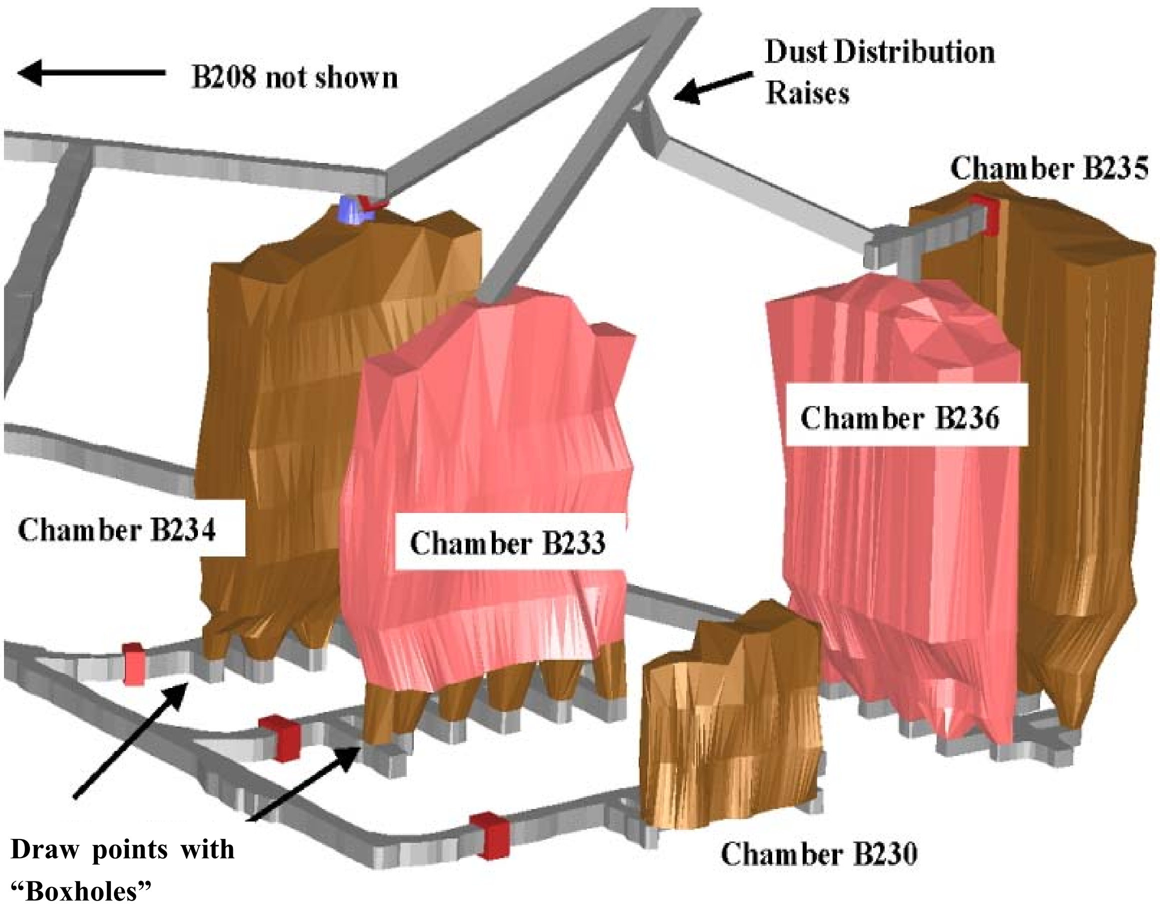


FIGURE 3: Area AR#3
Looks Northeast

Area AR#3

These chambers are similar to those in Area AR#2 except that the bottoms of the chambers feature boxholes above the draw points. The bottoms of these chambers are more complex than those in AR#2.

Figure 4: AR#4, Looks Northeast

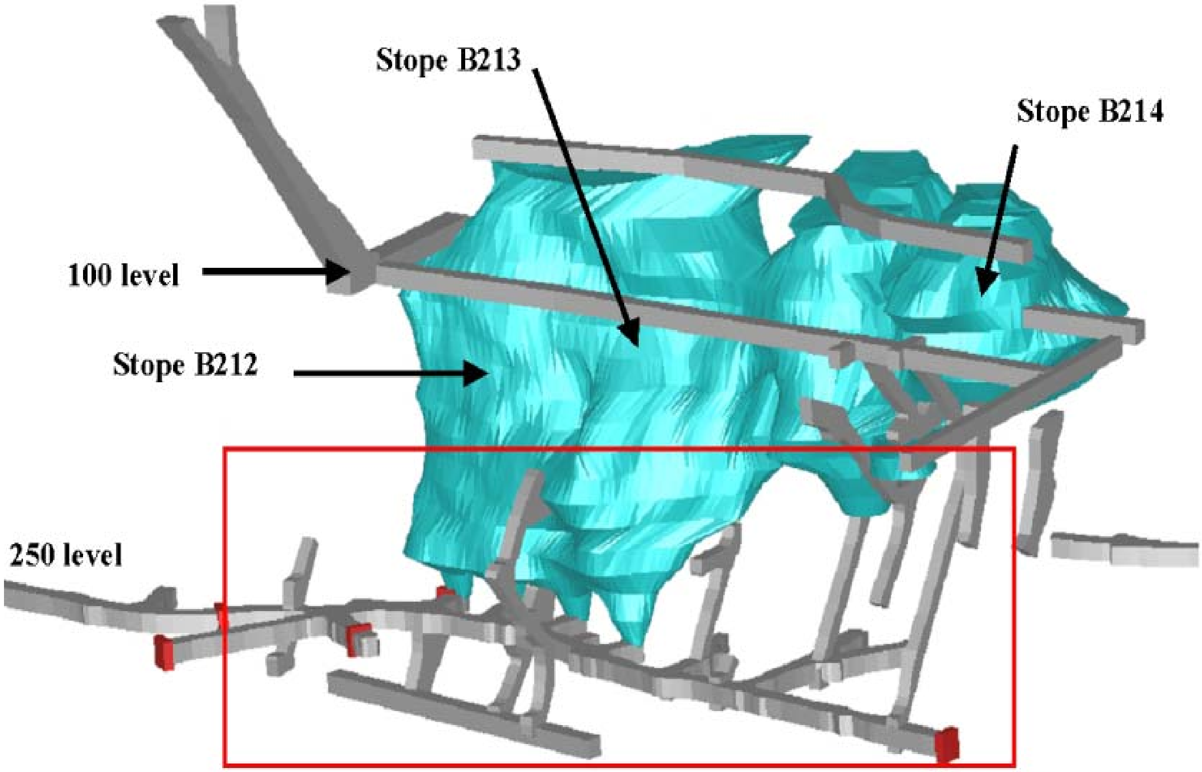


FIGURE 4: Area AR#4
Looks Northeast

Area AR#4

This area is the most complex of the four. A separate report explains the geometry and the approach to arsenic dust extraction unique to this area.

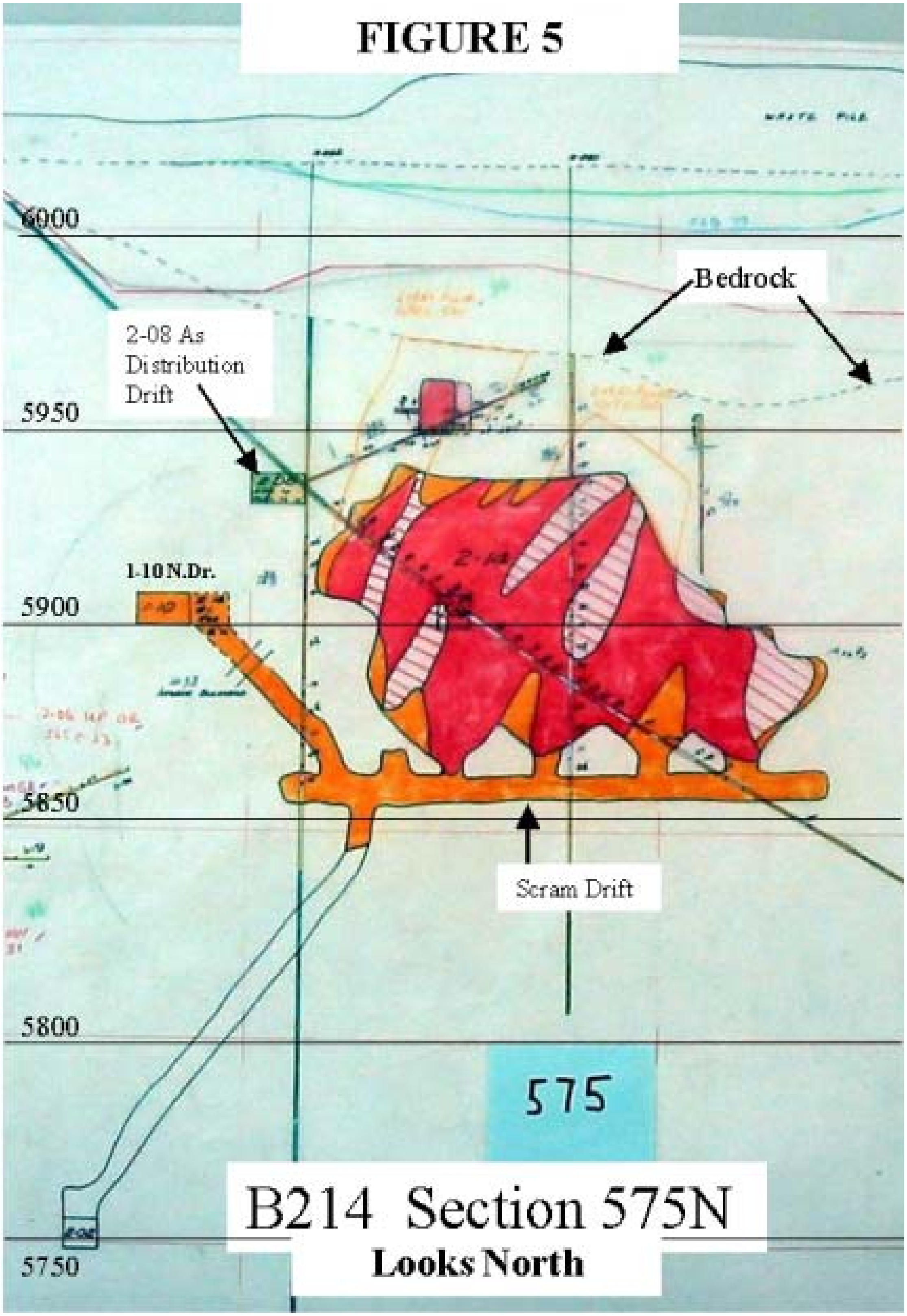
The best estimate of the in-situ density of the dust is 1.3 tonnes per cubic meter. Table 1 also shows how full each chamber is, based on this density. Chamber C9 is indicated to be more than 100% full, but this is really just showing that this data is not very accurate.

The ten chambers that were excavated specifically for the arsenic trioxide dust storage are regular and rectangular in shape. A key feature of these chambers is that they have flat bottoms. The average dimensions for these chambers are 38m high, 36m long and 10m wide, as shown in Table 1. Figure 1 shows four typical purpose built chambers.

The average dimensions for the five arsenic stopes are 41m high, 39m long and 12m wide. Compared to the purpose built chambers, the arsenic stopes are larger, less stable openings with complex geometry. At the bottom of these stopes there are drifts, cross cuts, raises, and draw cones. Their overall shapes are irregular, following the shape of the ore zone. Some have been mined very close to surface, with minimal rock crown pillars in areas. Other stopes, which do not contain arsenic dust, have been mined very close to these arsenic stopes, presenting ground stability concerns. Figures 4 and 5 illustrate the irregular shape of the stopes and the complex mine workings located at the stope bottoms.

The terminology for naming levels at the Giant Mine is based on the shaft collar at roughly elevation 6000 feet. First level at 5900 elevation, is also called 100 level. Second level at 5750 elevation, is also called 250 level. Third level just below 5600 elevation, is also called 425 level.

Figure 5: B214 Section 575N, Looks North



5. BASIS OF THE DEEP DISPOSAL METHOD

Before presenting the proposed deep disposal method, it is necessary to define the objectives, assumptions and constraints that have been applied to the process of developing the method.

5.1 Objectives

The objectives of the deep disposal method are:

- Recover at least 98% of the dust out of the current storage chambers and stopes.
- The arsenic dust must be placed deep enough underground so that it can be left in place permanently, with an acceptable environmental impact.
- Use safe, accepted methods. Reduce the risk to men. Avoid or minimize the risk of mud rush.
- Minimize costs.
- Reduce uncertainty. Use proven methods wherever possible.
- Achieve an acceptable overall schedule.

5.2 Assumptions/Constraints

A successful deep disposal method must take into account these assumptions:

- The deep disposal method is considered for the Giant Mine only because of the constraint of keeping the operation on mine property. To involve property that is not part of the mining lease would be difficult and complicated.

- The arsenic dust must be handled entirely underground, and must not be brought to surface as part of the method. Minimize the area of contamination in the mine caused by dust handling.

- For the purpose of this study, the dust will be placed at or below elevation 3800 feet. This is more than 200 feet below the lowest level in the mine, 2000 level. It is more than 2200 feet below surface.

- No men will be allowed to work within the arsenic storage chambers. They will only be required to work on dust recovery tasks that are located in stable surrounding access drifts.

- Mining work must be based on proven, off the shelf, methods.

6. DEEP BURIAL OVERVIEW

All of the arsenic dust will be relocated to new storage chambers excavated at a depth of over 2200 feet below surface. This is approximately 200 feet below 2000 level, currently the deepest level at the Giant Mine. Refer to Figure 6, which is a long section view of part of the Giant Mine.

The area of the new, deep storage chambers will be accessed by ramp. Trackless equipment will drive this new decline starting from 2000 level. The taking off point for the new ramp is the bottom of the existing ramp system that extends from surface to 2000 level. Refer to Figure 7, a plan view of 2000 level, showing the new decline ramp.

The arsenic dust will be transported to the new chambers through a new system of raises. There are 3 main raises planned, one for each of the following arsenic storage areas, AR1 and AR2 combined as one, AR3, and AR4. Each raise will be 6 feet in diameter, driven by the raise boring method and extending from 250 level down to the top of the new arsenic chambers.

The new chambers will be cylindrical in shape, 20 meters in diameter, and 90 meters in height. Nine new chambers are required and they will be excavated by the longhole mining method.

Dust extraction from the 15 arsenic chambers/stopes will begin by using the wet borehole mining method to recover as much of the dust as possible from each storage chamber and stope. The recovered dust will be kept inside a closed system on surface and sent directly back underground through large diameter bore holes to 250 level. There will be no exposure to the dust on surface and no inventory of dust will be stored on surface. Water used by the borehole mining equipment will be recycled in a closed system and reused in the borehole mining method.

On 250 level, the dust transfer boreholes coming from surface will feed into the bored raises to transport the dust by gravity to the new chambers at depth.

Some arsenic dust will remain in the original storage chambers and stopes after the completion of wet borehole mining, and this remaining dust will be excavated by underground methods (referred to as re-stoping) and dumped into the bored raises on 250 level. The material excavated during this final mining phase will be a mixture of dust and rock.

Wet borehole mining and re-stoping of the remaining arsenic dust in the storage chambers and stopes are described in the separate report, *Re-assessment of Mining Methods* (Supporting Document 7)

Each of the 4 arsenic storage areas, AR1 to AR4, will require the development of new cross cuts and ramps to access the raise bore machine set up locations, and to facilitate the dust mucking and haulage to the new bored raises.

The arsenic dust will be directed into the 9 new storage chambers by finger raises branching off from the 3 main bored raises. When all of the arsenic dust has been excavated and transferred, the area of the new chambers will be sealed off by the construction of concrete bulkheads in all raises and access drifts.

The Giant Mine will then be allowed to flood.

