8ZM 141 From Norm Berg

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MINING AT GOLDSTREAM

BY

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PREPARED FOR PRESENTATION

AT THE

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OF THE

CANADIAN INSTITUTE OF MINING AND METALLURGY

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ABSTRACT

The Goldstream copper-zinc property is located 93 kilometers north of Revelstoke in South Eastern British Columbia. (Figure 1) The known ore reserves of four million tonnes will maintain a production rate of 1360 metric tonnes per day for eight years.

This paper describes the Goldstream property with emphasis on the underground mining method termed "Step Room and Fill".

1.0 INTRODUCTION

Maclaren Forest Products, a division of Noranda Mines Ltd., is currently operating the Goldstream copper zinc property. The property includes a small open pit, an underground mine, service buildings, a campsite, a concentrator and a tailings pond. (Figure 2)

The Goldstream deposit was discovered during the construction of a logging road in 1972. The first claims were staked by Frank King, Gordon Bried and Bruce Bried in 1973. Noranda Exploration optioned the property in 1974 and completed 8900 metres of surface diamond drilling in 1975. In 1976, 1100 metres of drifting and 2250 metres of underground diamond drilling took place. Subsequent feasibility studies were carried out from 1977 to 1979 and the decision to proceed with development and construction was made in 1980. The first concentrate was produced in May of 1983.

2.0 GEOLOGY OF GOLDSTREAM MINE

2.1 Geometry and Sequence

The deposit lies within a sequence of metamorphosed and deformed sedimentary and volcanic rocks. The shape is that of a "flattened rod" or "ruler" and although it occurs concordantly with the surrounding rock units and at a particular stratigraphic horizon, it rakes across the dip of the other units.

The general sequence of rocks encountered from hanging wall to footwall is as follows; dark banded phyllite, garnet zone, grey green phyllite, massive sulphides, grey green phyllite and metamorphic limestone. (Figure 3)

2.2 Description of the Deposit

The deposit consists of a single continuous bed of massive and disseminated sulphides varying in thickness from one to fifteen metres. The average thickness is three metres. The strike length varies from 340 metres at the outcrop to 180 metres at depth. The average dip is 33°. The rake is 45° off of true dip. The hanging wall and footwall contacts roll on dip as well as on strike. The down dip length is open but proven to 1050 metres in length.

The zone outcrops at the 920 metre elevation on the north side of the valley. The Goldstream River crosses over the deposit at the 645 metre elevation. The valley slope is covered by four to six metres of glacial till with up to 30 metres of boulders and gravel in the valley bottom.

3.0 SERVICES

3.1 Power

B. C. Hydro constructed a 69,000 volt hydro line from Mica Dam to Goldstream. The line parallels highway 23 to the Goldstream Valley and then follows the valley to the Mine Site. The twin 400 KW Cullen Detroit diesel generators, that supplied power during construction, have been maintained on standby.

3.2 Water Supply

The supply of fresh water has been a major problem at Goldstream since the beginning of construction. It was not anticipated that this would be a problem as the mine is in the Interior Rain Belt with an average annual precipitation of 1.15 metres. Several wells were drilled in high potential areas and all hit water but not in the quantities required by the concentrator. The Goldstream River could supply the necessary quantity of water but during spring run off the quality of water is poor. The major creeks on the south slope of the valley were tested for supply. The closest creek large enough was sourced 1.5 kilometres east of the mine site and can only supply sufficient water for about 10 months of the year.

Therefore, a dual system was established using the East Creek for the majority of the year and the Goldstream River, when it is clear. (Figure 4) A filter bed was constructed beside East Creek with a 15 centimetre sclair line gravity feeding the 110,000 litre head tank located above the concentrator. This system can supply the mill and mine for the majority of the year without pumping. During low water periods the Goldstream River is relatively clear. A pumping system was installed below the concentrator beside the Goldstream. This system can supply the entire plant as a backup source but will normally only be used for the concentrator during low water season.

3.3 Propane

Propane is used in large quantities in most areas of the mine site. To eliminate the requirement for several small tanks, an underground grid system was installed. A 68,000 litre tank was placed at the 770 portal area. This is the site of the main mine ventilation station and the largest propane consumer, the mine air heaters. (Figure 5) The grid system distributes propane to the compressor room mine air heater, the main service building and the concentrator. The propane vaporizer and a cylinder fill facility are also located at 770.

3.4 Compressed Air

The compressed air requirements for the site are produced in a compressor room located just inside the 700 portal. The compressors are two Atlas Copco ZR5-B units and two Gardner Denver EAYPT 400 units with provisions for a third Gardner Denver. The four installed units can supply 8,000 CFM at 110 PSI.

The compressed air is piped from the compressors to an abandoned drill drift used as an air receiver. A 1.2 metre thick concrete wall was constructed at the entrance to the drill drift to give approximately 2000 cubic metres storage capacity. (Figure 6)

The compressors are cooled by a closed circuit glycol system. Fluid cooling towers were erected on surface above the compressor room to cool the glycol in the summer. The glycol is used to heat the fresh air supply to the compressor room and the main service building shop in the winter.

3.5 Sewage System

Two identical and independent sewage collection and treatment systems are used. One is located at the mine site, and the other at the mancamp. The sewage plants are rotating biological discs for primary treatment and a subsequent drainage field for final disposal. (Figure 7)

3.6 Manpower

Goldstream will have between 180 to 200 employees. (Figure 8) Presently about half live in the Goldstream camp and half commute daily from Revelstoke.

The camp is located five kilometres west of the mine site. The housing units are two story bunkhouse facilities connected to a central recreation dining complex by covered walkways. This camp will accommodate 120 people. (Figure 9)

The employees that commute from Revelstoke are transported in 8 passenger vans which are supplied and maintained by the Company. Employees are not charged for transportation and are not paid for travelling time.

3.7 Ore Processing

The crushing and screening plants are located at the 632 metre elevation. The primary crushing unit is a 36" x 48" jaw crusher which breaks the ore to minus 6". The primary crushed ore is conveyed to a 5' x 10' rod deck screen set at minus 5/8". The screen is in a closed circuit with a 5½' shorthead cone crusher. The minus 5/8" material is conveyed to a 4800 ton fine ore bin for storage. Ore is reclaimed from the bin via a slot feeder and conveyed directly to the concentrator. (Figure 10)

The concentrator building is located below the main service building at the 660 metre elevation. (Figure 11 & 12) The primary grind is obtained in a rod mill and a ball mill in a closed circuit with cyclones. Copper and zinc regrind mills are used for further liberation, as required. The grinding circuits were designed to give 85% minus 200 mesh at 60 tonnes per hour. The flotation process uses 7450 cubic feet of conventional flotation cells. The largest cell is 100 cubic feet and the smallest is 25 cubic feet. Two concentrates are produced, copper and zinc. Thickening is by conventional gravity thickeners. Further dewatering takes place

A seepage collection system and pumping facility at the west dam will return the water back to the tailings pond. Future dam construction will be staged as required to provide sufficient storage, 2 to 3 years, at any time during the life of the operation.

Interception and diversion of surface water flows have been achieved by constructing ditches on the south side of the area. Flows to the east and north are naturally diverted from the area by Brewster Creek and the local divide.

Water, as required, will be returned to the mill for re-use via a reclaim pump system. Excess water resulting from precipitation will be discharged as necessary from the impoundment area to natural drainage flowing to the Goldstream. The quality of the water discharged to the environment will be monitored on a regular basis.

4.0 OPEN PIT

A small open pit, located above the main service building (Figure 11), is being used to mine the top 70 metres of the orebody. This method ensures recovery of the upper part of the ore that would not be totally recoverable by underground methods.

The pit ore is in the form of a thin lense with an average strike length of 300 metres, an average width of 2 to 8 metres and an average dip of 40°. The reserve contained in the pit is 424,000 diluted tonnes at 4.08% copper. The total waste stripping will involve 1.2 million tonnes which is being dumped two kilometres east of the pit. The overburden stripping involved 160,000 cubic metres and was disposed of on roads and with the waste.

An interceptor ditch was dug around the top of the pit and the overburden was sloped back at 30°. A 15 metre wide safety berm was cut in waste above the ore outcrop. The pit design calls for mining ten 7.5 metre benches, along the footwall contact. The hanging wall will be mined on a 45° slope with 7.5 metre berms. (Figure 14) Access to the pit is from both the east and west ends. (Figure 15) Ore is dumped into the pit ore pass to the 700 metre level underground and handled to the main ore pass.

The ore has proven to be extremely hard to fracture, while the waste is relatively easy. The drilling patterns use all verticle holes. The ore is drilled on a 1.5 metre square pattern using 6 centimetre holes. The waste is drilled on a 3.6 metre square pattern using 10 centimetre holes. Current practice is to blast the holes containing all waste first and remove to the waste pile. The remaining waste is blasted with the ore and is visually separated by the loader operator with a geologists instructions.

The footwall is scaled as required. Rock bolts are installed in the footwall on a 3 metre square pattern, except where wall conditions warrant additional support. The bolts used are 2.5 centimetre rebar grouted in place. The holes are drilled with the production drills.

The equipment used in the pit is as follows:

Drilling	-	1 - Atlas Copco ROC 810 H Hydraulic
		1 - Tamrock Fixtrack DH
Trucks	-	4 - Caterpillar 769C
Loaders	-	2 - Caterpillar 988B
		1 - Caterpillar 930
Dozers	-	2 - Caterpillar D8K - 1 ripper
		- 1 winch
Miscellaneous	-	1 - Caterpillar 14G Grader
		1 - JCB 3D 111 Loader-Backhoe

5.0 UNDERGROUND

5.1 Main Accesses And Services (Figure 16)

The main access to the mine is via two portals at the 700 metre elevation. One portal is a service portal and one is a man access way.

The access to the crusher, fine ore bin and main sumps is from the 672 portal. The 660 portal is the conveyorway to the mill.

The portal at the 770 elevation is the main ventilation intake and the portal at the 830 elevation will be the main ventilation exhaust. (Figure 17)

The basic ventilation scheme is to intake 240,000 CFM at the 770 portal down raises on the east side of the mine distributed through the stoping areas and haulages, then exhausted out a ramp system on the west side of the mine to the 830 portal. The compressor room and crusher station are supplied with fresh air from the compressor raise. This system is isolated from the rest of the mine. (Figure 18)

An electrical distribution system has been installed throughout the mine. The main transformers are at the crusher, in the compressor room and by the 770 ventilation station. The ore development transformer is in a station at the west end of 715 drift. This transformer feeds most of the electric mining equipment like the electric jumbos and fans.

Water is supplied underground, from the main head tank, through the main service building to a booster pump located in the compressor room. The underground distribution system is via five and ten centimetre victaulic lines.

Compressed air is piped from the receiver drift, described in section 3.4, throughout the mine in twenty, fifteen or ten centimetre victaulic lines as required.

5.2 Mine Development

The orebody is accessed from the hangingwall by 5 metre x 3.5 metre crosscuts on 60 metre intervals. Sills are driven on strike at these horizons along the hanging wall contact, to the east and west limits of the ore zone. They are 4 metres wide by 3 metres high with a shanty back for ground control and to provide room for vent tubing. (Figure 19)

A footwall ramp system on the west side of the ore zone has been developed to provide equipment access and for an exhaust air route.

Raises were developed on the east side of the ore zone to provide fresh air and an emergency escape way.

5.3 Equipment

Goldstream has been planned and developed as a mechanized mine. Only raising and some rockbolting are currently being done using conventional airleg methods.

The equipment currently in use underground is as follows:

Drilling	-	2 - Two Boom Jarvis Clark MJM 20B Air Jumbo
		3 - Single Boom Tamrock Electric-Hydraulic Jumbo
		1 - Single Boom Tamrock Diesel-Hydraulic Jumbo
		8 - Secan Stopers
		8 - Secan Jacklegs
		2 - Canun Stopers
		2 - Canun Jacklegs
Trucks	-	5 - Jarvis Clark JDT 413
		3 - Jarvis Clark JDT 426
LHD	-	8 - Jarvis Clark JS220
		2 - Jarvis Clark JS500
Ventilation	-	2 - Joy 200 HP 54-26-1770 Axial Vane, Series 1000
		4 - Joy 60 HP 42-26-1770 Axial Vane, Series 2000
		12 - Joy 40 HP 34-26-1770 Axial Vane, Series 2000
		1 - Joy 20 HP 48-21-1170 Axial Vane, Series 1000
		1 - Joy 20 HP 42-17-1170 Axial Vane, Series 1000
Miscellaneous	-	1 - D3 Caterpillar Dozer
		1 - True Gunal Shotcrete Machine
		1 - Nortec Alimak Raise Climber

The Jarvis Clark air jumbo and the Tamrock diesel electric jumbo have been used strictly in mine development. The Tamrock electric hydraulic jumbos are being used in stoping and its associated ore development. They have a flexible boom that allows them to be used for rockbolting as well as for stoping. The 1.5 metre wide Getman carrier is small enough to allow mining in a narrow twisting stope with a minimum of dilution.

Stope mucking is with the Jarvis Clark JS 220 scooptrams to mill holes. The narrow width of the ore body and their low ventilation requirements make them ideal. Development mucking is also usually done with the JS 220s' dumping into the JDT 413 trucks. Again size and ventilation requirements were the deciding factors in equipment selection.

Drawpoint mucking and production retramming is done by the JS 500 scooptrams loading the JDT 426 trucks. The main retram from the open pit ore pass has a chute that loads the JDT 426 trucks.

The airleg drills are used in rockbolting and raising. The alimak raise climber is used in the larger raises over 60 metres in length. Road maintenance is done with the D-3 Caterpillar dozer. The shotcrete machine is used mainly for construction work but also gets some use for ground control.

The 40 HP fans are the main type used for directional ventilation in development and stoping applications. They are used with either 0.9 metre or 1.2 metre diameter vent tubing, depending on the ventilation requirement. The 60 HP fans are used in the main haulage drifts, where the large equipment is used, with 1.2 metre diameter tubing.

5.4 The Mining Method

The three mining blocks currently in production or under development are 655, 715 and 770. Each of these blocks will be mined in the same manner using the "Step Room and Fill" method. (Figure 20)

Ore block development is started by driving a ramp in ore from the extreme west end of the top level breaking through into the bottom level. This ramp is driven with a shanty back at 4 metres wide by 3 metres high, down at 17% grade. Access must be maintained around the ore ramp collar on the sill horizons. Therefore, a footwall slash is required. The ramp is started by benching the floor of the sill and slashing the wall to the hanging wall contact. (Figure 21) The line of the ramp is under geological control.

Great care must be taken not to break the hangingwall contact. Whenever this has happened, ground conditions have been poor. When the ramp face is 4 - 5 metres wide, a pillar is established between the sill and the ramp. At this stage the ore ramp is driven like any other ramp, except the line is under geological control. A geologist usually marks up each round, but the shifters and miners soon gain expertise at defining the ore-waste contact.

A vertical drop is left from the ramp benching. This is a potential safety hazard and requires a safety fence. They are usually constructed from 20 centimetre timber bolted to the back and concreted to the floor.

The ore ramps average 350 metres in length and can take a long time to develop. The time span can be shortened by driving the ramp from the bottom up, as well as from the top. A problem with this approach is in trying to connect the two legs. The ramp layout is never exactly known because of the rolling nature of the hangingwall. Therefore, the ramps are connected by either adjusting the grade near breakthrough or they are connected with a strike sublevel.

An ore haulage drift is driven on the bottom level paralleling the ore ramp. (Figure 22) Drawpoints are cut from this haulage and 1.5 x 1.5 metre mill hole raises are driven to the ore horizon near the ore ramp. This work is completed as early as practical so that the mill holes can be used for stope development as well as production. Ore is picked up in the drawpoints by 5 yard scooptrams and loaded into 26 ton trucks. All ore is hauled to the main ore pass on 700 level which feeds directly to the crusher.

The ore ramp splits the ore block into east and west stoping areas at about a 75 - 25 ratio.

