ALASKA LEGISLATURE COMMITTEE FILES 1985-1986 8672

3534 HRES COMINCO RED DOG PROJECT--OVERVIEW

410

## B. Outline of Topics to be Considered in a Right-of-Way Agreement

# MEMORANDUM State of Alaska

DEPARTMENT OF NATURAL RESOURCES - DIVISION OF LAND AND WATER MANAGEMENT
NORTHCENTRAL DISTRICT - 4420 AIRPORT WAY, FAIRBANKS, ALASKA 99707

TO: John Sims, Director
Department of Commerce
Office of Minerals Development
Fairbanks

DATE: December 20, 1983

FILE NO: Red Dog

TELEPHONE NO: 479-2243

FROM: Jerry Brossia
District Manager

SUBJECT: Red Dog R/W

This memorandum outlines topics that should be considered in a ightof-Way agreement for the Red Dog project. This information has n been reviewed by the Commissioner's office; therefore, these topics are considered as a draft. This information will also need to be reviewed by the Department of Law prior to meeting with NanaCominco.

We have been actively meeting with the Attorney General in Fairbanks and hope to receive further policy guidance from him and the task force in the near future.

In order to complete a Right-of-Way agreement it is necessary to determine land ownership for the entire route. There may be a variety of land owners along the proposed road (ie. National Park Service, Nana, Kivalina, Native Allotments, or mining claims). This review is currently underway and should be complete by late January 1984.

The RightofWay with Nana should include the following sections:

1. <u>General discussion of grant</u>
   a. Purpose
   b. Definitions
   c. Location
   d. Third parties interests.
2. <u>Reciprocal agreements with Nana</u>
3. <u>Late comers' user agreements</u>
4. <u>Port and tideland use</u>
5. <u>Upland expansion for industrial purpose.</u>
6. <u>Availability of road use</u>
   a. Industrial
   b. Public
   c. Subsistence



02-001A(Rev. 10/79)

7. Alignment/realignment for engineering or environmental purposes

8. Mitigative measures

   a. Environmental
   b. Maintenance

9. Liability

10. Indemnification of State

11. Bonding

12. Insurance

13. Books/Accounting record access

14. Reservations

   a. State
   b. Nana

15. Compliance with Notice to Proceed and Stop Work

16. Forfeiture/Breaches

17. Termination Plans

Other Items:

Land Exchanges

Cost Reimbursement Schedules (if State financed)

Toll Charges

Nana has been advised, on December 20, 1983, that we are willing to discuss the R/W with them. Don Argestinger will contact me to set up a time.

cc: Jim Barnette
Tom Hawkins
Esther Wunnicke

## C. Commissioner's Response to Cominco and GCO Minerals Right-of-Way Applications

STATE OF ALASKA

BILL SHEFFIELD, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES

OFFICE OF THE COMMISSIONER

POUCH M
JUNEAU, ALASKA 99811
PHONE: (907)465-2400

March 9, 1983

Mr. W. H. Tonking
Executive Vice President
GCO Minerals Company
P. O. Box 4258
Houston, TX 77210

Mr. H. M. Giegerich
President and General Manager
Cominco Alaska
5660 "B" Street
Anchorage, AK 99502

Dear Mr. Tonking:

The Department of Natural Resources has now received applications and supporting documentation for rights-of-way from both Cominco Alaska and GCO Minerals Company to connect mineral deposits in the Western Delong Mountains with tidewater. We are pleased to see the significant effort that is underway to develop these mineral resources with due regard for engineering and environmental concerns. As the Department's involvement in this project gets underway, it is appropriate to provide both companies with our position on several key issues.

1. The State of Alaska will authorize the development of a single transportation corridor. The route will be public and available to multiple use by other future resource developments in the region. As a public route, reciprocal right-of-way agreements must be acquired wherever private or corporate ownership is encountered.

2. Tideland (and associated upland) port development will also be available to support multiple users such as oil and gas, coal exploration, or support services development.

3. Local concerns, particularly subsistence use must be accommodated to the maximum extent possible.

4. One EIS should be produced that considers all potential options. To this end, the research data collected by both companies should be available to all participating agencies.

In consideration of these points and as an aid to the various agencies that will participate in this project a unified industry position is desirable. Since the primary objective of both companies is to ship mineral commodities, and consolidation of support facilities in the coastal zone is required under State law, you should strive to resolve any differences you may have and mutually support a common right-of-way and port site development.

The Department will be an active review agency during the EIS process and will be prepared to provide the requested permits and/or leases within six months of EIS adoption.

I am hopeful that these points provide better direction at the outset of this project and I look forward to a successful venture. We also will be available to meet with all involved parties in Anchorage at your earliest convenience.

Sincerely,

Esther C. Wunnicke

Esther C. Wunnicke
Commissioner

cc: Commissioner Dan Casey, DOT/PF
Curt McVee, BLM
Bill Riley, EPA
Harris Saxon, Ely, Guess & Rudd
Jerry Brossia, NCDO
Tom Hawkins, DLWM
Don Argetsinger, NANA

# IX. Appendices

Appendix A: Project Description from Preliminary Draft Environmental Impact Statement

Appendix B: Red Dog Fact Sheet

Appendix C: Project Permitting Time-Line

Appendix D: Permit Flow Chart

Appendix E: Base Metal Markets (Cu, Pb, Zn): Alaskan Opportunities (Paper by Gordon H. Laurie, Cominco, Ltd.)

## Appendix A: Project Description from Preliminary Draft Enviromnmental Impact Statement

### INTRODUCTION

Development of the Red Dog mining project would involve an open pit lead/zinc mine located 131 km (82 mi) north of Kotzebue. The ore would be crushed and the metallic sulfides concentrated in a mill near the mine site, with the concentrates transported to the coast for shipment to market. While the deposit has not yet been fully defined by geologists, at least 77 million Mg (85 million tons) of ore exist. The ore contains approximately 5.6 percent lead, 17.1 percent zinc, 75 g/Mg (2.4 oz/ton) silver and measurable levels of barite. The project has a potential life of at least 40 years under expected production rates, with the possibility of extension if additional ore is found. The mine would be developed in two phases. The "initial" phase of production would extend five years and produce approximately 434,450 Mg/yr (479,000 tons/yr) of combined concentrates (Table II-1). The "expanded" phase of production would extend from the sixth year of development through the life of the project. Approximately 683,878 Mg/yr (754,000 tons/yr) of combined concentrates would be produced during this phase (Table II-1).

The mine, tailings pond, mill, power plant, worker housing and water reservoir would all be located within a 8,975 ha (22,176 ac) parcel of private land in Red Dog Valley. The port site would also be on private land if located at VABM 28, but on public land if located at Tugak Lagoon. The transportation corridor would be almost totally on public land.

## PROJECT COMPONENTS AND OPTIONS

In reviewing this document, it is important that the reader understand the relationship among the terms "component", "option" and "alternative". The project has several components, each one a necessary part of an entire viable mining project (e.g., the mine, mill site, tailings pond*, transportation system, port site, etc.). For each component there may be one or more options (e.g., a northern or a southern transportation corridor option). An alternative is a combination of options (one for each component) that constitutes an entire functioning project.

Table II-1

CONCENTRATE PRODUCTION SCHEDULE

| Daily Production (Average Amount/Day) | Initial Production Rate | | Expanded Production Rate | |
|---|---|---|---|---|
| | Mg[1] | Tons | Mg[1] | Tons |
| Ore | 2,721 | 3,000 | 5,079 | 5,600 |
| Lead Concentrate | 204 | 225 | 308 | 340 |
| Zinc Concentrate | 907 | 1,000 | 1,515 | 1,670 |
| Barite Concentrate | 127 | 140 | 127 | 140 |
| Tailings* | 1,678 | 1,850 | 2,766 | 3,050 |
| Annual Production | | | | |
| Ore | 958,700 | 1,057,000 | 1,779,534 | 1,962,000 |
| Lead Concentrate | 71,650 | 79,000 | 107,933 | 119,000 |
| Zinc Concentrate | 317,450 | 350,000 | 530,595 | 585,000 |
| Barite Concentrate | 45,350 | 50,000 | 45,350 | 50,000 |
| Tailings | 524,250 | 578,000 | 1,095,656 | 1,208,000 |

[1] 1 Mg (megagram) = 1.102 tons
1 ton = 0.907 Mg

Source: Cominco Alaska, Inc.

* Defined in Glossary.

The EIS scoping process initially identified at least two, and often several, options for each component. The process by which this large number of options was screened to reduce the number to a manageable level, and the ultimate project alternatives were selected, is described in detail in Chapter III. The following description of each project component, therefore, addresses only those component options which were ultimately retained and are specifically addressed in at least one of the three action alternatives.

Mine

The Red Dog deposit is located on a side hill on the main fork of Red Dog Creek. The immediate topography generally consists of rolling hills with wide valleys. The zone of mining influence would impact the main stem of Red Dog Creek (Fig. II-1).

The outcropping ore body and its geological configuration dictate that a conventional underground mine would not be feasible. Open pit mining would require overburden (waste rock) removal from the surface of the ore body, followed by drilling and blasting of the ore in benches within an open pit. Overburden material not suitable for mill processing would be stockpiled near the tailings pond.

The mine pit would be developed in two stages: preproduction followed by production mining. During preproduction, overburden would be removed from the pit, and access roads, pit ramps and the initial benches would be established. Unmineralized waste would be used for road and tailings dam construction. Mineralized waste would be stockpiled in a catchment area above the tailings pond. During preproduction, it is estimated that a total of 1,242,000 Mg (1,365,000 tons) of material would be removed.

Ore production rates are an important economic factor and are normally based on the extent of services and the estimated quantities of concentrates that would be accepted in the markets. Initial production mining would involve the annual extraction of 958,700 Mg (1,057,000 tons) of ore. On an initial operating basis, an average of 2,721 Mg (3,000 tons) of ore would be

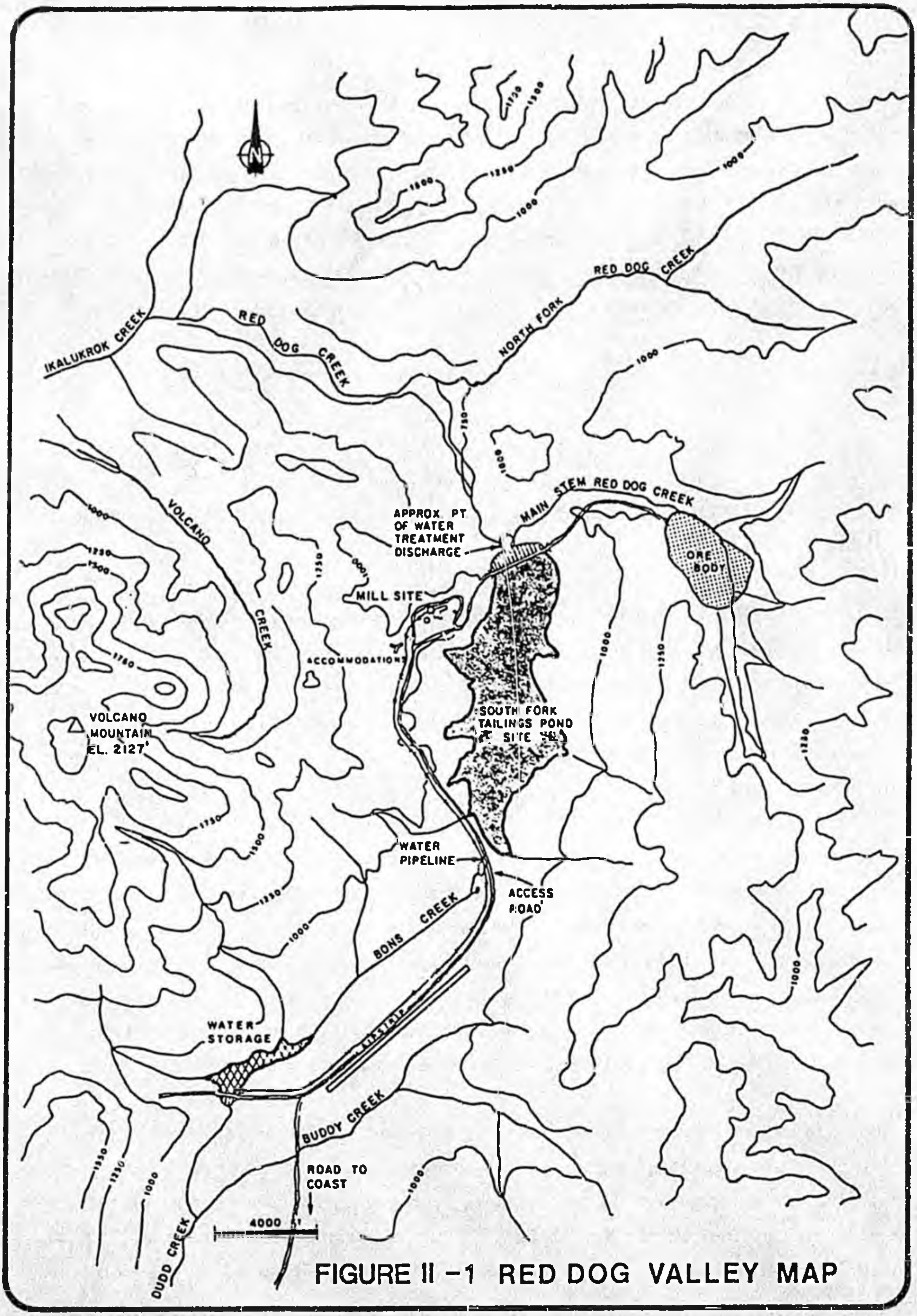


FIGURE II -1 RED DOG VALLEY MAP

sent each day to the concentrator (mill) for upgrading (Table II-1). Drilled and blasted ore would be loaded into mine type trucks using front-end loaders. The mine trucks would transport the ore to a crushing facility adjacent to the mill. The same loaders and trucks would be used to transport low grade ore and waste materials to stockpiles at the tailings pond.

The open pit would be designed to optimize ore recovery with due consideration given to protection of the Red Dog Creek watershed adjacent to the pit area (Fig. II-2). Pit slopes would be designed at 35 degrees and would be confirmed by rock mechanics design. Benches would be 7.6 m (25 ft) high and access ramps 18.3 m (60 ft) wide at an eight percent grade. The initial pit would be approximately 244 m (800 ft) in diameter and would contain seven benches down to the 297 m (975 ft) elevation. The final pit could be 853 m x 305 m (2,800 ft x 1,000 ft) in area and contain up to 28 benches to the 152 m (500 ft) elevation.

A diversion ditch would be constructed between Red Dog Creek and the open pit to collect runoff from the mine area. The ditch would initially intercept runoff from an approximate area of 0.65 $km^2$ (0.25 $mi^2$). The depth of the ditch would be sufficient to ensure that it would collect most of the ore zone runoff from the south side of the creek. If significant subsurface inflow from the creek occurred, a seepage cutoff wall would be added where necessary to block this inflow.

The drainage ditch would also collect surface erosion sediment originating from the open pit and the associated ore haul road to the mill. A pump station would route runoff from the open pit to the tailings pond. The ditch, collection sump and pump to the tailings pond would be sized for a 10-year recurrence 24-hour storm event. Adequate capacity would be allowed for winter icings and snow accumulation. The ditch would be cleaned of ice and erosion debris, if necessary, in late winter or spring to retain capacity for spring breakup and summer storm runoff.