Figure 6: Giant Mine Long Section

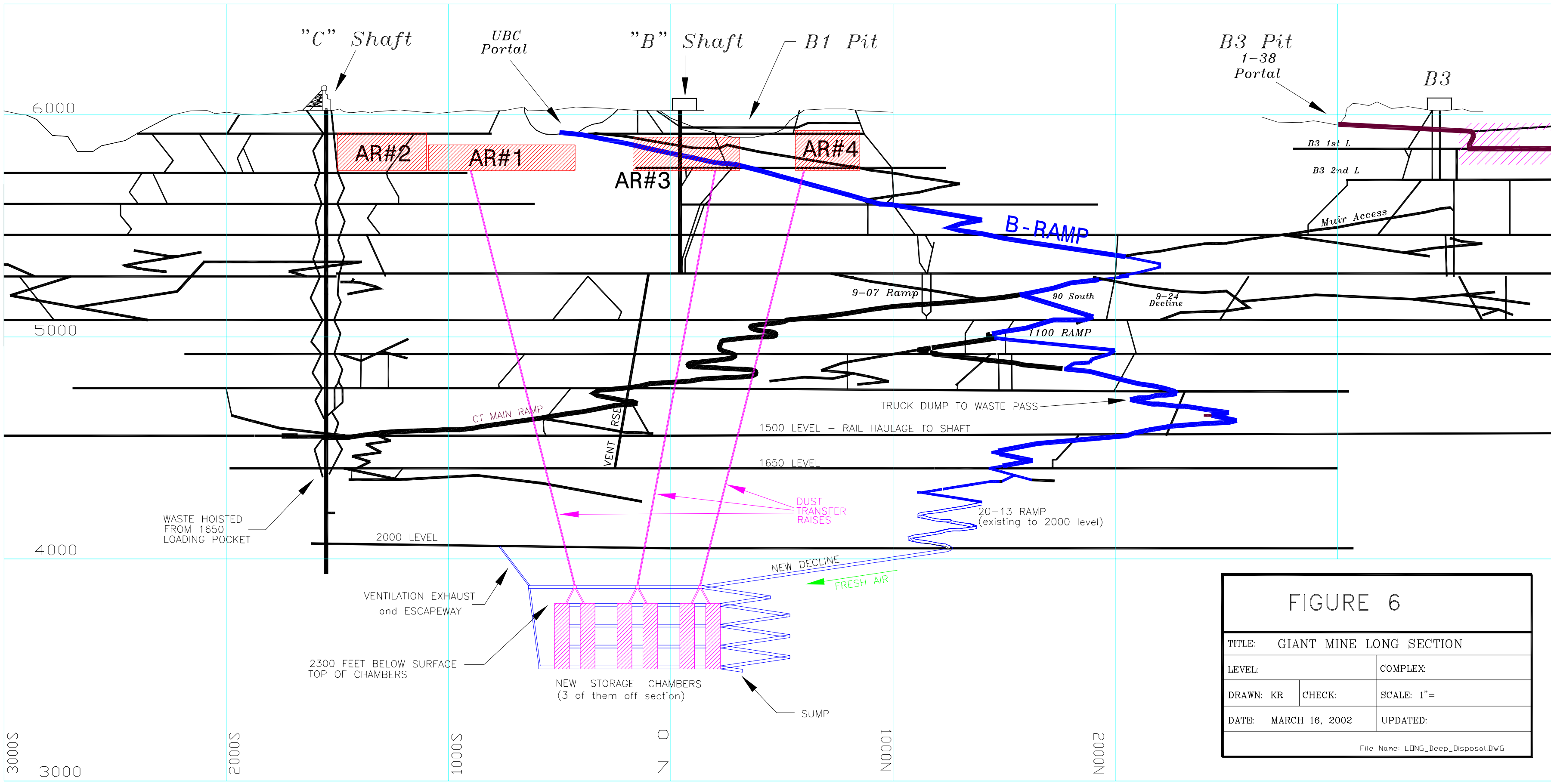
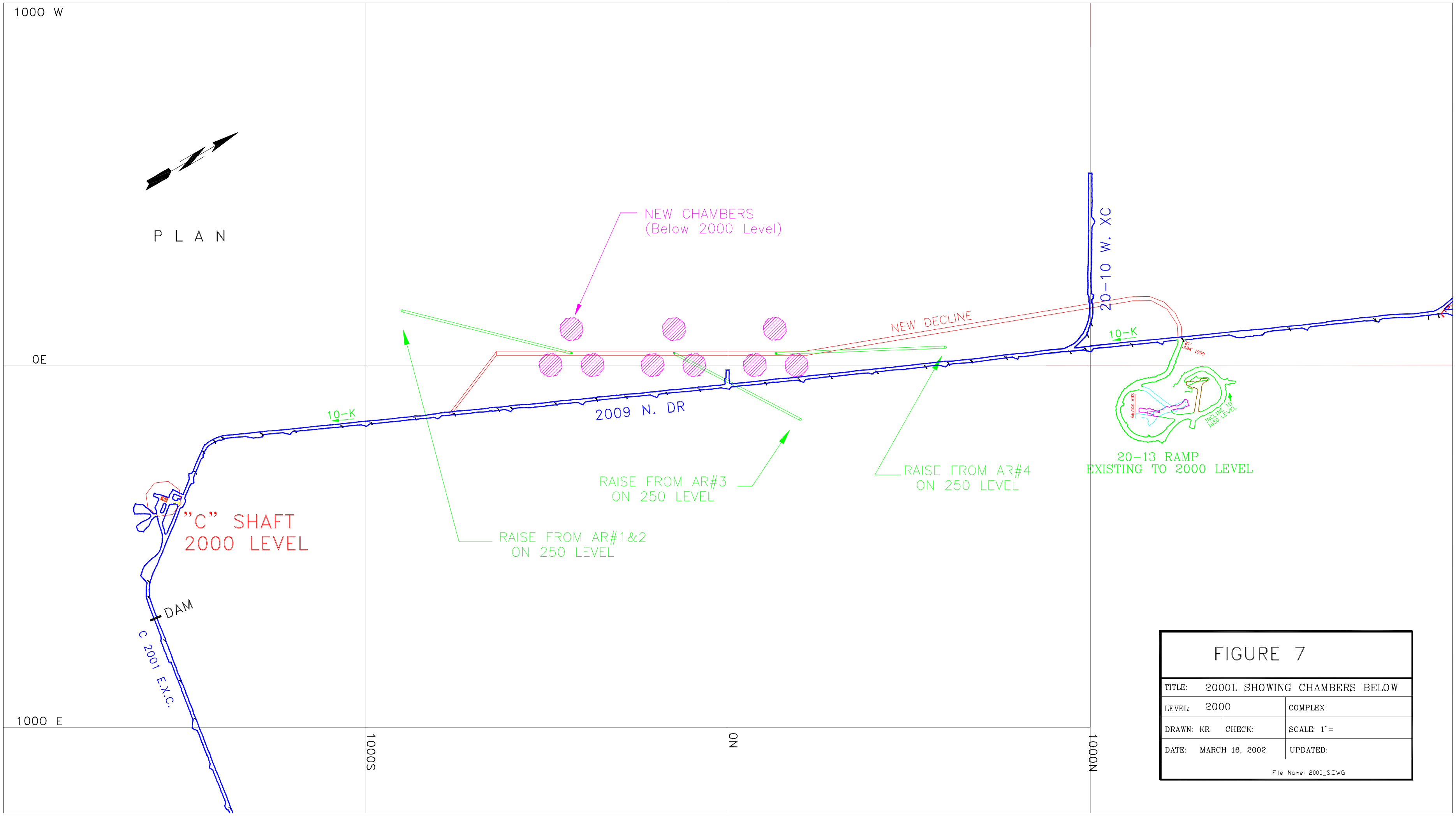


Figure 7: 2000L Showing Chambers Below



7. DEVELOPMENT OF DEEP BURIAL CONCEPTS

7.1 Introduction

The following sections describe the initial concepts that have been developed for each stage of the deep burial method. The logic behind key decisions is presented in cases where two or more choices have been considered.

7.2 Depth of Burial

Concerning the depth of burial, shaft deepening was not considered, and the conceptual plans are based on ramp access. The depth of burial selected in this study, below 3800 elevation, is a purely practical selection based on the geometry of the Giant Mine, in particular:

- The depth and location of the point of deepest ramp access to surface
- The relationship of the above point to the location of the arsenic storage chambers
- The desire to have steep raises from the existing storage chambers down to the new storage chambers

The depth used in this study is thought to be the minimum (highest elevation) that should be considered. No hydrogeology work has been performed to support this depth from an environmental point of view. Greater burial depths are possible, but they will be more costly and will take longer to implement.

7.3 Access to 3800 Elevation

The new storage chambers will be excavated below El.3800, and situated together in one area such that steep raises can be driven up to the existing arsenic storage areas. This defines the target area that must be accessed. Refer to Figure 6, a long section view of a portion of the Giant Mine.

Two choices were considered for where to start the decline ramp to the target area.

1. Start ramp at lowest shaft station, 2000 level. This would create a captive situation for mobile equipment in the target area.

2. Start ramp from 2000 level at the point where the ramp from surface connects to the level. This would allow ramp access to surface from the target area.

The second choice was selected because of these advantages:

- Equipment for driving the decline can be driven directly to the ramp collar to begin work. Under option 1, equipment must be slung down the shaft. This would be very restrictive to the size of equipment that could be used.

- The 2050 loading pocket below 2000 level would have been an attractive feature of option 1, but it was determined from Miramar staff that the bottom of the shaft, from 2000 level to shaft bottom 2100 level, is in very poor condition. This section of shaft is mostly filled with slimes and spill, and the timber work has been damaged by this build up. It was decided that no consideration would be given to rehabilitating shaft bottom and 2050 loading pocket. This eliminated one of the best features of option 1, the ability to hoist muck from 2050 level.

The ramp system from surface to 2000 level is shown in Figure 6. It is nominally sized at 12ft wide by 10ft high. With ramp access to surface under option 2, the following equipment was selected for driving the new decline ramp below 2000 level:

- 2 each 2 boom jumbo
- 3 each 3.5 yard scoop
- 3 each 15 ton underground trucks
- 1 each scissor or utility truck

7.4 Waste Handling

A major cost component of the deep disposal method will be the excavation of the new decline ramp and the new storage chambers. Waste handling and disposal are always key components of a development program in waste.

On this project, waste will be hauled by truck up the new decline ramp and will be directed to old stopes that can be filled, or to an existing waste pass for hoisting to surface. The volume of old stope voids available for filling has not been quantified.

Regarding the waste pass, it would be an existing muck raise coming from above 1500 level, terminating at a chute on 1500 level. Some development will be required to break into the existing raise at about 75 feet above 1500 level. The raise will be slashed out to create more waste storage capacity, and a rock breaker and grizzly will be installed.

1500 level is currently in use as a tramming level and will continue to be used to tram development waste across to C shaft. Waste will be dumped into a muck raise near the shaft and skipped to surface from the 1650 loading pocket. Refer to Figure 6.

7.5 Services to Target Area

Fresh air ventilation can be picked up on 2000 level at the collar of the new decline, at roughly 1200N. The current air flow is only 10,000cfm during the limited production mining at Giant Mine, but once the Supercrest Zone mining is completed, much more fresh air can be directed to 2000 level.

The ventilation circuit to the target area will be set up as follows. Fresh air will be drawn down the new decline to the area where the new chambers will be excavated. Exhaust air will pass through a new ventilation raise driven from the target area up to 2000 level, just north of 2000 level shaft station. Exhaust air will go up the shaft just as it now does.

The ventilation raise will serve other functions as well. It will be equipped with a manway and piping for water supply, compressed air, and dewatering. These services will tie into the existing services at C shaft 2000 level.

A main sump will be excavated at the lowest level of the new storage chambers. Mine water will be pumped up through the new manway to the 2000 level sump. A refuge station will be constructed near the base of the ventilation/escapeway raise.

Mobile equipment maintenance will be performed underground at one of the existing shops.

Special ventilation measures required during arsenic dust placement are discussed in a following section.

7.6 Arsenic Dust Transfer Raises

The following factors influenced the conceptual design of the arsenic dust transfer raises:

- The vertical elevation difference is too great to consider using trucks to haul the dust down to the new chambers. Also, trucking would spread arsenic dust through spillage and dusting. This led to the decision to use transfer raises.

- At the top of the raises on 250 level, 3 dump points are required, otherwise the lateral haulage distances are too great. One dump point (raise collar) will be provided for each of the areas AR3 to AR4. Areas AR1 and AR2 are considered together and provided with one dump point because their dust tonnages are lower.

- At the bottom of the raises, the design concept is that the dust must flow by gravity inside an enclosed system, with no requirements for handling to distribute the dust among the chambers. This consideration means that all three main raises must extend to the new chambers.

- The raises are relatively small in diameter for an ore pass, but 6 ft diameter is considered acceptable because the raises will always be operated empty.

- Although no layouts have been prepared, the raises are planned with two legs making up each raise. This provides some flexibility in the raise layout to avoid existing mine workings because a change in azimuth and dip can be planned at mid height. Also, the raise boring requirements are much less demanding with each leg of raise averaging only about half of the required total length.

The three main raises will extend from 250 level (5750 elevation) down to 3800 elevation. The raises will be designed to be steep for good material flow. The total raising requirements are over 6,000 feet (considering the dip length), and this work will be performed by a raise boring contractor. Planning of the logistics of this raising is beyond the scope of this study. The logistical considerations are:

- Transport of raise bore machine underground. Shaft access or ramp access. Dimensions and weights of components versus size of mine openings and hoist capability.

- Development of access to the set up locations, and excavation of the machine set up chamber.

- Provision of services to each set up point: water, compressed air, electricity (voltage and total power), communications, and water recycling sump.
- Shift schedules. They affect raise boring performance and cost. The owner has staffing issues to consider on back shifts: cage, hoist, nipping, mucking, supervision.
- Mucking and underground disposal of raise bore cuttings.
- Contractor access to union site.

7.7 Other Raising Work

The following raising is required in addition to the three main dust transfer raises described above:

- 9 slot raises. One is needed in each of the new chambers that are described below. This totals 2400 feet of small diameter raising. These raises will be used as initial void space for the longhole blasting of each chamber.
- 9 finger raises. One is needed for each of the new chambers. This totals 720 feet. These are the short raises that branch off the bottom end of the main dust transfer raises, and direct the dust into the individual chambers.
- Ventilation raising, totaling about 500 feet. This will provide a ventilation circuit to the deepest level of the new decline.

Various methods will be used to drive these raises including raise boring, open raising and drop raising.

7.8 New Arsenic Dust Storage Chambers

The following factors influenced the conceptual design of the new arsenic dust storage chambers:

- Only one arsenic distribution point per chamber is desirable. This will keep the system of finger raises as simple as possible, and avoid the need for re-handling the dust to distribute it.
- One distribution point will work well for a circular shape. The circular shape is also good for stability.

- The chambers were made as large as possible, without risking ground control problems. The dimensions of 20m in diameter and 90m in height are considered stable. Tall chambers such as these may provide some compaction of dust, increasing effective storage capacity.

Table 2 shows how the required number of new chambers was estimated. The volume of the new chambers must accommodate the arsenic dust and the re-stoped rock (described in a subsequent section). A contingency of 10% has been added to the required chamber volume, and the resulting estimate is for 9 new chambers, each 20m in diameter and 90m in height.

Table 2
Deep Disposal Storage Chamber Calculations

Area:	**AR 1 and AR 2**				**AR3**		**AR4**		**Combined Total**
Top of Dust Transfer Raise:	**Northing**	900S			200N		600N		
	Easting	150W			150E		050W		
	Elevation	5750			5750		5750		
Chamber/Tonnage	**B11**	5,860	**C9**	18,394	**B208**	29,364	**B212**	n/a	
	B12	26,243	**C10**	9,569	**B230**	2,835	**B213**	n/a	
	B14	12,257	**C212**	16,946	**B233**	11,426	**B214**	n/a	
	B15	empty			**B234**	12,048	**Sub-total**	59,289	
					B235/236	33,112			
Total Dust Tonnage:	separate	**44,360**		**44,909**		**88,785**		**59,289**	**237,343 t**
Dust Density: t/m3		1.3		1.3		1.3		1.3	1.3
Dust Volume: m3	separate	**34,123**		**34,545**		**68,296**		**45,607**	**182,572 m3**
	combined		**68,668**						
Extra Volume:									
re-stoping (1)	8%	2,730	15%	5,182	20%	13,659	calculated	25,000	
contingency	10%	3,412	10%	3,455	10%	6,830	10%	4,561	
		6,142		**8,636**		**20,489**		**29,561**	
Total Vol. Needed:	combined		**83,447**			**88,785**		**75,168**	**247,400 m3**
New Chambers:									
Vol. per chamber (2)			28,260			28,260		28,260	**m3**
Number Required:			**2.95**			**3.14**		**2.66**	**8.75 ea.**

Notes: (1) Re-stoping volume is rock volume only, all dust is accounted for above
(2) New chambers are 20m diameter, 90m height

All of the 9 new chambers will be designed in one general area to minimize development requirements. The area of the proposed new chambers will be diamond drilled before the design is finalized. This will check for any adverse geological structures such as faults.

The chambers will be excavated by longhole mining. They will be divided into three sublevels, nominally 30 meters vertical. The top cut will be slashed out completely by the development crews and supported by rebar bolts. No other ground support is planned for the chambers. They will be treated as open stopes with no man entry.

The lowest sublevel will also be slashed out completely to create an undercut for blasting the first sublevel blasting. A bored raise will provide the slot for blasting.