The east mining block is divided into stopes with sublevels at 10 - 12 metre elevation intervals and with internal ramps at 50 - 70 metre strike intervals. The sublevels are driven with a slight upgrade, three metres high and three to five metres wide. If the ore is wider than five metres, then the footwall contact will be found by test holing and the remaining ore will be left for slashing at a later date. In narrow areas, the sublevels are driven three metres wide with a shanty back to facilitate vent tubing. (Figure 23)

The sublevels must be turned off the main ore ramp in such a manner that ramp access can be maintained. Wall slashing is started at the designed sublevel elevation in the ore strike direction at the grade of the ramp. When the ramp plus slash, is eight to ten metres in width a pillar is established. (Figure 24) Since the sublevel has dropped below the designed elevation, it is brought back to proper grade as steeply as possible. The sublevel is driven the extent of the ore zone, under geological control, following the hangingwall contact. The strike length of each sublevel will determine the number of stopes there will be at that horizon. The locations of the internal ore ramps are chosen with the most easterly one being driven first. Pipe and vent ducting are removed beyond the ramp collar. Access on the sublevel beyond the beginning of the ramp bench is lost but is no longer required. The ramp is started in the same manner as the main ore ramp, by benching the floor and slashing the wall under geological control. The internal ramp is 22% because of the short ramp length involved. It is driven 12 to 14 metres or just enough to give access to the first 2.5 metre cut in the stope. (Figure 25) Each cut is benched at a slight upgrade to the full width of the ore. The cuts are advanced in three metre horizontal benches to the ore limit in the end stope or to a rib pillar in an internal stope. The benches are drilled as a slash without a cut. (Figure 26) Each cut is accessed in the same manner by advancing the internal ore ramp.

Ground control is carried out as close to the mining face as practical. Current practice is to use 1.8 metre split sets on a 1.4 metre pattern. Longer bolts, 2.4 split sets and rebar are used as required. Swellex bolts are currently being tested. They are attractive because the holes can be drilled with the stoping jumbo and the bolts can be installed later in a remote fashion. This routine more efficiently matches the mining cycle.

Stopes are mined in the manner discussed from the bottom of a block up and from the east end of the ore zone in towards the main ore ramp. (Figure 27)

Sill and rib pillars are left for ground support until the stope can be backfilled. The backfill plant is currently being designed and is scheduled for use in the summer of 1984.

The fill sequence will be from the bottom up and from the main ramp east. The sequence is such that it will potentially allow for all rib and sill pillar recoveries. (Figure 28) A stope will be prepared for fill by building fill fences and drainage towers. The stope will be flood filled as tight to the back as possible. The sill pillar above the filled block can then be removed as can the rib pillar to the east of the filled stope. All pillar recovery must be from above or beside a filled stope as cemented fill is not being planned.

The mining method to be used for the 25% of the ore zone that is west of the main ore ramp will be similar to that on the east side. A permanent barrier rib pillar will be left below the ore ramp for ground support and to make the mining of the east and west sides independent of each other.

The main difference in mining the two areas is in the method of access. Access to the west stopes is from the foot-wall ramp system. Short ramps or crosscuts are driven to intersect the ore horizon at the designed sublevel elevations. The sublevels and internal ore ramps are driven in the same manner as on the east side. The ore on this side is narrower so the pillars will be less attractive to recovery. Therefore, the stopes are designed for a larger size to try and extract a higher percentage of ore in primary mining. Filling and pillar recovery will be sequenced from the footwall ramp to the barrier pillar and from the bottom up. Recovery of ore remnants and pillars will depend on the economics of each individual block. (Figure 29)

Production requirements from each stoping block will be 12,000 tonnes per month. During the pit operation, two stoping blocks and development ore from a third, are required. At the end of the pit production, three stoping blocks and development in a fourth, will provide the total mine production required.

6.0 CONCLUSION

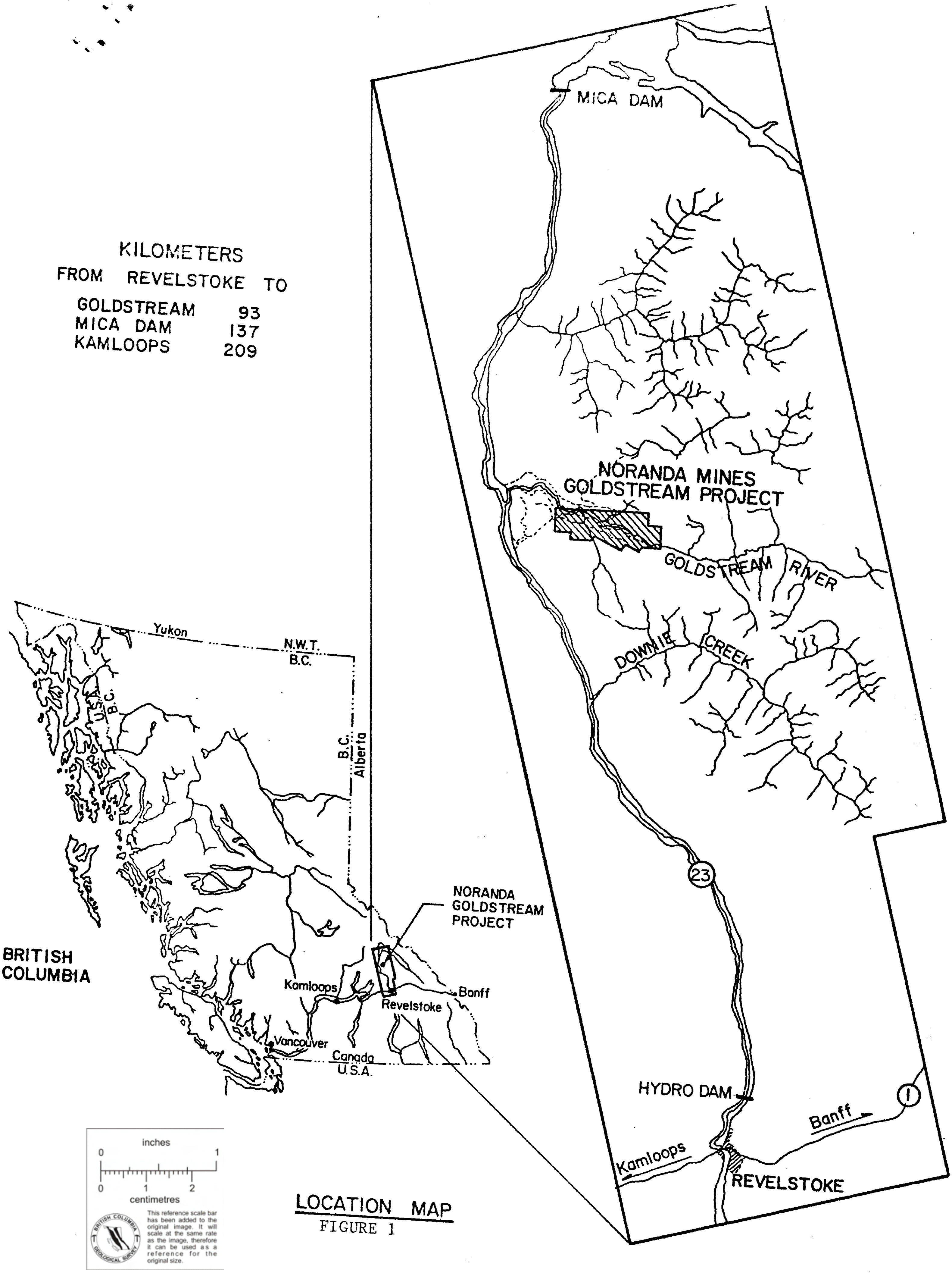
Construction and development of Goldstream took place at a time of severe economic recession in the mining industry. It was recognized from the beginning of the Goldstream Project, that in order to be profitable in the 1980's, it must be a very efficient operation. This fact was one of the main reasons for the automation of the concentrator and the use of a highly mechanized mining method.

It is the belief of Goldstream Management that a high degree of employee involvement in decision making will also add substantially to the efficiency of the operation.

The project was a very welcome addition to the Revelstoke area where unemployment levels are high. It will also help to reduce the economic downturn of the Revelstoke Dam completion.

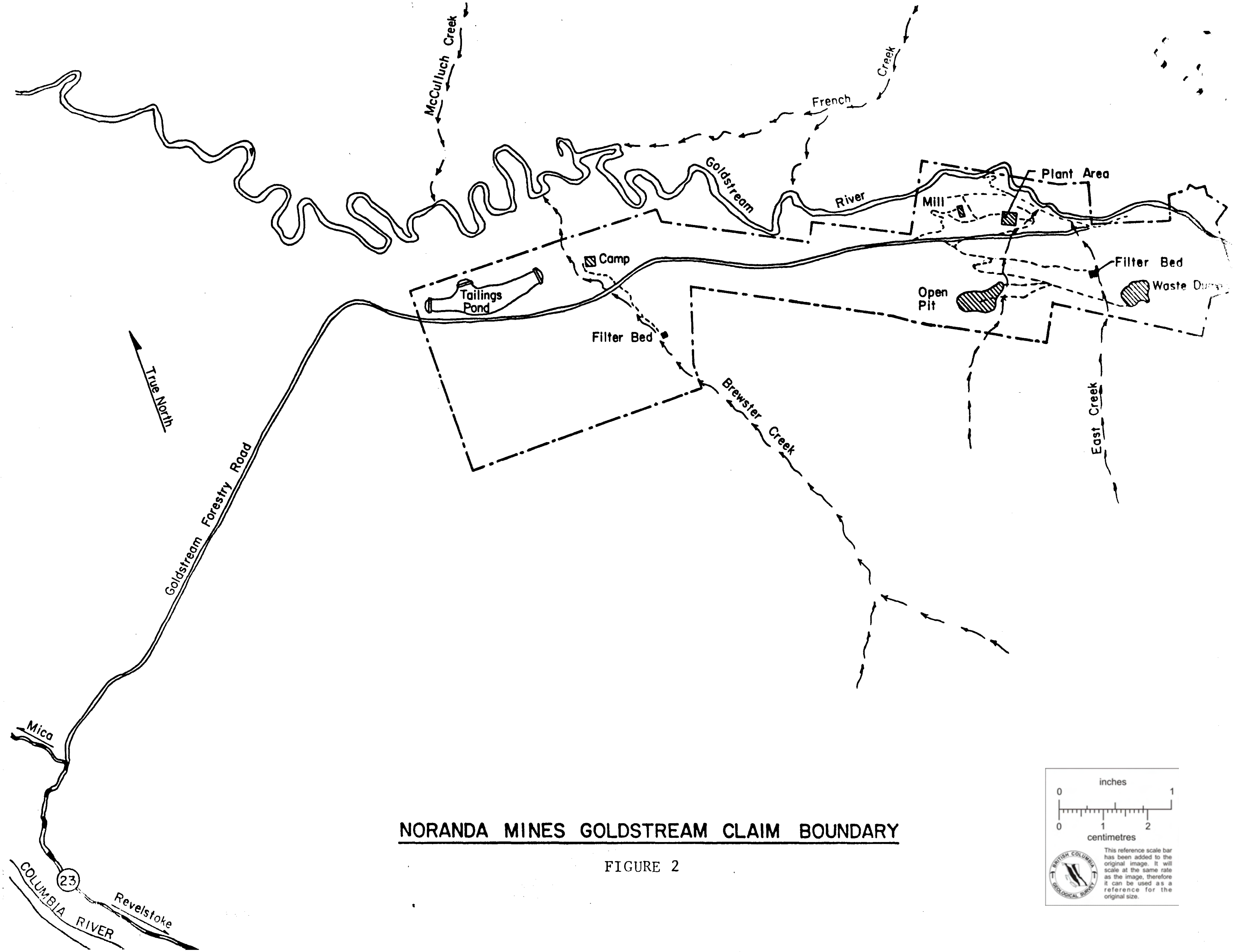
The total capital and preproduction costs were $71,200,000. (Figure 30) Ongoing capital projects will include the backfill plant, raising the tailings dams and deep ore development.