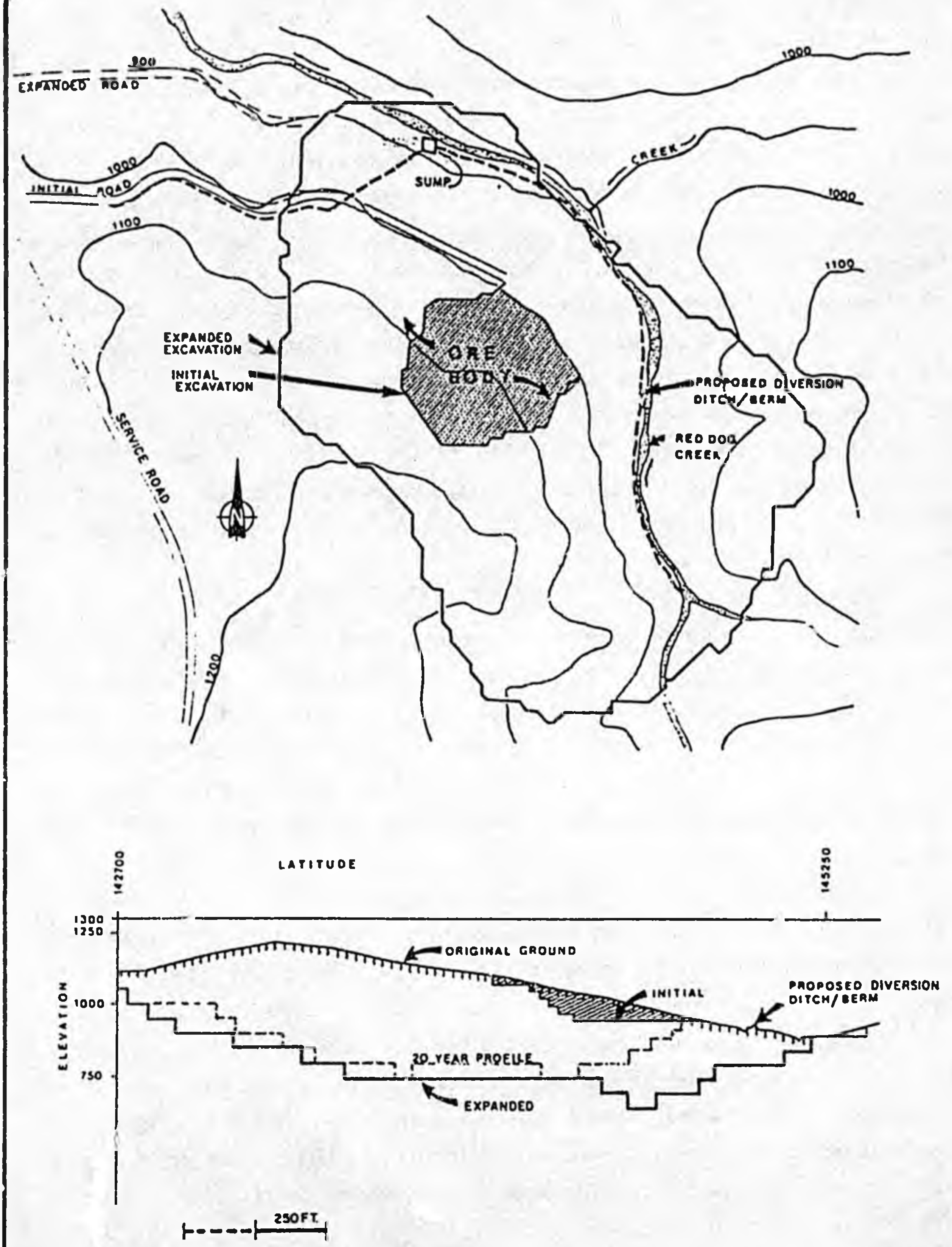


FIGURE II -2 MINE PIT LAYOUT

Tailings Pond

The location of the South Fork tailings pond in Red Dog Valley is shown on Figure II-1. A detailed diagram of the approximately 237 ha (585 ac) tailings pond facility is shown on Figure II-3. The tailings pond dam would be in the form of an impervious earth-filled structure with a spillway designed to maintain structural competency in the event of an overflow. The earth-filled dam would be constructed in stages. Prior to full production, the dam would be constructed to contain five years of production tailings. The dam would then be raised to its final elevation in stages which may take 15 years to complete. The top of the dam would be used as a road to haul ore from the pit to the mill complex.

Thickened tailings slurry from the mill concentrating process would contain about 60 percent solids by weight, with the liquid portion consisting of excess process water, dissolved minerals and residual reagents. The slurry would flow by gravity from the mill into the tailings pond. An internal process using a thickener would be used to return water directly to the mill process circuit as a step in minimizing process water loss. It is estimated that approximately 64 percent of mill process water could be recirculated directly in the mill in this way. Additional mill process water would be recycled from the tailings pond (25 percent) or from the freshwater source (11 percent). These recycle estimates are based upon water balance flowsheet data (Cominco Engineering Services, Ltd., 1983). Tailings in the form of a sand slurry would be deposited behind the dam.

Red Dog Creek tributaries with known metal content of toxic concentrations would continue to drain into the tailings pond for treatment, as would precipitation-related runoff. Diversion structures and ditches would be built to control or prevent excess surface drainage of uncontaminated water into the tailings pond. The surface water would be routed into the Bons Creek drainage, thus reducing the amount of water accumulating in the tailings pond. Chemical treatment and metals removal of tailings pond water would take place in a treatment plant prior to discharge to the presently minerals-contaminated Red Dog Creek. A seepage contingency dam would be con-

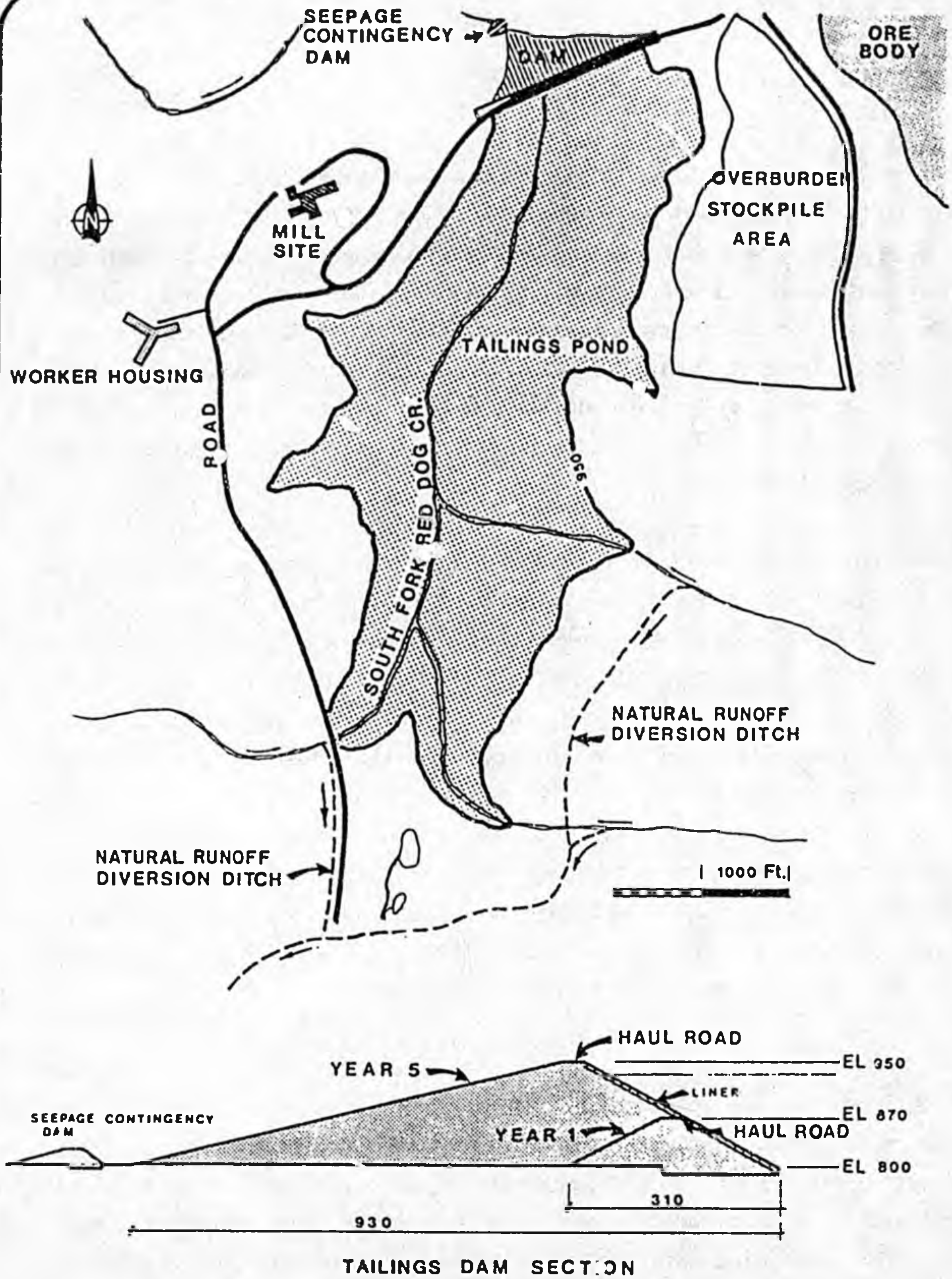


FIGURE II -3 SOUTH FORK TAILINGS POND

structed downstream of the main tailings pond dam to collect any seepage and return it to the tailings pond.

## Mill

Proximity to the mine and tailings pond were determining factors in mill location. The proposed mill site would be on a small hill of bedrock outcrop located opposite the ore body on the northwest side of the South Fork tailings pond (Fig. II-1). This site would be located within the pond catchment area so that tailings slurry could flow by gravity from the concentrator complex to the tailings pond. In addition, worker housing facilities would be located within a reasonable distance of the mill site so that waste heat produced in the power generation process could be used to heat the accommodations.

The proposed mill complex is shown on Figure II-4. The approximately 14 ha (35 ac) complex would include a water treatment plant, a diesel-based power plant, fuel storage and distribution facilities, and a vehicle maintenance/warehouse structure in addition to facilities integral to the milling process.

The project would use a selective flotation milling process to concentrate valuable minerals. The flotation process would consist of three major steps: size reduction, selective mineral concentration and moisture reduction of the concentrates. During the milling process, lead, zinc and barite minerals would be separated and concentrated, while the residual tailings slurry containing waste rock would be directed to the tailings pond. Silver complexes with the lead and zinc concentrates in the milling process, and would be separated out later during smelting.

After grinding, the ore would be suspended in a water slurry and transported to flotation cells (tanks) where the valuable minerals would be separated from waste materials in a froth flotation process. In this process, valuable minerals adhere to air bubbles that rise to the surface of the tanks and are removed. To make the process work efficiently, it is necessary to

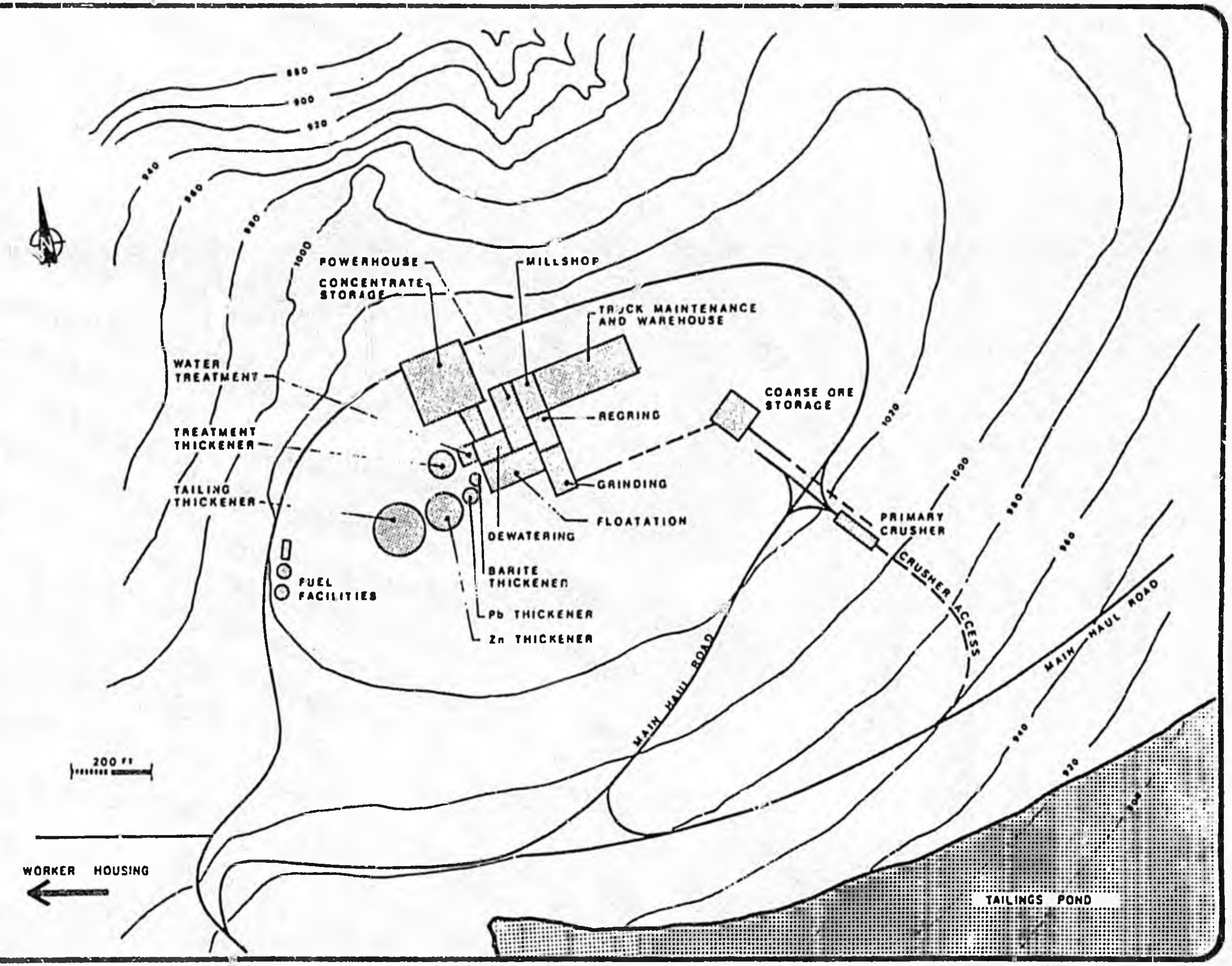


FIGURE II -4 MILL SITE FACILITIES

add air and various reagents. The reagents either aid flotation of valuable components or suppress flotation of waste material. This allows the bubbling and frothing action to float different ore minerals selectively so that metal concentrates can be produced. The ore minerals would be separated as sulfide concentrates of lead and zinc, with barite recovered in the last stage of the process as barium sulfate. Waste would include silicate minerals and small concentrations of sulfides.

Following separation of the ore minerals from waste rock, dewatering of the concentrates would take place using lead and zinc thickeners, followed by filtration and thermal drying. Wherever possible, waste heat from the diesel-based power generation would be used for drying the concentrates.

No reduction of sulfides to base metals or other changes in the chemical composition of ore minerals would take place in the concentrator or at the project site. The upgraded lead and zinc concentrates (which would also contain silver) would be shipped to smelters outside of Alaska for processing to refined metals. Barite concentrate would be dried and bagged locally for possible use in formulating oil well drilling mud.

The mill would be a major consumer of water and, as such, recirculation of process water would be used to the fullest extent possible. In addition to concentrate thickeners, a tailings thickener would be used to recycle water, thus decreasing the volume of tailings slurry produced. This would decrease the amount of water that would have to be treated, and would reduce annual water demand by approximately 49 million ℓ (13 million gal).

Reagents are an integral part of mill operation and sufficient quantities for a year's operation would be stored at the mill site. Reagents to be used for the Red Dog project are shown in Table II-2. These materials would be supplied in annual shipments and stored in a secure area at the port site.

The zinc ($ZnSO_4$) and copper ($CuSO_4$) sulfates used as conditioners in flotation would be handled in polylined and sealed palletized cartons of approximately 0.9 Mg (1 ton) capacity. These materials could be compatibly stored together and their toxic environmental hazards are well known.

Table II-2

RED DOG CONCENTRATOR REAGENTS

| | Initial Production | | Expanded Production | |
|---|---|---|---|---|
| | Mg/yr | tons/yr | Mg/yr | tons/yr |
| Zinc sulfate ($ZnSO_4$) | 480 | 529 | 1,401 | 1,544 |
| Copper sulfate ($CuSO_4$) | 480 | 529 | 2,505 | 2,761 |
| Sodium cyanide (NaCn) | 96 | 106 | 299 | 330 |
| Methylisobutyl carbinol (MIBC) | 48 | 53 | 199 | 220 |
| Sodium isopropyl xanthate | 480 | 529 | 1,766 | 1,947 |
| Sodium cetylsulfonate (EC-111) | 72 | 79 | 148 | 163 |
| Sulfuric acid ($H_2SO_4$) | 959 | 1,057 | 3,002 | 3,309 |
| Hydrated lime [$Ca(OH)_2$]* | 2,396 | 2,642 | 9,018 | 9,941 |
| Polyacrylamide flocculant* (Percol 730) | 5 | 6 | 5 | 6 |

* Note: Part of the lime and all of the flocculant supply would be used in the wastewater treatment process.

Sodium cyanide (NaCn) is a toxic reagent and must, at all times, be stored and handled in isolation from other chemicals, particularly those which are acidic in nature, including the sulfate salts. This material would be shipped in 102 kg (225 lb) sealed drums on pallets. The reagent is essential to the metallurgical process as a depressant of iron minerals.

Methylisobutyl carbinol (MIBC) is an aliphatic liquid alcohol which has only a moderate solubility in water. It is moderately toxic to aquatic life and comparable in this respect to most intermediate molecular weight liquid alcohols. This chemical would be shipped in 181 kg (400 lb) steel drums and could be safely stored with the other chemicals.