The finger raising at the top of each chamber will be completed before the top sublevel is blasted. These finger raises will connect each main raise to 3 of the new chambers.

Longhole mining waste rock will be handled in the same way as the development waste, hauled up ramp by truck for placement in old stopes, or for hoisting to surface. Three trucks will be scheduled to haul on a continuous basis.

A main sump will be constructed at the lowest level, at the bottom of the chambers. It is expected that the new chambers will have some ground water inflow, and it will be permitted by design to leak out of the lower bulkheads, much like the existing chambers. This water will be collected and pumped up to 2000 level.

7.9 Arsenic Dust Extraction

(For details and estimated costs for arsenic dust extraction, refer to the separate report, *Re-assessment of Mining Methods, Giant Mine Arsenic Trioxide Dust* Supporting Document 7.)

The specific excavation methods required to extract the arsenic dust from the original chambers and stopes will vary among them because:

- Some are stopes and some are purpose built chambers. The differences have been explained in a previous section.
- Among the chambers, there are significant differences in the geometry of the floors. Two of the chambers (#12 and #14) have flat floors that were excavated by trackless equipment. The others have draw points and draw cones, having been excavated by mucking machines on rail.

Despite the variations, the following general approach applies to all of the dust storages. Wet borehole mining will be used as a first step to extract as much of the dust as possible. Wet dust will pass from the drill rig on surface, to a centrifuge unit, and thickened dust (concrete consistency) will be sent directly back underground in a closed system. The centrifuged dust will be dropped by gravity down large diameter boreholes to 250 level, where these bore holes will line up with the main bored raises described in a previous section. There will be three such boreholes, one for each of the main raises.

The centrifuge process will also produce water that will be reused in the wet borehole mining process. None of this water will be released to the surface environment. It will be contained within process tanks.

It is expected that the wet borehole mining process will recover at least 80% of the dust in each of the dust storages, and possibly as high as 90% or more, in the two flat bottomed chambers. The final stage of wet borehole mining will be to use the high pressure rotating water jet to wash down the stope walls, and then lower the drill string to the lowest accessible point in the chamber to remove as much of the water and wet dust as possible.

After the wet borehole mining, the next stage has been termed re-stoping, and it will involve the use of conventional underground methods and equipment to mine out the old mine workings at the bottom of each of the storages near 250 level. Re-stoping will excavate the remaining dust along with the surrounding waste rock at the bottom. This is considered the only effective way to achieve the 98% dust recovery needed, when faced with the complex geometry of the old draw points. These old draw points will contain wet or dry arsenic dust, any original broken ore not mucked out, any waste oversize that has fallen off the chamber walls, and any trash that may have been buried in the chamber bottom.

Concerning the design of the re-stoping, each of the 15 storages must be individually considered. Ramp access and new cross cuts must be provided for each, to facilitate the re-stoping. Closely spaced cross cuts will be driven into the re-stoping areas to act as new draw points for trackless equipment. A remote controlled 5 yard scoop and remote controlled blockholer (small one boom drill jumbo designed for drilling off oversized rock) will be used.

This re-stoped material will be hauled by scoop and dumped down the nearest main raise to the new chambers, completing the arsenic dust extraction.

Of all the existing arsenic storages, B212, B213 and B214 are expected to be the most difficult to handle. These three stopes are actually one large stope (referred to as B212-4) due to the blasting of the 20ft thick pillars that first separated them. B212-4 has the most complex workings at its bottom. A specific mining plan has been proposed for B212-4 in the separate report, *Re-assessment of Mining Methods* (Supporting Document 7.)

There are two aspects of the companion report, *Re-assessment of Mining Methods* (referred to below as the “Re-assessment Report”) that do not apply directly to this current study, and these are described below. It is important to understand these differences since the cost build up in this current study partly relies on the cost estimates of the Re-assessment Report.

- The Re-assessment Report does not include the assumption that the dust extracted by the wet borehole mining method would be sent directly back underground through boreholes and into the dust transfer raises. Rather, it assumes that the extracted dust is suitably contained on surface pending further handling or processing deemed beyond the scope of the study.

- Secondly, the Re-assessment Report is based on trucking the remaining dust (from the re-stoping) up to surface for temporary storage and further processing deemed beyond the scope of the study. This current Deep Disposal study is based on hauling (by scoop) the re-stoped dust to the three dust transfer raises on 250 level.

These two differences have been properly accounted for in the cost build up in this current study by making appropriate (and relatively small) adjustments to the costs presented in the Re-assessment Report.

7.10 Transfer of Dust to New Chambers

The transfer of dust through the three main raises will be done in two stages, with the first being the wet borehole mining stage. The upper portions of the existing dust storages are expected to contain some dry dust. Lower down it will be wet, and in any event, water will be used for washing down stope walls. Thus, both a dry and a wet product will be created during the borehole mining.

As discussed above, this material will be transferred by gravity down through large boreholes leading into the three main raises at 250 level. The raise boreholes and the large diameter drill holes will be sealed up tight at their junction at 250 level. This will be done with piping.

At each junction, 10 inch diameter steel pipe will connect to the large diameter borehole at the back. This pipe will extend down through a raise cover and extend a short distance down the main transfer raise. The raise cover will remain closed to prevent dusting problems on 250 level. The dust transfer system will be sealed all of the way from surface to the new chambers.

The second stage of dust transfer will be the re-stoping, which will produce a product consisting of a mixture of dust and rock. It is likely that much of this remaining dust will be wet, but it is also expected that areas of dry dust will be encountered. The raise transfer system must be able to handle this dry product and the associated problem of dust creation during handling.

Dust will not be easy to control for two reasons:

- The arsenic dust has two unfavourable characteristics; it is very fine, and it is very difficult to wet (hydrophobic).

- Dumping material down a raise causes a piston effect, whereby the falling material creates a strong downward air movement in the raise. This creates pressurized air that in a typical mine raise will do one of two things; blow out on other levels where the raise is open, or, blow back up the same raise (reverse direction) if there is no other place for the air to go.

To put this in perspective, it is noted that the piston effect can create a serious dust problem in an underground mine, even when dealing with a normal ore material (blasted rock) that has passed under a water spray in the draw point.

The solution to this potential arsenic dust problem must begin at the design stage. No detailed solution is presented in this report, however some of the design concepts that can be employed are discussed below.

- The wetting of any dry arsenic dust (or any dry material handled underground) must be attempted before it is handled. It may not work well, but must be done, often to comply with mining regulations. This can best be done with an air/water atomizer that can be left running for hours without creating a water problem.

- Effective raise covers must be constructed over the dump points to the three main dust transfer raises on 250 level. They must be mechanically controlled for ease of use, and designed to be closed after each bucket is dumped.

- A dedicated air exhaust raise can be run in parallel to the main dust transfer raise. It would have an exhaust fan and bag house on surface to capture dust. There would be one or more horizontal openings connecting the exhaust raise to the dust raise. The dust transfer raise would be placed under negative pressure.

- Piston effect air will pressurize the new storage chamber as material falls down. By design, this air could be allowed to pass into a neighboring empty chamber where the dust could settle out. Cleaner air from this empty neighboring chamber could be routed back up one of the other dust transfer raises not being used at the time. In effect the empty neighboring chamber would act as an area of very low air velocity where dust would settle out.

At this time it is not known which of these measures (or others) will be needed to control airborne arsenic dust in and around the dust transfer raises, but it is reasonable to assume that the potential problem can be controlled.

7.11 Final Cleanup and Closure

When re-stoping is completed, the drifts on 250 level will be cleaned up where arsenic dust has been spilled. This can be done by digging up the road bed as much as possible and dumping the waste rock down the transfer raises. Slimes will be fully excavated from all sumps and dumped down the raises. Some areas may need to be washed down, and this water will be collected in sumps and pumped to surface.

Some contaminated debris will be hauled to surface for disposal. This will include timber from arsenic chamber bulkheads and any junk discovered in the stopes. These types of materials cannot safely be passed down the 6ft diameter transfer raises.

Access to the new arsenic storage chambers will be sealed off with concrete bulkheads. The openings to seal are the three transfer raises, the decline ramp and the ventilation raise. At this time, consideration can be given to any kind of long-term monitoring equipment that may be useful in the area of the new chambers.

After the seals are constructed the mine can be naturally flooded.

8. COSTS

As shown in Tables 3 and 4, the grand total cost of the deep disposal method is estimated to be CDN$156 million. The dust extraction cost, as presented in companion report, *Re-assessment of Mining Methods*, Supporting Document 7, is shown in Table 3. Table 4 presents the cost estimate for the work described in this report on deep disposal.

Table 3
Arsenic Dust Extraction Costs

		Contingency Included	Total Cost
	Preparatory Work Required on Surface	30%	$187,000
	Preparatory Work Required Underground	25%	$714,000
	Lower Bulkheads: Work Required	25%	$194,000
Phase I	Underground Development for Re-stoping	25%	$19,060,000
Phase II	Wet Borehole Mining	25%	$34,473,000
Phase III	Backfilling with Cemented Rockfill	25%	$1,844,000
Phase IV	Re-Stoping	30%	$15,165,000
Phase V	Final Extraction, Wash Down	30%	$8,494,000
	Investigations and Observations	50%	$5,291,000
	Services	25%	$11,311,000
	Adjustment in Trucking Costs for Deep Disposal		**($760,000)**
SUB-TOTAL COST FOR TABLE 3 (includes contingencies)		27%	$95,973,000

Prepared by T. Whillans
Checked by K. Reipas

Table 4
Deep Disposal Costs

		Total Cost
Phase VI	Waste rock dump set up and start of ramp	$2,733,000
Phase VII	Development of new ramp and levels for bins	$18,791,000
Phase VIII	New bin excavation ø 20m x 90m high x 9 bins	$20,247,000
Phase IX	Excavation of arsenic dust transfer raises	$5,074,000
Phase X	Bulkhead installation	$390,000
Appendix	Electrical power supply system	$643,000
	SUB-TOTAL COST Table 2	$47,878,000
	Contingency 25%	$11,970,000
SUB TOTAL COST FOR TABLE 4 (includes contingency)		$59,848,000
GRAND TOTAL COST TABLE 3 + TABLE 4 (with contingencies)		**$155,821,000**

Prepared by T. Whillans
Checked by K. Reipas

The total cost of CDN$156 million includes extraction of at least 98% of the arsenic dust from all storage chambers and stopes, excavation of new storage chambers at depth in the Giant Mine, and transfer of all of the arsenic dust and re-stoped material into the new chambers.

The costs presented in this report are project specific costs that are exclusive of the regular, ongoing care and maintenance costs estimated for the Giant Mine. The costs presented in Tables 3 and 4 are based on the assumption that the mine is already being maintained on a care and maintenance basis. Care and maintenance cost estimates are the subject of the separate report, *Contract Preparation for Care & Maintenance, Giant Mine*, March 2002.

The costs shown in Table 3 have been slightly adjusted (compared to those in the Re-assessment Report) to account for the fact that two changes have been made to the underlying cost assumptions. Wet borehole mining dust will be sent directly back underground in the case of deep disposal, and secondly, the re-stoped arsenic dust will not be trucked to surface, but will instead be dumped into the dust transfer raises on 250 level.

The details of the costs presented in Tables 3 and 4 are included in appendices A and B respectively.

8.1 Development Costs

For lateral development (drifting), a mining contractor would typically charge \$2,500/m, which is equivalent to \$140/m³ for development advance in a 4.0m wide x 4.0m high drift, and this cost has been used in this deep disposal study.

The raising costs used in this study were estimated by Dynatec Corporation in the report, *Budget Proposal for the Raisebore Program at the Giant Mine*, May 22, 2002.

8.2 Other Unit Costs

Some of the other unit costs used in the deep disposal cost estimate are shown in Table 5.

Table 5
Deep Disposal Unit Costs

Power Costs	\$0.187/kWhr	estimate of power costs
Mine Air Heating	Propane Costs	Pro-rated on ventilation requirements and compared to existing vent flow and propane costs at Giant.
ITH Drilling Costs	ø 152 mm	\$ 2.61/tonne drilled
Blasting Costs		\$ 2.16 /tonne blasted

9. RISKS

9.1 Environmental Impact

The long term environmental impact of deep disposal must be carefully studied before a decision is made to use the method. There is a risk that the release of arsenic into surrounding ground water could be higher than estimated.

9.2 Technical Risks

Technical risks related to the deep disposal method include operation of the dust transfer raises, the stability of the new chambers, and management of groundwater entering the chambers.

9.2.1 Dust Transfer Raises

Potential problems with the dust transfer raises are excessive arsenic dust creation, hang ups (blockages), and physical deterioration of the raises. The creation of dust is the most likely to occur of these problems and it is discussed in a preceding section. Hang ups are not likely because the raises will be operated empty. Physical deterioration is not likely because of the low tonnage of material to be transferred. If major fault zones are intersected by the transfer raises then there would be a significant risk.

9.2.2 Chamber Instability

The risk of chamber instability will be managed by the rock mechanics design process and underground investigation, including diamond drilling.

9.2.3 Groundwater

Groundwater will pose a risk to the new chambers, just as it does to the existing arsenic storages. This risk will be managed through bulkhead design, possible incorporation of chamber bottom drainage, pressure monitoring and construction of dewatering infrastructure at the lowest level.

9.3 Public Perception

There is a risk with this method related to public perception. This method would likely not be employed if the public perception was strongly negative, and there is no risk under this scenario. A risk exists if a choice is made to use deep disposal. The risk is that in future years public perception could change, demanding that the arsenic be removed. It would be very expensive to remove the arsenic dust from the increased depth of burial.

9.4 Arsenic Dust Extraction

There are risks related to this alternative concerning the arsenic dust extraction from the stopes and chambers. These risks, not related to the deep disposal method itself, include ground control issues in the old stopes, uncertainty regarding the condition and contents of the stope bottoms, and the risk of not achieving the required 98% recovery. These risks are discussed in the separate report, *Re-assessment of Mining Methods*, Supporting Document 7.

10. CONCLUSIONS AND RECOMMENDATIONS

This report presents the findings of a limited study of the deep disposal method. This study deals with all of the existing arsenic storages. The concepts of deep disposal are discussed, but details have not been developed in the following key areas:

- Dust transfer raise design.
- New storage chamber design.
- Long term environmental impact.

The most important of the above is the last item, long term environmental impact. The author has no expertise in this area, and cannot assume there is no related fatal flaw.

Concerning the first two points, it is anticipated that no fatal flaws will be revealed during detailed work.

This study relies on the results of Supporting Document 7. It outlines the methods and risks of extracting 98% of the arsenic dust from all of the storage stopes and chambers. All of the risks described apply also to this study.

If the deep disposal alternative is to be advanced further, beyond this preliminary study, the following work is recommended:

- A geohydrological evaluation of water movement at depth and its influence on the deep ecosystem is required. An assessment of the long-term effects of deep disposal is needed.
- Determine the ongoing environmental monitoring requirements.
- Determine the long-term effect on groundwater assuming that 2% of the arsenic trioxide will not be removed from the present stopes and chambers.
- The new storage chambers and dust transfer raises must be designed. The geotechnical investigation to locate the chambers must consider rock composition and chemistry for minimum environmental effect. The raise designs must incorporate provisions for dust control.
- The mine dewatering program during the mining and filling of the chambers must be developed.
- Health and safety issues that may arise must be identified, along with control strategies.