LIST OF ILLUSTRATIONS



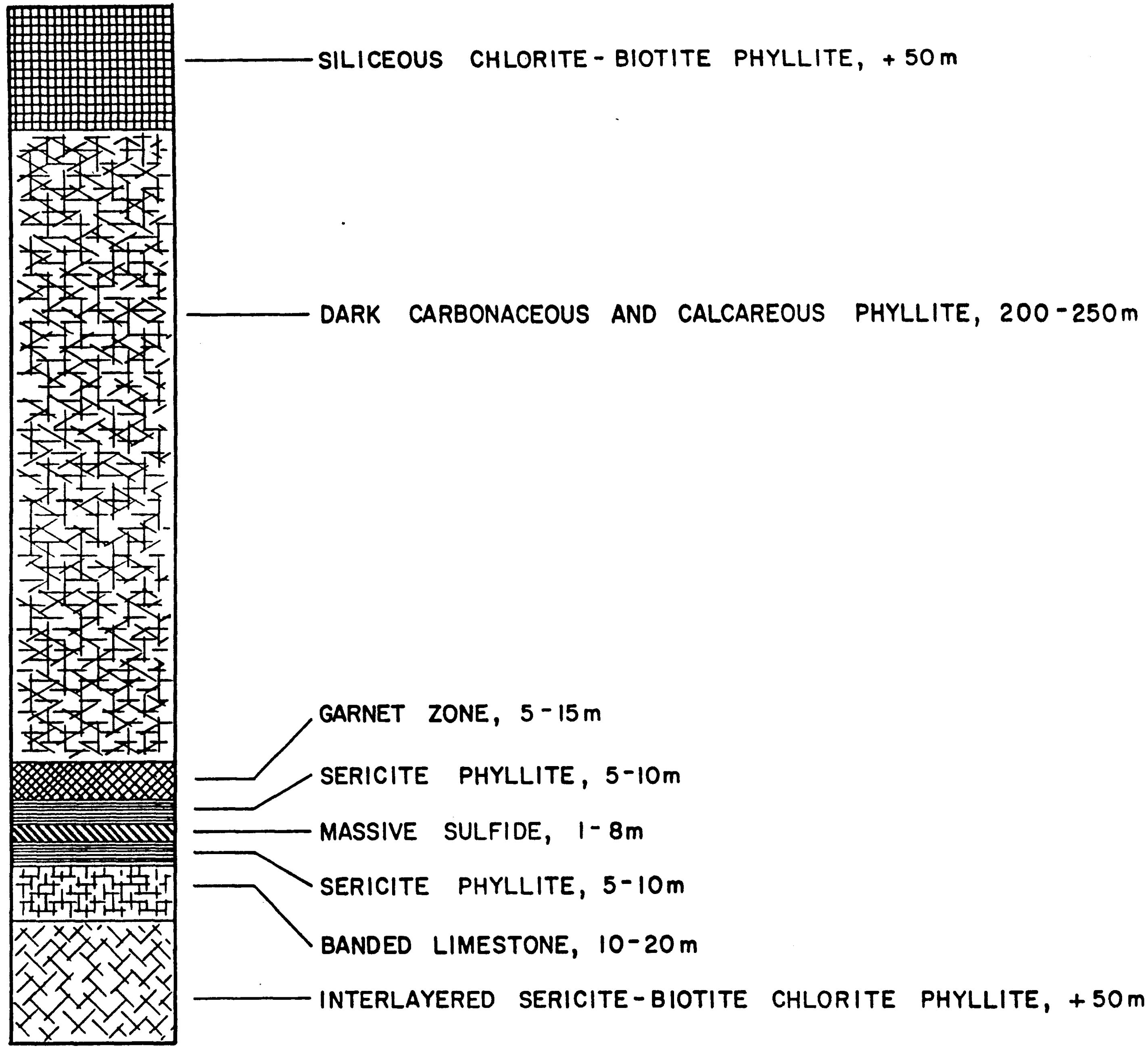
LOCATION MAP

FIGURE 1



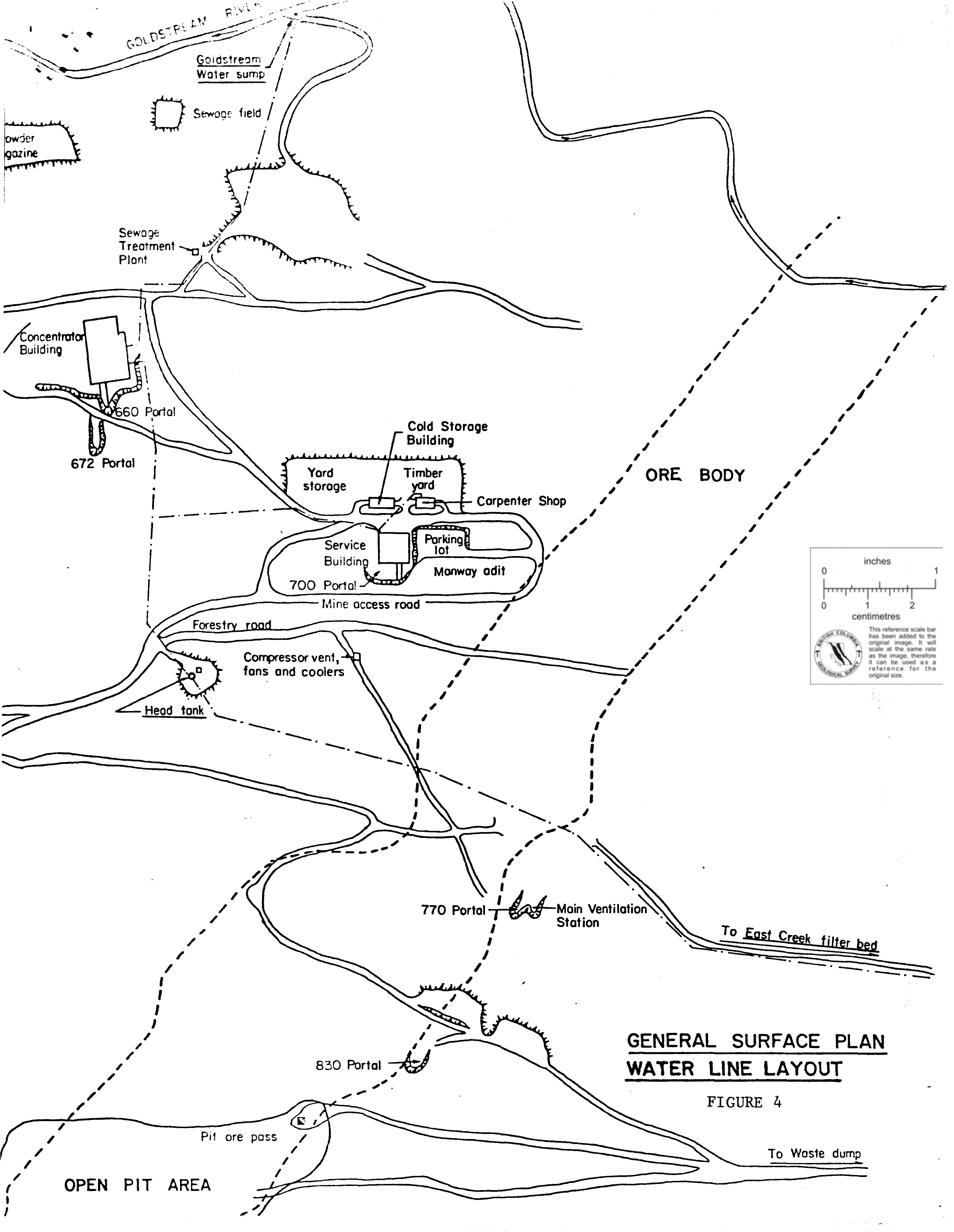
NORANDA MINES GOLDSTREAM CLAIM BOUNDARY

FIGURE 2



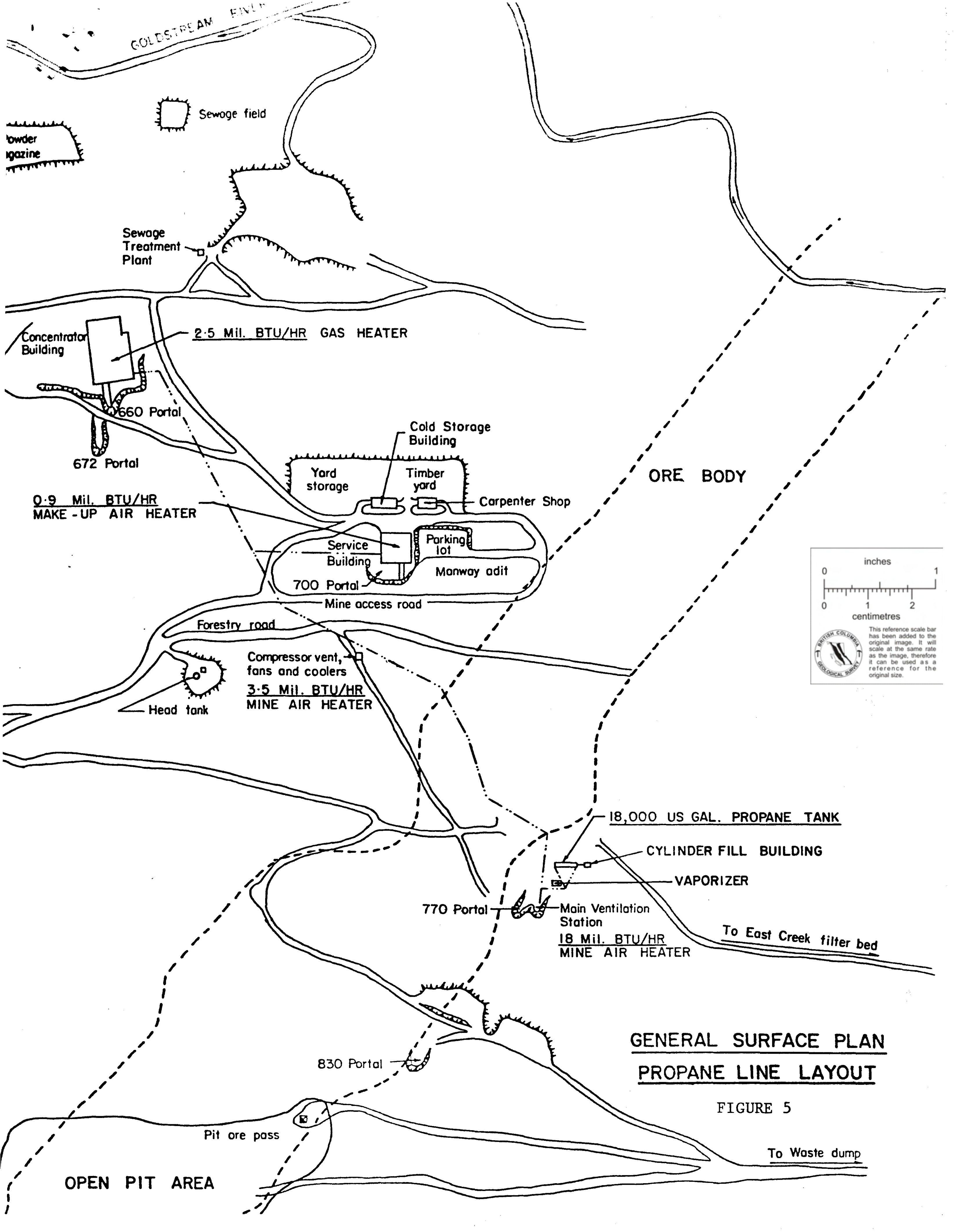
GOLDSTREAM ROCK UNITS

FIGURE 3



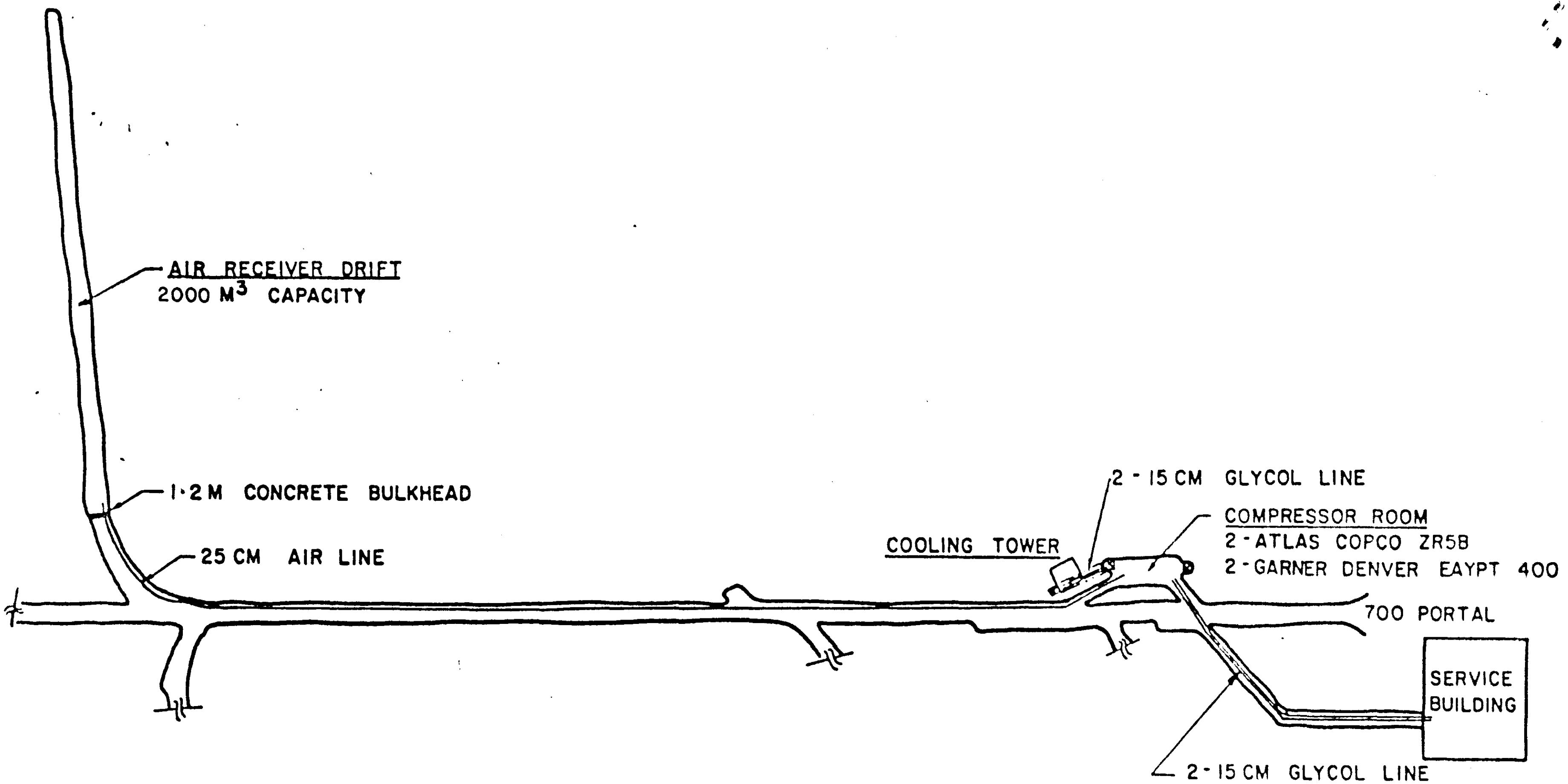
GENERAL SURFACE PLAN
WATER LINE LAYOUT

FIGURE 4



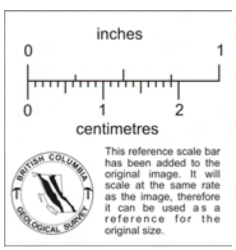
GENERAL SURFACE PLAN
PROPANE LINE LAYOUT