Sodium isopropyl xanthate is an essential sulfide mineral collector in the flotation process, and is very toxic in the environment. It would be shipped in approximately 0.9 Mg (1 ton) sealed, palletized containers which preferably would be stored apart from acidic materials. A potential problem with xanthate is that it may deteriorate from prolonged contact with moisture and then would require disposal as it would be unusable as a reagent.

Sodium cetylsulfonate (EC-III) is a paste-like surface active agent used for barite flotation that has only a moderate solubility in water. It is essentially non-toxic and has been approved for use in food applications. This material would be shipped in 181 kg (400 lb) steel drums on pallets and would be compatible with all other reagents.

Sulfuric acid ($H_2SO_4$) is a hazard to aquatic life by virtue of pH reduction effects. Because of its liquid nature, spills would be difficult to contain and the chemical could have long lasting impacts on vegetation recovery unless lime were applied as a neutralizing agent. Sulfuric acid would be stored at the port in an isolated, berm-protected bulk tank and hauled to the mine in acid standard tank trailers of 24,227 ℓ (6,400 gal) capacity.

Lime would be used as a pH modifier in the mill flotation process and in the wastewater treatment plant. It is only toxic in concentrations which result in high alkalinity and would be relatively safe to manage in the hydrated form. It would be shipped and stored in heavy-wall plastic bags of about 1.8 Mg (2 tons) capacity. There would be no constraints on its storage with other reagents.

Polyacrylamide flocculant (Percol 730) is a slowly water soluble, high molecular weight, acrylamide-based polymer that would be used as a solids settling aid in the wastewater treatment plant. This material is relatively nontoxic. It would be shipped in 23 kg (50 lb) sacks on pallets and must be protected from temperature extremes in storage or its effectiveness might deteriorate.

The mill would produce lead, zinc and barite concentrates. Lead and zinc concentrates would be shipped to the port site in covered gondola-type trailers while barite would be moved in sealed containers on flat bed units.

The mill would operate on a continuous, round-the-clock basis for an estimated 350 days per year. Initial and final mill production rates are shown in Table II-1. Concentrates would be transported from the mill site to the main storage terminal at the port site in truck/trailer units. Approximately nine to 12 daily truck trips to the seaport would be required to handle the estimated daily production rate. Six weeks' production of concentrates could be stored at the mill to allow for transportation delays during periods of bad weather, when the roads were unsafe for travel, or if transportation activities were temporarily suspended to protect subsistence activities or animal migrations.

Worker Housing

A campsite or hotel-style facility would be constructed a reasonable distance from the mill site complex. The actual location of the accommodations would be more specifically defined during the detailed design stage of the project in accordance with Mining Safety and Health Administration (MSHA) regulations that mandate specific criteria for worker safety and comfort.

Approximately 225 to 250 full-time employees would comprise the project site workforce at any given time. Workers would be scheduled on a rotation of approximately two weeks on and two weeks off so the total project workforce would be twice that figure. The projected mine/mill workforce breakdown would be as follows:

| | |
|---|---|
| Miners/Mill Operators | 50 percent |
| Mechanics/Electricians | 15 percent |
| Support | 15 percent |
| Supervisory/Management | 20 percent |

## Water Supply

The mill would be a major consumer of water so a guaranteed year-round water source would be essential to the project. Wells would not be feasible since the permanently frozen ground prohibits free-flowing water aquifers. An approximately 25 ha (63 ac) water storage reservoir located on Bons Creek at the south end of Red Dog Valley would serve as the water supply (Fig. II-5). A rock-filled dam would be constructed on bedrock foundation near the existing airstrip, and a pipeline would follow the existing road system to the mill site. The reservoir would also serve as a domestic water supply. It would have a capacity of 1,462 $dam^3$ (1,185 ac-ft) of water to meet an expected total daily consumption rate of 1,136 ℓ/min (300 gal/min) for all the mine area facilities.

## Power Generation

For the concentration of minerals to take place, a large amount of power would be expended in grinding to achieve a fineness which allows adequate liberation of lead sulfide, zinc sulfide and barite particles from waste particles. On an average basis, electric power at a rate of 19.3 kWh/Mg (17.5 kWh/ton) of mill feed would be required for the grinding process. In order to meet this and other support facility demands, a dedicated power plant would be necessary The Red Dog project would consume approximately 10.2 MW, and an 18 MW diesel-based power plant would be installed to allow for down time of some generators.

It was desirable to minimize both the loss of waste heat and air pollutant discharge by designing a system whereby waste heat would be used for concentrate drying, with the dryer exhaust treated in a scrubber or other type of pollutant control device. Diesel fuel storage and distribution facilities would be provided at the mill site. Fuel storage units (capacity of 4,800 bbls) would periodically be replenished from the main fuel depot at the coast by tanker trucks or by ore trucks specially fitted with tanker units.

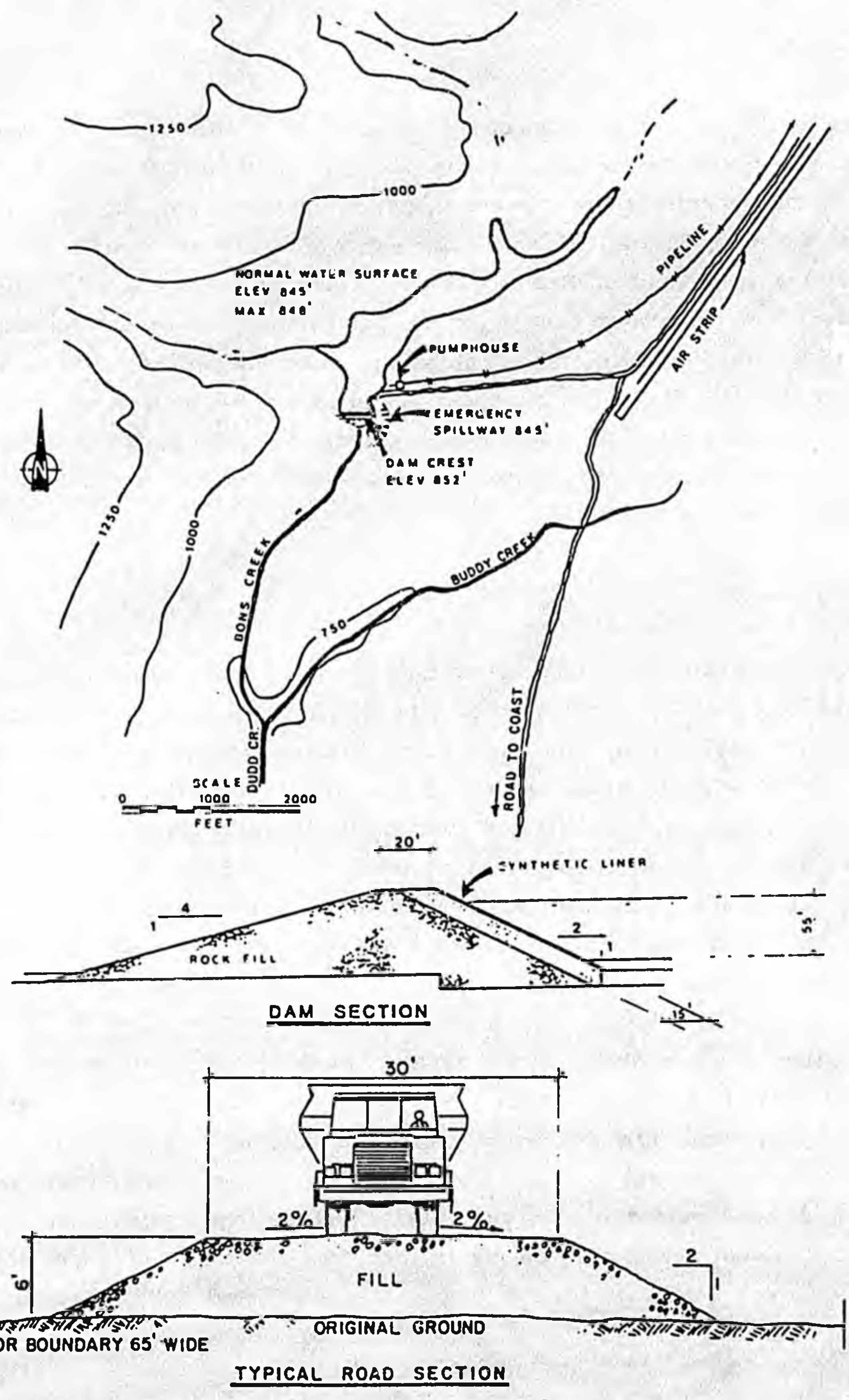


FIGURE II -5 WATER STORAGE RESERVOIR

## Transportation Corridor

A transportation corridor would link the Red Dog Valley mine facilities with the Chukchi Sea coast. Two corridor options are included in the alternatives: a northern and a southern corridor (Fig. II-6). For the first 11.8 km (7.4 mi) the two corridors follow a common alignment. At a point near Dudd Creek, the northern corridor swings westward across the Wulik, Kivalina and Asikpak River drainages to a port site near Tugak Lagoon 24 km (15 mi) northwest of Kivalina. At Dudd Creek the southern corridor continues southwest along the flanks of the Mulgrave Hills to a port site near VABM 28, approximately 25.6 km (16 mi) southeast of Kivalina. The topography of both corridors would be gentle enough to handle railroad grades. Both corridors have therefore been laid out to accommodate a railroad at some future time.

### Northern Corridor

The northern transportation corridor would be approximately 117.0 km (73.1 mi) long and would require the construction of six major (greater than 30.5 m [100 ft]) multiple-span bridges, seven minor bridges and approximately 300 culverts. The route would traverse the main stems of Ikalukrok Creek, and the Kivalina, Wulik and Asikpak Rivers (Fig. II-6). It would cross approximately 12 streams which contain fish.

### Southern Corridor

The southern transportation corridor would be 89.9 km (56.2 mi) long and would require the construction of one major bridge, four minor bridges and approximately 182 culverts. The corridor would cross tributaries of the Wulik, Noatak and Omikviorok Rivers near their headwaters, and would generally stay at a higher elevation than the northern corridor until its terminus at the VABM 28 port site (Fig. II-6). It would cross approximately 11 streams which contain fish.

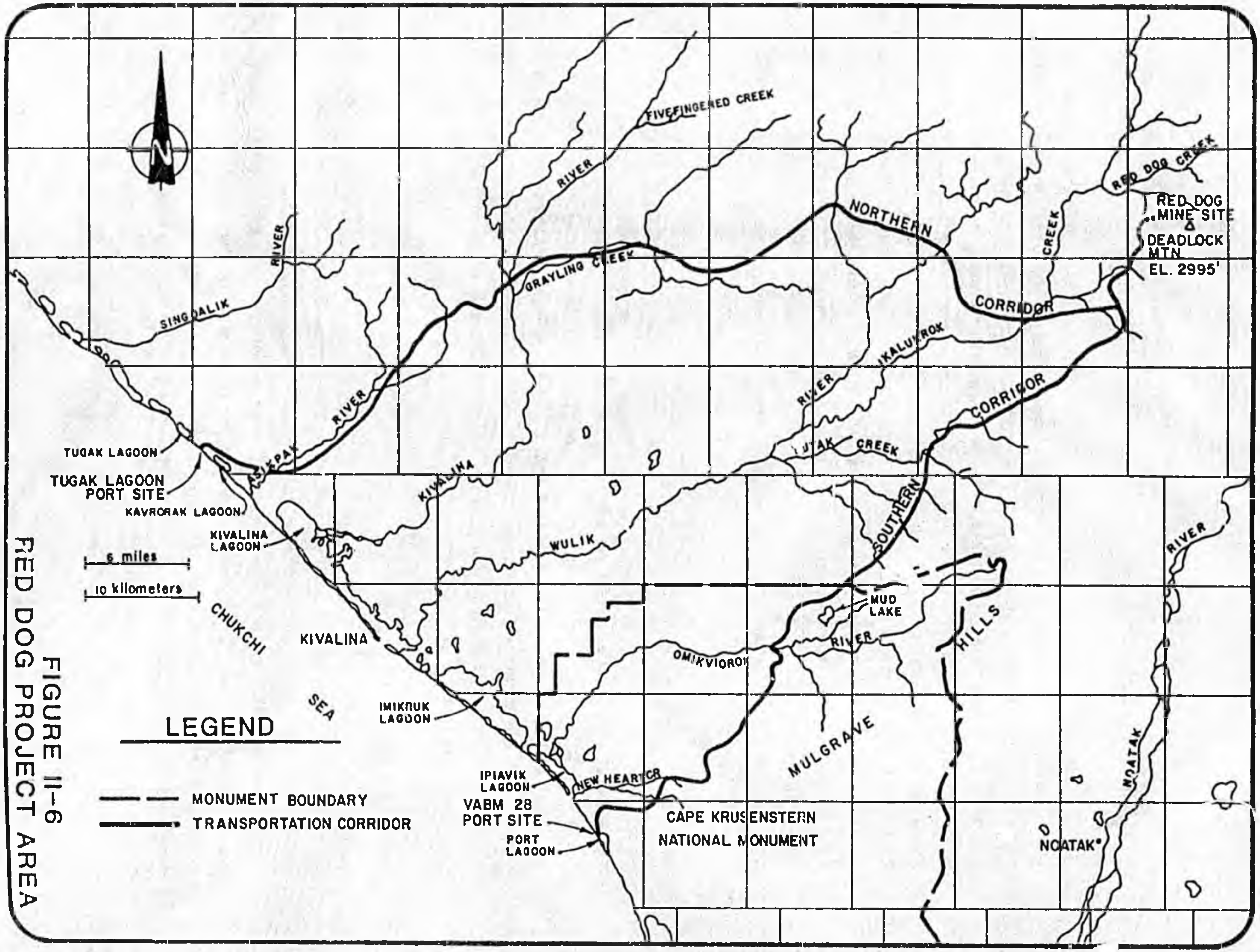


FIGURE II-6
RED DOG PROJECT AREA

Road Transportation System

The road haulage system would be comprised of a gravel surfaced road and double truck/trailer haulage units similar to normal highway vehicles, but over-sized. The roadbed or subbase would be composed of granular fill 2.0 m (6.5 ft) thick to prevent degradation of permafrost. The majority of the fill needed for construction would come from quarry sources as few gravel sources have been located along the corridors.

The top surface of the road would be 9 m (30 ft) in width as shown in Figure II-5. Turnouts and passing places would be provided along the route. Curvature and grade would generally be limited to 10 degrees and three percent, respectively, to permit eventual construction of a railroad. Bridge structures and culverts would be designed to accommodate year-round concentrate haulage by combined truck/trailer units. A truck and a trailer would weigh approximately 103 Mg (114 ton) and 90 Mg (108 ton), respectively, or 201 Mg (222 tons) for one combined truck and trailer unit. Nine to 12 daily truck/trailer round trips to carry concentrates to the port site would be required for the first five years at initial production rates. Following proposed expansion of production after five years, daily trips would average between 16 and 20.

Inbound freight would likely be containerized, though some specialized trailers such as tanker units (to haul fuel oil to the mill site) would be required. Periodic maintenance of the roadway would be necessary, thus requiring a full complement of road maintenance and repair equipment.

Port Site

Though operations at the mine would continue year-round, activity at the deep-draft port site would be limited to the receipt of supplies and fuel during the summer sealift, and the shipment of concentrates from late June until early October. Climatic constraints on shipping activities thus require that adequate storage facilities for concentrates, fuel and other supplies exist at the port site. Using an all-weather road, it is estimated that eight and a half months of concentrate storage capacity would be required at the port site.

Schematics of the approximately 20 ha (50 ac) proposed port site facilities are shown on Figures II-7 and II-8. Depending upon the type of transfer facility (described below), fuel would be stored either onboard the "offshore island" or in tanks on land at the port site. In either case, a year's supply would be kept there to serve as the main fuel depot for the project. Fuel would be periodically hauled to the mine site as required. A short causeway/dock structure would be required to receive incoming freight and supplies, and for transfer of the concentrates for shipment.

Only emergency and temporary ship loading crews would be housed at the port site. A small accommodation complex would be provided to support activities during the summer shipping season. Domestic sewage would be collected and treated using a package treatment facility before discharge into the sea. A small diesel-based 1.5 MW power plant would be required to operate conveyor equipment and life support facilities. In addition to the facilities located immediately at the coast, the main concentrate storage building would be located approximately 4.0 km (2.5 mi) inland, adjacent to the transportation corridor. This structure would be constructed on an excavated borrow site* to minimize habitat destruction, and to take advantage of foundation materials and protection from the wind.