This report, **1CI001.10, Assessment of Deep Disposal, Giant Mine Arsenic Trioxide Dust,** was prepared by:

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Appendix A

Cost Details
Arsenic Trioxide Removal by Underground Methods

APPENDIX A COST OF EXTRACTION
Summary of Costs

	Description	Total before contingencies	Contingencies		Totals	
	PREPARATORY WORK REQUIRED ON SURFACE	$ 144,000	30%	$ 43,000	$ 187,000	
	PREPARATORY WORK REQUIRED UNDERGROUND	$ 571,000	25%	$ 143,000	$ 714,000	
	LOWER BULKHEADS : WORK REQUIRED	$ 155,000	25%	$ 39,000	$ 194,000	
PHASE I	UNDERGROUND DEVELOPMENT FOR RESTOPING	$ 15,248,000	25%	$ 3,812,000	$ 19,060,000	Loop in ramp added. Access to B11 removed
PHASE II	WET BOREHOLE MINING	$ 27,578,000	25%	$ 6,895,000	$ 34,473,000	Higher cost for slower method
PHASE III	BACKFILLING WITH CEMENTED ROCKFILL	$ 1,475,000	25%	$ 369,000	$ 1,844,000	
PHASE IV	RE-STOPING	$ 11,665,000	30%	$ 3,500,000	$ 15,165,000	Variation to mining method proposed
PHASE V	FINAL EXTRACTION, WASH DOWN	$ 6,534,000	30%	$ 1,960,000	$ 8,494,000	Final Extraction costs reduced
	INVESTIGATIONS, MONITORING AND OBSERVATIONS	$ 3,527,000	50%	$ 1,764,000	$ 5,291,000	Surveyor stays on as contract administrator
	SERVICES	$ 9,049,000	25%	$ 2,262,000	$ 11,311,000	Power and Pumping costs adjusted
	GRAND TOTALS	**$ 75,946,000**	**27%**	**$ 20,787,000**	**$ 96,733,000**	

APPENDIX A COST OF EXTRACTION
Unit Costs

Development Size	4.0m wide	4.5m high	3.4m long
Development Cost	\$2,680/m	\$ 150/m³	
Re-stoping, Man-Entry, non-toxic conditions		\$ 270/m³	
Re-stoping, Man-Entry, toxic dust conditions		\$ 490/m³	
Re-Stoping, Longhole, Toxic Dust Conditions		\$ 56/m³	
Final Extraction, old track drifts and raises		\$ 510/m³	
Mine Air Heating : Propane Costs per year	\$94,750/yr	based on slower wet borehole mining rates and assumes the mine is operated 8 months of the year	
Power Costs	\$0.187/kWhr	based on existing power costs	
Cement Cost/tonne	\$150	includes warehousing and freight	
Backfill Costs (without cement)	\$ 5.00/t		
Portal	\$80,000	(equivalent to 30m development)	
Contractor Mobilization, Demob.	\$200,000		
Contractor Charge Rates for Odd Jobs	\$1,276/day/man		

APPENDIX A COST OF EXTRACTION
COST DETAILS

Description	Quantity		Unit Cost	Total Cost	Total before contingencies		Contingencies	Totals
PREPARATORY WORK REQUIRED ON SURFACE								
B1 Pit add/remove overburden, scale pit wall, make safe for wet borehole drill				$ 40,000				
B1 Pit / surface. Level off each set-up area	6	set-ups	$ 1,500	$ 9,000				
Provide air, water, power, construct portal				$ 80,000				
Provide access to 1-10N Drift if possible	14days	3 men	$ 1,276/manshift	option only				
Provide Cement Pad for Maintenance Shop				$ 15,000	**$ 144,000**	30%	$ 43,000	**$ 187,000**
PREPARATORY WORK REQUIRED UNDERGROUND								
Upgrade Dewatering Capabilities	1	New Sump, dev't costs included elsewhere						
Clear water pumps installed for B208, B212-4	2	pumps	$40,000	$80,000				
Cased Boreholes sump to surface, 250ft ea for B208, B212-4, AR2	3	boreholes	$ 300/m	$69,000				
Water control dams 1m high for B208, B212-4, AR1, AR2, AR3	10		$18,000	$180,000				
PVC line 250 Level to C Shaft	750m		$ 35/m	option only				
1-10 N Drift Rehab as required and clean up any remaining arsenic.(Diamond drilling included under Investigations and Monitoring)	14days	2 men	$ 1,276/manshift	$ 36,000				
2-08As Distribution Drift. Test drill with stoper/plugger to confirm pillar above and below.	3days	2 men	$ 1,276/manshift	$ 8,000				
2-08As Distribution Drift. Clean up and open the inspection hatches	14days	2 men	$ 1,276/manshift	$ 36,000				
AR1 Top Access clean-up	21days	2 men	$ 1,276/manshift	$ 54,000				
AR2 Top Access clean-up	21days	2 men	$ 1,276/manshift	$ 54,000				
AR3 Top Access clean-up	21days	2 men	$ 1,276/manshift	$ 54,000	**$ 571,000**	25%	$ 143,000	**$ 714,000**
LOWER BULKHEADS : WORK REQUIRED								
BH#32. Clean out slimes. Drill holes to drain. Place pipes to monitor pressure.	6days	2 men	$ 1,276/manshift	$ 15,000				
BH#33. Install manway ladders and landings from 3-10 Stope.	3days	2 men	$ 1,276/manshift	$ 8,000				
BH#34 no work required, see monitoring section				$ 0				
BH#35 Install second bulkhead farther down raise. Likely Option				$ 50,000				
BH#36. Install manway ladders, landings 48' in 212-218 orepass from 425 Level.	3days	3 men	$ 1,276/manshift	$ 11,000				
BH#37 Drill holes grout pipes in place	10days	2 men	$ 1,276/manshift	$ 26,000				
AR1 Bulkheads drill holes, grout pipes in place	6days	2 men	$ 1,276/manshift	$ 15,000				
AR2 Bulkheads drill holes, grout pipes in place	6days	2 men	$ 1,276/manshift	$ 15,000				
AR3 Bulkheads drill holes, grout pipes in place	6days	2 men	$ 1,276/manshift	$ 15,000	**$ 155,000**	25%	$ 39,000	**$ 194,000**

APPENDIX A COST OF EXTRACTION
COST DETAILS

	Description	Quantity		Unit Cost	Total Cost	Total before contingencies		Contingencies	Totals
PHASE I	**UNDERGROUND DEVELOPMENT FOR RESTOPING**								
	Mobilization, Demobilization of Contractors				$ 200,000				
	Ramp for B212-4 and B208	1,196m		$ 2,680/m	$ 3,206,000				
	AR2 Ramp Access from AR1	213m		$ 2,680/m	$ 572,000				
	B212-4 Lateral Development, Footwall and Draw Points	1,007m		$ 2,680/m	$ 2,698,000				
	B208 Lateral Development, Footwall and Draw Points	410m		$ 2,680/m	$ 1,100,000				
	AR1 Lateral Development, Footwall and Draw Points	221m		$ 2,680/m	$ 592,000				
	AR2 Lateral Development, Footwall and Draw Points	374m		$ 2,680/m	$ 1,002,000				
	AR3 Lateral Development, Footwall and Draw Points	569m		$ 2,680/m	$ 1,525,000				
	Raising required for all areas	568m		$ 2,680/m	$ 1,523,000				
	Trucking Costs	215,000t		$ 7.92/t	$ 1,704,000				
	Power Costs	1.8years		$640,000/yr	$ 1,126,000	**$ 15,248,000**	25%	$ 3,812,000	**$ 19,060,000**
		4,559m							
PHASE II	**WET BOREHOLE MINING**	**(based on**	**Slower**	**Estimate working 8 months of the year with one rig)**					
	Mobilization CT550 Hydraulic Casing Rig and TH150 Layne Top drive Production Drill Rig				$ 925,000				
	B212-4 Drill and install casing 16" average length 80m. Includes one hole for return water.	7 holes	80m ea.	$ 875/m	$ 490,000				
	B208 Drill and install casing 16" average length 80m	5 holes	80m ea.	$ 875/m	$ 350,000				
	AR-1 Drill & case 16" avg length 80m for B11, B12 and B14. Includes one hole for return water.	10 holes	80m ea.	$ 875/m	$ 700,000				
	AR-2 Drill and install casing 16" average length 80m for C9, C10 and C212	7 holes	80m ea.	$ 875/m	$ 490,000				
	AR-3 Drill&case 16" avg length 80m: B230, B233, B234, B235, B236. Incl. hole for return water.	10 holes	80m ea.	$ 875/m	$ 700,000				
	Total Holes Drilled and Cased	39 holes							
	Drill Test Holes Sample and Install Camera average 17 hours per hole	663 hours		$600/hour	$ 398,000				
	B212-4 Wet Borehole Mining	85% of dust	50,396t	$98/t	$ 4,939,000				
	B208 Wet Borehole Mining	85% of dust	24,959t	$98/t	$ 2,446,000				
	AR-1 Wet Borehole Mining of B11, B12 and B14	85% of dust	37,706t	$98/t	$ 3,695,000				
	AR-2 Wet Borehole Mining C9, C10 and C212	92% of dust	41,316t	$98/t	$ 4,049,000				
	AR-3 Wet Borehole Mining of B230, B233, B234, B235, B236	85% of dust	50,508t	$98/t	$ 4,950,000				
	Moves and Set-ups	39 holes	24 hours/hole	$600/hour	$ 562,000				
	Consumables, Surfactant etc + Additional Washing time				$ 750,000				
	Safety Equipment and Consumables	400	days	$1,500/day	$ 600,000				
	Computer Monitoring System for two rigs	350	days	$400/day	$ 280,000				
	Power Costs	15.0years		$80,000/yr	$ 1,200,000				
	1-10 N Drift, Blast bulkheads in crosscuts, wash dust into stope	14days	3 men	$ 1,276/manshift	$ 54,000	**$ 27,578,000**	25%	$ 6,895,000	**$ 34,473,000**
			205,000t	dust extracted					

APPENDIX A COST OF EXTRACTION
COST DETAILS

	Description	Quantity		Unit Cost	Total Cost	Total before contingencies	Contingencies		Totals
PHASE III	**BACKFILLING WITH CEMENTED ROCKFILL**								
	CRF to B212-4 via Boreholes High Cement content	26,000t	tonnage calc only						
	CRF to B212-4 via Boreholes Low Cement content	56,000t	tonnage calc only						
	CRF to B212-4 Labour and machines only for high+low cement	82,000t		$ 5.00/t	$ 410,000				
	CRF to B212-4 via Boreholes. Cement costs only for upper portion of stope	3%	1,680t	$ 150/t	$ 252,000				
	CRF to B212-4 via Boreholes. Cement costs for lower 16m portion of stope	8%	2,080t	$ 150/t	$ 312,000				
	CRF to B208 via Boreholes High Cement content	6,000t	tonnage calc only						
	CRF to B208 via Boreholes Low Cement content	42,000t	tonnage calc only						
	CRF to B208 Labour and machines only for high+low cement	48,000t		$ 5.00/t	$ 240,000				
	CRF to B208 via Boreholes. Cement costs only for upper portion of stope	3%	1,260t	$ 150/t	$ 189,000				
	CRF to B208 via Boreholes. Cement costs only for lower 16m portion of stope	8%	480t	$ 150/t	$ 72,000	**$ 1,475,000**	25%	$ 369,000	**$ 1,844,000**
PHASE IV	**RE-STOPING**								
	B212-4 Re-Stoping Method 2 downhole variation, man-entry portion (see text)	10,000m³	2.4 density	$ 490/m³	$ 4,900,000				
	B212-4 Re-Stoping Method 2 downhole variation, longhole mining portion	20,000m³	2.7 density	$ 56/m³	$ 1,111,000				
	B208 Re-Stoping Method II downhole variation, man-entry portion	1,750m³	2.0 density	$ 490/m³	$ 858,000				
	B208 Re-Stoping Method II downhole variation, longhole mining portion	5,250m³	2.7 density	$ 56/m³	$ 292,000				
	AR-1 Re-Stoping with ITH Required for B12 only up to 10m high off floor	5,574m³	1.5 density	$ 56/m³	$ 310,000				
	AR-2 Re-Stoping Required for C9 and C10 only up to 7m high off floor	3,809m³	1.7 density	$ 56/m³	$ 212,000				
	AR-3 Re-Stoping Required for B233, B234, B235 and B236 only up to 7m high off floor	8,748m³	1.6 density	$ 56/m³	$ 486,000				
	Truck the dust to surface (Assume 30% more for sand that has to be added) Assume density 2.5	55,131m³	125,000t	$ 27.96/t	$ 3,496,000	**$ 11,665,000**	30%	$ 3,500,000	**$ 15,165,000**
PHASE V	**FINAL EXTRACTION, WASH DOWN**	(Extra development required for this extraction is included above, in "Phase I Underground Development")							
	B212-4 Final Extraction Area 1: Raises from 250 level up to bottom of stopes	823m³		$ 510/m³	$ 420,000				
	B212-4 Final Extraction Area 2 Remaining portions of track drift on 250 Level	1,176m³		$ 510/m³	$ 600,000				
	B212-4 Final Extraction Area 3: Orepass from B212 Scram down to El.5635 Plug (212-218 pillar raise and 2-12N Raise)	315m³		$ 510/m³	$ 161,000				
	B208 Final Extraction Area 1:	425m³		$ 510/m³	$ 217,000				
	B208 Final Extraction Area 2	238m³		$ 510/m³	$ 121,000				
	B208 Final Extraction Area 3	306m³		$ 510/m³	$ 156,000				
	AR1 Clean up old track drifts of Arsenic for B11, B12 and B14. Slash as required	1,189m³		$ 510/m³	$ 607,000				
	AR2 Clean up old track drifts of Arsenic for C9, C10 and C212. Slash as required	4,078m³		$ 510/m³	$ 2,080,000				
	AR3 Clean up old track drifts of Arsenic for B230, B233, B234, B235, B236. Slash as required	3,466m³		$ 510/m³	$ 1,768,000				
	Truck rock&slop to surface (Assume 15% more as some drifts may have to be enlarged)	12,016m³	33,000t	$ 12.25/t	$ 404,000	**$ 6,534,000**	30%	$ 1,960,000	**$ 8,494,000**

APPENDIX A COST OF EXTRACTION
COST DETAILS

Description	Quantity		Unit Cost	Total Cost	Total before contingencies		Contingencies	Totals
INVESTIGATIONS, MONITORING AND OBSERVATIONS			$ 124,800					
Surveyor includes living costs and underground vehicle rented from contractors	1 men	20years	$100,000/yr	$ 2,047,000				
Project Engineer, includes living costs and surface vehicle	1 men	5years	$150,000/yr	$ 750,000				
Diamond drill hangingwall from 1-10N Drift	20	holes		$ 30,000				
Self Contained Pressurized Breathing Apparatus Purchase, Training and Maintenance		Included in Contractor costs						
Arsenic Trioxide Monitors Purchase and Upkeep				$ 50,000				
Dust sampling programme	Done by engineer + surveyor			$ 50,000				
Environmental Consultants (visit 3 times/ year)	25	visits	$20,000/visit	$ 500,000				
Rock Mechanic Consultant Total 5 visits	5	visits	$20,000/visit	$ 100,000	**$ 3,527,000**	50%	$ 1,764,000	**$ 5,291,000**
SERVICES								
Ventilation								
B205, B212-4 Vent Raise Fans installed on surface with housing (see also A.08.c. below)	4	fans	$ 20,000	$ 80,000				
B208, B212-4 Vent Bulkheads	7	bulkheads	$ 6,000	$ 42,000				
B208, B212-4 Vent Curtain Installations on Each Sublevel	7	curtains	$ 2,000	$ 14,000				
Vent ducting, spiral, installed on surface between vent raises and bag house	244m		$ 60/m	$ 15,000	Ventilation			
Bag House move close to vent raises (includes some costs for modification)				$ 250,000	$ 401,000			
Mine Air Heating (see unit cost sheet)	20years		$94,750/yr	$ 1,940,000	Heating			
Move and Set-up Mine air Heater				$ 150,000	$ 2,090,000			
Power								
High Tension Cables 1/0 in an MPF (line power feeder type) Anixter # 5P-1008 around $28/m, $50/m installed	1,700m		$ 50/m	$ 85,000				
Splitter Boxes installed, 1 per sublevel	8		$ 8,000 ea	$ 64,000				
Transformers around $78,000 ea, $100,000 installed	3	350kVA	$ 100,000 ea	$ 300,000				
Power Costs : Phase I Development	1.8 yr		$640,000/yr	$1,126,000				
Power Costs : Phase II wet borehole mining	15.0 yr	Slower Method	$80,000/yr	$1,200,000				
Power Costs : Phase IV Restoping	2.9 yr		$960,000/yr	$2,763,000	Power			
Power Costs : Phase V Final Extraction, Wash Down	0.8 yr		$780,000/yr	$650,000	$ 6,188,000			
Water Supply, Drainage and Pumping during Development								
Install PVC lines on 250 Level		Included in A.07.b.iii) above						
Water Supply Drainage and Pumping during Re-Stoping . Pumping		A lot of this is covered in report section A.07.b.iii) above						
5hp Pumps installed	7		$ 10,000	$ 70,000				
Miscellaneous		Included in Contractor Costs						
Underground Wash Bay install hi pressure pump, reservoir, sprays, pour cement floor				$ 100,000				
Air Compressors		Included in Contractor Costs						
Refuge Station Construction Costs	2		$ 100,000	$ 200,000	**$ 9,049,000**	25%	$ 2,262,000	**$ 11,311,000**
				GRAND TOTALS	**$ 75,946,000**	27%	$ 20,787,000	**$ 96,733,000**