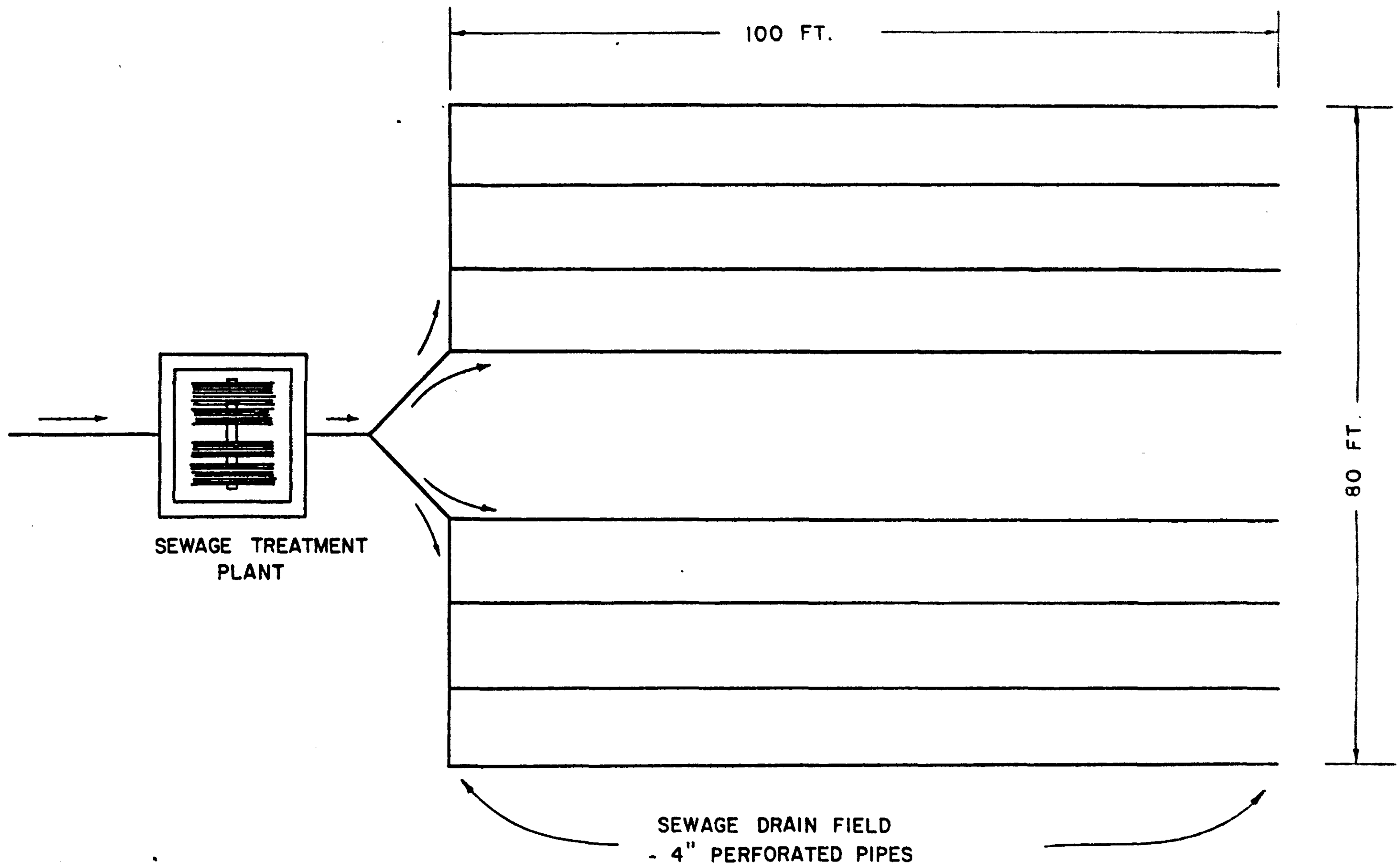
FIGURE 5



COMPRESSED AIR SYSTEM

Figure 6





SEWAGE TREATMENT GENERAL ARRANGEMENT

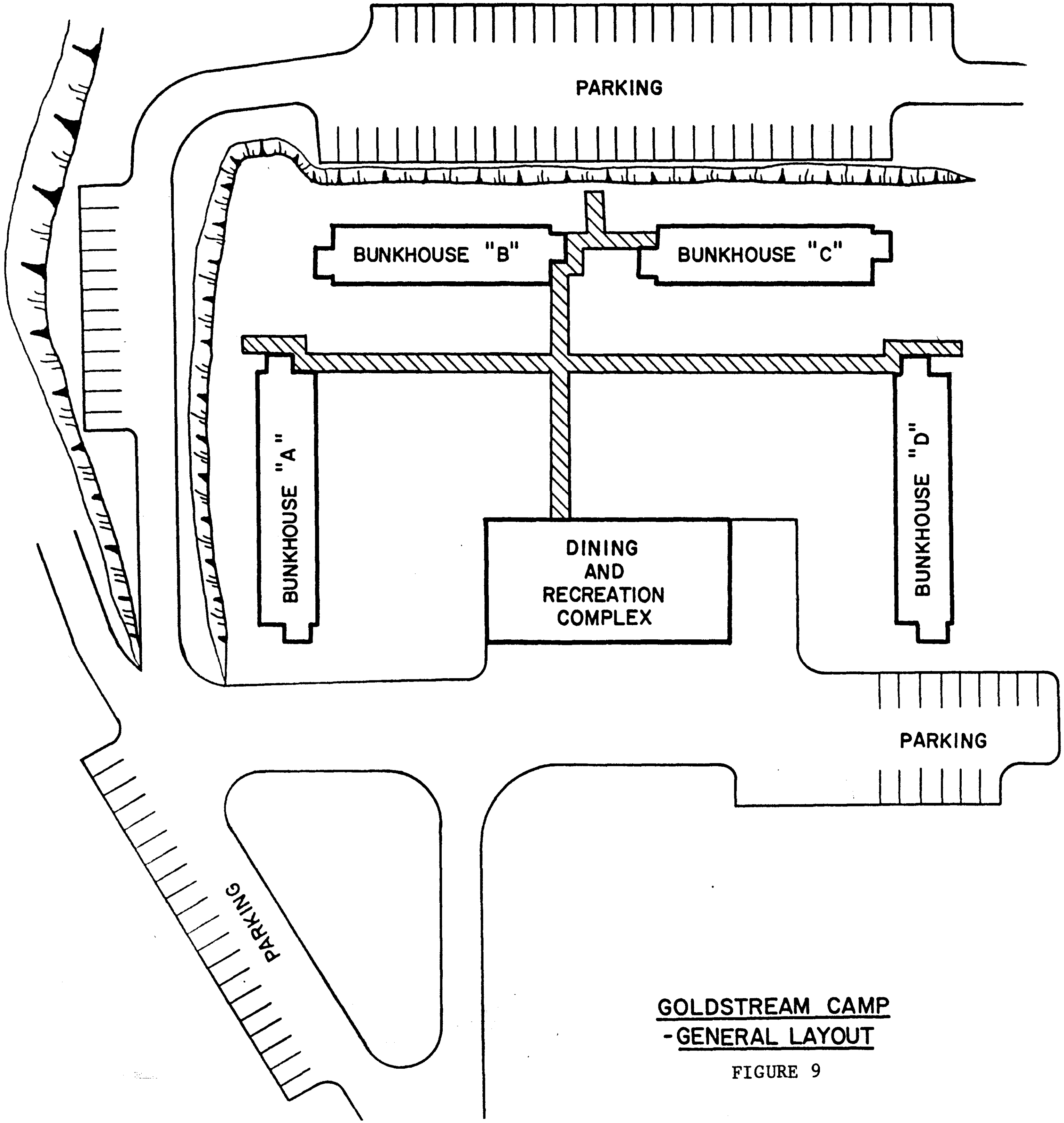
FIGURE 7

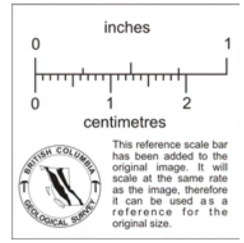
GOLDSTREAM WORKFORCE PROJECTION

	STAFF	HOURLY	TOTAL
UNDERGROUND	5 (7)	42 (73)	47 (80)
OPEN PIT	2 (0)	18 (0)	20 (0)
MILL OPERATIONS	13	21	34
MINE MAINTENANCE	1	20	21
MILL MAINTENANCE	1	10	11
ELECTRICAL	1	6	7
SURFACE	1	7 (8)	8 (9)
SAFETY/FIRST AID	2	4	6
WAREHOUSE	1	3	4
ENGINEERING	9	-	9
GEOLOGY	3	-	3
ACCOUNTING/PURCHASING	9	-	9
EMPLOYEE RELATIONS	1	-	1
MANAGEMENT	4	-	4
	53 (53)	131 (145)	184 (198)