Transfer Facility

Two methods to transfer concentrates from the port site storage facility to ocean going vessels are included in the alternatives: a short causeway/lightering* transfer system and a short causeway/offshore island transfer system. Both systems would use a 122 m (400 ft) causeway/dock structure as an interface between the shore and the concentrate loading vessels or offshore island. The causeway/dock structure would extend to the 4.6 m (15 ft) water depth. Concentrates would be transferred by conveyor belt

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* Defined in Glossary.

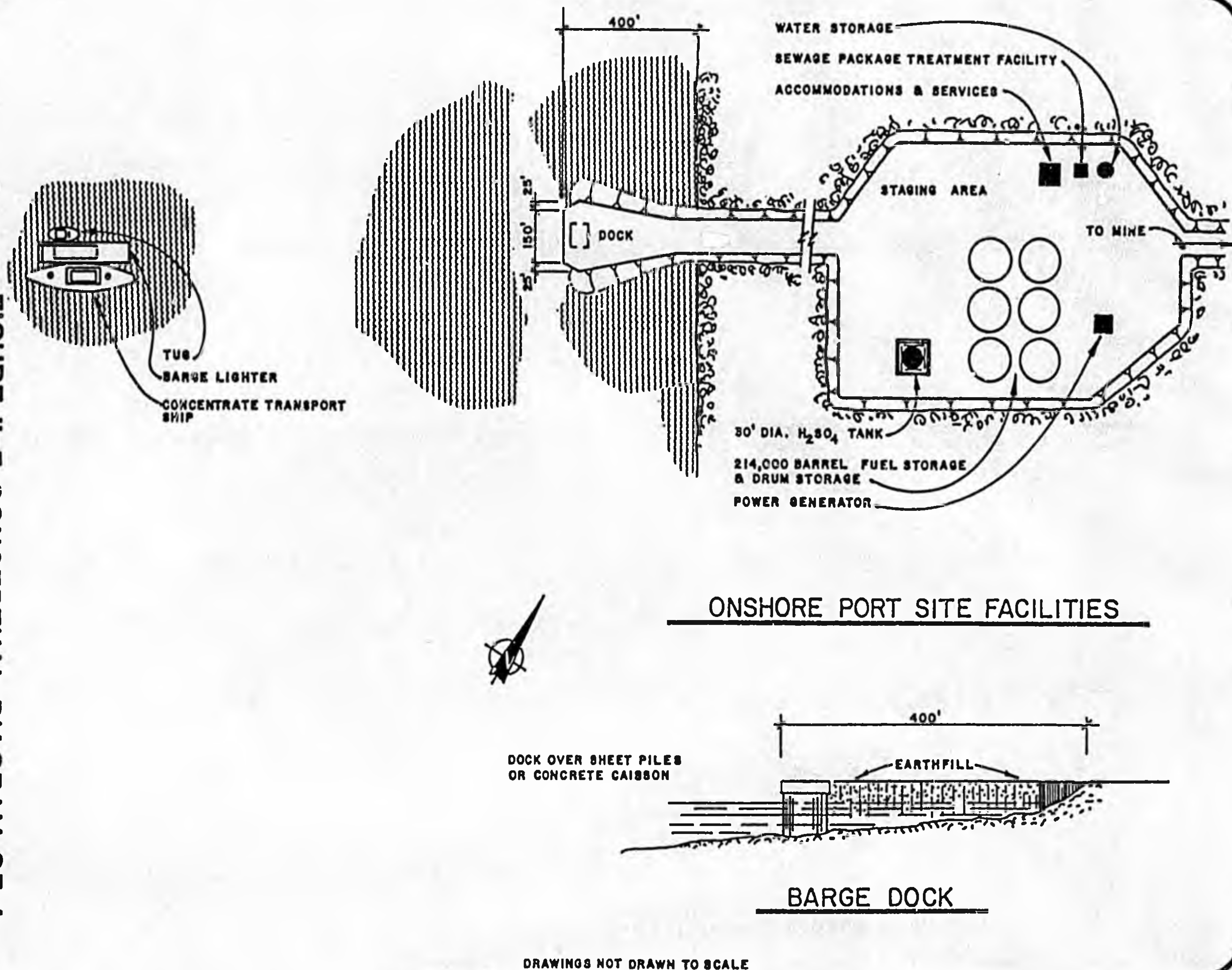


FIGURE II-7 CONCEPTUAL DIAGRAM OF A SHORT CAUSEWAY/LIGHTERING TRANSFER FACILITY

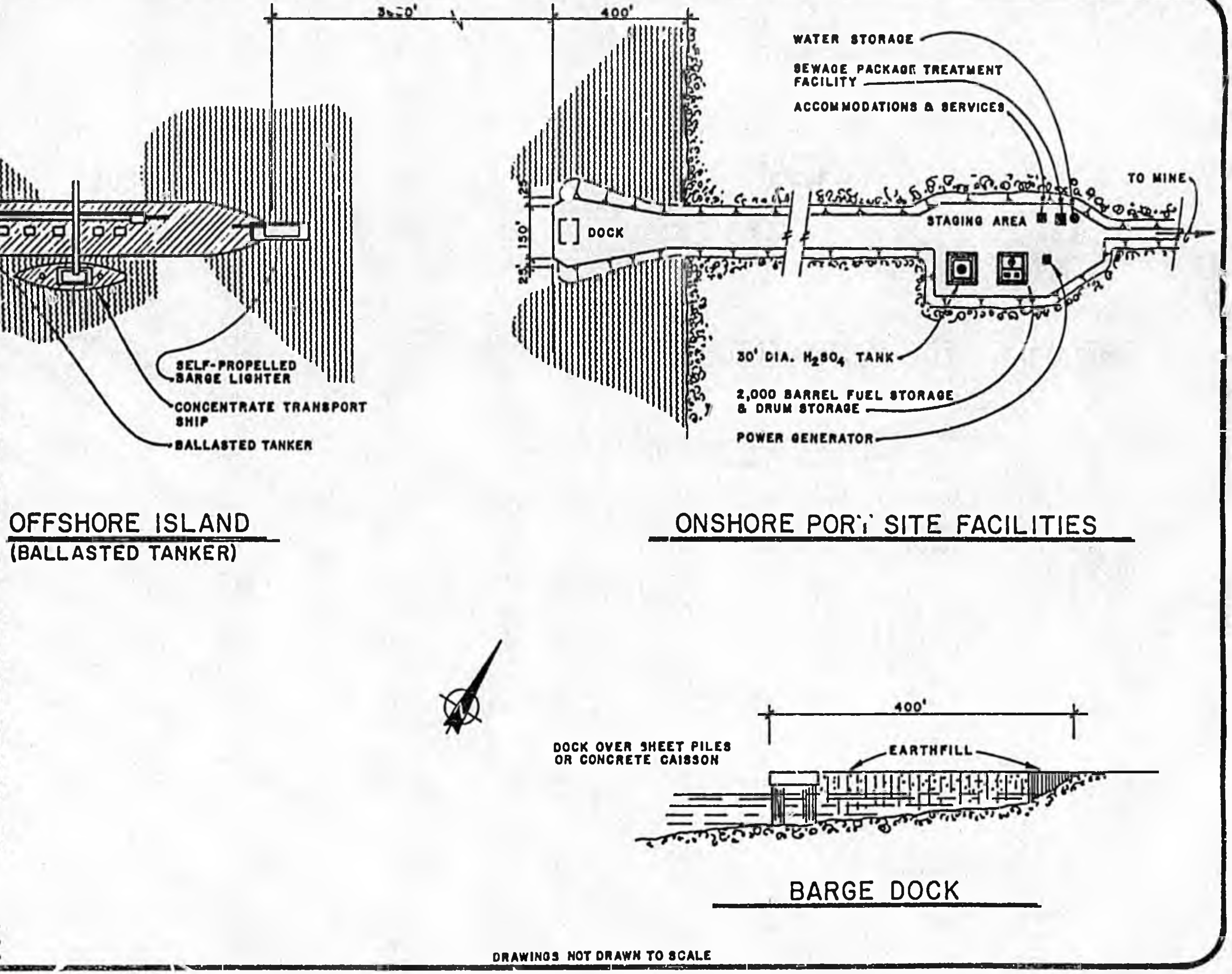


FIGURE II-8 CONCEPTUAL DIAGRAM OF A SHORT CAUSEWAY/OFFSHORE ISLAND TRANSFER FACILITY from a storage building, along the causeway, to a barge loader structure mounted on the dock face.

The causeway structure would be constructed of sheet pilings with solid earth fill (Fig. II-7). It would be suitably capped and faced to allow lighter* barges to tie up at its seaward face. Depending on the transfer facility option selected, lighter barges ranging from 907 to 4,535 Mg (1,000 to 5,000 tons) would be used.

Short Causeway/Lightering System

This transfer method would use two 4,535 Mg (5,000 ton) lighters and two support tugs to transfer concentrates from the dock directly to the side of a moored ocean going bulk-handling ship. The ocean going vessel would load concentrates with clam shell cranes, though rough sea conditions might make this transfer method unreliable. Winter shelter for the two large-capacity lighters and their tugs would be provided in a coastal lagoon located adjacent to the port facilities.

Short Causeway/Offshore Island

This transfer method would use a 226,750 Mg (250,000 ton) surplus oil tanker with an ice-strengthened hull which would be ballasted to the bottom perpendicular to shore (Fig. II-8). The landward end of the tanker would be in approximately 7.6 to 8.5 m (25 to 28 ft) of water and the seaward end in 10.6 to 12.1 m (35 to 40 ft) of water. Depending upon the port site selected, the landward end of the tanker would be approximately 1,213 m (4,000 ft) from shore. This 305 m (1,000 ft) tanker "island" would serve as an offshore dock for the smaller, ocean going bulk carriers. The tanker would be large enough to accommodate storage of concentrates, fuel and supplies. Onboard concentrate storage capacity would be sufficient to load three to five ocean going bulk carriers.

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* Defined in Glossary.

The bow of the ship would be modified to accommodate a 907 Mg (1,000 ton), self-unloading lighter which would discharge directly by conveyor belt into the ship (Fig. II-8). Only one self-propelled lighter would be needed to transport concentrates because of the storage capacity onboard the tanker. Shelter for the single, smaller lighter could be provided in the lee of the tanker if necessary during bad weather. Winter shelter would be provided in a coastal lagoon adjacent to the port site. If ice conditions were suitable, winter transfer of concentrates to the tanker island might be accomplished by trucks driven directly over the ice.

Transfer of concentrates from the ballasted tanker to bulk carriers would be accomplished using moveable conveyors between ships which would be loaded from storage by a clam shell bucket. Similar to the shore-based system, conveyors would be covered, and the end of the loader would be fitted with a telescoping spout or "elephant's trunk", to direct the concentrate into the receiving ship's hold below deck level. Conveyor return belts would be brushed in an enclosure to prevent losses to the sea. Sealed barite containers would be loaded by crane.

Fuel Storage

Location of the major fuel storage depot for the project would depend upon the transfer facility selected. For the short causeway/lightering option a full year's supply of fuel for the project, as well as fuel to meet the annual needs of the region's villages, would be stored in tanks on land at the port site. The fuel would be lightered to the dock from ships moored offshore. Storage capacity would be approximately 214,000 bbls with about 56 percent of that (120,000 bbls) being for the project. Fuel would be hauled to the mine area facilities by tanker truck as needed during the year. It would be distributed to the villages from the port site using the same smaller barges as used presently by local barge services to navigate the rivers.

For the offshore island option, the same amount of fuel would be transferred directly into the ballasted tanker and stored in tanks aboard the ship. It would be moved to shore year-round through a buried 10 to 15 cm (4 to

6 in) pipeline designed to withstand wave and ice forces and scour in the surf zone. The pipeline would be pressure tested for leaks prior to fuel transfers. Fuel would be stored at the port site to a capacity of approximately 2,000 bbls. It would then be transported to the mine area facilities by tanker truck as needed. Regional village fuel would be distributed by barges directly from the tankers.

## DEVELOPMENT SCHEDULE

As is the case with any endeavor in the Arctic, the critical factor affecting the development schedule is the limited shipping season (generally July through September). Within these confines and assuming a project start-up date of January 1985, key periods in the development schedule are discussed below.

Construction equipment for road building activities would be landed at the port site during the summer of 1985. This equipment would be idled until freeze-up occurred prior to moving inland to the first borrow site. From January to July of 1986, a road would be built inland from the first borrow site, as well as back to the port site.

The first major construction sealift of equipment and materials would be made in the 1986 shipping season. The equipment for constructing the main road, as well as the mining equipment, would be brought in at that time. A 100-person barge-mounted camp would be located in a lagoon at the port site to support construction activity during the same sealift. A small 20-person "fly-in" construction camp would be set up at the Red Dog mine site.

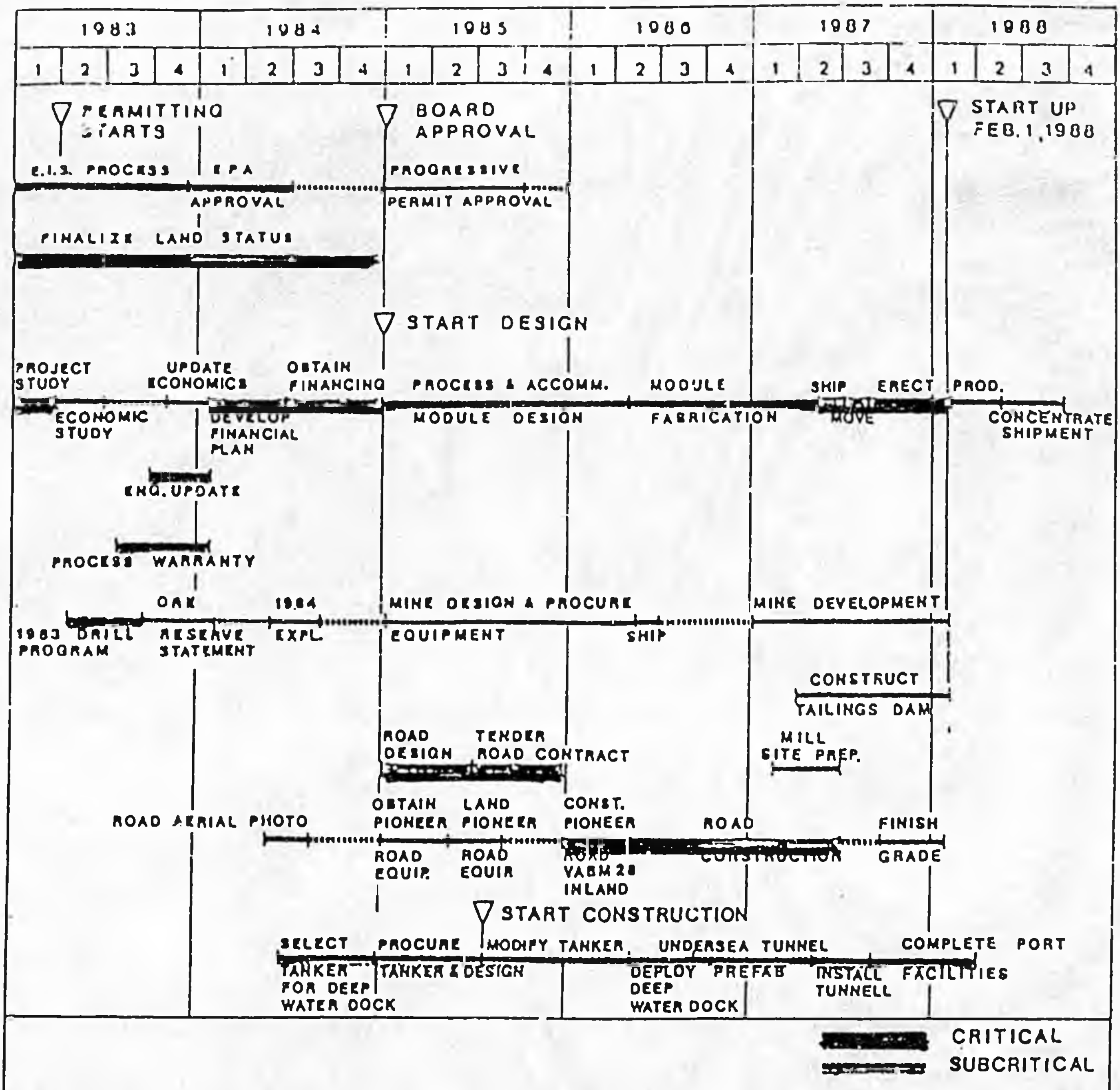
In January of 1987 the main road would be completed from the port site to Red Dog Valley. Construction equipment to prepare the mill site, as well as mining equipment to begin development work, would then be moved to the site. Additional camp facilities (for 50 people) would also be moved over the road to the Red Dog site at that time. Mine development would continue through 1987 to the time of production mining start-up in early 1988. Suitable mine waste would be used to construct the tailings pond dam during this period. To the extent that schedule constraints would allow, initial mine work would be carried out by permanent crews so that fully trained personnel would be available by the commencement of full operation.