APPENDIX A COST OF EXTRACTION
Development Metres

RAMPS	Colour Codes	Length	Sump, Refuge Chamber	Flat gradient at Each Level	Remuck Bays	Truck Loadout Slash Equivalent	Total	
Start of Ramp in Pit		280ft					280ft	
B212-4 Ramp above and below 1-10N, 1-06N		298ft		24' included	46ft	33ft	377ft	
B212-4 Ramp above and below El.5855 includes wash bay 30'		226ft		24' included	46ft	33ft	305ft	
B212-4 Ramp above and below El.5830		200ft		24' included	46ft	33ft	279ft	
B212-4 Ramp above and below El.5790		360ft		24' included	46ft	33ft	439ft	
B212-4 Ramp above and below 250 Level at El.5750'		316ft		24' included	46ft	33ft	395ft	
B212-4 Ramp below 250 level at El.5720		220ft		24' included	46ft	33ft	299ft	
B212-4 Ramp to reach plug in B212 Orepass El.5635'		567ft			46ft	33ft	645ft	
B212-4 Ramp Refuge Station close to bottom of ramp			use remuck				0ft	920m
B208 Start of Ramp at about El.5816'		160ft		24' included		33ft	193ft	
B208 Ramp to 250 Level El.5750'		238ft		24' included	46ft	33ft	317ft	
B208 Ramp to 3-06 Stope Top of Fill at El.5730'		364ft		24' included		33ft	397ft	
B208 Ramp Refuge Station close to bottom of ramp			use remuck				0ft	276m
AR2 Ramp Access from AR1		292ft					292ft	
AR2 Ramp Access from AR1		362ft			46ft		408ft	213m
							Total : Ramps	**1,409m**

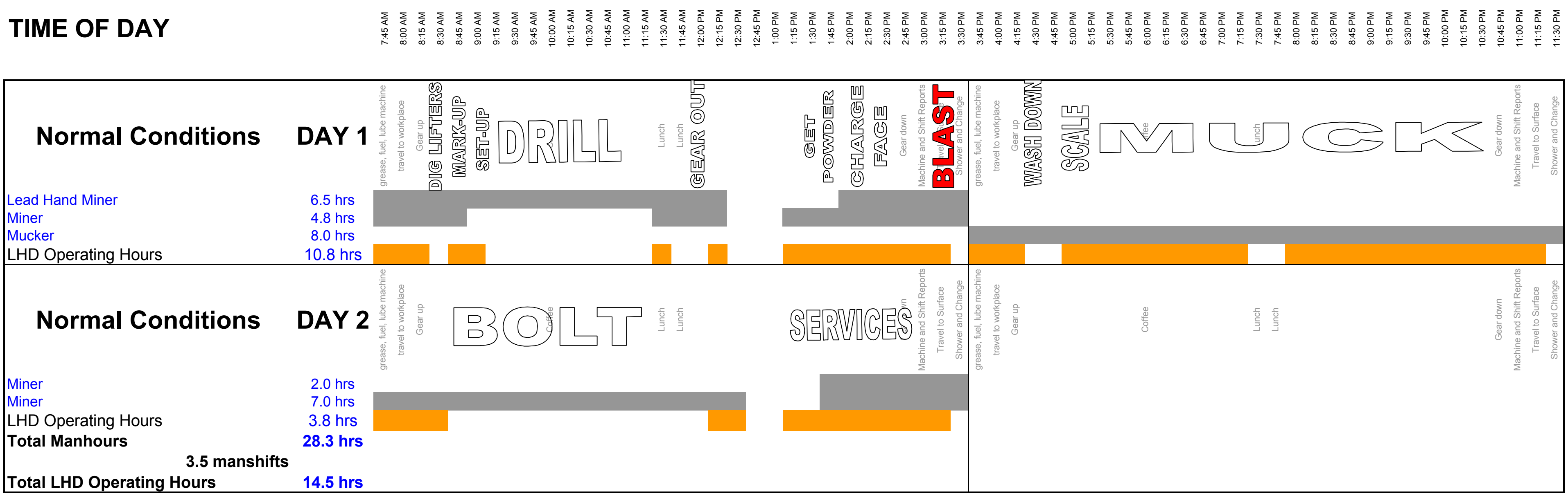
APPENDIX A COST OF EXTRACTION
Development Metres

Lateral Development, Footwall and Draw Points	Colour Codes	Length	Sump	Vent Raise Access	Room for Vent Curtain to Isolate Access	Truck Loadout Slash Equivalent	Total	
B212-4								
B212-4 at El.5897 (50' small shop incl. Not on drawing)		308ft	40ft	79ft	40ft	33ft	500ft	
B212-4 at El.5855'		574ft	20ft	40ft	included	33ft	667ft	
B212-4 at El.5830'		220ft	20ft	40ft	40ft	33ft	353ft	
B212-4 at El.5790'		588ft	20ft	92ft	40ft	33ft	773ft	
B212-4 at El. 5750 250 Level		491ft	20ft	92ft	40ft	33ft	676ft	
B212-4 at El. 5720'		50ft	82ft	40ft		33ft	205ft	
B212-4 Bottom of ramp, access to orepass plug		50ft	40ft	40ft			130ft	1,007m
B208								
B208 Footwall back up to El.5790		495ft		40ft		33ft	568ft	
B208 Footwall and Draw Points at El.5750 (250 Level)		624ft	82ft	40ft		33ft	779ft	410m
AR1								
Access for B11		115ft					115ft	
Access Draw Points B14		185ft					185ft	
Access, Sump and Draw Points B14		284ft	35ft	40ft		66ft	425ft	221m
AR2								
Access, Sumps and Draw Points for #9, #10 and C212		1,006ft	82ft	40ft		99ft	1,227ft	374m
AR3								
Access, Slash old track drift to accommodate trucks		420ft	Volume difference is double. Count half footage for slashing				420ft	
Access, Sumps & DPs for B230, B233, B234, B235, B236		1,348ft	included			99ft	1,447ft	569m
							Total : Lateral Development, Footwall and Draw Points	**2,581m**

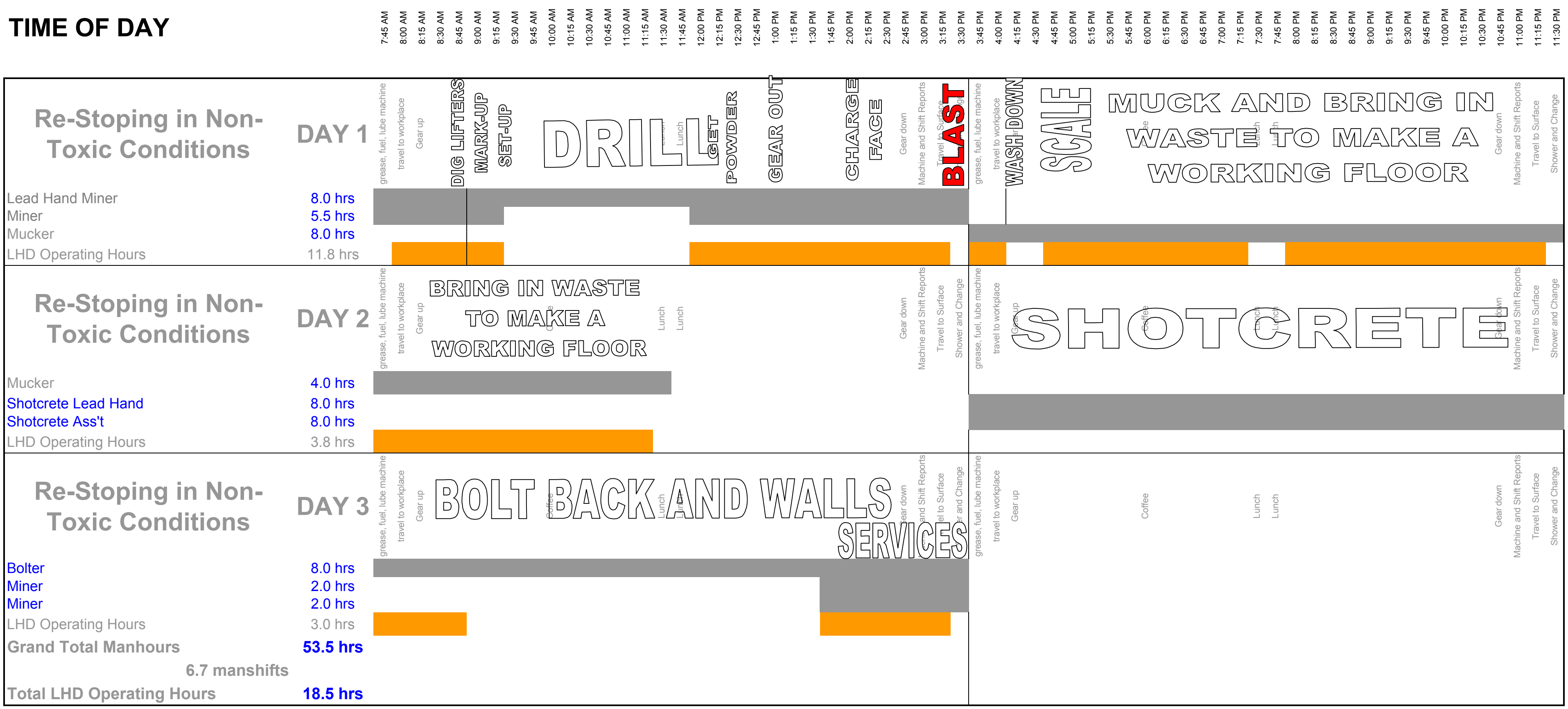
RAISES	Diameter	Length		
B212-4 Vent Raise Surface to 5855 Access for B214	ø 36 ' '	133ft		
B212-4 Vent Raise Surface to 5830 Access for B213	ø 36 ' '	158ft		
B212-4 Vent Raise Surface to 5635 Access for B212	ø 36 ' '	353ft		
B212-4 Waste Raise Surface to 5720 for B212	ø 48 ' '	268ft		
B208 Vent Raise Surface to 5750	ø 48 ' '	238ft		
AR1 Vent Raise to Surface from 5750	ø 48 ' '	238ft		
AR2 Vent Raise to Surface from 5750	ø 48 ' '	238ft		
AR3 Vent Raise to Surface from 5750	ø 48 ' '	238ft	1,864ft	568m

Grand Total all Ramp and Lateral Development + Raises	**4,560m**
Waste Tonnes (incl. 10% overbreak)	215,000 t

APPENDIX A COST OF EXTRACTION
Activities During Shift



APPENDIX A COST OF EXTRACTION
Activities During Shift



APPENDIX A COST OF EXTRACTION
Activities During Shift

TIME OF DAY

Re-Stoping in Toxic Conditions — DAY 1

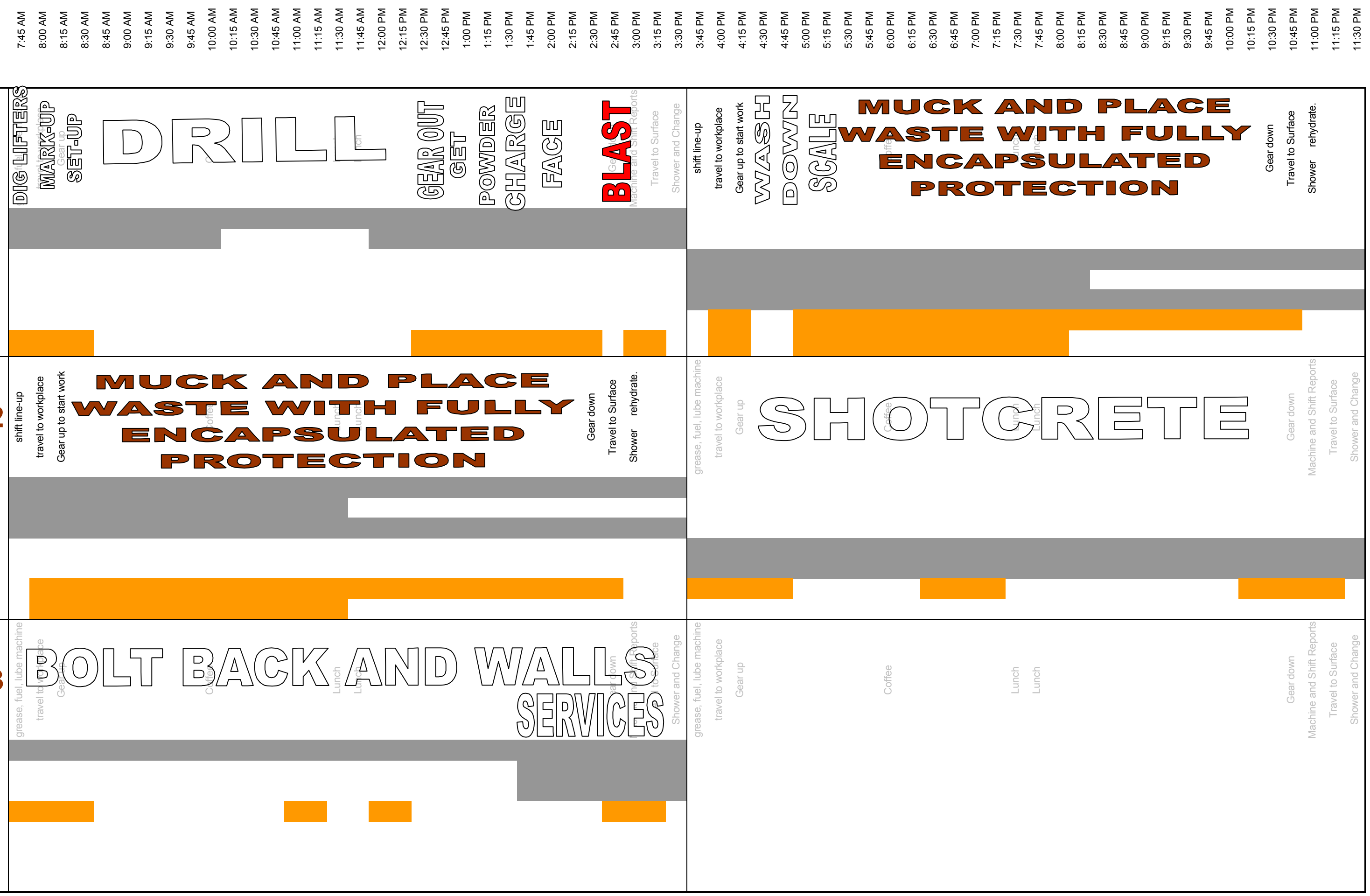
Lead Hand Miner	8.0 hrs
Miner	6.3 hrs
Crew A First Hot Seat Change Mucker	8.0 hrs
Crew A 2nd Hot Seat Change Mucker	4.8 hrs
Crew B Hot Seat Change Mucker	8.0 hrs
First LHD Operating Hours	6.5 hrs
Second LHD Operating Hours	7.5 hrs

Re-Stoping in Toxic Conditions — DAY 2

Crew C 1st Hot Seat Change Mucker	8.0 hrs
Crew C 2nd Hot Seat Change Mucker	4.0 hrs
Crew D Hot Seat Change Mucker	8.0 hrs
Shotcrete Lead Hand	8.0 hrs
Shotcrete Assistant	8.0 hrs
First LHD Operating Hours	10.5 hrs
Second LHD Operating Hrs	3.8 hrs

Re-Stoping in Toxic Conditions — DAY 3

Bolter	8.0 hrs
Miner	2.0 hrs
Miner	2.0 hrs
LHD Operating Hours	2.8 hrs
Grand Total Manhours	**83.0 hrs**
10.4 manshifts	
Total LHD Operating Hours	**31.0 hrs**



APPENDIX A COST OF EXTRACTION
Advance Normal,Restoping,Final

		NORMAL FACE ADVANCE NON-TOXIC CONDITIONS		RE-STOPING FACE ADVANCE NON-TOXIC CONDITIONS	
For rounds	3.4m long	4.0m wide	4.5m high	3.4m long	4.0m wide x 4.5m high
Dig out, flag lifters, mark face for drilling		2.5 manhours			More time digging lifters
Set–up, drill round, tear down		4.5 manhours	11.3 manhours	13.5 manhours	Difficulty flushing drill holes
Charge face and wire for blasting		4.3 manhours			Difficulties loading lifters
Scale, Wash muckpile		1.8 manhours			Additional Scaling
Muck to remuck		6.3 manhours	8.0 manhours	12.0 manhours	Slimes and Oversize to Muck
Dump waste over slimes to make working floor		0.0 manhours			Need to bring in waste
Truck from remuck		Not included in productivity calculations		Not included in productivity calculations	
Spray dry shotcrete on back and walls				16.0 manhours	
Bolt back and walls		5.0 manhours	5.0 manhours	8.0 manhours	3m Swellex or 3m Splitsets
Install Services		4.0 manhours	4.0 manhours	4.0 manhours	
Hose Caked Dust					
Maintain pumps, muck slimes					
Total		3.5 x 8hr.manshifts or	28 manhours	54 manhours	6.7, 8hr.manshifts
Labour Productivity for 8hr shift			1.0m/ms	0.5m/ms	
LABOUR COSTS					
Lead Hand Miner	$75/hr	6.5 manhours	$ 143/m	8.0 manhours	$ 176/m
Miner	$70/hr	13.8 manhours	$ 283/m	9.5 manhours	$ 196/m
Mucker	$70/hr	8.0 manhours	$ 165/m	12.0 manhours	$ 247/m
Shotcrete Lead Hand	$70/hr			8.0 manhours	$ 165/m
Shotcrete Ass't	$70/hr			8.0 manhours	$ 165/m
Bolter	$70/hr			8.0 manhours	$ 165/m
Crew A First Hot Seat Change Mucker	$70/hr				
Crew A 2nd Hot Seat Change Mucker	$70/hr				
Crew B Hot Seat Change Mucker	$70/hr				
Crew C 1st Hot Seat Change Mucker	$70/hr				
Crew C 2nd Hot Seat Change Mucker	$70/hr				
Crew D Hot Seat Change Mucker	$70/hr				
Standby Mine Rescue Personnel	$70/hr				
Technicians to Maintain Suits and Cylinders	$55/hr				
Paramedics	$55/hr				
Mechanics	$70/hr				
		28.3 manhours	$ 591/m	53.5 manhours	$ 1,113/m