( ) INDICATES WORKFORCE AFTER PIT COMPLETION

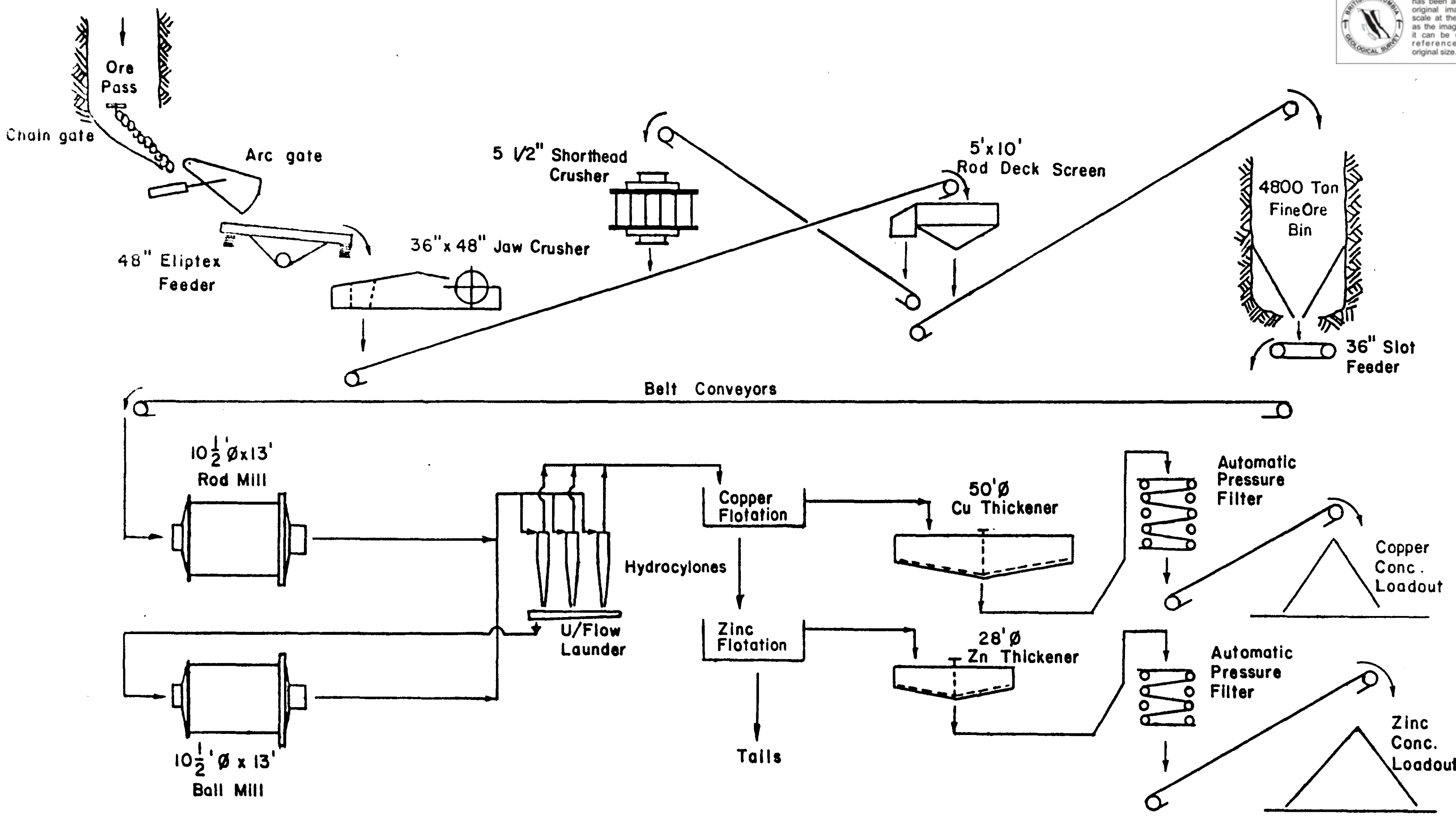
FIGURE 8





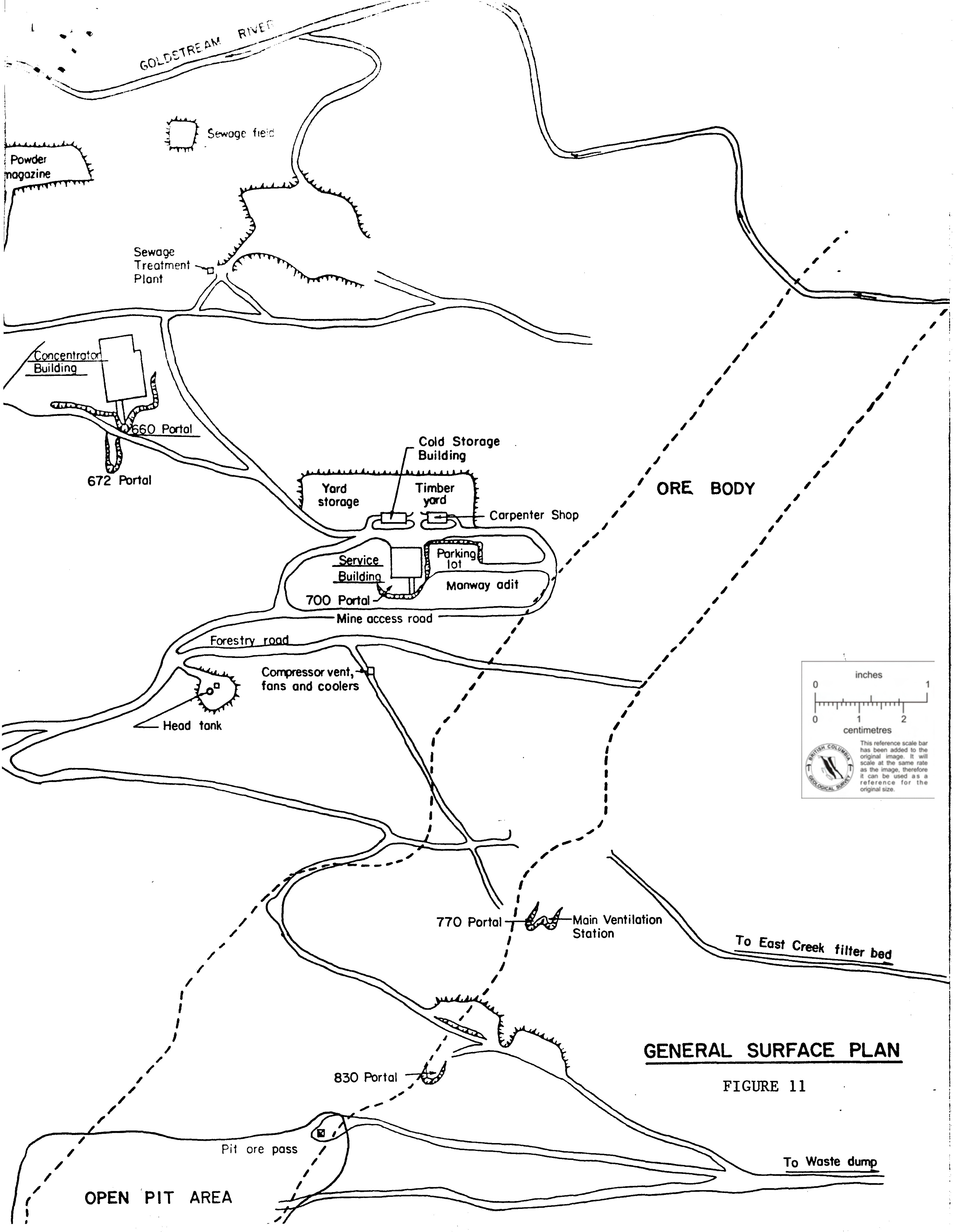
GOLDSTREAM CAMP
-GENERAL LAYOUT

FIGURE 9



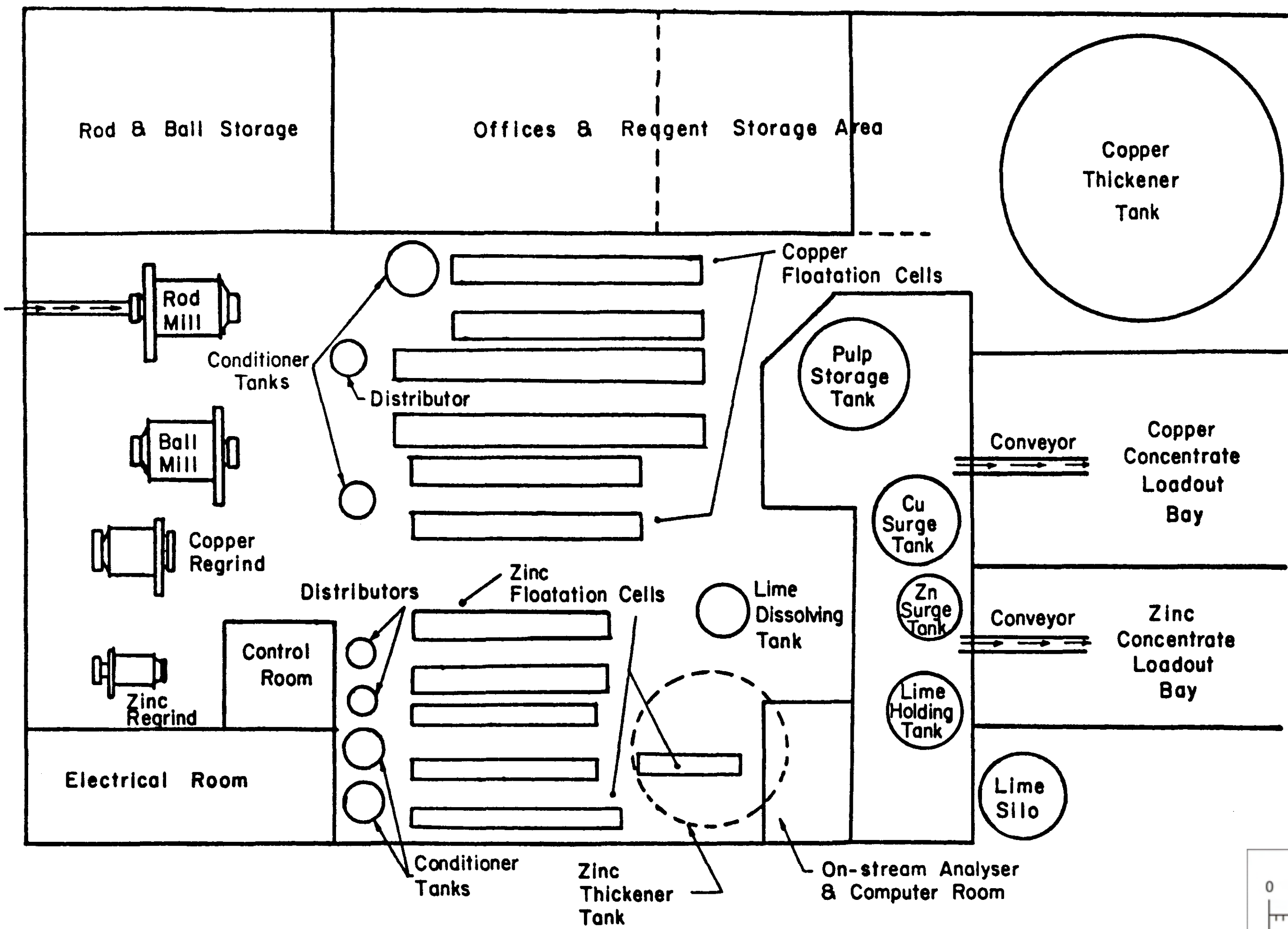
GOLDSTREAM GENERAL PROCESS FLOW DIAGRAM

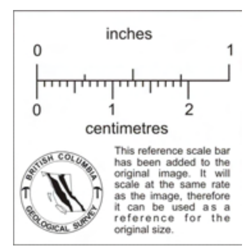
FIGURE 10



GENERAL SURFACE PLAN

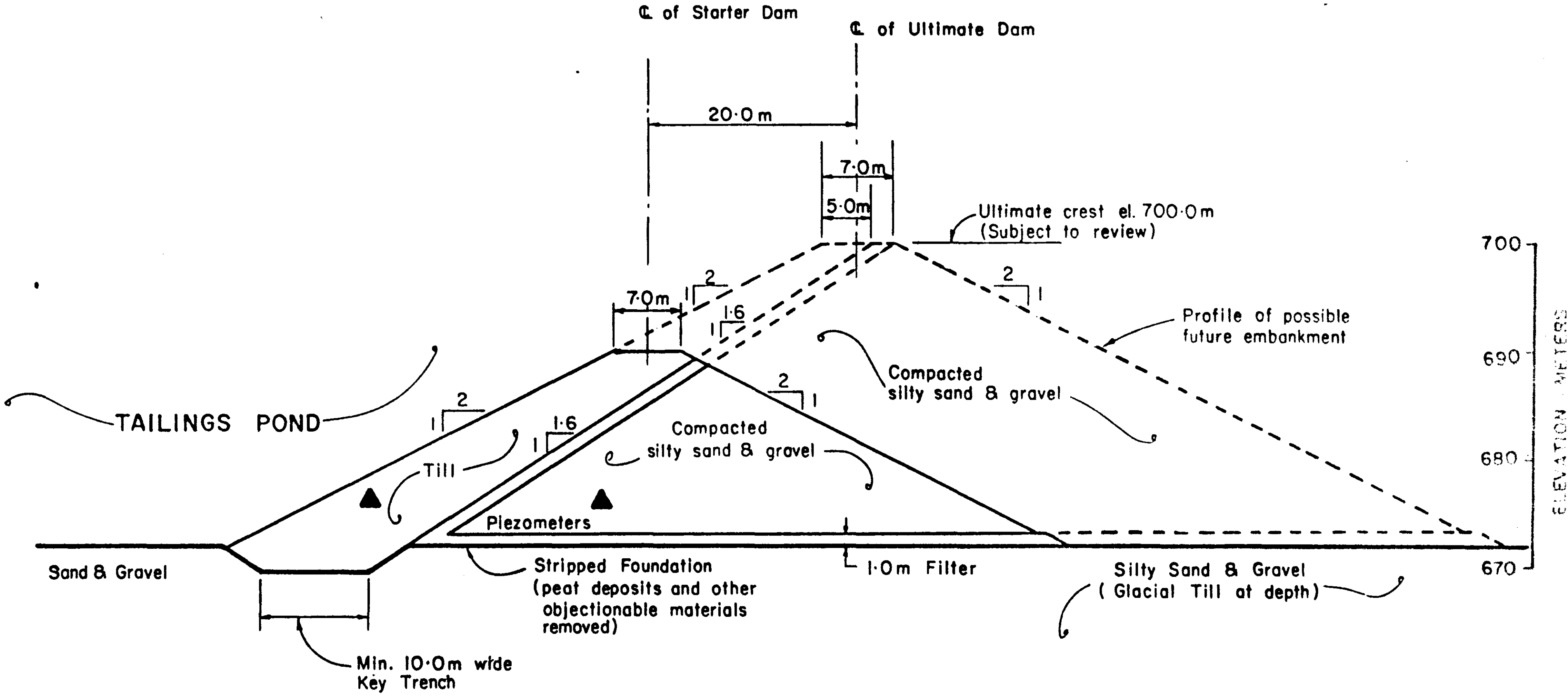
FIGURE 11





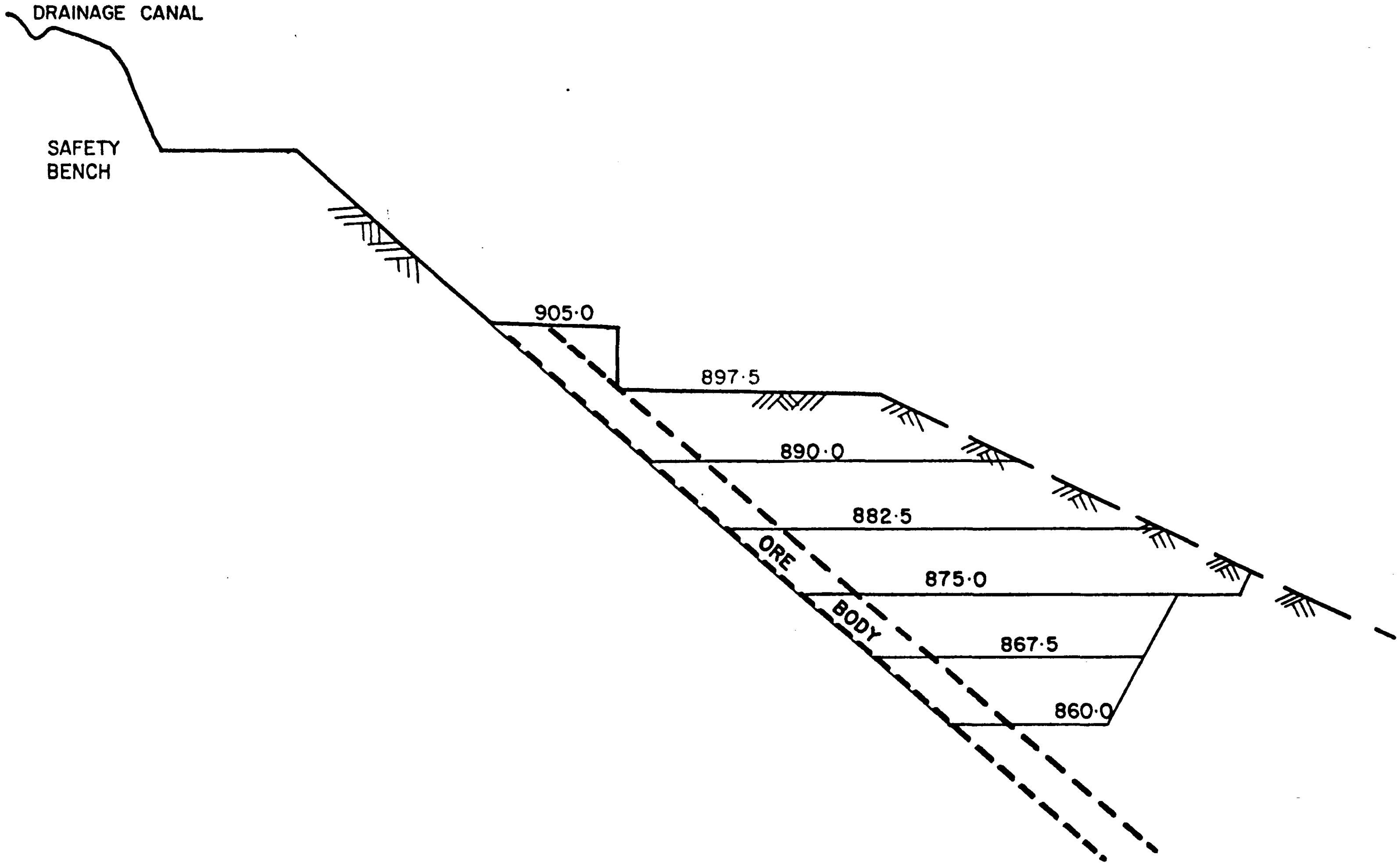
GOLDSTREAM CONCENTRATOR - GENERAL ARRANGEMENT

FIGURE 12