A permanent dockface (in 3 m [10 ft] of water) and short causeway would be constructed prior to the 1987 sealift. This facility would be used to offload ore concentrator and worker housing modules, as well as other mine equipment. During the 1987 sealift the worker housing modules would be the first to be moved to the mine site. These living quarters would be commissioned as quickly as possible for use by construction crews, and later by operating personnel during the project start-up period. In this manner, the additional expense of a larger construction camp would be avoided.

During the summer and early fall of 1987, the concentrate storage building and other port site facilities would be constructed. If the offshore island transfer facility were approved, the modified tanker would be towed to the site and ballasted to the bottom during the 1987 shipping season.

During the period September to December 1987, the concentrator complex modules at the mine site would be joined and services installed. The facilities would be ready for commissioning (start-up) in December. Once commissioned, operations would commence in February 1988. Construction activities would be completed prior to the 1988 sealift. Construction surplus and equipment would be shipped out at that time.

The first movements of concentrates to market would probably be during the 1988 shipping season, though this would depend on project financing and the status of world-wide lead and zinc markets.




PROJECT SUMMARY SCHEDULE - 1988 PRODUCTION

RED DOG FACT SHEET November 1983

## 1.0 LOCATION

### A. Orebody/Mill Complex

The orebody is located 55 miles from the Chukchi Sea, east-northeast of Kivalina at the based of Deadlock Mountain; and 90 miles north of Kotzebue. Red Dog is approximately 440 air miles northwest of Fairbanks.

### B. Seaport

The proposed location of the seaport is in the vicinity of VABM-28 about 17 miles southeast of Kivalina on the Chukchi Sea.

## 2.0 CLIMATIC DATA

| | | | |
|---|---|---|---|
| Temperature (°F): | Summer -- mean daily | maximum | 65 |
| | | minimum | 35 |
| | Winter -- mean daily | maximum | 3 |
| | | minimum | -21 |
| | Extremes | | 75 to -60 |

Precipitation* -- 11 inches.

NOTE: The above information has been extracted from the Climatic Atlas for Noatak.

* Recent measurements at the site indicates precipitation in the order of 18 inches per year.

## 3.0 EXPLORATION HISTORY

The first report of mineralization in the Red Dog area was in a 1970 U.S. Geological Survey open file report. Further exploration done by the U.S. Bureau of Mines provided a more detailed description of mineralization significance in a press announcement in the fall of 1975. Cominco American geologists explored the area and staked claims on adjoining areas soon after the USBM announcement.

## 4.0 EXPLORATION CAMP

Cominco American has operated temporary camps on land adjoining the Red Dog deposit every summer since 1976 with 25-50 employees.

## 5.0 OWNERSHIP

At different times there have been numerous federal, state, regional, and corporate claims to land adjoining the Red Dog deposit. As of February 5, 1982, Cominco American Incorporated and the NANA Regional Corporation reached agreement for evaluation and potential development of the deposit by Cominco American, with NANA retaining a carried interest.

## 6.0 GEOLOGY AND ORE RESERVES

A program of core drilling in 1981 defined a deposit estimated to contain, as calculated in place without mining dilution, 85 million tons of 17.1% zinc, 5.0% lead and 2.4 ounces/ton silver. The tons and grade are inferred from 14,700 feet of drilling in 39 holes, generally located on grid spacings of 400 feet in north-south and east-west directions, and are calculated to include contiguous mineralization averaging more than 3% zinc/lead. In 1982 CAI drilled an additional 14,600 feet in 32 holes to further define the orebody on a 200 foot grid spacing. This work confirmed the 1981 results. The 1983 drill program includes additional infill drilling for metallurgical testwork as well as diamond drilling in the Hilltop deposit one-half mile to the south of the main deposit.

The deposit is nearly flat-lying and suitable for open-pit mining, with upper portions exposed at the surface. The deposit in a north-northwesterly direction is approximately 4,400 feet long, varying in width from 200 feet up to 1,400 feet and is commonly 100 feet in thickness.

Current information ranks the Red Dog zinc-lead-silver deposit among the largest deposits of its type in the world. Although the orebody has not been completely defined, current reserves and mining plans gives a mine life of 50 years.

## 7.0 ENVIRONMENTAL ISSUES AND PERMITTING

In anticipation of the regulatory requirements applicable to the project development, environmental baseline studies were initiated in 1981 and continued through to the end of 1982. This comprehensive program of work included an evaluation of water quality and hydrology, fresh water and marine biology with emphasis on fish resources, archaeology and cultural values, terrestrial biology, socioeconomics and subsistence uses in all areas potentially affected by project components. In addition, metereological monitoring at the mine site commenced in 1982 and will continue as the project progresses.

## 7.0 ENVIRONMENTAL ISSUES AND PERMITTING (continued)

The findings from these studies have played an important role in regulatory planning, the development of a the project, and the designing of facilities and operating plans which are consistent with the social and economic objectives of NANA and the communities of the region. Therefore, the project as currently envisioned satisfies engineering, economic and environmental criteria to ensure its acceptance by the regulatory agencies and the NANA people.

Since the project is classed as a "major federal action" under criteria of the National Environmental Policy Act (NEPA), an Environmental Impact Statement (EIS) is necessary and work on its preparation was initiated in January, 1983 under the Environmental Protection Agency (EPA). This is expected to be completed in the spring of 1984. It will contain an overall impact assessment of the project alternatives with specific endorsement of the facilities to be constructed. Simultaneous with the development of the EIS, applications will be made for key permits requiring substantial lead times to obtain. Once the EIS is complete, the way is cleared for the issuance of the various federal and state permits required for both construction and operation according to the present project schedule.

## 8.0 PROJECT COSTS AND SCHEDULE

Project costs through to the end of 1983 are estimated to be $19 million. Capital outlays for constructing the project are expected to be in the $300 to $500 million range.

Construction could take 2 to 2-1/2 years with operation beginning in 1988. The actual beginning of construction will depend on world economic conditions, ability to complete detailed engineering design, and the completion of the environmental permit process.

## 9.0 CONSTRUCTION TECHNIQUES

Early engineering studies established that the cost of conventional on-site construction of the concentrator and related facilities at Red Dog would be expensive. Current engineering studies are based on the concept of modularization wherein completed building blocks are fabricated away from the site where access to a large and relatively inexpensive work force is possible. The success of modular projects for Alaskan North Slope Oil and elsewhere in the world clearly indicate cost and schedule advantages to this construction technique. For Red Dog, portions of the process plant and accommodations would be built outside of Alaska (where the constraints of Arctic construction would not apply), be barged to the Red Dog port, transported

## 9.0 CONSTRUCTION TECHNIQUES (continued)

inland to the mine on specialized transporter vehicles and then placed on their respective foundations. Buildings or service facilities that are not equipment intensive, such as warehouse and repair shops, will be site erected using conventional construction techniques.

## 10.0 EMPLOYMENT

The operation is expected to generate approximately 400 jobs involving a cross-section of mining, milling, maintenance, managerial and administrative skills. In keeping with NANA's desire to avoid the establishment of a townsite near the mine, a hotel-type accommodation complex will be used to serve a rotational work force which will transport from the local villages or Kotzebue to the site.

## 11.0 MARKETS

There are zinc and lead smelters in several Pacific Rim countries where concentrates from Red Dog could be sent. Cominco Ltd.'s Trail, B.C. smelter is one consideration, while Japanese smelters present other possibilities. European smelters are also being considered.

## 12.0 PRODUCT USES

a) Zinc is a shiny, bluish-white metal with two major industrial uses: galvanizing and die-casting. Galvanizing is a zinc coating which is a very effective rust prevention agent for use in products such as chain-link fencing, steel siding, household products, automobile bodies, structural steel coatings, and marine hardware. In the die-casting process, molten zinc is injected or poured into a metal mold where it hardens. Products such as plumbing fixtures, power tools, carburetors, and electrical appliances are typical applications.

b) Lead is a metal with many industrial uses, the largest one being storage batteries for all types of vehicles. Other uses include an anti-knock additive to gasoline, lead shielding, and cable coverings. Lead is also mixed with other metals to make various products such as solder, munitions and for use in making fine crystal tableware and glaze for pottery.

c) Silver is used in various industries and in many products, the largest user being photographic industry where it is employed to coat film as well as in the development of film. As a precious metal, it is used for jewelry, silverware, tableware, and ornaments. It is also used in surgery and dentistry.

## 13.0 PRODUCTION SCHEDULE

| Years | FEED TONS Day | FEED TONS Year | FEED GRADE % Pb | FEED GRADE % Zn | CONCENTRATE TONS/YR Pb | CONCENTRATE TONS/YR Zn | CONCENTRATE TONS/YR Total | DESIGN Tons/Day |
|---|---|---|---|---|---|---|---|---|
| 1 to 5 | 3,000 | 1,057,000 | 6 | 21 | 79,000 | 350,000 | 429,000 | 3,400 |
| 6 + | 5,600 | 1,962,000 | 5 | 19 | 119,000 | 585,000 | 704,000 | 6,300 |

## 14.0 WORK SCHEDULES -- OPERATIONS

a) All employees:

-- 7 days per week

b) Mine:

-- 10 hours per shift, 2 shifts per day, 700 shifts/year

c) Concentrator:

-- 12 hours per shift, 2 shifts per day, 700 shifts/year

d) Power Plant:

-- 12 hours per shift, 2 shifts per day, 730 shifts/year

e) Seaport:

-- 12 hours per shift, 2 shifts per day, 240 shifts/year Summer operation.
-- 12 hours per shift, 1 shift per day, 60 shifts/year Winter operation.

## 15.0 MINE FACILITIES

| | Length feet | Width feet | Height feet | Wt. tons | Plan Area Sq. Ft. |
|---|---|---|---|---|---|
| Primary Crusher Module | 66 | 32 | 62 | 600 | 2112 |

## 16.0 CONCENTRATOR

| Modules | Length feet | Width feet | Height feet | Wt. tons | Plan Area Sq. Ft. |
|---|---|---|---|---|---|
| Grinding | 132 | 67 | 73 | 1390 | 8844 |
| Regrind | 104 | 67 | 73 | 870 | 6968 |
| Flotation(3) | 150 | 68 | 83 | 1700 | 10200 |

16.0 CONCENTRATOR (continued)

| | Length feet | Width feet | Height feet | Wt. tons | Plan Area Sq. Ft. |
|---|---|---|---|---|---|
| Dewatering | 136 | 64 | 71 | 1220 | 8704 |
| Drying | 79 | 40 | 61 | 500 | 3160 |
| Power Plant(3) | 136 | 71 | 55 | 1600 | 9656 |
| Subtotal | | | | 7280 | 47532 |
| **Conventional Construction** | | | | | |
| Water Treatment Plant | 78 | 65 | 56 | -- | 5070 |
| Workshop | 109 | 67 | 47 | -- | 6970 |
| Warehouse (incl. space under modules) | -- | -- | -- | -- | 50600 |
| Changehouse (1) | 136 | 64 | -- | -- | 8700 |
| Offices (2) | -- | -- | -- | -- | 10000 |
| Vehicle Repair | 200 | 80 | -- | -- | 16000 |
| Subtotal | | | | | 97340 |

NOTES: (1) Changehouse is part of dewatering module.
(2) Office space allowed for in modules.
(3) May be reduced in size at the detail design stage.

17.0 CONCENTRATE STORAGE -- MILL SITE

Dome Structure 180 ft. diameter x 70 ft. high for Zn (adequate for 6 weeks storage).
Dome Structure 100 ft. diameter x 42 ft. high for Pb (adequate for 6 weeks storage).

18.0 MISCELLANEOUS MILL SITE FACILITIES

| | |
|---|---|
| Fuel Storage | 2 x 200,000 USG |
| Fresh Water Storage | 350,000 USG |
| Coarse Ore Storage | 10,000 ton |

19.0 THICKENERS

| | |
|---|---|
| Pb | 45 ft. dia. |
| Zn | 110 ft. dia. |
| Tailing | 125 ft. dia. |
| Water Treatment | 90 ft. dia. |

20.0 POWER SYSTEM

| | | |
|---|---|---|
| Demand: | Average | 7825 kW |
| | Peak | 9530 kW |

## 20.0 POWER SYSTEM (continued)

| Generators: | Main | Emergency |
|---|---|---|
| Number of units | 6 | 3 |
| Cylinders/unit | 8 | 12 |
| BHP -- full load | 4225 | |
| Kw -- full load/unit | 3000 | 500 |
| -- total installed | 18000 | 1500 |
| RPM | 720 | 1800 |
| Voltage | 4160 | 480 |

## 21.0 ACCOMMODATIONS

| Modules | Length feet | Width feet | Height feet | Weight tons |
|---|---|---|---|---|
| Living (4 modules) | 144 | 55 | 50 | 1150 x 4 |
| Communal | 164 | 78 | 50 | 1400 |
| Services | 130 | 78 | 50 | 1100 |
| TOTAL | | | | 7100 |

Facilities

- 111 single rooms
- 112 single (or 56-2 room suites), 8 two-roomed suites
- Dining capacity -- 235 people
- Gymnasium -- 90' x 78' x 24' high

| AREA | SQ. FT. |
|---|---|
| Building Services | 7,500 |
| Storage | 10,900 |
| Laundry | 1,100 |
| Accommodations | 59,150 |
| Commons | 39,370 |
| Dining & Serving | 3,520 |
| Kitchen | 1,600 |
| Kitchen Storage | 1,280 |
| Administration | 2,300 |
| Infirmary | 960 |
| Gymnasium | 7,000 |
| Changerooms & Sauna | 2,850 |
| Hobby Rooms | 3,800 |
| Commissary | 800 |
| Lounges | 1,970 |
| Library | 400 |
| Radio/Communications | 400 |
| Post Office | 140 |
| Janitors' Rooms | 420 |
| TOTAL AREA | 145,460 |

## 22.0 LAND TRANSPORTATON

a) Route from mine to VABM 28 through Cape Krusenstern National Monument:

Distance 57 miles
Elevation @ Mine + 1030 ft.
Elevation @ Port + 10 ft.
Maximum grade 4%
Road Width 30 ft.
No. of bridges -- 5
Passing lanes @ 2 mile intervals

b) Concentrate Haulage Trucks

Years 1 to 5 -- 4 - 700 HP tractors each with 2 side-dump or end dump
Trailers each with a 36 cu.yd. capacity.

Years 6 + -- 6 units as per above.

## 23.0 PORT

a) Shallow Water Dock

Sheetpile dock face in 10' water depth
Earthfill causeway 400' long

b) Deepwater Dock

(i) Ship ballasted to seabed in 35' water depth with storage capacity for: 71,000 tons of Zn concentrate
38,000 tons of Pb concentrate
9,400,000 USG of Fuel
Deck storage for 400 - 8'x8'x20' containers

(ii) 1000 ton self-propelled lighter barge -- summer operation

c) Shore Facilities

(i) Truck dump pad and barge loading facility.

(ii) Sulphuric acid storage tank (155,000 USG) and truck loading facility.

(iii) Fuel transfer tank (50,000 USG) and truck loading facility.

(iv) Accommodations for 20 - left over construction camp.

23.0 PORT (continued)

c) Shore Facilities

(v) Small 250 kW power plant.

(vi) Small storage building: 40' x 40'.

d) Facilities at Mile 2.5

(i) A-frame structure 180' x 912' x 80' high to store 55,900 tons of Pb concentrate and 247,900 tons of zinc concentrate.

(ii) Small 250 kW plant.

24.0 WATER SYSTEM

Fresh Water Consumption

° Process -- Avg. = 328,320 USGPD
-- Max. = 864,000 USGPD
° Domestic -- Avg. = 34,560 USGPD
-- Max. = 208,800 USGPD

Recycled Water Consumption = 2,645,280 USGPD

Fresh Water Supply

° Bons Creek Reservoir
° Drainage area -- 3.7 sq.mi.
° Daily usage -- 362,880 USGPD
° Dependable yield (based on 3 consecutive drought year @ 25% annual mean) -- 481,000 USGPD
° Dam height -- 37 ft. (30' for minimum storage)
° Dam crest length -- 280 ft.
° Total storage -- 630 ac.-ft.
° Live storage -- 246 ac.-ft.
° Dam crest elev. -- 852 ft.
° Normal water surface elev. -- 845 ft.

Fresh Water Facility Specs.

° Floating raft -- 16 ft. x 9 ft.