APPENDIX A COST OF EXTRACTION
Advance Normal,Restoping,Final

		NORMAL FACE ADVANCE NON-TOXIC CONDITIONS		RE-STOPING FACE ADVANCE NON-TOXIC CONDITIONS	
MATERIAL COSTS					
Shotcrete					$ 250/m
Supplies and consumables for maintenance of suits					
Vent duct, rockbolts, hoses, picks, timber, bits, etc.			$ 301/m		$ 301/m
Fuel, tyres		$35/oper. hrs	$ 149/m		$ 190/m
			$ 450/m		$ 741/m
R&M EQUIPMENT includes R&M Labour					
5yd LHD	$120/hr	14.5hrs	$ 512/m	19hrs	$ 653/m
2yd LHD	$85/hr			Refer to "Activities During Shift" sheet.	
jumbo	$40/hr	4hrs	$ 47/m	5.5hrs	$ 65/m
Scissor Deck	$17/hr			6.5hrs	$ 33/m
Shotcrete Machine	$25/hr			8.0hrs	$ 59/m
Pick-Up	$17/hr	3hrs	$ 15/m	6hrs	$ 28/m
Jackleg	$0.25/ft	30ft	$ 2/m	90ft	$ 7/m
Pump	$3/hr	4hrs	$ 4/m	5hrs	$ 4/m
Air Fan	$2/hr	8hrs	$ 5/m	15hrs	$ 9/m
			$ 584/m		$ 857/m
RENTAL CHARGES					
Small Tools	$25/day	2 days	$ 15/m	2.5 days	$ 18/m
Jumbo Face Drill	$600/day	1.0 days	$ 176/m	1.5 days	$ 265/m
5yd LHD	$600/day	1 days	$ 176/m	2.5 days	$ 441/m
2yd LHD	$300/day				
Shotcrete Machine	$60/day		$ 0/m	2.0 days	$ 35/m
Pick-Up	$60/day	1 days	$ 18/m	2.5 days	$ 44/m
Jackleg	$50/day	1 days	$ 15/m	2.0 days	$ 29/m
Pump	$15/day	1 days	$ 4/m	2.5 days	$ 11/m
Air Fan	$15/day	2 days	$ 9/m	2.5 days	$ 11/m
			$ 413/m		$ 855/m
TRUCKING					
Trucking Cost (incl. 15% back-hauling)		53 t/m	$ 424/m	$12.25 /t	$ 753/m
Trucking Cost reported separately		$7.92 /t	-$ 424/m	$12.25 /t	-$ 655/m
			$ 0/m		$ 98/m
OVERHEAD					
Supervision, profit, warehouse & Freight		24%	$ 644/m	24%	$ 1,200/m
TOTAL		**$ 150/m³**	**$ 2,680/m**	**$ 270/m³**	$ 4,900/m

APPENDIX A COST OF EXTRACTION
Advance Normal,Restoping,Final

	RE-STOPING FACE ADVANCE TOXIC CONDITIONS		FINAL EXTRACTION	
For rounds	3.4m long	4.0m wide x 4.5m high	2.3m wide	2.3m high
Dig out, flag lifters, mark face for drilling		done with partial face mask	2 men	at the face with a
Set–up, drill round, tear down	14 manhours	done with partial face mask		hose advancing
Charge face and wire for blasting		done with partial face mask		2.0m/shift
Scale, Wash muckpile		Fully Encapsulated Suit	2 men	as back up to
Muck to remuck	41 manhours	Fully Encapsulated Suit		operate the scoop
Dump waste over slimes to make working floor		Fully Encapsulated Suit		ensure the pumps
Truck from remuck	Not included in productivity calculations			are running and to
Spray dry shotcrete on back and walls	16 manhours	done with partial face mask		spell the others
Bolt back and walls	8 manhours	done with partial face mask		when they get
Install Services	4 manhours	done with partial face mask		fatigued
Hose Caked Dust			4 men	Total
Maintain pumps, muck slimes				
Total	83 manhours	10.4, 8hr.manshifts	0.50m/ms	
Labour Productivity for 8hr shift	0.33m/ms		1.7 shifts	for 3.4m advance
			54 manhours	for 3.4m advance
LABOUR COSTS				
Lead Hand Miner	8.0 manhours	$ 176/m	13.6 manhours	$ 300/m
Miner	10.3 manhours	$ 211/m	27.2 manhours	$ 560/m
Mucker			13.6 manhours	$ 280/m
Shotcrete Lead Hand	8.0 manhours	$ 165/m		
Shotcrete Ass't	8.0 manhours	$ 165/m		
Bolter	8.0 manhours	$ 165/m		
Crew A First Hot Seat Change Mucker	8.0 manhours	$ 165/m		
Crew A 2nd Hot Seat Change Mucker	4.8 manhours	$ 98/m		
Crew B Hot Seat Change Mucker	8.0 manhours	$ 165/m		
Crew C 1st Hot Seat Change Mucker	8.0 manhours	$ 165/m		
Crew C 2nd Hot Seat Change Mucker	4.0 manhours	$ 82/m		
Crew D Hot Seat Change Mucker	8.0 manhours	$ 165/m		
Standby Mine Rescue Personnel	20.4 manhours	$ 419/m		
Technicians to Maintain Suits and Cylinders	20.4 manhours	$ 330/m		
Paramedics	16.0 manhours	$ 259/m		
Mechanics	4.1 manhours	$ 84/m		
	144 manhours	$ 2,812/m	54 manhours	$ 1,140/m

APPENDIX A COST OF EXTRACTION
Advance Normal,Restoping,Final

	RE-STOPING FACE ADVANCE TOXIC CONDITIONS		FINAL EXTRACTION	
MATERIAL COSTS				
Shotcrete		$ 250/m		
Supplies and consumables for maintenance of		$ 300/m		
Vent duct, rockbolts, hoses, picks, timber, bits,		$ 301/m		$ 200/m
Fuel, tyres		$ 319/m		$ 209/m
		$ 1,170/m		$ 409/m
R&M EQUIPMENT includes R&M Labour				
5yd LHD	31hrs	$ 1,094/m		
2yd LHD	Refer to "Activities During Shift" sheet.		11hrs	$ 276/m
jumbo	5.5hrs	$ 65/m		
Scissor Deck	8.0hrs	$ 40/m		
Shotcrete Machine	8hrs	$ 59/m		
Pick-Up	6hrs	$ 30/m	5.7hrs	$ 28/m
Jackleg	90ft	$ 7/m		
Pump	8hrs	$ 7/m	13.6hrs	$ 12/m
Air Fan	24hrs	$ 14/m	14hrs	$ 8/m
		$ 1,315/m		$ 325/m
RENTAL CHARGES				
Small Tools	3 days	$ 22/m	2 days	$ 15/m
Jumbo Face Drill	3 days	$ 529/m		$ 0/m
5yd LHD	5 days	$ 882/m		$ 0/m
2yd LHD	2 machines required		2.0 days	$ 176/m
Shotcrete Machine	3 days	$ 53/m		$ 0/m
Pick-Up	3 days	$ 53/m	2 days	$ 35/m
Jackleg	3 days	$ 44/m	3 days	$ 44/m
Pump	3 days	$ 13/m	3 days	$ 13/m
Air Fan	3 days	$ 13/m	2 days	$ 9/m
		$ 1,610/m		$ 293/m
TRUCKING				
Trucking Cost (incl. 15% back-hauling)	$27.96 /t	$ 1,719/m		
Trucking Cost reported separately	$27.96 /t	-$ 1,495/m	Trucking in non-toxic conditions	
		$ 224/m		$ 29/m
OVERHEAD				
Supervision, profit, warehouse & Freight	20%	$ 1,747/m	19%	$ 500/m
TOTAL	**$ 490/m³**	$ 8,900/m	**$ 510/m³**	$ 2,695/m

APPENDIX A COST OF EXTRACTION
Shift Productivities

Effective Work that is done in an 8 hour shift in normal, non-toxic conditions

Sum of productive work time over 8 hours	Utilized Hours		TIME OF DAY
5.5hs	69%	1 crew	Day Shift

TIME OF DAY	Day Shift
7:00 AM	
7:15 AM	Change into u/g gear
7:30 AM	shift line-up
7:45 AM	grease, fuel, lube machine
8:00 AM	travel to workplace
8:15 AM	Gear up
8:30 AM	100% productivity
8:45 AM	100% productivity
9:00 AM	100% productivity
9:15 AM	100% productivity
9:30 AM	100% productivity
9:45 AM	100% productivity
10:00 AM	Coffee
10:15 AM	100% productivity
10:30 AM	100% productivity
10:45 AM	100% productivity
11:00 AM	100% productivity
11:15 AM	100% productivity
11:30 AM	Lunch
11:45 AM	Lunch
12:00 PM	100% productivity
12:15 PM	100% productivity
12:30 PM	100% productivity
12:45 PM	100% productivity
1:00 PM	100% productivity
1:15 PM	100% productivity
1:30 PM	100% productivity
1:45 PM	100% productivity
2:00 PM	100% productivity
2:15 PM	100% productivity
2:30 PM	100% productivity
2:45 PM	Gear down
3:00 PM	Machine and Shift Reports
3:15 PM	Travel to Surface
3:30 PM	Shower and Change

Note that miners grease fuel and lube their machines

Effective Work that Can be Done with Fully Encapsulated Suits

Sum of productive work time over 8 hours	Utilized Hours		TIME OF DAY
3.0hs	38%	2 crews	Day Shift "Hot Seat Change" Crew A / Day Shift "Hot Seat Change" Crew B

TIME OF DAY	Day Shift "Hot Seat Change" Crew A	Day Shift "Hot Seat Change" Crew B
7:00 AM		
7:15 AM	Change into u/g gear	
7:30 AM		
7:45 AM	shift line-up	
8:00 AM	travel to workplace	
8:15 AM	Gear up to start work	
8:30 AM	50% productivity	
8:45 AM	50% productivity	Change into u/g gear
9:00 AM	50% productivity	
9:15 AM	50% productivity	shift line-up
9:30 AM	50% productivity	travel to workplace
9:45 AM	50% productivity	Gear up to start work
10:00 AM	Gear down	50% productivity
10:15 AM	Travel to Surface	50% productivity
10:30 AM	Shower,re- hydrate,eat. Put on Clean u/g Gear	50% productivity
10:45 AM		50% productivity
11:00 AM	travel to workplace	50% productivity
11:15 AM	Gear up to start work	50% productivity
11:30 AM	50% productivity	Gear down
11:45 AM	50% productivity	Travel to Surface
12:00 PM	50% productivity	Shower,re- hydrate,eat. Put on Clean u/g Gear
12:15 PM	50% productivity	
12:30 PM	50% productivity	travel to workplace
12:45 PM	50% productivity	Gear up to start work
1:00 PM	Gear down	50% productivity
1:15 PM	Travel to Surface	50% productivity
1:30 PM	Shower rehydrate.	50% productivity
1:45 PM		50% productivity
2:00 PM		50% productivity
2:15 PM		50% productivity
2:30 PM		Gear down
2:45 PM		Travel to Surface
3:00 PM		Shower rehydrate.
3:15 PM		
3:30 PM		

3.0hs / 5.5hs = 55% of the work gets done with twice the manpower of miners

Labour cost increase for encapsulated suits with productivity taken into Account

3.7	Labour Cost Increase Factor for Miners			
50%	1	standby rescue person required for every	2	miners
10%	Mechanics will be required to grease fuel and lube machines.			
50%	2	technicians required for every	4	miners to maintain and charge compressed air cylinders mounted on heavy equipment and to clean and maintain suits
7.7	Overall Labour Increase compared to work in normal conditions			

APPENDIX A COST OF EXTRACTION
Re-Stoping Longhole

RE-STOPING LONGHOLE DRILLING COSTS		Good Conditions	Difficult Drilling Production 75%	Toxic Conditions Difficult Drilling Production 38%	
Productivity ITH 6" holes	30m/shift	60m/day	45m/day	23m/day	
LABOUR COSTS		$4.49/m	$5.61/m	$18.24/m	Short shifts, increase number of drillers by 2.5
MATERIAL COSTS		$4.03/m	$5.04/m	$5.04/m	
R&M EQUIPMENT includes R&M Labour		$8.50/m	$10.62/m	$10.62/m	
RENTAL CHARGES					
Longhole Drill with rod handler	$700/day	$11.67/m	$15.56/m	$31.11/m	
OVERHEAD					
Profit		$3.00/m	$3.00/m	$3.00/m	
Supervision, Administration		$4.75/m	$5.94/m	$7.72/m	
Warehousing and Freight		$3.75/m	$4.69/m	$4.69/m	
TOTAL		$40.19/m	$50.45/m	$80.42/m	Indirect manpower ; Mine Rescue, Technicians, etc. also required
Drill Factor		18 t/m	6 t/m	6 t/m	
COST PER TONNE		$ 2.23/t	$ 8.41/t	$ 13.40/t	
BLASTING COSTS					
Gravity ANFO & Emulsion		$1.43 /t	$5.72 /t	$5.72 /t	
Labour		$0.56 /t	$1.11 /t	$1.11 /t	
R&M Blasting Truck		$0.12 /t	$0.24 /t	$0.24 /t	
R&M Loaders Guesstimate		$0.05 /t	$0.10 /t	$0.10 /t	
				$7.17 /t	
GRAND TOTAL LONGHOLE DRILL & BLAST				$20.58 /t	**$ 56/m³**

APPENDIX A COST OF EXTRACTION
Truck Costs and Time

PHASE I UNDERGROUND DEVELOPMENT FOR RESTOPING

Average Elevation to Truck	210ft	64m						
Truck-Hauling loaded up ramp on a	13%	grade up a	0.5 km	incline at a speed of	7.5kph	would take	3.9	minutes
Drive along flat loaded	3.0%	grade for	0.2 km	at a speed of	8.0kph	would take	1.5	minutes
Drive along flat unloaded	3.0%	grade for	0.2 km	at a speed of	9kph	would take	1.3	minutes
Returning unloaded down ramp on a	13%	grade down a	0.5 km	decline at a speed of	14kph	would take	2.1	minutes
Loading Time							5	minutes
Dumping Time							5	minutes
Cycle time for a Load							19	min/load
Productive Truck Hours per Shift	5	hours						
Operating Minutes per Hour	50	min	83%	system availability				
	13.2	loads per shift						
Assume	**13**	**loads per shift**						
A Truck rated for	15 t	loaded at	85%	capacity will haul	13	tonnes per load, or	169 t	/shift
Labour Costs are	$70 /hour	for	8	hours worked	$560/shift			
Truck Operating Material Fuel and tyres	$40 /hour	for	5.5	hours running time	$220/shift			
Truck Operating R&M costs are	$40 /hour	for	5.5	hours running time	$220/shift			
Total					$1,000/shift			
Trucking Cost is			**$5.92 /t**					
Additional Costs to Removing Waste from the Mine								
Scoop Loading Costs			**$2.00 /t**					
Rail Haulage to Shaft + Rockbreaker operator + maintenance								
Shaft Hoisting (electrical costs only)								
Waste Handling to Surface			**$7.92 /t**	$21/m³				

PHASE II WET BOREHOLE MINING

There are no trucking costs associated with wet borehole mining

APPENDIX A COST OF EXTRACTION
Truck Costs and Time

PHASE III BACKFILLING WITH CEMENTED ROCKFILL

Trucking costs in backfilling are covered with the overall rate of $5/ tonne backfilled