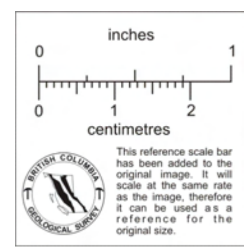
WEST TAILINGS DAM SECTION

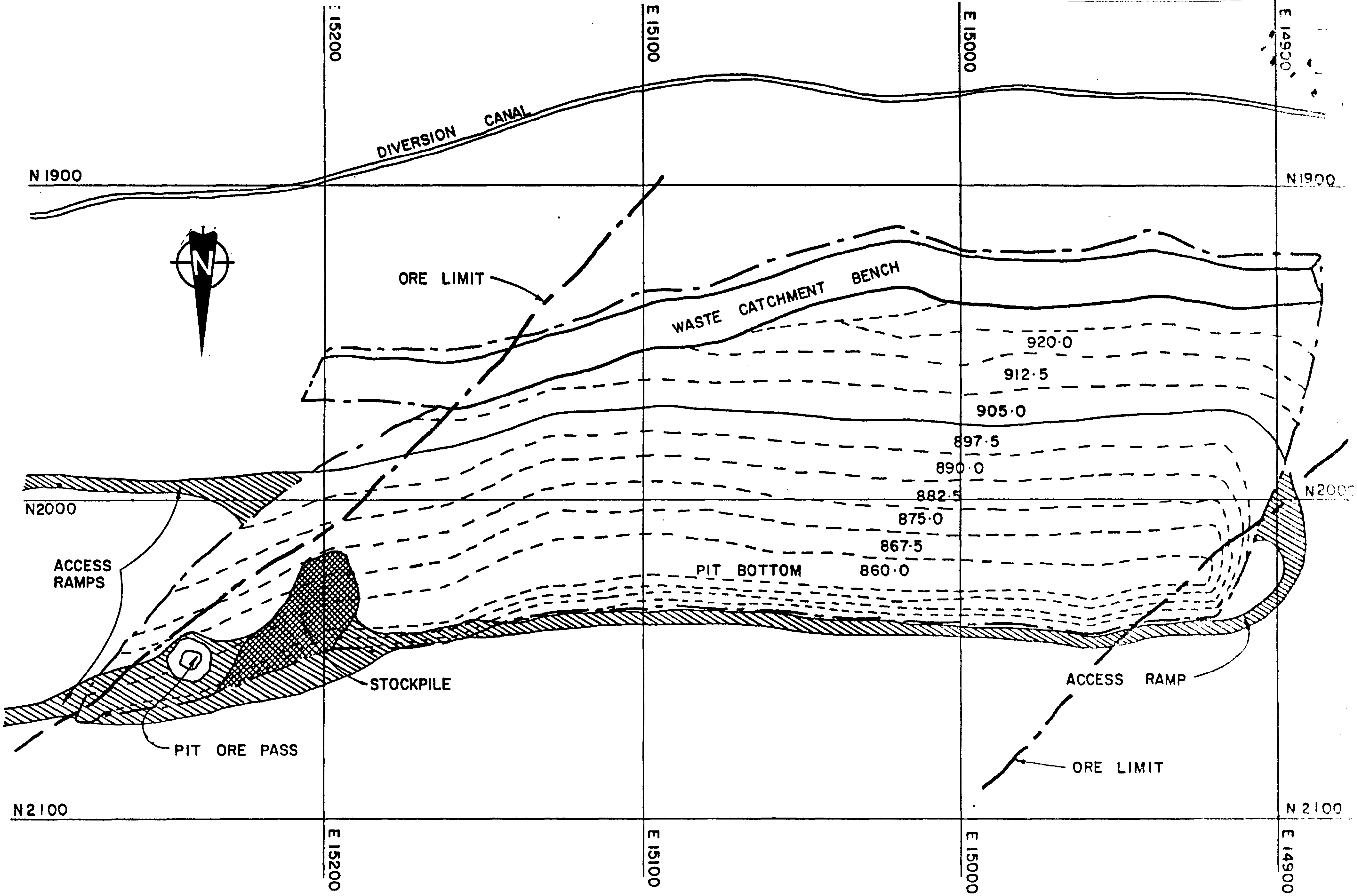
FIGURE 13



TYPICAL SECTION OF OPEN PIT

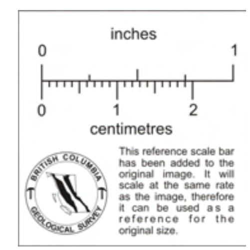
FIGURE 14

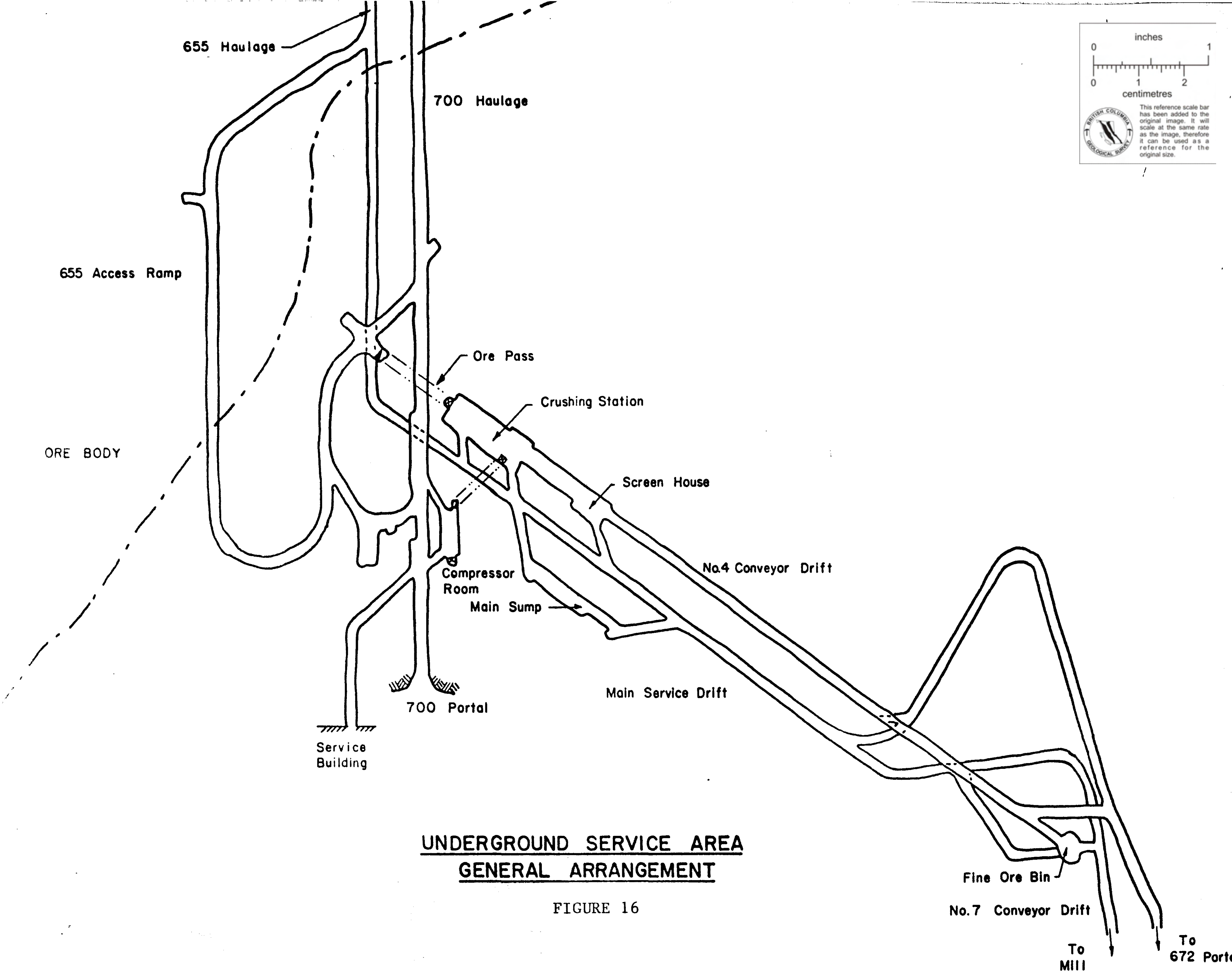




OPEN PIT PLAN

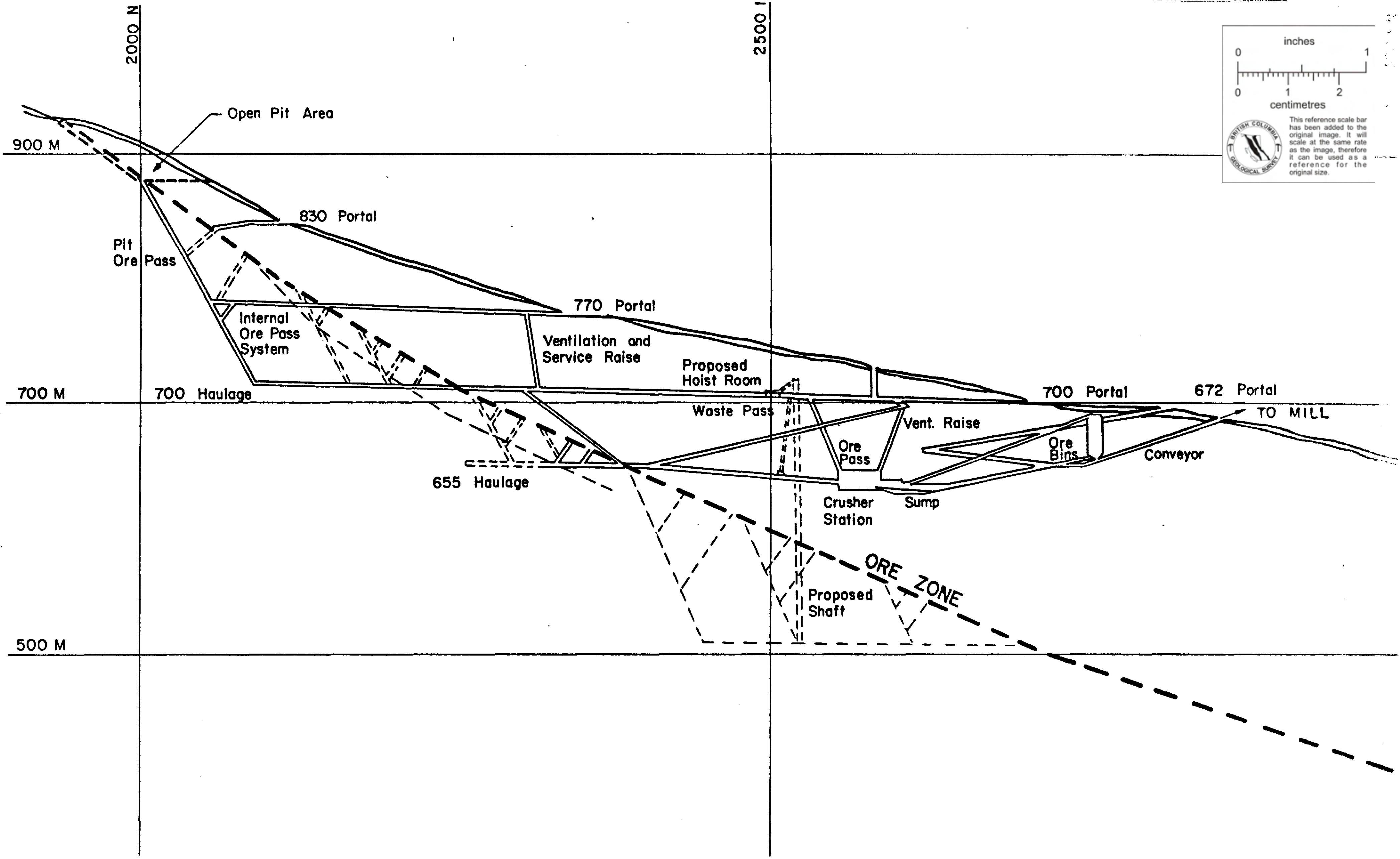
FIGURE 15





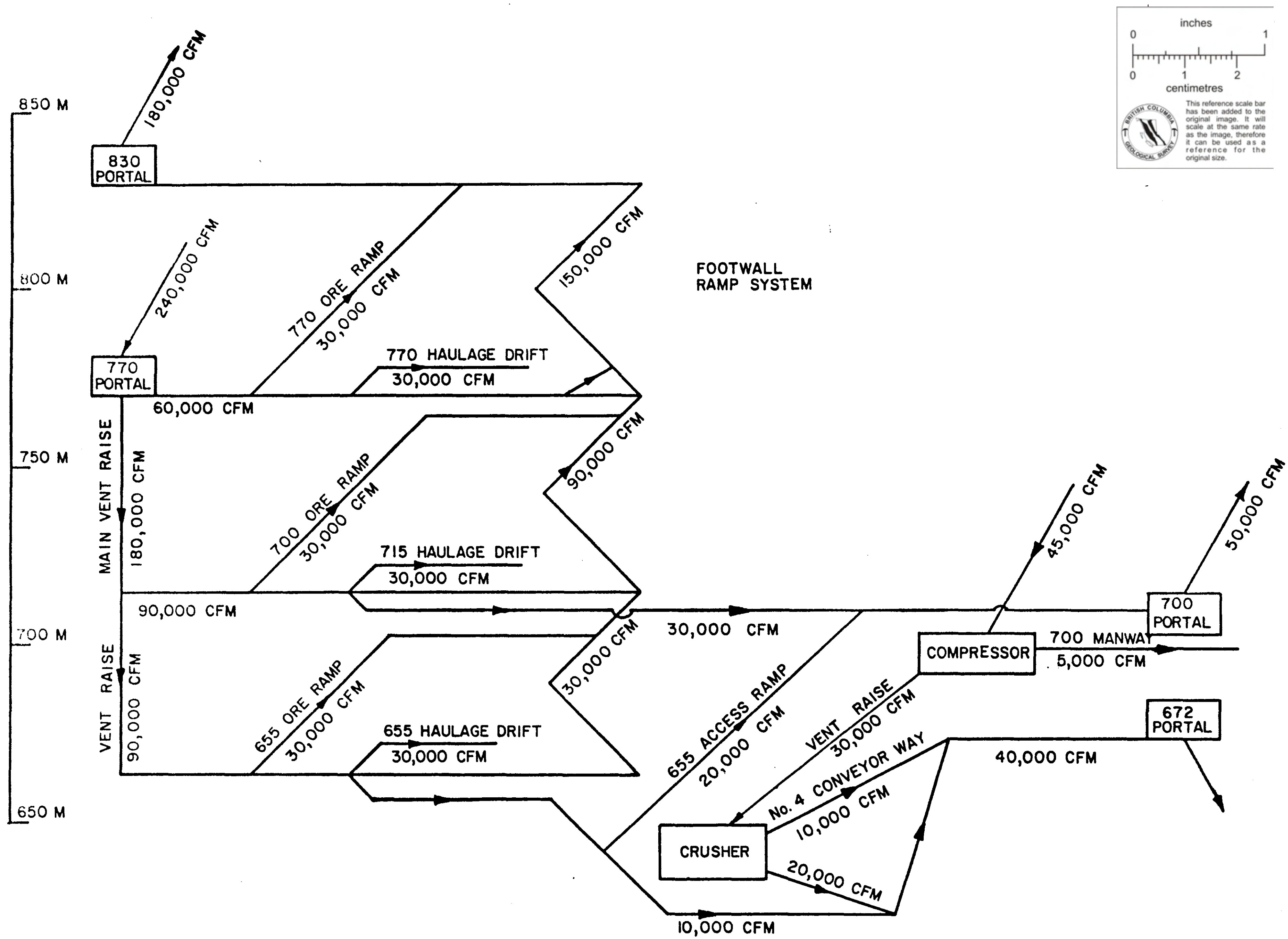
UNDERGROUND SERVICE AREA
GENERAL ARRANGEMENT

FIGURE 16



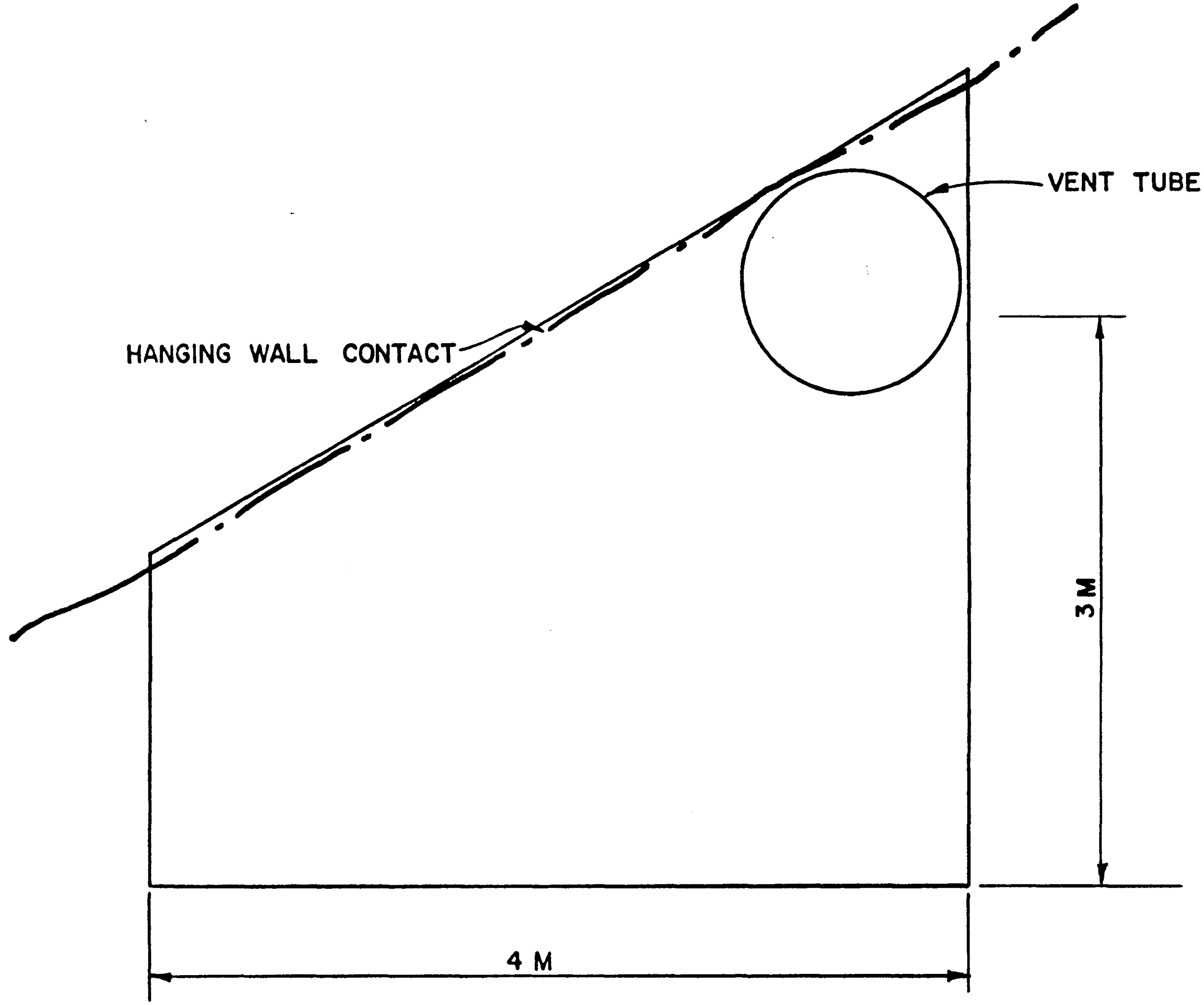
VERTICAL SECTION OF UNDERGROUND DEVELOPMENT