° Pumps: Type -- Vertical turbine
No. -- 2 operating and 1 standby
HP -- 75 each pump

24.0 WATER SYSTEM (continued)

Fresh Water Facility Specs. (continued)

° Pipeline: Material -- high density polyethelene (SCLAIR)
  Length -- 18,000 ft.
  Diameter -- 10 in. to main storage tank
  Heat Tracing -- 110 volt
  Insulation -- 2 inch styrofoam

Fresh Water Tank

° Elevation -- 1,030 ft.
° Dimension: Diameter -- 46 ft.
  Height -- 30 ft.
° Volume -- 350,000 USG

25.0 TAILING SYSTEM

| | % Solids | Volume |
|---|---|---|
| Tailing -- from process to thickener | 17 | 2,203,000 USGPD |
| -- from thickener to pond | 60 | 298,000 USGPD |
| -- recycle - thickener overflow | 0 | 1,905,000 USGPD |

Tailing Embankment:

° Height -- 150 ft.
° Length -- 2,200 ft.
° Fill Volume -- 265,000 cu.yd. starter dam (2 million cu.yd. to Elev. 950)

Tailing Impoundments @ 950 Elev.

° Area -- 25,472,000 $ft^2$
° Volume -- 29,860 ac.-ft.

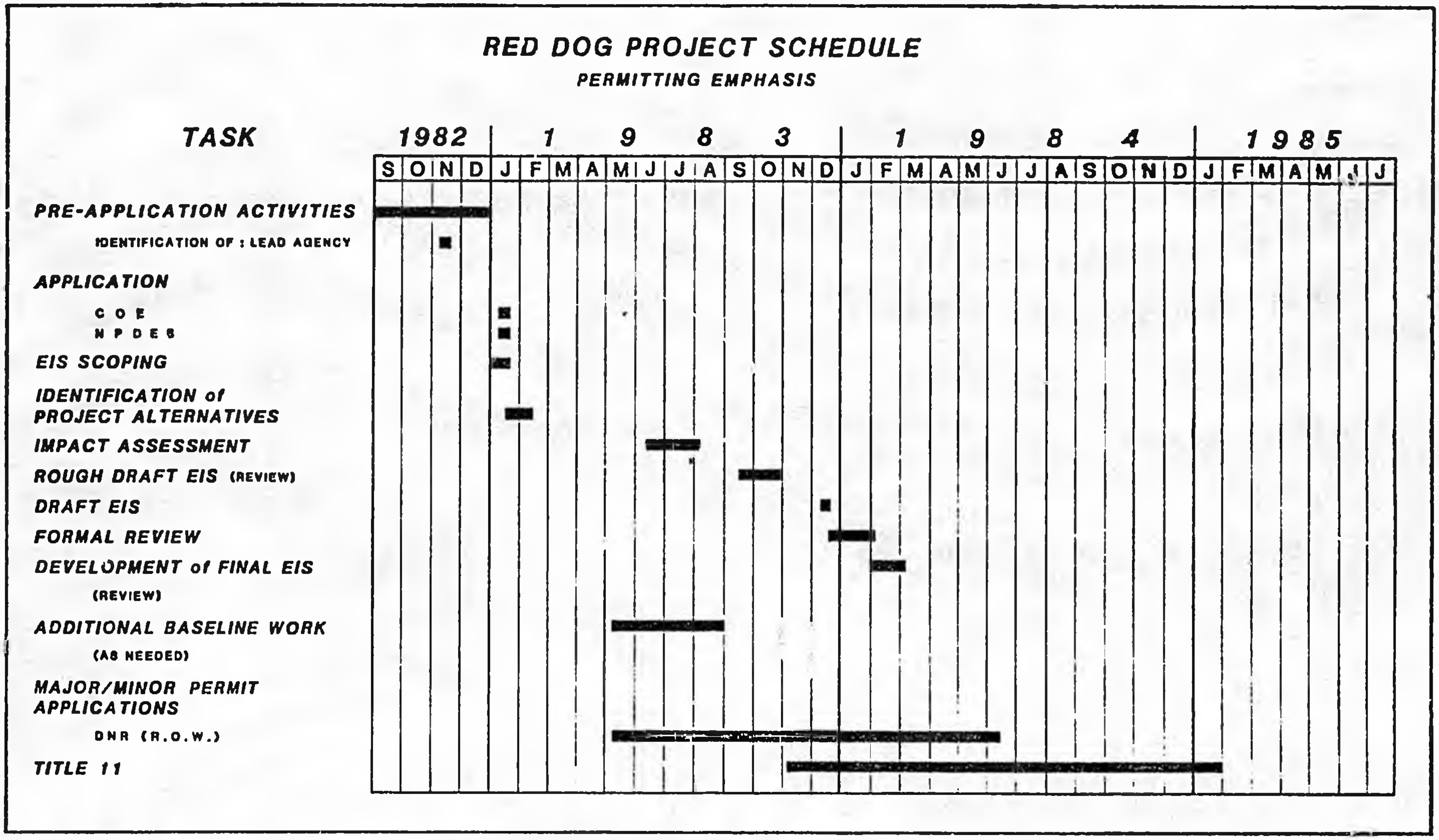
Tailing Thickener -- 125 ft. dia.

Tailing Facility Specs.

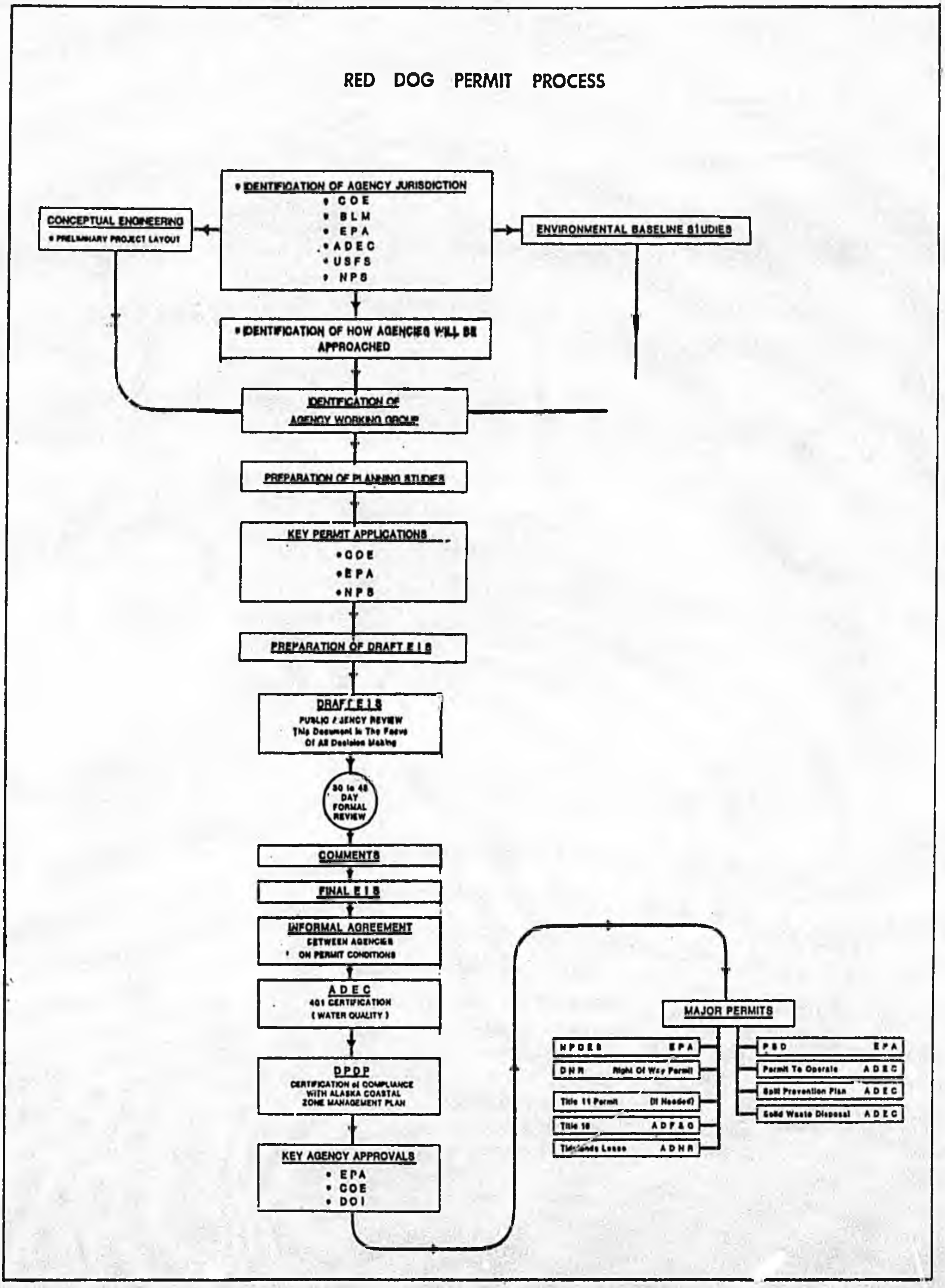
° Tailing line: Material -- H.D.P.E. (SCLAIR series 80)
  Length -- 3,500 ft.
  Diameter -- 6 inches
  Insulation -- 2 inches styrofoam
  Heat tracing -- 110 volt

RD05/b

## IX.C. Appendix C: Project Permitting Time-Line


RED DOG PROJECT SCHEDULE
PERMITTING EMPHASIS
TASK
1982
1983
1984
1985
S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J
PRE-APPLICATION ACTIVITIES
IDENTIFICATION OF : LEAD AGENCY
APPLICATION
C O E
N P D E S
EIS SCOPING
IDENTIFICATION of PROJECT ALTERNATIVES
IMPACT ASSESSMENT
ROUGH DRAFT EIS (REVIEW)
DRAFT EIS
FORMAL REVIEW
DEVELOPMENT of FINAL EIS (REVIEW)
ADDITIONAL BASELINE WORK (AS NEEDED)
MAJOR/MINOR PERMIT APPLICATIONS
DNR (R.O.W.)
TITLE 11

## Appendix D: Permit Flow Chart



## Appendix E: Base Metal Markets (Cu, Pb, Zn): Alaskan Opportunities (Paper by Gordon H. Laurie, Cominco, Ltd.)

Presented at:
Alaska Miners Association
Eighth Annual Convention
"Alaskan Minerals for Pacific Rim Markets"

October 19-22, 1983
Anchorage, Alaska

Cominco Ltd./Suite 1500-120 Adelaide St. West/Toronto, Ontario M5H 1T1/Canada/Tel. (416) 869-1850

BASE METAL MARKETS (Cu, Pb, Zn),

:ALASKAN OPPORTUNITIES

(Long Abstract)

Metals Market Research

By: G.H. Laurie/Cominco Ltd.

Alaska appears to be on the verge of becoming one of the world's important mineral suppliers. In the case of base metals, Cominco's Red Dog discovery is already recognized as being a very major future zinc and lead producer. Geologists have high expectations for other discoveries of commercially viable copper, lead, and zinc mines. The question addressed in this paper is how do these Alaskan opportunities match the world's future needs for copper, lead, and zinc.

Examination of the historical demand in the Western World for these three base metals brings us to the conclusion that all are in a state of maturity with saturation of use occurring in the developed nations. Growth in consumption will more and more depend upon the increases in the living standards of the newly industrializing countries. Fortunately for the Alaskan resources, the economies in the Pacific Rim have shown substantial growth. Long-term prospects in this area of the world look promising.

Copper consumption in the Western World grew at a rate of about 4½% per year from 1960 to the energy disruption of the mid 1970's. We expect that the resumption of demand growth will be in the order of 1½% once the economies of the world recover but that this will mean the 1979 consumption peak will not be regained until the mid 1980's. After the mid 1980's, we expect increasing Western World consumption and mine exhaustion to create a demand of over 150,000 tonnes/year of new mine production. Copper prices have weakened since 1979/80 and we, along with most forecasters, have revised our long-term expectations. World-wide distribution of copper concentrates will be influenced as some of the LDC's establish smelter/refinery facilities and consume their domestic mine production.

Lead consumption in the Western World grew at about 3½% per year from 1960 to 1973 but is expected to show a resumed growth of only about 1% in the future. The peak consumption of 4.2 million tonnes in 1979 is not expected to be reached again until near the end of this decade. Mine production of lead has continued at approximately 2.5 million tonnes since 1973 whereas lead metal from secondary sources increased from near 1.0 million tonnes in 1973 to close to 1.9 million tonnes in 1979 and since then has dropped back to approximately 1.5 million tonnes during the current recession. It is difficult to predict the need for new lead mine production due to the uncertainties of secondary lead. However, it is safe to say that without the introduction of any new significant end-uses for lead the mines which are brought into production to satisfy zinc and silver requirements will provide enough new lead as a co-or by-product to satisfy needs. In this regard, the Red Dog property, which has a zinc to lead ratio of 3½ to 1, better matches the expected new mine zinc and lead needs than higher ratio lead properties.

Zinc consumption in the Western World grew at approximately 4.8% per year from 1960 to 1973 where it peaked at about 4.8 million tonnes. With economic recovery, a growth rate of near 2% per year should see the 73 and 79 peaks in consumption re-established in the mid to late 1980's starting from the current level of near 4.2 million tonnes. Future new mine demand, to satisfy consumption growth and mine exhaustions, is estimated to be somewhat less than 150,000 tonnes per year after about 1985. Zinc prices have weakened since the 1973/74 bullish period and the 1979/80 highs but, with expected reasonable balance between demand and supply, longer term strengthening is expected. World-wide demand for concentrates should result in the need for future supplies from Alaska.

GHL:hmw
October 7, 1983

BASE METAL MARKETS (Cu, Pb, Zn)

: Alaskan Opportunity

By: G.H. Laurie/Cominco Ltd.

Market Overview

The world shall continue to need base metals and from our analysis there is an opportunity for Alaska to become an important supplier of copper, lead and zinc concentrates. Markets for these materials will depend upon the overall growth of the world's economy, the specific requirements for capital and consumer goods, and the availability of competitive concentrate supplies.

Slides

- OECD IPI
2. • Growth in IP & Major Metal Consumption
3. • Metal Prices & Ind. Bus. Cycle

Note: The slides marked (MMRS) are taken from "Metals Analysis and Outlook" published by Metals & Minerals Publication Ltd.

Metals consumption growth has often been related to various industrial production indexes rather than to overall GNP-type of economic growth measurements[1,2,3]. As our western world's growth has progressed an increasing proportion of the GNP has been from the service sectors with corresponding less growth from the basic industrial sectors. Therefore, as our industrial societies have matured the rate of new capital investment for plants has tended to decline. Furthermore, various measures show a declining relationship between metals consumption and overall industrial production as substitute materials are used and as end uses make more efficient use of the materials of construction. Another factor which negatively affects the need for mined metal is the increased recycling of scrap. This movement towards more secondary metal has been supported by both the conservation and environmental priorities of the last number of years.

Offsetting the above trend to a state of maturity for the basic industries in the developed nations of the world, is the exciting prospects for the emerging developing nations[4]. Many of these are the markets that can be served by suppliers adjacent to the Pacific. I recently reviewed economic growth forecasts made by a major USA research group. Their data pointed out the following differences for the period up until year 2000.

Slide

4. • Zinc Consumption by Region

| Area | GNP Growth |
|---|---|
| Western Europe | 2.3% |
| Eastern Europe | 2.3% |
| North America | 2.8% |
| Latin America | 4.3% |
| Africa | 4.2% |
| Asia and Far East | 3.9% |
| Total World | 3.0% |

Other forecasts will be different depending on the respective views of economic opportunities or problems. However, I don't know of one forecast that doesn't indicate the maturing of the current industrial countries with lower basic materials consumption growth rates and considerably higher rates for the newly developing countries - despite their balance of payments and other economic problems.

Our company, like most in the mining business, assesses the current concentrate supply and also makes judgements on future supply requirements due to consumption growth and mine exhaustions. This expected demand on the mines will be met by some expansions and by new mines. The main interest in this meeting is obviously what new mines can be found and opened in Alaska. Cominco has one we feel will be economically viable, other companies are equally optomistic and still others are no doubt going to find suitable economic deposits.

Demand on the Mines

| | (Growth) Consumption | + Closures | = Total |
|---|---|---|---|
| Cu | 100 | 60 | 160 |
| Pb | nil | 10/15 | 10/15 |
| Zn | 60 | 70 | 130 |

A major consideration we have in assessing our opportunities is where do we believe our potential mine is on an estimated cost-curve of the Western Worlds' mines for any particular metal[5]. With the current and expected future economic growth we firmly believe any proposed operation should be in the lower half and preferably the lower third of the cost-curve. To some extent new mines which open may act in a predatory manner and hasten the death of marginal producers.