PHASE IV RE-STOPING

RE-STOPING	Truck to Surface		TOXIC CONDITIONS					
Elevation to Truck	260ft	79m						
Truck-Hauling loaded up ramp on a	13%	grade up a	0.6 km	incline at a speed of	7.5kph	would take	4.9	minutes
Wash Truck with each load to get rid of Arsenic Trioxide							20.0	minutes
Drive along flat loaded	0.5%	grade for	0.5 km	at a speed of	8.0kph	would take	3.8	minutes
Drive along flat unloaded	0.5%	grade for	0.5 km	at a speed of	9kph	would take	3.3	minutes
Returning unloaded down ramp on a	13%	grade down a	0.6 km	decline at a speed of	14kph	would take	2.6	minutes
Loading Time							15	minutes
Dumping Time							5	minutes
Cycle time for a Load							55	min/load
Productive Truck Hours per Shift	5	hours assuming hot seat changes						
Operating Minutes per Hour	50	min	83%	system availability				
	4.6	loads per shift						
Assume	**4**	**loads per shift**						
A Truck rated for	15 t	loaded at	77%	capacity will haul	11	tonnes per load, or	53 t	/shift
Need 2 Operators w/ hot seat change	$140 /hour	for	8	hours worked	$1,120/shift			
Truck Operating Material Fuel and tyres	$20 /hour	for	5	hours running time	$100/shift			
Truck Operating R&M costs are	$50 /hour	for	5	hours running time	$250/shift			
Total					$1,470/shift			
Trucking Cost is			**$27.96 /t**					
Additional Costs to Removing Waste from the Mine								
Scoop Loading Costs are included in mucking								
Waste Handling to Surface			**$27.96 /t**	toxic conditions				

PHASE V FINAL EXTRACTION, WASH DOWN

Truck rock&slop to surface.	**$12.25 /t**	Assume this can be done without fully encapsulated suits

APPENDIX A COST OF EXTRACTION
Timing

PHASE I **UNDERGROUND DEVELOPMENT FOR RESTOPING**

Main Ramp to B212-4 and B208	1,196m	110m/mo.	10.9months	
All Development B208, B212-4 except main ramp	1,385m	150m/mo.	9.2months	
		260m/mo.		
Ramp development that must be done before sublevels start	1,196m	110m/mo.	10.9months	
		Phase I will take	21.1months	**1.8years**

PHASE II **WET BOREHOLE MINING**

Underground Development must finish before start of wet Borehole mining because of possibility of large amounts of contaminated water flooding decline he

1 Machine can extract	30 t/hr	of dry dust per stoping area. It is assumed that two machines would be used and they would work in separate areas			
Shifts per Day	2				
Hours per Shift	8				
Number of Machines	1.8	this allows for some scheduling conflicts. For example manpower restrictions may require that both machines can't be moved at the same time etc.			
	860 t/day				
Total Dust Tonnes	237,343t				
Wet Borehole Mining is likely to extract	85%	of the above tonnage			
Total Dust Tonnes to be extracted by Wet Borehole Method	202,000t				
Assume Machines are engaged in other activities for	65%	of the time. This includes camera inspections, moving, drilling and casing breakthrough holes, general standby time			
Extraction Time for the Above Tonnes	388days				
	18 months				
Assume Wet Borehole Mining will be operational for only	9 months	of the year due to cold weather			
Total Time for Wet Borehole Mining Fast Method	23 months	2.0years	assume		2.0years
Total Time for Wet Borehole Mining Using Slow Method					**15.0years**

PHASE III **BACKFILLING WITH CEMENTED ROCKFILL**

Backfilling can happen at the same time as wet borehole mining.

Assume a delivery rate of	500 t/day	**N/A**

APPENDIX A COST OF EXTRACTION
Timing

PHASE IV RE-STOPING

Restoping productivity will be lower for the following reasons:

- Toxic environment and requirement to wear protective suits fewer effective working hours
- Conditions unfavourable, possibly lots of slimes and extreme dust
- Possible requirement to shotcrete with advance.
- Difficulty with drill blast and mucking cycles

Assume Productivity during re-stoping will be 1/3 of drifting productivity

Typical Drifting Productivity	0.33m/ms	1.5men/shift	0.49m/shift	2 shifts/day	1.0m/day		
	7m³/shift				20m³/day		
Re-stoping Working faces active on any shift	2	faces			197m³/week		
Working days / Week	5	days per week			865m³/mo.		
B212-4 Restoping	10,000m³	197m³/week	865m³/mo.	12months			1.0years
B208 restoping	1,750m³	197m³/week	865m³/mo.	2months			0.2years
AR1 Restoping	5,574m³	197m³/week	865m³/mo.	6months			0.5years
AR2 Restoping	3,809m³	197m³/week	865m³/mo.	4months			0.4years
AR3 Restoping	8,748m³	197m³/week	865m³/mo.	10months			0.8years
							2.9years

PHASE V FINAL EXTRACTION, WASH DOWN

Estimate	10months	**0.8years**
	GRAND TOTAL TIME	**20.5years**

APPENDIX A COST OF EXTRACTION
Mine Air Heating

Mine Air Heating	Units		HP	B212-4		Giant Mine Care and Maintenance Page 32
Ventilation Requirement	1	Toro 151D	71	7,100cfm		
	1	Toro 400	215	21,500cfm		
	1	EJC 430	277	27,700cfm		
	1	EJC 430	277		Assume only 2 trucks running at any time	
	Light Vehicles and Jumbo			50,000cfm		
	Extra 5,000cfm per level			30,000cfm		
	Total			136,300cfm		compared to 220,000cfm
	Propane Requirements			1,053,227 litres		proportional to 1,700,000 litres
	Cost / litre			$0.36		
	Mine Air Heating : Propane Costs per year			$379,000/yr	based on slower extraction rates and the mine operating 12 months of the year	
				$94,750/yr	**based on slower wet borehole mining rates and assumes the mine is operated 8 months of the year**	
				$516,000/yr	based on faster extraction rates and the mine operating 12 months of the year	

APPENDIX A COST OF EXTRACTION
Power Costs

		Quantity	Size		Per Day	Per Year	Unit Cost	Cost per Year
PHASE I	**UNDERGROUND DEVELOPMENT FOR REST**							
	Fans, Surface, 150KW	1	150kW	150kW	24 hrs/day			
	Fans, 45kW Underground	5	45kW	225kW	24 hrs/day			
	Jumbo 150kW	1	150kW	150kW	12 hrs/day			
	Pumps 7.5hp, 5.6kW	3	6kW	17kW	10 hrs/day			
			Total	0.5 MWhr	11 MWhr	3,422 MWhr	$0.187/kWhr	**$640,000/yr**
PHASE II	**WET BOREHOLE MINING**							
	Tonnage to be extracted		237,343t	over	15.0years	15,823 t/year		
	Rate of extraction when machines are operating	860 t/day	25,800 t/mo.	309,600 t/year	5%	machine utilization for actual dust extraction		
	Wet Borehole Rig	1	300kW	300kW	1 hrs/day			
	Pump to deliver water to wet Borehole Rig	1	22kW	22kW	1 hrs/day			
	Fans, Surface 150KW ea	1	150kW	150kW	5 hrs/day			
	Fans, 45kW Underground	1	45kW	45kW	3 hrs/day			
	Pumps 7.5hp, 5.6kW	2	6kW	11kW	1 hrs/day			
	Pumps 200hp, 150kW	1	150kW	150kW	1 hrs/day			
			Total	0.7 MWhr	1 MWhr	450 MWhr	$0.187/kWhr	**$80,000/yr**
								$990,000/yr
PHASE III	**BACKFILLING WITH CEMENTED ROCKFILL**							
	Fans, Surface 150KW ea	2	150kW	300kW	20 hrs/day	Power costs are not significant in this phase as there		
	Fans, 45kW Underground	5	45kW	225kW	20 hrs/day	is an overlap with wet borehole mining and re-stoping		
	Pumps 7.5hp, 5.6kW	5	6kW	28kW	9 hrs/day			
			Total	0.6 MWhr	11 MWhr	~~3,355 MWhr~~	~~$0.187/kWhr~~	~~$630,000/yr~~
PHASE IV	**RE-STOPING**							
	Fans, Surface 150KW ea	3	150kW	450kW	20 hrs/day			
	Fans, 45kW Underground	5	45kW	225kW	20 hrs/day			
	Jumbo 150kW	1	150kW	150kW	5 hrs/day			
	Pumps 7.5hp, 5.6kW	5	6kW	28kW	12 hrs/day			
	Pumps 200hp, 150kW	1	150kW	150kW	12 hrs/day			
			Total	1.0 MWhr	16 MWhr	5,112 MWhr	$0.187/kWhr	**$960,000/yr**
PHASE V	**FINAL EXTRACTION, WASH DOWN**							
	Fans, Surface 150KW ea	2	150kW	300kW	20 hrs/day			
	Fans, 45kW Underground	5	45kW	225kW	20 hrs/day			
	Jumbo 150kW	1	150kW	150kW	5 hrs/day			
	Pumps 7.5hp, 5.6kW	5	6kW	28kW	12 hrs/day			
	Pumps 200hp, 150kW	1	150kW	150kW	12 hrs/day			
			Total	0.9 MWhr	13 MWhr	4,176 MWhr	$0.187/kWhr	**$780,000/yr**

APPENDIX A COST OF EXTRACTION
Dust Tonnes

EXISTING ARSENIC STORAGE: Reported Tonnes, Reported Volumes, Dimensions

Area		Reported Tonnes t	Calc. Dust Volume @ 1.3 t/m3	Col.#3 Reported Chamber Volume m3	Percent Full %	Dimensions Height m	Dimensions Length m	Dimensions Width m	Calc. Volume m3	Percent of Col.#3 %
AR1	B11	5,860t	4,508m³	9,833m³	46%	22m	36m	10m	7,920m³	81%
	B12	26,243t	20,187m³	25,485m³	79%	36m	61m	13m	28,548m³	112%
	B14	12,257t	9,428m³	12,006m³	79%	24m	52m	12m	14,976m³	125%
	Sub-total	44,360t	34,123m³	47,324m³					51,444m³	
AR2	C9	18,394t	14,149m³	13,337m³	106%	49m	30m	12m	17,640m³	132%
	C10	9,569t	7,361m³	7,750m³	95%	49m	21m	9m	9,261m³	119%
	C212	16,946t	13,035m³	18,070m³	72%	50m	46m	8m	18,400m³	102%
	Sub-total	44,909t	34,545m³	39,157m³					45,301m³	
AR3	B208	29,364t	22,588m³	22,847m³	99%	45m	45m	14m	28,350m³	124%
	B230	2,835t	2,181m³	2,294m³	95%	15m	22m	6m	1,980m³	86%
	B233	11,426t	8,789m³	12,307m³	71%	44m	33m	9m	13,068m³	106%
	B234	12,048t	9,268m³	12,035m³	77%	44m	33m	9m	13,068m³	109%
	B235	16,647t	12,805m³	17,896m³	72%	50m	33m	11m	18,150m³	101%
	B236	16,465t	12,666m³	15,178m³	83%	44m	34m	12m	17,952m³	118%
	Sub-total	88,785t	68,296m³	82,557m³					92,568m³	
AR4	B212	32,099t	24,691m³	25,740m³	96%	50m	45m	11m	24,750m³	96%
	B213	11,723t	9,018m³	9,401m³	96%	30m	25m	14m	10,500m³	112%
	B214	15,467t	11,898m³	12,403m³	96%	30m	33m	14m	13,860m³	112%
	Sub-total	59,289t	45,607m³	47,544m³	96%				49,110m³	
TOTAL		237,343t	182,572m³	216,582m³	84%				238,423m³	110%
	Chambers	131,744t	56%							
	Stopes	105,599t	44%							

Chamber Average Dimensions		
38	36	10

Stope Average Dimensions		
41	39	12

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Appendix B

Cost Details
Underground Deep Disposal Method

Giant Yellowknife Mines
Project to Deliver Arsenic Trioxide Dust to Chambers below 2000 Level

Underground Deep Disposal Method
Deep - Dev't and Cot
Appendix B

		Dimensions		Quantity	Unit Cost	Total Cost	Subtotals
Phase VI	**Waste Rock Dump Set-up and Start of Ramp**						
	Upgrade Dewatering Capabilities					$150,000	
	1500 Incline to 1425 Wastepass	4.0m	4.0m	275m	$2,500/m	$689,000	
	Install safety Bulkhead in Existing Raise			1	$50,000ea.	$50,000	
	Slash out raise to new dimensions	5.0m	5.0m	471m³	$ 300/m³	$141,000	
	Repair chute at bottom			1	$20,000ea.	$20,000	
	Rockbreaker installed				$120,000	$120,000	
	Grizzly installed				$76,423	$76,000	
	Vent Raise for Rockbreaker Chamber	2.0m	2.0m	23m	$2,500/m	$57,000	
	2000 Decline to 2500 first 275m	4.0m	4.0m	275m	$2,500/m	$688,000	
	Truck Waste to Surface			27,810 t	$14.24 /t	$396,000	
	Mine Air Heating : Propane Costs			10mo.	$24,016 /mo.	$231,000	
	Power Costs			10mo.	$12,000 /mo.	$115,000	$2,733,000
			Total Development	**574m**			
Phase VII :	**Development of New Ramp and Level for Bins**			Haul to 15 Level, Tram to Shaft, Hoist to Surface.			
	2000 Decline to 2500 after first 275m	4.0m	4.0m	1,212m	$2,500/m	$3,029,000	
	Vent Drop Raises for 2000 Decline 2500	4.0m	4.0m	168m	$2,500/m	$419,000	
	Main Sump (Dual Sumps)	4.0m	4.0m	30m	$2,500/m	$75,000	
	Sump Construction Water Control Dams			2	$18,000ea.	$36,000	
	Top Bin Elevation Excavation	4.0m	4.0m	1,200m	$2,500/m	$3,000,000	
	Mid Bin Elevation Excavation	4.0m	4.0m	1,200m	$2,500/m	$3,000,000	
	Bottom Bin Elevation Excavation	4.0m	4.0m	1,200m	$2,500/m	$3,000,000	
	Install ladderway in 2500Vent Raise to 2000				$100,000	$100,000	
	Refuge Station Construction			use remuck	$100,000	$100,000	
7.5, 7.7	2500 Vent Raise to 2000 exhaust manway	2.0m	2.0m	199m	$2,500/m	$497,000	
	Truck to 1425, tram to shaft, hoist to surface			240,570 t	$16.20 /t	$3,896,000	
	Mine Air Heating : Propane Costs			23mo.	$34,796 /mo.	$794,000	
	Power Costs			23mo.	$37,000 /mo.	$845,000	$18,791,000
			Total Development	**5,208m**			

Giant Yellowknife Mines
Project to Deliver Arsenic Trioxide Dust to Chambers below 2000 Level

Underground Deep Disposal Method
Deep - Dev't and Cot
Appendix B

		Dimensions		Quantity	Unit Cost	Total Cost	Subtotals
Phase VIII	**New Bin Excavation 20m diameter 90m High x 9**	ø 20 m	83m height	**9 bins**			
7.7	Raisebore slot holes, using a rig similar to Subterranean 004	ø 1.1 m		83m			
	Mobilization			1	$28,500ea.	$29,000	
	Move underground and set-up on first hole			1	$13,100ea.	$13,000	
	Tear Downs moves and re-setups between bins			8	$5,500ea.	$44,000	
	Pilot 9 holes for Storage Bins			747m	$328/m	$245,000	Raiseboring
	Ream 9 holes for Storage Bins			747m	$427/m	$319,000	$922/m
	Tear Down and Move to Surface			1	$12,100ea.	$12,000	
	Demobilization			1	$27,400ea.	$27,000	
	Drilling Costs ITH	ø 152 mm	40m	44,700m	$37/m	$1,663,000	
	Blasting Costs						
	Gravity ANFO & Emulsion			258,000 Kg	$1.43 /t		
	Labour				$0.56 /t		
	R&M Blasting Truck				$0.12 /t		
	R&M Loaders Guesstimate				$0.05 /t		Bin Mining
	Total			633,628 t	$2.16 /t	$1,367,000	$5.59 /t
	Mucking Costs						
	Material Cost				$0.03 /t		
	Labour cost				$0.70 /t		
	R&M materials + labour				$0.04 /t		
	Total Mucking Costs			668,500 t	$0.77 /t	$513,000	
7.7	Finger Raises	2.0m	2.0m	286m	$2,500/m	$716,000	
	Trucking,Tramming and Hoisting			668,520 t	$16.20 /t	$10,827,000	
	Mine Air Heating : Propane Costs			32mo.	$44,741 /mo.	$1,432,000	
	Power Costs			32mo.	$95,000 /mo.	$3,040,000	$20,247,000
			Total Development	**286m**			

Giant Yellowknife Mines
Project to Deliver Arsenic Trioxide Dust to Chambers below 2000 Level