FIGURE 17



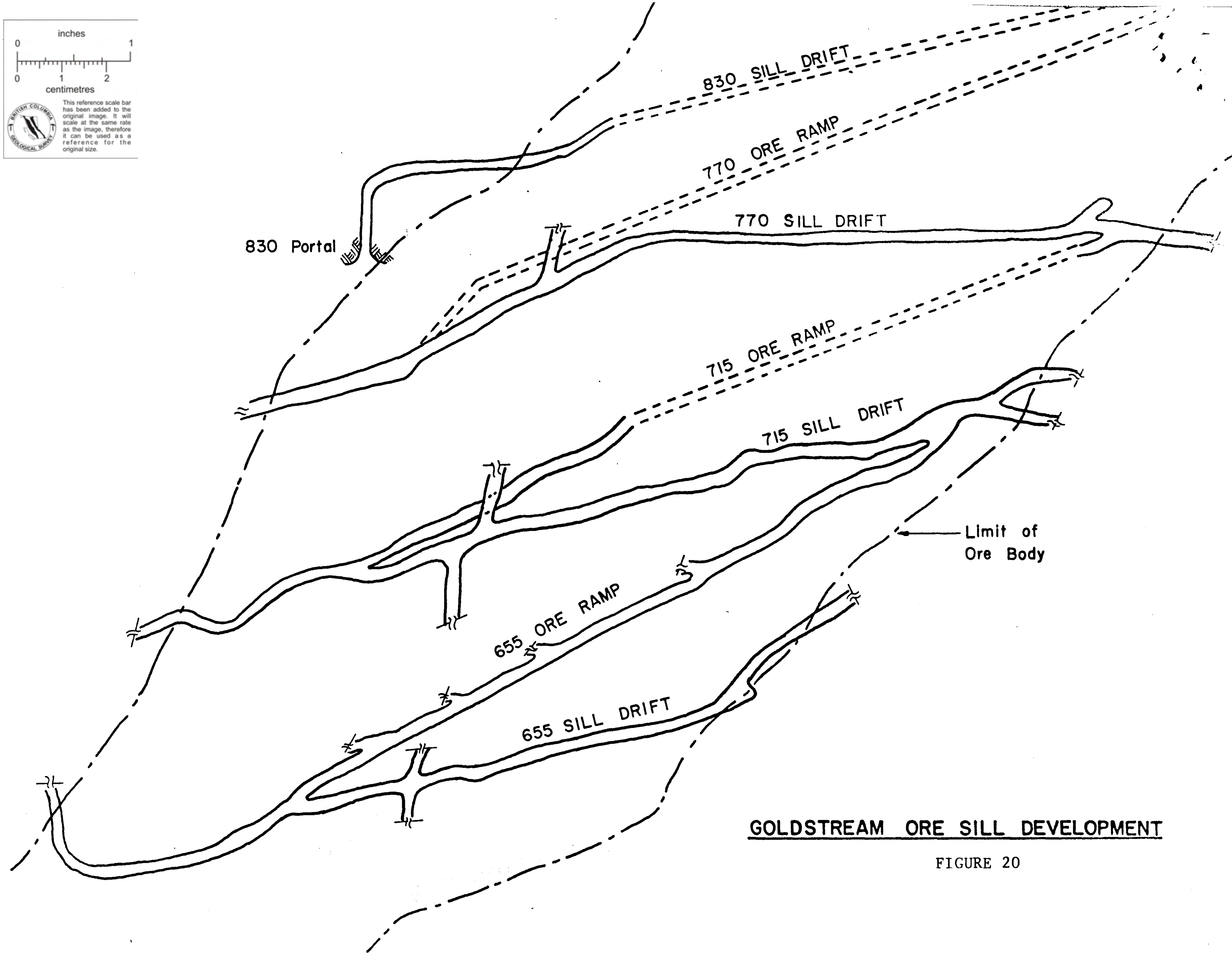
UNDERGROUND VENTILATION SCHEMATIC

FIGURE 18



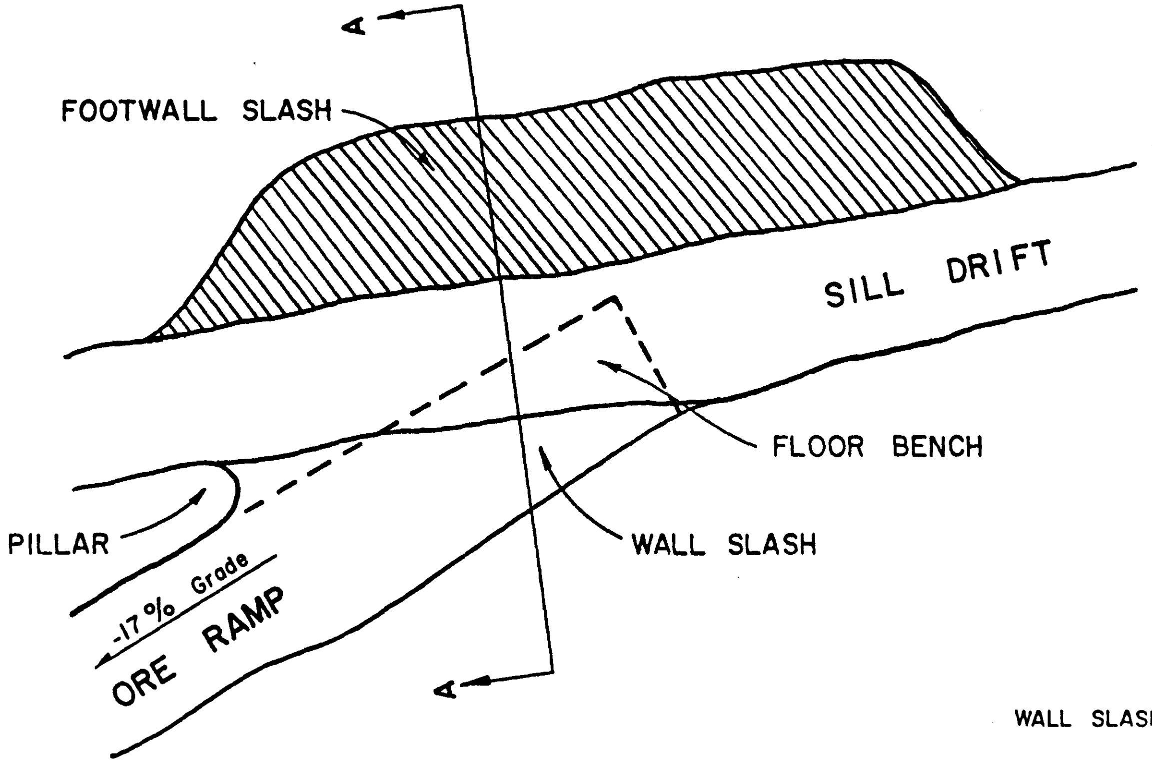
CROSS SECTION OF SILL DRIFT

FIGURE 19



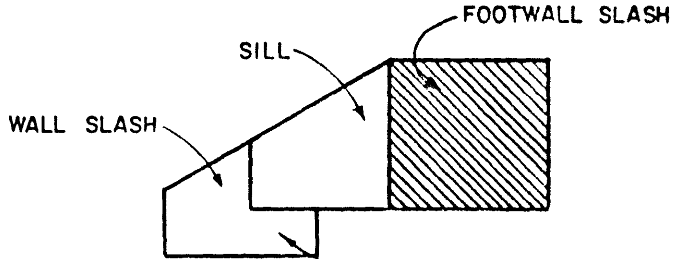
GOLDSTREAM ORE SILL DEVELOPMENT

FIGURE 20

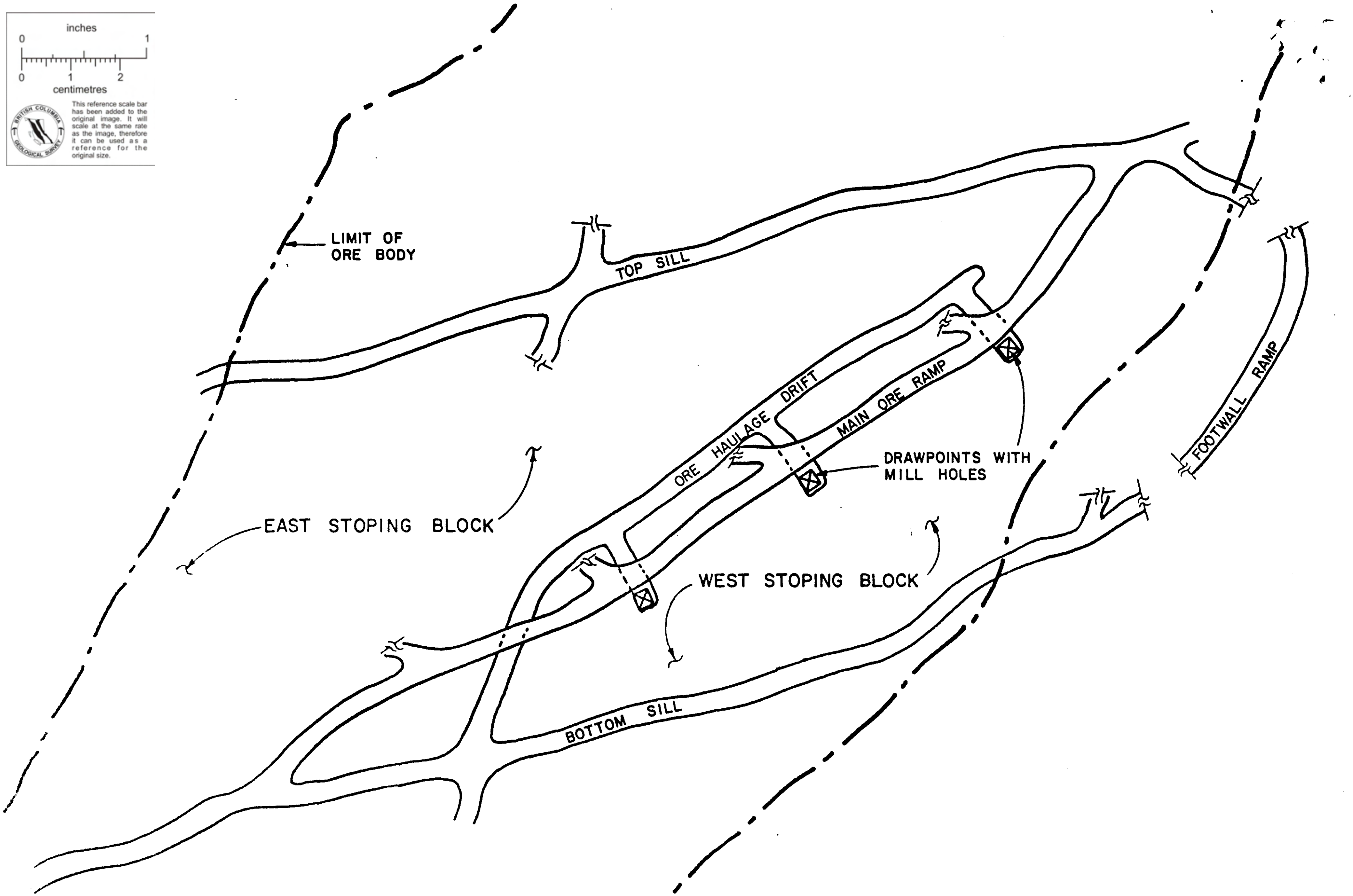


PLAN OF ORE RAMP COLLAR

FIGURE 21

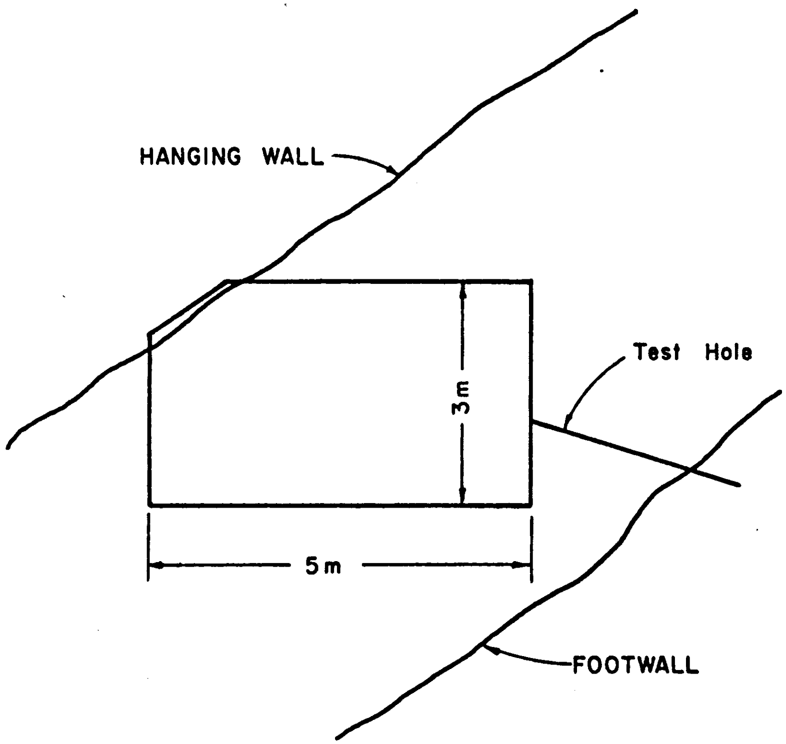


SECTION "A-A"