Slide

5. • Cost-curve

To rank the opportunities for future mines for copper, lead and zinc one's crystal ball must assess the consumption demand, the competitive mines (both existing and those known to be likely new entrants and those expected to be near reserve or economic exhaustion), and the competition from secondary supplies. I personally have no difficulty in ranking the three metals based on what I know and what my crystal ball tells me. All other factors being equal I would first want to find a good zinc mine, next a quality copper mine would be attractive, and finally if I felt I had a really low cost producer I would deal with a lead mine.

The factors which lead me to my choice are:

1) Known ore bodies - I feel there are a good number of copper deposits in the world that have a good chance to be reasonably low-cost producers. There are fewer zinc ore bodies in the same category as far as I can see. Lead is rapidly becoming a by-product of zinc and will come to market as zinc requirements are met.

2) Depletions/exhaustions - It is difficult to get a definitive picture of this factor but it appears there may be more of the existing large zinc bodies coming closer to exhaustion over the next 20 years than is the case for copper - time will tell.

3) Consumption - The growth rates we predict for all three metals are very modest and we all hope we are proven to be overly conservative. However, I

believe our forecasts of zinc at 2%, copper at 1.5% and lead at 1% are in the right order. Of the above base metals, zinc is expected to continue to have the smallest part of its supply as secondary metal.

4) Ownership - The zinc industry currently is, and is expected to remain, more in the hands of free enterprisers than is the case for copper. We believe this supports a better long-term pricing structure - in particular, as metal stock levels can be kept in better balance [6].

Slide

6 Metal Stocks & Metal Prices

Despite my preferences as outlined above it goes without saying that any mine, whether a copper, lead or zinc mine, that is determined to be a low-cost producer is likely to be brought into production.

Copper Markets

The recognition that copper is a mature metal should not be taken too negatively. It can be said it is our oldest mature metal but one which continues to fulfill mans' needs with renewed bursts of consumption as new technologies such as electricity implant new life. The slides I have gathered for you today give you some idea of the consumption patterns, mined production and prices for copper.

Slides

7. • Cu Mine Production
8. • WW Copper Consumption
9. • Consumption/Prod. & Stocks
10. • Copper Prices
11 Copper Prices with Highs/Lows

Slides on Copper - here [7-11]

The events which are likely to affect the opportunities for any future copper properly in Alaska are:

- the cost influences of remote locations with or without state infrasturucture support;
- overall supply needs for United States demands;
- new smelters built by previous suppliers of concentrates; and
- the expansion of the copper industry in Chile and other known regions possessing good copper properties.

Any new domestic world-class copper operation that may be developed in Alaska would help offset the decline of the USA copper industry. The reduction of concentrate shipments from the Phillipines to Japan with the start-up of the Phillipine smelter creates an opportunity for new concentrate suppliers - especially as there seems to be a relatively over capacity of copper smelters in the world. The expansion of Chile's copper industry which some claim has a goal of nearly 2 million tonnes capacity will, on the other hand, have a negative overall effect on the copper industry and in particular if world over-capacity is the result.

The copper concentrate suppliers and the smelter customers as outlined by the World Bureau of Metal Statistics are more or less as follows:

- Africa supplies to Western Europe and Japan
- Canada supplies to Western Europe, South Korea, Taiwan, and Japan

- South America supplies to Western Europe, South Korea, Taiwan and Japan
- Australia supplies to Japan
- South East Asia supplies to Western Europe, South Korea, Taiwan and Japan
- USA supplies to Japan

Lead Markets

Lead is also a very old metal which has benefitted by easy extraction and fabrication. Again we have an example of a mature metal which regained vigour with technological break-throughs such as the lead-acid battery and the internal combustion engine and its ignition system with the use of high octane fuels. Currently this metal is in a stable stage with some uses actually in decline. The most significant changes have been the growth of the recycled lead supply and, somewhat related, the tendency for lead to have become a by-product of zinc and silver production. The slides shown of lead's historical supply, demand and prices give you some insight into leads future.

Slides

12. Lead Production - Metal
 - Mine
 - 2nd

13. WW Consumption

14. Pb Prices

15. Pb Prices with Highs/Lows

16. Prices & Stocks

Slides on Lead - here[12-16]

The shipment of lead concentrates as outlined by the WMBS shows significant movements as follows:

- Africa supplies to Western Europe, North America, and Japan
- Canada supplies to Western Europe and Japan
- South America supplies to Western Europe, North America and Japan

- Australia supplies to Western Europe and Japan.

Zinc Markets

Compared to both copper and lead, zinc is a much younger metal. The significant role zinc plays in protecting steel in a sacrifical manner ensures the continuing need for a large part of the metal supply being new mined metal, as scrap recovery from this use is minimal. The market discipline of zinc suppliers coupled with somewhat better market support is emphasised by the relatively low level of metal stocks. This fact and other trends are shown in the following slides:

Slides

17. Zinc Mine Production
18. WW Zinc Consumption
19. Zn Price
20. Zn Price & Highs/Lows
21. Prices & Stocks

Slides of Zinc - here[17-21]

The most significant fact about the zinc market has been the rapid decline of the USA zinc industry over the 1970's and since the economic downturn of 1979/80. Since it's heyday in the late 1960's/early 1970's the US zinc industry has been reduced to about 1/4 to 1/3 of its maximum. Although consumption has also declined it still remains the largest market in the Western World. Cominco Alaska's planned entry into the world's zinc markets will help reverse the domestic supply situation.

Zinc concentrate movements as reported by the WBMS are as follows:

- Africa supplies to Western Europe
- Canada supplies to Western Europe, USA and Japan
- South America supplies to Western Europe, USA and Japan
- Australia supplies to Western Europe and Japan

Prices

The presentation today is not focused on prices for metal. Cominco's long-range price forecasts are confidential and furthermore my group are currently deeply involved in our annual up-date forecast so I am without firm numbers in any case.

Of greater value I believe, are some qualitative comments about the mine returns realized for concentrates. The treatment charges negotiated for metal concentrates are quite variable as each concentrate is in fact an unique product with different advantages and disadvantages. The location of the concentrate is also a factor in its price (via differing treatment charges as well as different transportation etc. costs). I am told by our concentrate sales people that the factors that enter into the determination of treatment charges are as follows:

- Concentrate quality
  - low quality concentrate will result in higher treatment charges.
- Smelter customer location
  - if far away and without alternate near-by concentrate this will normally result in lower treatment charges (i.e. the smelters have to compete).
  - close by smelters will use their location to obtain somewhat higher treatment charges.
- Smelter capacity
  - if the world's smelter capacity is in surplus (i.e. concentrates in relative shortage) this will result in lower treatment charges.
  - if the world's smelter capacity is in shortage this will result in higher treatment charges.
- Mine location
  - for northern mines or any others that have restricted shipping seasons the extra costs involved in storage by the receiving smelter will either be reflected by higher treatment charges or the seller would tend to have to cover the financing charges directly.

Conclusions

- From what I have been told Alaska is proving to be a valuable storehouse of needed mineral resources
- Despite high infrastructure costs it appears various deposits will become economic mines. This may be positively assisted by the development of the state's transportation system.

- Being located on the Pacific Rim will be beneficial as larger growth of metal consumption is forecast for many countries bounding the Pacific.
- World-class deposits of the base metals copper, lead and zinc will become viable mines if they are able to establish low operating costs.
- It appears the opportunities to supply can be ranked zinc, first; copper, second; and lead, third.

GHL:hmw

October 18, 1983

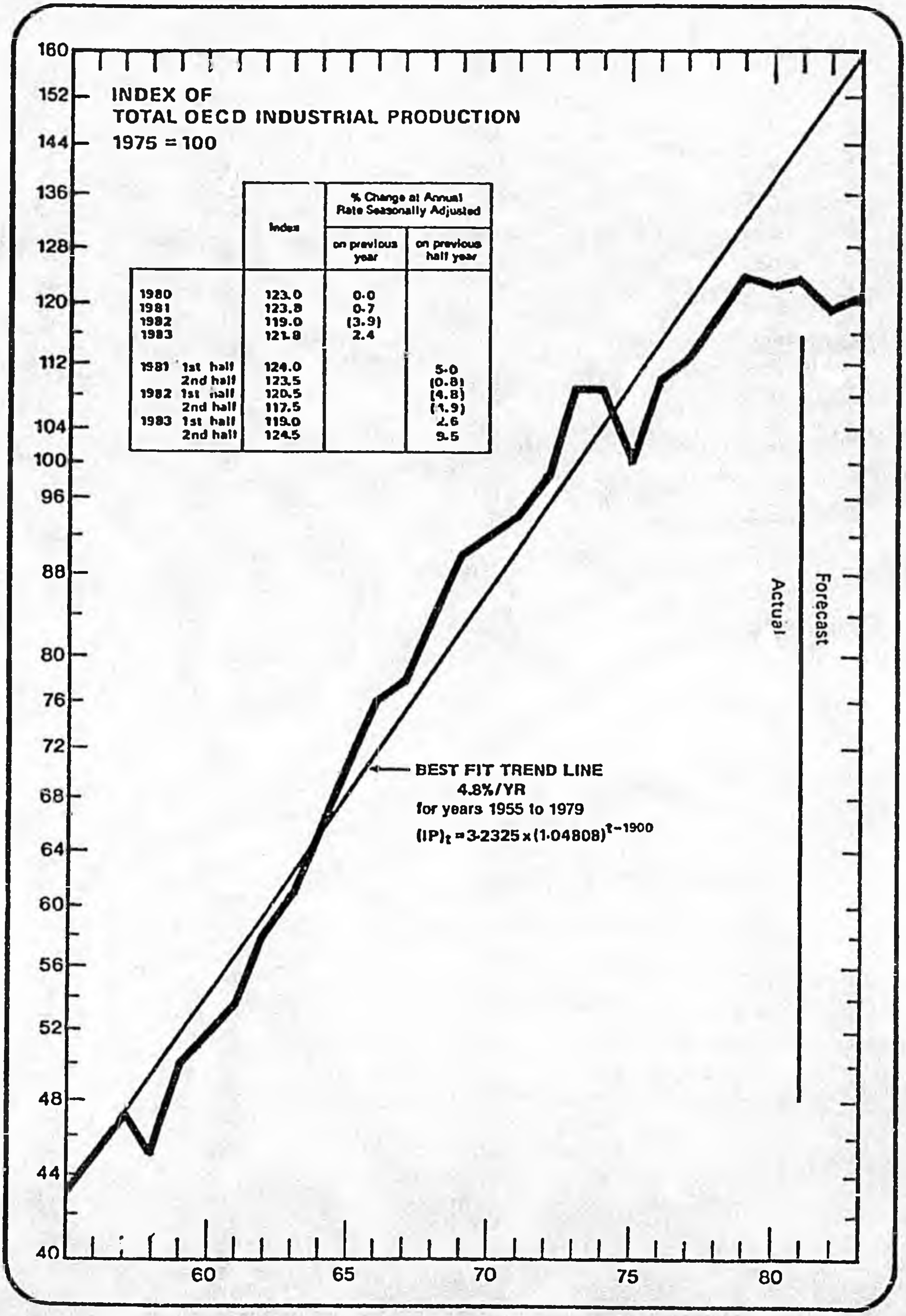
BASE METAL MARKETS (Cu, Pb, Zn)

: ALASKAN OPPORTUNITIES

By: Gordon H. Laurie
Cominco Ltd.

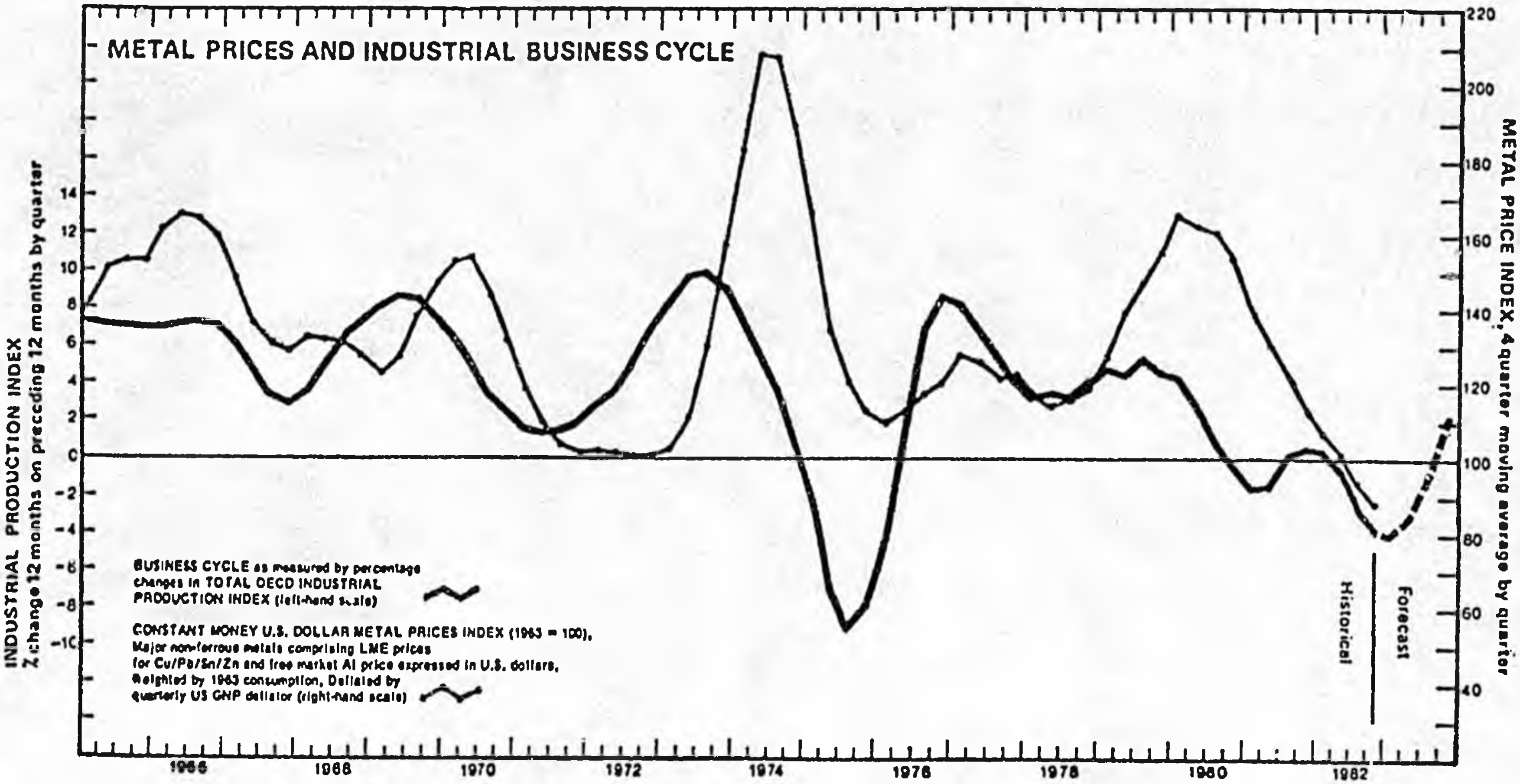
PRESENTATION SLIDES

1. Index of Total OECD Industrial Production
2. Growth in Industrial Production and Major Non-Ferrous Metals Consumption
3. Metal Prices and Industrial Business Cycle
4. Zinc Consumption by Region
5. Western World Zinc Mines Cumulative Production[2] VS. Costs[1]
6. Metal Stocks and Metal Prices
7. Copper Mine Production
8. Western World Copper Consumption
9. World Refined Copper Consumption less Production Commercial Stocks
10. Copper Prices - Cathode Settlement
11. LME Cash Wirebar Copper Price in 1983 US $ Per Lb*
12. Western World Lead Mine Production
13. Western World Lead Consumption
14. LME Lead Price
15. LME Cash Lead Price in 1983 US $ Per Lb
16. Lead Metal Prices + Stocks
17. Western World Zinc Mine Production
18. Western World Zinc Consumption
19. LME Cash Zinc Price
20. LME Cash Zinc Price in 1983 US $ Per Lb
21. Zinc Metal Prices + Stocks