Underground Deep Disposal Method
Deep - Dev't and Cot
Appendix B

		Dimensions		Quantity	Unit Cost	Total Cost	Subtotals
Phase IX	**Excavation of Arsenic Dust Transfer Raises**						
	Development						
	3 x Site Access and Slashing Top for AR1, AR3, AR4	4.0m	4.0m	150m	$2,500/m	$375,000	
	3 x Site Access and Slashing Middle for AR1, AR3, AR4	4.0m	4.0m	200m	$2,500/m	$500,000	
	Deliver Power to Top set-ups						
	Deliver Power to Middle set-ups						
	Raiseboring, using rig similar to Subterranean 009	ø 1.5 m		6 half-raises	271m	ea. half-raise	
	Mobilization			1	$82,600ea.	$83,000	
	Move underground and set-up on top of AR1,2			1	$41,800ea.	$42,000	
	Pilot top half of AR1,3 and 4			900m	$361/m	$325,000	
	Ream top half of AR1, 3 and 4			900m	$597/m	$537,000	
	Tear Down and move AR1-AR3, AR3-AR4			2	$46,200ea.	$92,000	
	Tear Down and move to middle of AR1,2			1	$32,200ea.	$32,000	
	Pilot bottom half of AR1,3,4			900m	$361/m	$325,000	Raiseboring
	Ream bottom half of AR1,3,4			900m	$597/m	$537,000	$1,630/m
	Tear Down and move to middle of AR1-AR3, AR3-AR4			2	$46,200ea.	$92,000	
	Tear Down and Move to Surface			1	$40,300ea.	$40,000	
	Demobilization			1	$80,500ea.	$81,000	
	Contingency, redrill pilot holes			1	$325,000ea.	$325,000	
	Muck and truck Raisebore Cuttings			8600	16.20	$139,000	
	Trucking to 15 level or surface. Assume Phase II costs			18,099 t	$16.20 /t	$293,000	
	6 x 12" ITH holes surface to Arsenic Dust Raises on 250 level	ø 0.15 m	76m	457m	$300/m	$137,000	
7.10	3 x Ventilation Exhaust Raises 250 to Surface			229m	$2,500/m	$572,000	
7.10	3 x 25m Ventilation Exhaust drifts			75	$2,500/m	$188,000	
	Mine Air Heating : Propane Costs			4mo.	$29,812 /mo.	$119,000	
	Hermetic Dump Points on 250 Level			3	$80,000ea.	$240,000	$5,074,000
			Total Development	**579m**			

Giant Yellowknife Mines
Project to Deliver Arsenic Trioxide Dust to Chambers below 2000 Level

Underground Deep Disposal Method
Deep - Dev't and Cot
Appendix B

		Dimensions	Quantity	Unit Cost	Total Cost	Subtotals
Phase X	**Bulkhead Installation**					
	To prevent 250 Level from being dusted out from ITH holes		6	$20,000ea.	$120,000	
	AR1,3,4 middle accesses		4	$20,000ea.	$80,000	
7.11	AR1,3,4 top accesses		3	$30,000ea.	$90,000	
7.11	Install Final Bulkhead in Decline		1	$30,000ea.	$30,000	
7.11	Install Final Bulkheads in Vent Exhaust Raises		2	$20,000ea.	$40,000	
	Mine Air Heating : Propane Costs		1mo.	$29,812 /mo.	$30,000	$390,000
Appendix	**Electrical Power Supply System**					
	Power					
	4150V Power Cable Installed in Ramp		1,212m	$50/m	$61,000	
	4150V Power Cable Installed to each raisebore setup		1,200m	$50/m	$60,000	
	600V Power Cable Installed in		2,000m	$25/m	$50,000	
	Ground Fault Panels, Splitter Boxes installed		4	$8,000ea.	$32,000	
	Raisebore		1	$20,000ea.	$20,000	
	Jumbo		1	$10,000ea.	$10,000	
	Fans, Secondary		5	$10,000ea.	$50,000	
	Fans, Primary		2	$20,000ea.	$40,000	
	Pumps Secondary		4	$10,000ea.	$40,000	
	Pumps in Sumps installed		2	$40,000ea.	$80,000	
	Transformer 500kW installed		2	$100,000ea.	$200,000	$643,000
		Grand Total All Development	**6,648m**	**955,000 t**	**waste**	
				Contingency	25%	$11,970,000
GRAND TOTAL COST OF PREPARING STORAGE BINS						**$59,848,000**

Giant Yellowknife Mines
Project to Deliver Arsenic Trioxide Dust to Chambers below 2000 Level

Underground Deep Disposal Method
Deep - Timing
Appendix B

				Critical Path Items	
Phase VI	**Waste Rock Dump Set-up and Start of Ramp**				
	Haul to Surface while Muck Handling Facilities are Being Set-up				
	Set up Power, air, water			1mo.	
	Rockbreaker Station Access (or Incline)				
	1500 Incline to 1425 Wastepass	275m	45m/mo.	6mo.	
	Install safety Bulkhead in Raise			1mo.	
	Slash out raise to new dimensions			2mo.	
	Repair chute at bottom + installation of rockbreaker and grizzly as well as the vent raise for rockbreaker chamber all happen simultaneously				
	Start of Decline for Deep Disposal	275m	45m/mo.	Happens simultaneously	
	Decline Vent Raise is done at the same time				
				10mo.	0.8 years
Phase VII :	**Development of New Ramp and Level for Bins**	Haul to 15 Level, Tram to Shaft, Hoist to Surface.			
	Timing of this phase is limited to what a crew of one jumbo, 1 deck, 2 LHD, 5 trucks can do.				
	Overall Development Rate Assumed (includes raises)		250m/mo.	5,208m	
				21mo.	
	Add two months taper at end of development			2mo.	
				23mo.	1.9 years
Phase VIII	**New Bin Excavation 20m diameter 90m High x 9**			9 bins	
	Timing of this phase is limited by trucking capacity. Please refer to "Truck Costs and Time" worksheet				
	Assume a fleet of	5	trucks	30mo.	of mucking
			Add	2mo.	head start required for drilling
				32mo.	2.7 years
Phase IX	**Excavation of Arsenic Dust Transfer Raises**				
	The timing of this work will overlap that of Phase III Assume it will finish			**4mo.**	after Phase III
Phase X	**Bulkhead Installation**				
	Again there is overlap. Assume the Bulkhead installation will take			**1mo.**	longer than Phase IV

Giant Yellowknife Mines
Project to Deliver Arsenic Trioxide Dust to Chambers below 2000 Level

Underground Deep Disposal Method
Deep - Mine Air Heating
Appendix B

Fleet Size	Operational Units		Horsepower	Ventilation Requirement		Giant Mine Care and Maintenance Page 32
Phase VI	**Waste Rock Dump Set-up and Start of Ramp**					
1	1	Toro 151D	71	7,100cfm		
2	1	Toro 400	215	21,500cfm		
0	0	EJC 430	277			
3	1.0	EJC 300????	250	25,000cfm	EJC 430 is too large	
		Light Vehicles and Jumbo		50,000cfm		
		Total		103,600cfm	compared to	220,000cfm
		Propane Requirements		800,545 litres	proportional to	1,700,000 litres
		Cost / litre		$0.36		
		Mine Air Heating : Propane Costs per year		$288,196/yr	$ 24,016 /mo.	
Phase VII :	**Development of New Ramp and Level for Bins**					
1	1	Toro 151D	71	7,100cfm		
2	2	Toro 400	215	43,000cfm		
0	0	EJC 430	277			
4	2.0	EJC 300????	250	50,000cfm	EJC 430 is too large	
		Light Vehicles and Jumbo		50,000cfm		
		Total		150,100cfm	compared to	220,000cfm
		Propane Requirements		1,159,864 litres	proportional to	1,700,000 litres
		Cost / litre		$0.36		
		Mine Air Heating : Propane Costs per year		$417,551/yr	$ 34,796 /mo.	
Phase VIII	**New Bin Excavation 20m diameter 90m High x 9**					
1	0	Toro 151D	71			
2	2	Toro 400	215	43,000cfm		
0	0	EJC 430	277			
5	4.0	EJC 300????	250	100,000cfm	EJC 430 is too large	
		Light Vehicles and Jumbo		50,000cfm		
		Total		193,000cfm	compared to	220,000cfm
		Propane Requirements		1,491,364 litres	proportional to	1,700,000 litres
		Cost / litre		$0.36		
		Mine Air Heating : Propane Costs per year		$536,891/yr	$ 44,741 /mo.	
Phase IX	**Excavation of Arsenic Dust Transfer Raises**					
1	1	Toro 151D	71	7,100cfm		
2	1	Toro 400	215	21,500cfm		
0	0	EJC 430	277			
5	2	EJC 300????	250	50,000cfm	EJC 430 is too large	
		Light Vehicles and Jumbo		50,000cfm		
		Total		128,600cfm	compared to	220,000cfm
		Propane Requirements		993,727 litres	proportional to	1,700,000 litres
		Cost / litre		$0.36		
		Mine Air Heating : Propane Costs per year		$357,742/yr	$ 29,812 /mo.	

Giant Yellowknife Mines
Project to Deliver Arsenic Trioxide Dust to Chambers below 2000 Level

Underground Deep Disposal Method
Deep - Power Costs
Appendix B

	Quantity	Size		Per Day	Per Month	Unit Cost	Cost per Month
Phase VI	**Waste Rock Dump Set-up and Start of Ramp**						
Fans, 45kW Underground	2	45kW	90kW	24 hours			
Jumbo 150kW	1	150kW	150kW	2 hours			
Pumps 7.5hp, 5.6kW	1	6kW	6kW	10 hours			
			0.2 MWhr	**3 MWhr**	**65 MWhr**	**$0.187/kWhr**	**$12,000**
Phase VII :	**Development of New Ramp and Level for Bins**						
Fans, 2000 Level 150KW ea	1	150kW	150kW	20 hours			
Fans, 45kW Underground	4	45kW	180kW	20 hours			
Jumbo 150kW	1	150kW	150kW	5 hours			
Rockbreaker	1	150kW	150kW	1 hours			
Pumps 7.5hp, 5.6kW	3	6kW	17kW	12 hours			
Pumps 750hp, 560kW	0	560kW	0kW	12 hours			
Rail Haulage	Included in "Trucking Costs"						
Hoisting	Included in "Trucking Costs"						
			0.6 MWhr	**8 MWhr**	**200 MWhr**	**$0.187/kWhr**	**$37,000**
Phase VIII	**New Bin Excavation 20m diameter 90m High x 9**						
Fans, 2000 Level 150KW ea	1	150kW	150kW	20 hours			
Fans, 45kW Underground	6	45kW	270kW	20 hours			
Jumbo 150kW	0	150kW	0kW	5 hours			
ITH Drill	2	150kW	300kW	11 hours			
Raisebore	0.25	150kW	38kW	11 hours			
Rockbreaker	1	150kW	150kW	4 hours			
Pumps 7.5hp, 5.6kW	3	6kW	17kW	12 hours			
Pumps 750hp, 560kW	1	560kW	560kW	12 hours			
Rail Haulage	Included in "Trucking Costs"						
Hoisting	Included in "Trucking Costs"						
			1.5 MWhr	**20 MWhr**	**510 MWhr**	**$0.187/kWhr**	**$95,000**
Phase IX	**Excavation of Arsenic Dust Transfer Raises**						
							not worked out yet

Giant Yellowknife Mines
Project to Deliver Arsenic Trioxide Dust to Chambers below 2000 Level

Underground Deep Disposal Method
Deep - Truck Costs and Time
Appendix B

Phase VI Waste Rock Dump Set-up and Start of Ramp

Truck to Surface

Elevation to Truck		1,300ft	396m							
Truck-Hauling loaded up ramp on a		13%	grade up a	3.0 km	incline at a speed of	7.5kph	would take		24.4	minutes
Returning unloaded down ramp on a		13%	grade down a	3.0 km	decline at a speed of	14kph	would take		13.1	minutes
Loading Time									5	minutes
Dumping Time									5	minutes
Cycle time for a Load									**47**	**min/load**
Productive Truck Hours per Shift		5	hours							
Operating Minutes per Hour		50	min	83%	system availability					
		5.3	loads per shift							
	Assume	**5**	**loads per shift**							
A Truck rated for		15 t	loaded at	85%	capacity will haul	13	tonnes per load, or		**64 t**	**/shift**
Labour Costs are		$70 /hour	for	8	hours worked	$560/shift				
Truck operating costs are		$40 /hour	for	5.5	hours running time	$220/shift				
Total						$780/shift				
Trucking Cost is				**$12.24 /t**						
Additional Costs to Removing Waste from the Mine										
Scoop Loading Costs				**$2.00 /t**						
Rail Haulage to Shaft + Rockbreaker operator + maintenance										
Shaft Hoisting (electrical costs only)										
Waste Handling to Surface				$\boxed{\textbf{\$14.24 /t}}$	$38/m³					
				KR corrected						
					Trucking requirement		27,810 t			
					over		10mo.			
							2,891 t	per month		
					Working 3 shifts per day 26 days per month, a truck can handle					
							4,973 t	per month		
							0.6	fully operational trucks		
					A fleet of		**2**	**trucks will be needed**		

1425 R/breaker

Underground Deep Disposal Method
Deep - Truck Costs and Time
Appendix B

Phase VII : Development of New Ramp and Level for Bins

	Haul from mid bin height to 1475 Level Rockbreaker, Tram to Shaft, Hoist to Surface.						295ft	90m	
Elevation to Truck	1,070ft	326m	(Half bin height to 1475 Level)						
Truck-Hauling loaded up ramp on a	13%	grade up a	2.5 km	incline at a speed of	7.5kph		would take	20.1	minutes
Returning unloaded down ramp on a	13%	grade down a	2.5 km	decline at a speed of	14kph		would take	10.8	minutes
Loading Time								5	minutes
Dumping Time								5	minutes
Cycle time for a Load								**41**	**min/load**
Productive Truck Hours per Shift	5	hours							
Operating Minutes per Hour	50	min	83%	system availability					
	6.1	loads per shift							
Assume	**6**	**loads per shift**							
A Truck rated for	15 t	loaded at	85%	capacity will haul	13		tonnes per load, or	**77 t**	**/shift**
Labour Costs are	$70 /hour	for	8	hours worked	$560/shift			28.3m³	
Truck operating costs are	$40 /hour	for	5.5	hours running time	$220/shift				
Total					$780/shift				
Trucking Cost is			**$10.20 /t**						
Additional Costs to Removing Waste from the Mine									
Scoop Loading Costs			$2.00 /t						
Rail Haulage to Shaft + Rockbreaker operator + maintenance			$2.00 /t						
Shaft Hoisting (electrical costs only)			$2.00 /t						
Waste Handling to Surface			**$16.20 /t**	$44/m³					
			KR corrected						

Trucking requirement 240,570 t
over 21mo.
11,548 t per month
Working 3 shifts per day 26 days per month, a truck can handle
5,967 t per month
1.9 fully operational trucks
A fleet of 3 trucks will be needed

Underground Deep Disposal Method
Deep - Truck Costs and Time
Appendix B

Phase VIII New Bin Excavation 20m diameter 90m High x 9 — 9 bins

Elevation to Truck	1,070ft	326m	(Total Bin Height to 1475 Level)						
Truck-Hauling loaded up ramp on a	13%	grade up a	2.5 km	incline at a speed of	7.5kph	would take		20.1	minutes
Returning unloaded down ramp on a	13%	grade down a	2.5 km	decline at a speed of	14kph	would take		10.8	minutes
Loading Time								5	minutes
Dumping Time								5	minutes
Cycle time for a Load								**41**	**min/load**
Productive Truck Hours per Shift	5	hours							
Operating Minutes per Hour	50	min	83%	system availability					
	6.1	loads per shift							
Assume	**6**	**loads per shift**							
A Truck rated for	15 t	loaded at	85%	capacity will haul	13	tonnes per load, or		**77 t**	**/shift**
Labour Costs are	$70 /hour	for	8	hours worked	$560/shift			28.3m³	
Truck operating costs are	$40 /hour	for	5.5	hours running time	$220/shift				
Total					$780/shift				
Trucking Cost is			**$10.20 /t**						
Additional Costs to Removing Waste from the Mine									
Scoop Loading Costs			$2.00 /t						
Rail Haulage to Shaft + Rockbreaker operator + maintenance			$2.00 /t						
Shaft Hoisting (electrical costs only)			$2.00 /t						
Waste Handling to Surface			**$16.20 /t**	$44/m³					

Trucking requirement	668,520 t		
over	30mo.	2.5	
	22,284 t	per month	857 tpd
Working 3 shifts per day 26 days per month, a truck can handle			
	5,967 t	per month	
	3.7	**fully operational trucks**	
A fleet of	**5**	**trucks will be needed**	

Phase IX Excavation of Arsenic Dust Transfer Raises

Assume same trucking cost as with phase II

Waste Handling to Surface	**$16.20 /t**	$44/m³