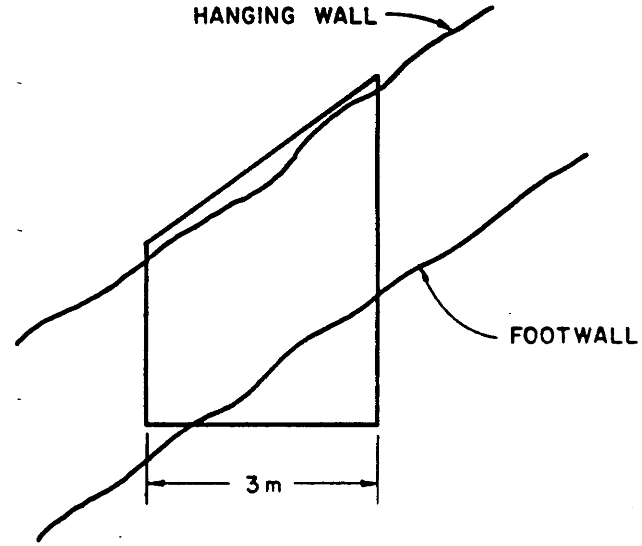


PLAN OF ORE BLOCK DEVELOPMENT

FIGURE 22

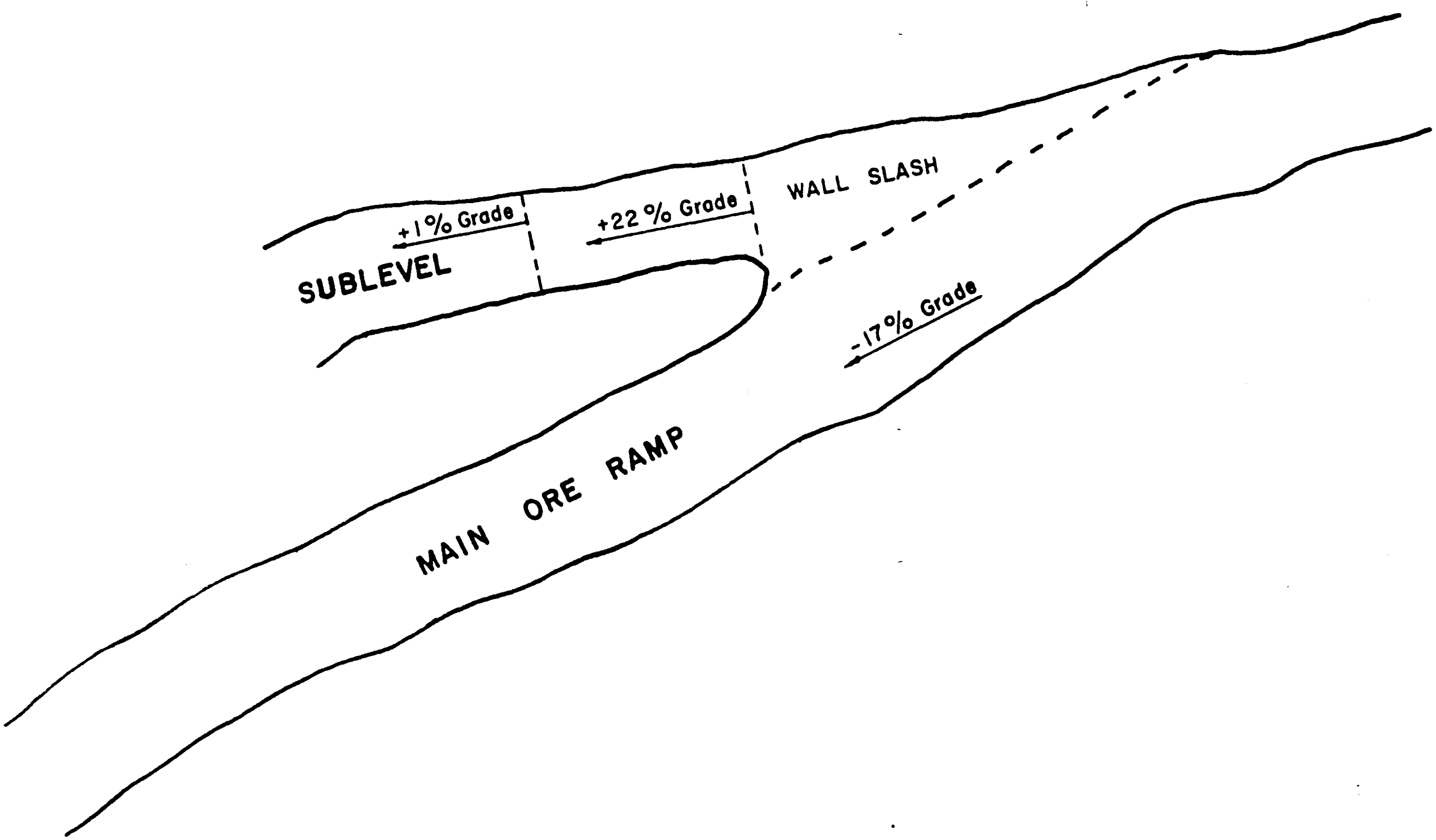


CROSS SECTION OF SUBLEVEL
IN WIDE ORE



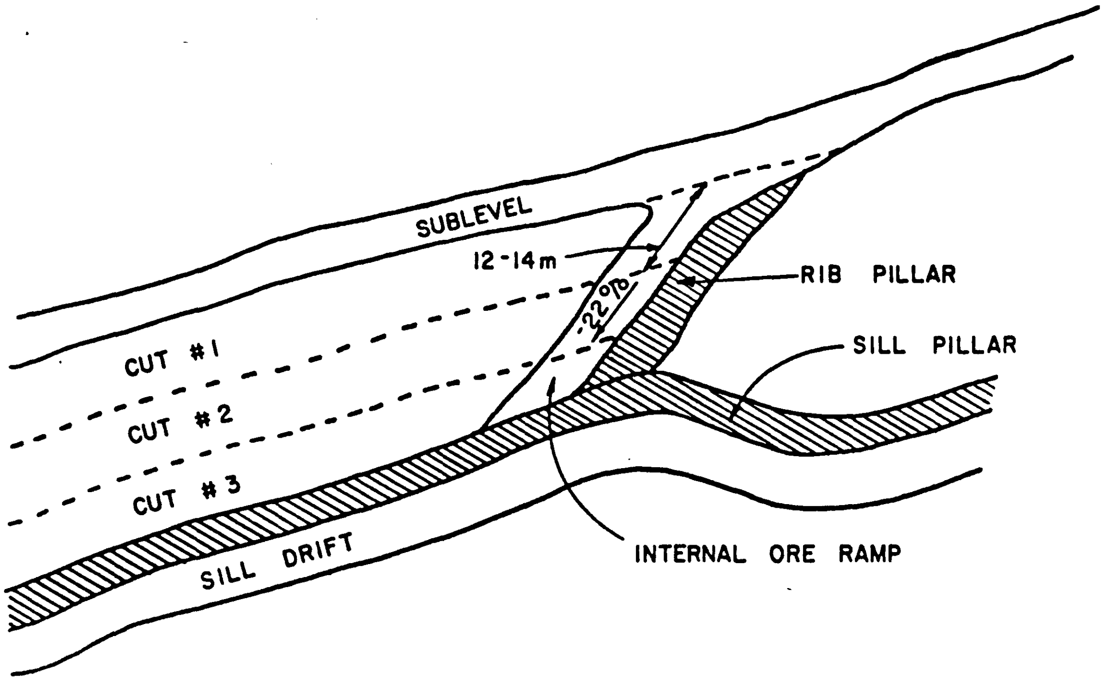
CROSS SECTION OF SUBLEVEL
IN NARROW ORE

FIGURE 23



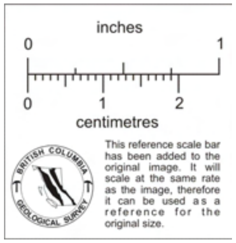
PLAN OF SUBLEVEL COLLARED OFF ORE RAMP

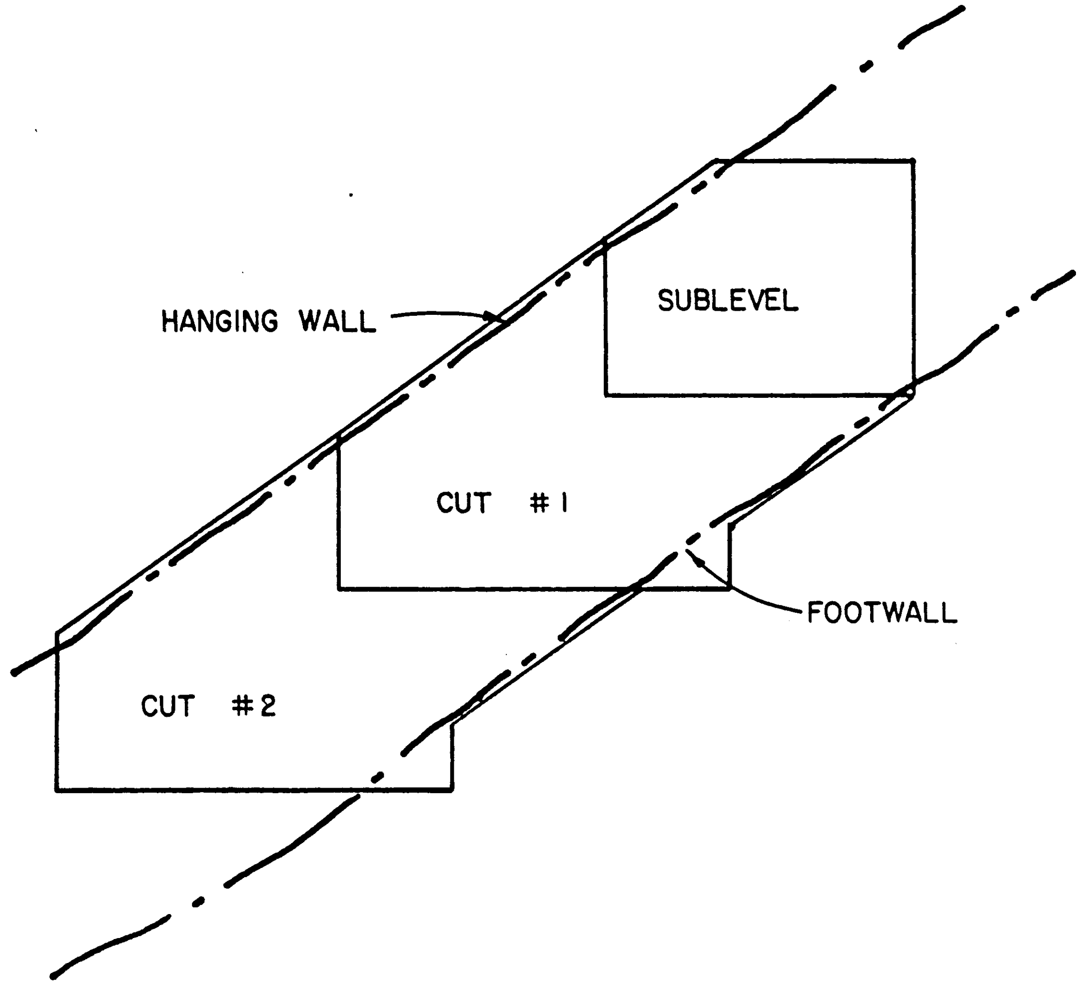
FIGURE 24



PLAN OF RAMP ACCESS TO STOPE CUT

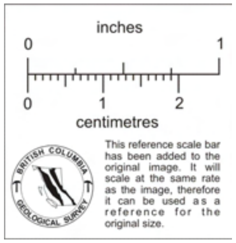
FIGURE 25

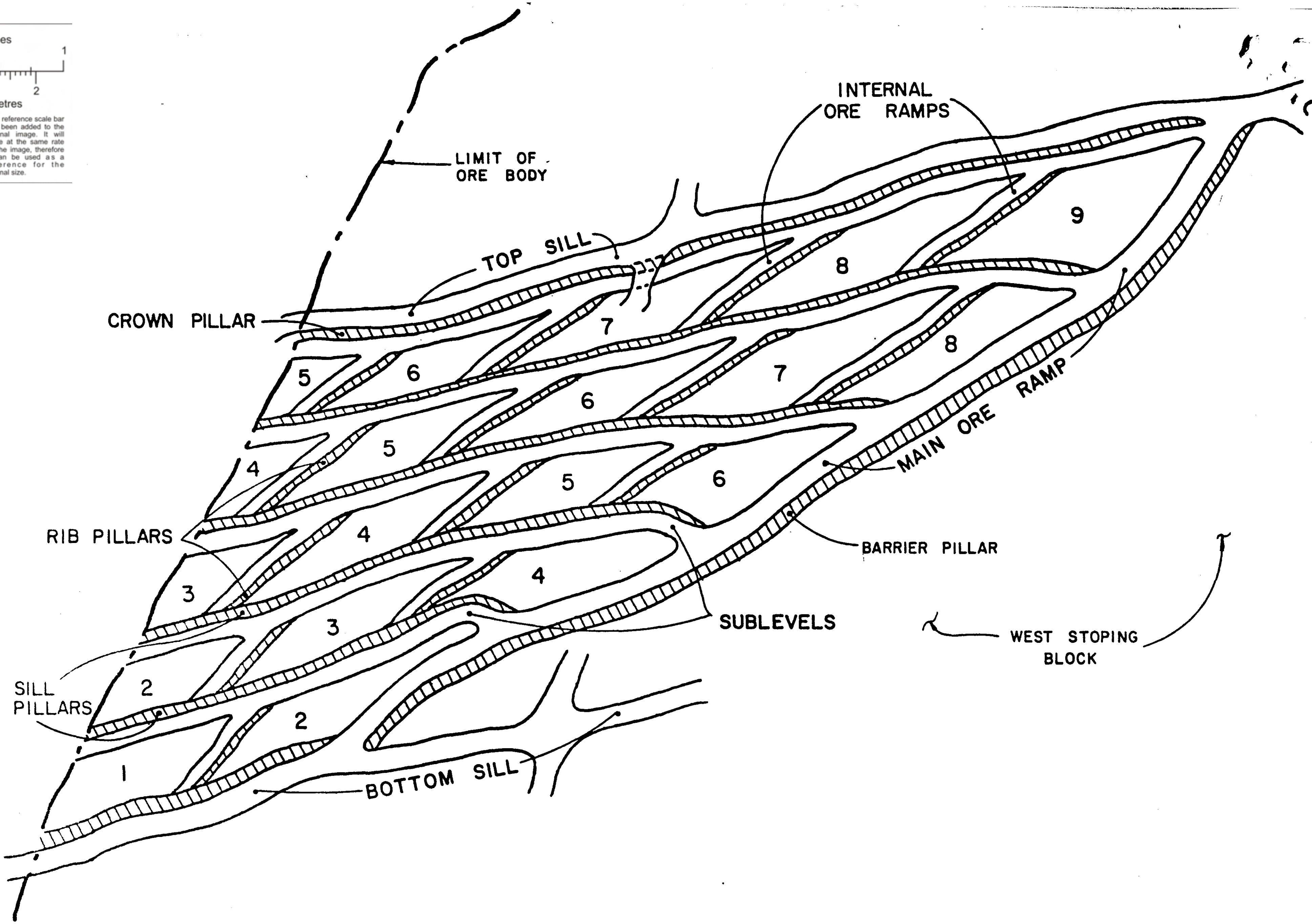




CROSS SECTION OF STOPE BENCHING

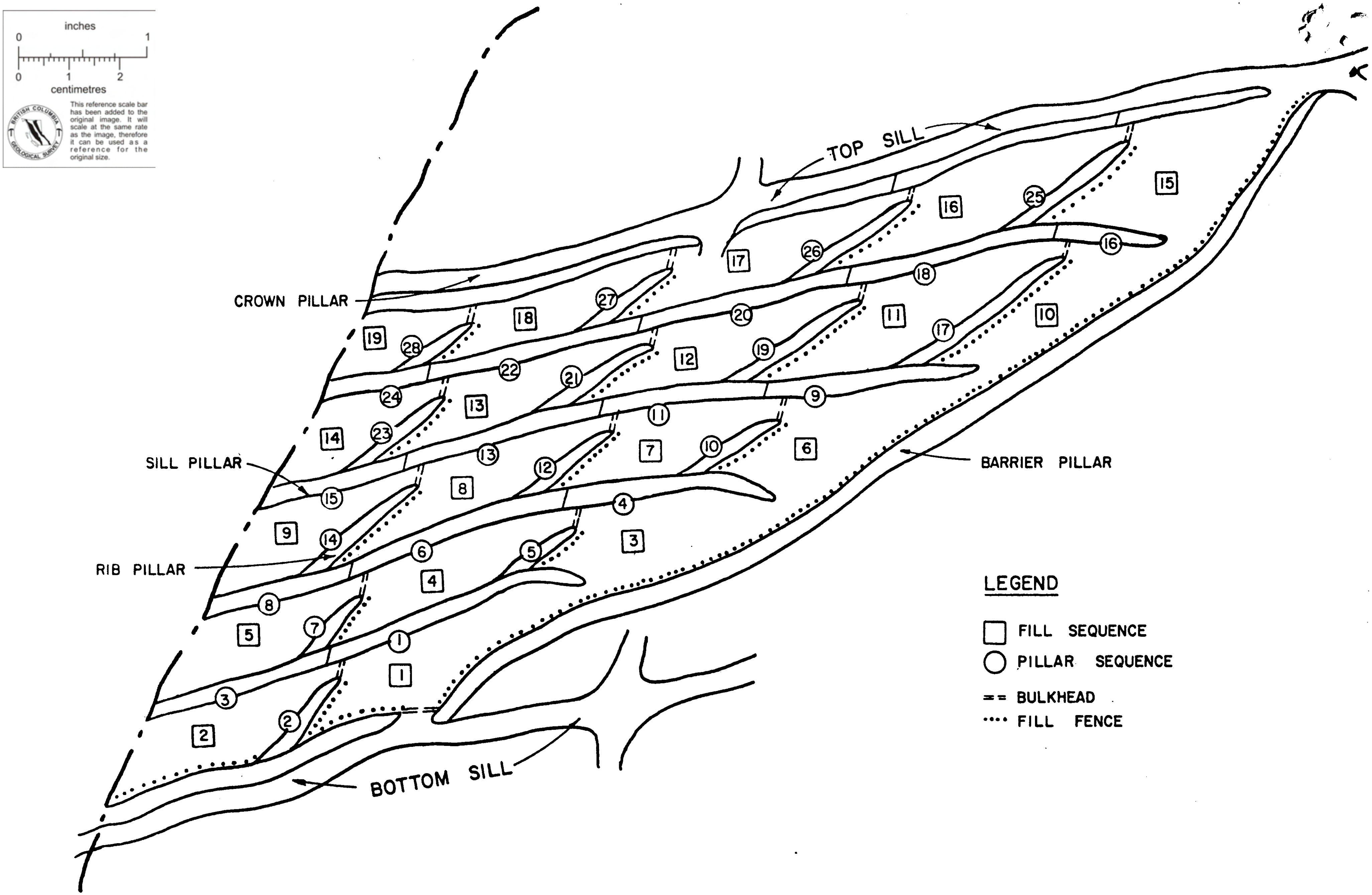
FIGURE 26





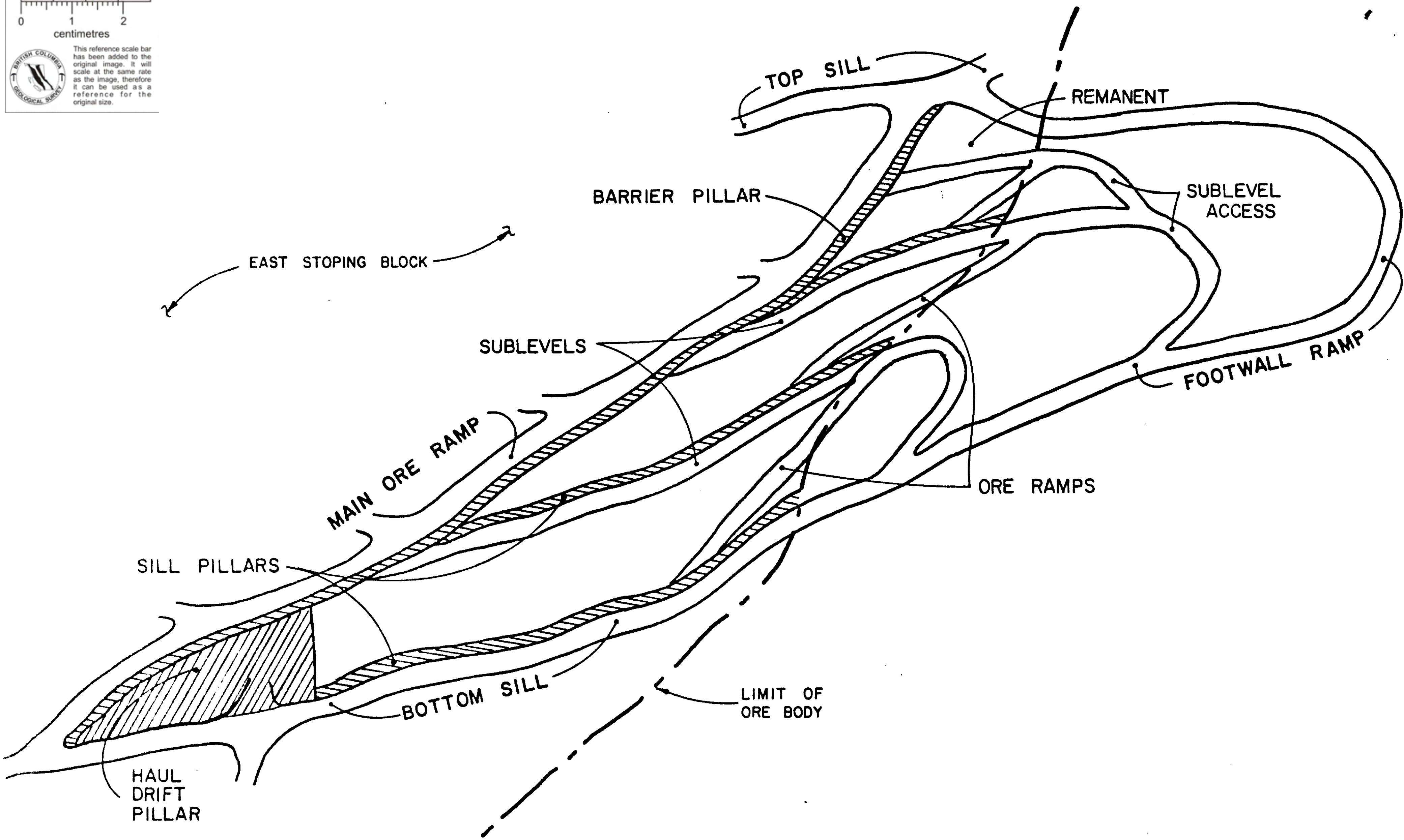
<u>MINING SEQUENCE OF THE EAST ORE BLOCKS</u>

FIGURE 27



FILLING AND PILLAR RECOVERY SEQUENCE

FIGURE 28



MINING OF WEST ORE BLOCK

FIGURE 29

CAPITAL AND PRE-PRODUCTION COSTS

UNDERGROUND	DEVELOPMENT	10,000,000
	EQUIPMENT	3,300,000
	INSTALLATIONS	5,800,000
OPEN PIT	DEVELOPMENT	1,300,000
	EQUIPMENT	1,700,000
CONCENTRATOR		18,000,000
GENERAL SITE AND BUILDINGS		5,700,000
POWER		6,300,000
CONCENTRATE LOADOUTS		1,000,000
CAMPSITE		3,700,000
STARTUP		1,700,000
PRE-PRODUCTION INDIRECTS		12,700,000
TOTAL		71,200,000

FIGURE 30

in Larox pressure filters obtaining three to five percent moisture. The dried concentrates are stored on covered concrete pads just outside the concentrator. Copper concentrate is trucked to a rail loadout facility in Revelstoke and loaded into rail cars for shipment to Noranda's Horne Smelter. Zinc concentrate is trucked directly to Cominco's Trail Smelter.

Tailings are pumped from the concentrator basement by two parallel pumping systems up to a tailings box at the 730 elevation. This control tank feeds the tailings line, which follows a route parallel to the mine access road, at a slope of about 0.5% to the tailings pond. It sits on a prepared base cut into the hillside. Localized cover has been placed on the line to protect it from minor earth and snow slides and culvert pipes have been used to protect the line at road crossings.

The tailings containment area is a rectangular, U-shaped valley approximately 1000 metres long and 200 metres wide. With its natural topographic relief it was well suited to the requirements for the tailings impoundment. The available tailings storage area is approximately 24 hectares to elevation 700. (Figure 2)

The tailings impoundment area required the construction of two earth dams averaging approximately 19 metres in height. The dams have been constructed as water retention structures. (Figure 13)