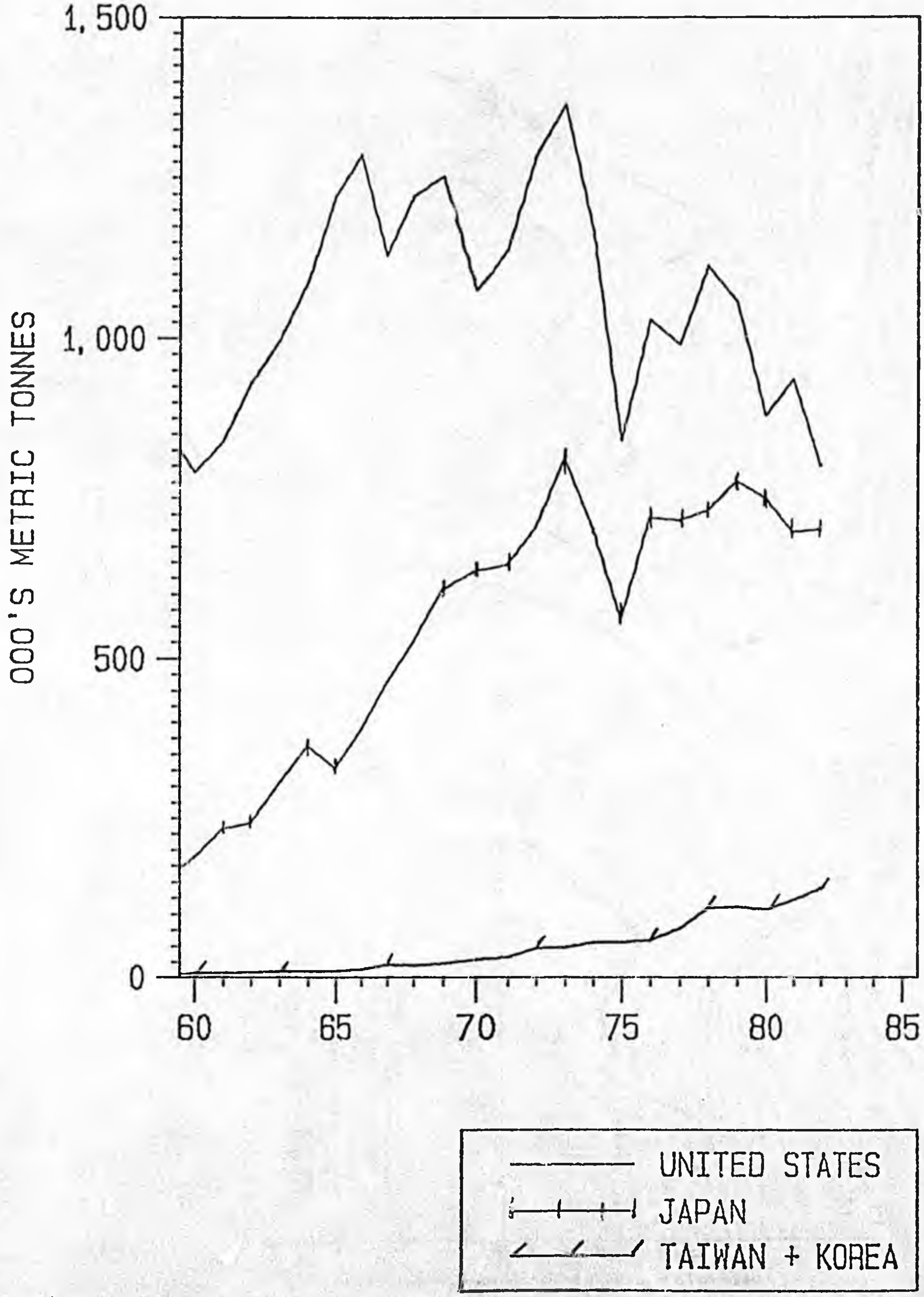

| | Index | % Change at Annual Rate Seasonally Adjusted on previous year | % Change at Annual Rate Seasonally Adjusted on previous half year |
|---|---|---|---|
| 1980 | 123.0 | 0.0 | |
| 1981 | 123.8 | 0.7 | |
| 1982 | 119.0 | (3.9) | |
| 1983 | 121.8 | 2.4 | |
| 1981 1st half | 124.0 | | 5.0 |
| 2nd half | 123.5 | | (0.8) |
| 1982 1st half | 120.5 | | (4.8) |
| 2nd half | 117.5 | | (1.9) |
| 1983 1st half | 119.0 | | 2.6 |
| 2nd half | 124.5 | | 9.5 |

SLIDE 1
(MMRS)


METAL PRICES AND INDUSTRIAL BUSINESS CYCLE
INDUSTRIAL PRODUCTION INDEX
% change 12 months on preceding 12 months by quarter
METAL PRICE INDEX, 4 quarter moving average by quarter
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
220
200
180
160
140
120
100
80
60
40
1966
1968
1970
1972
1974
1976
1978
1980
1982
Historical
Forecast
BUSINESS CYCLE as measured by percentage changes in TOTAL OECD INDUSTRIAL PRODUCTION INDEX (left-hand scale)
CONSTANT MONEY U.S. DOLLAR METAL PRICES INDEX (1963 = 100), Major non-ferrous metals comprising LME prices for Cu/Pb/Sn/Zn and free market Al price expressed in U.S. dollars, weighted by 1963 consumption, Deflated by quarterly US GNP deflator (right-hand scale)

SLIDE 3
(MMRS)

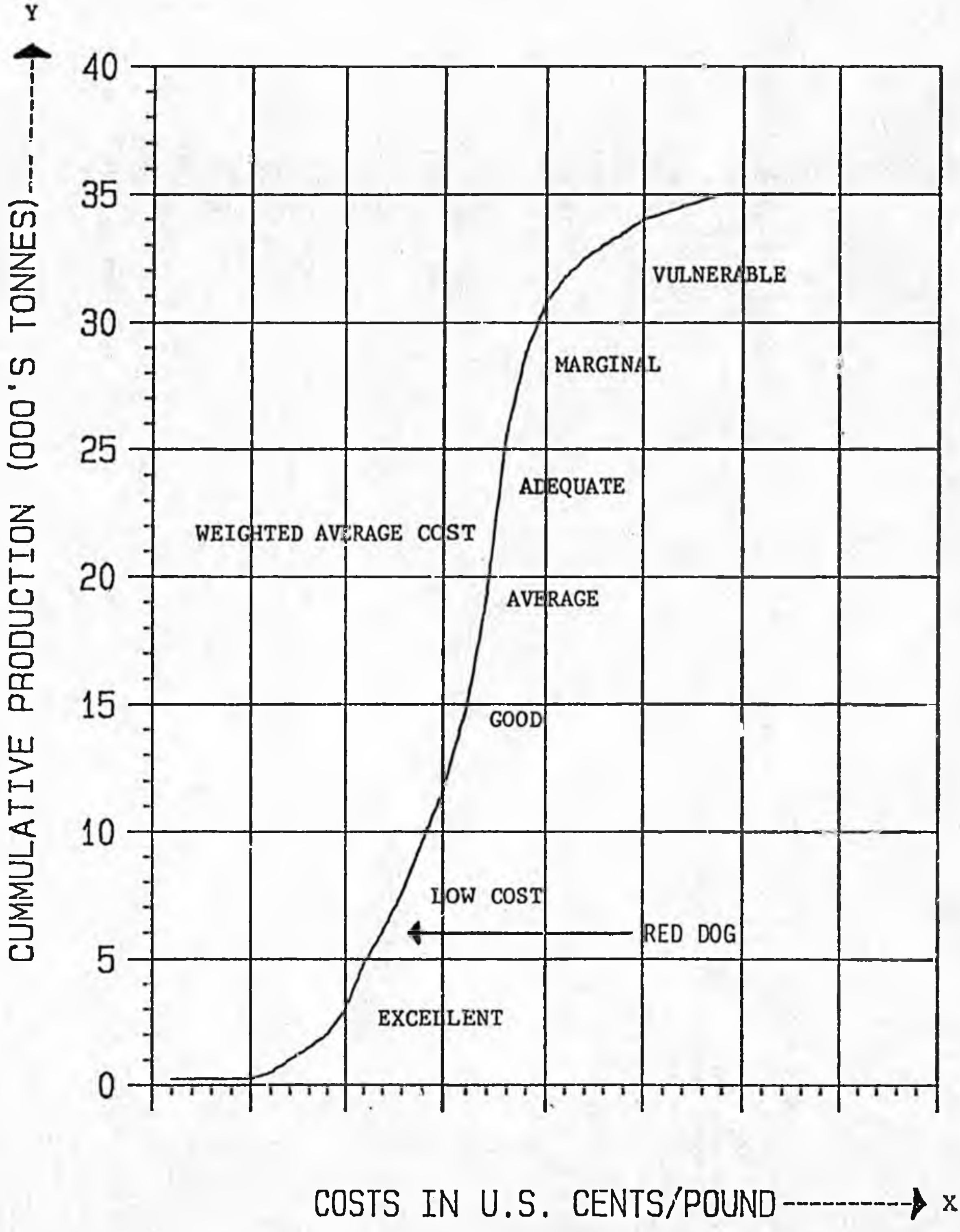
## ZINC CONSUMPTION BY REGION





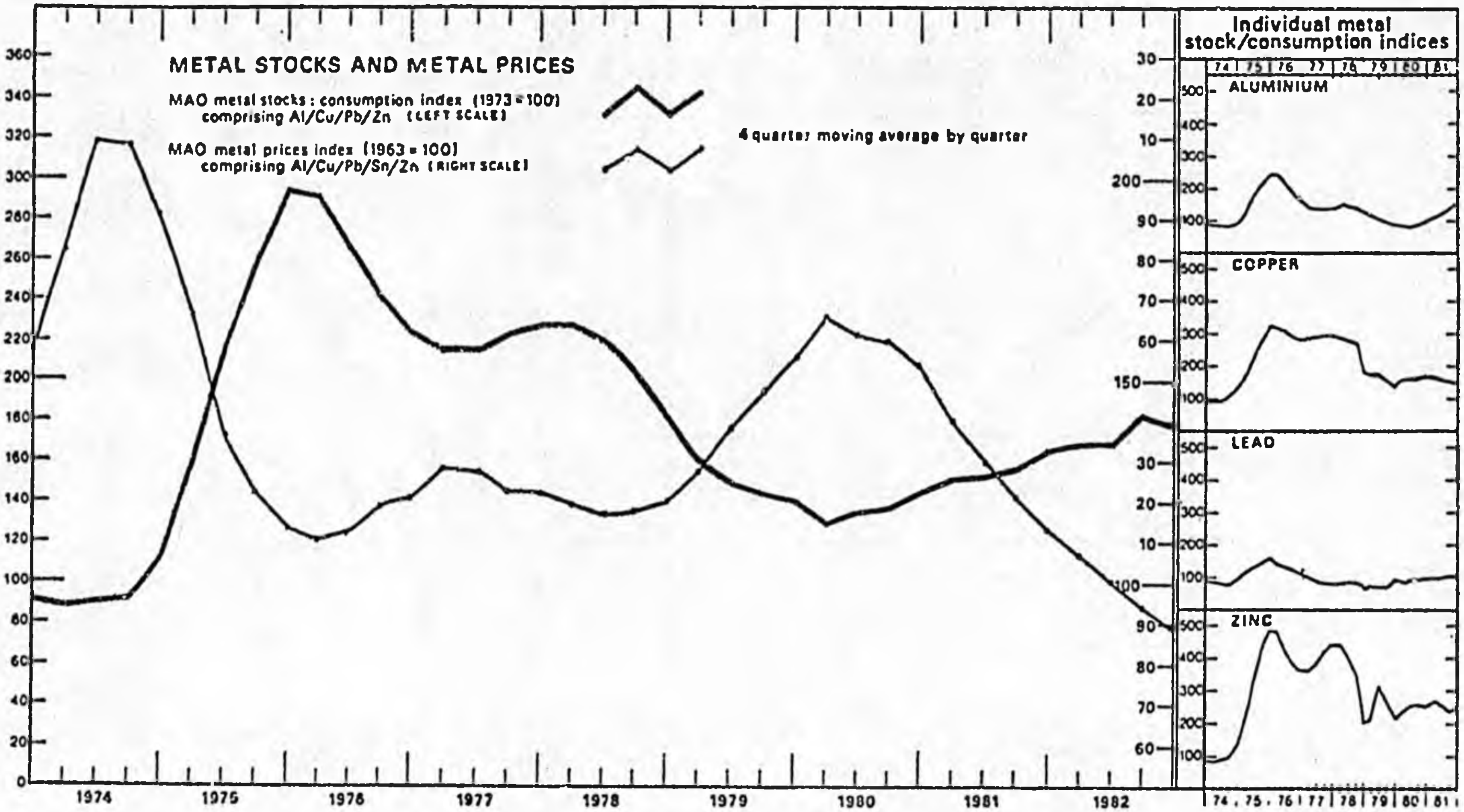

SLIDE 4

# WESTERN WORLD ZINC MINES
# CUMULATIVE PRODUCTION[2] VS. COSTS[1]



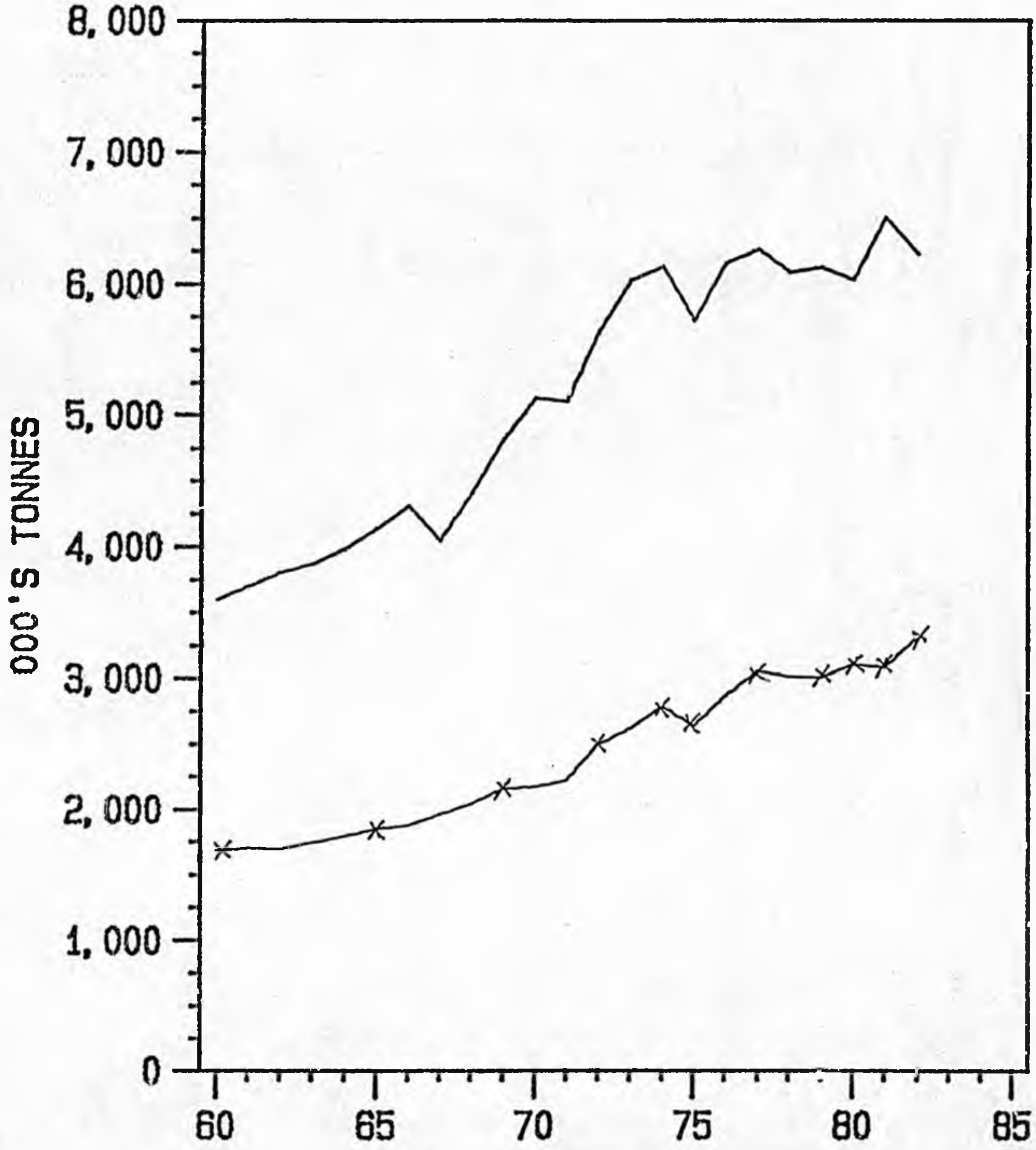

1) including depreciation and delivery to market.

2) represents X% of total Western World = Y thou. tonnes.


METAL STOCKS AND METAL PRICES
MAO metal stocks : consumption index (1973 = 100) comprising Al/Cu/Pb/Zn (LEFT SCALE)
MAO metal prices index (1963 = 100) comprising Al/Cu/Pb/Sn/Zn (RIGHT SCALE)
4 quarter moving average by quarter
Individual metal stock/consumption indices
ALUMINIUM
COPPER
LEAD
ZINC
1974
1975
1976
1977
1978
1979
1980
1981
1982

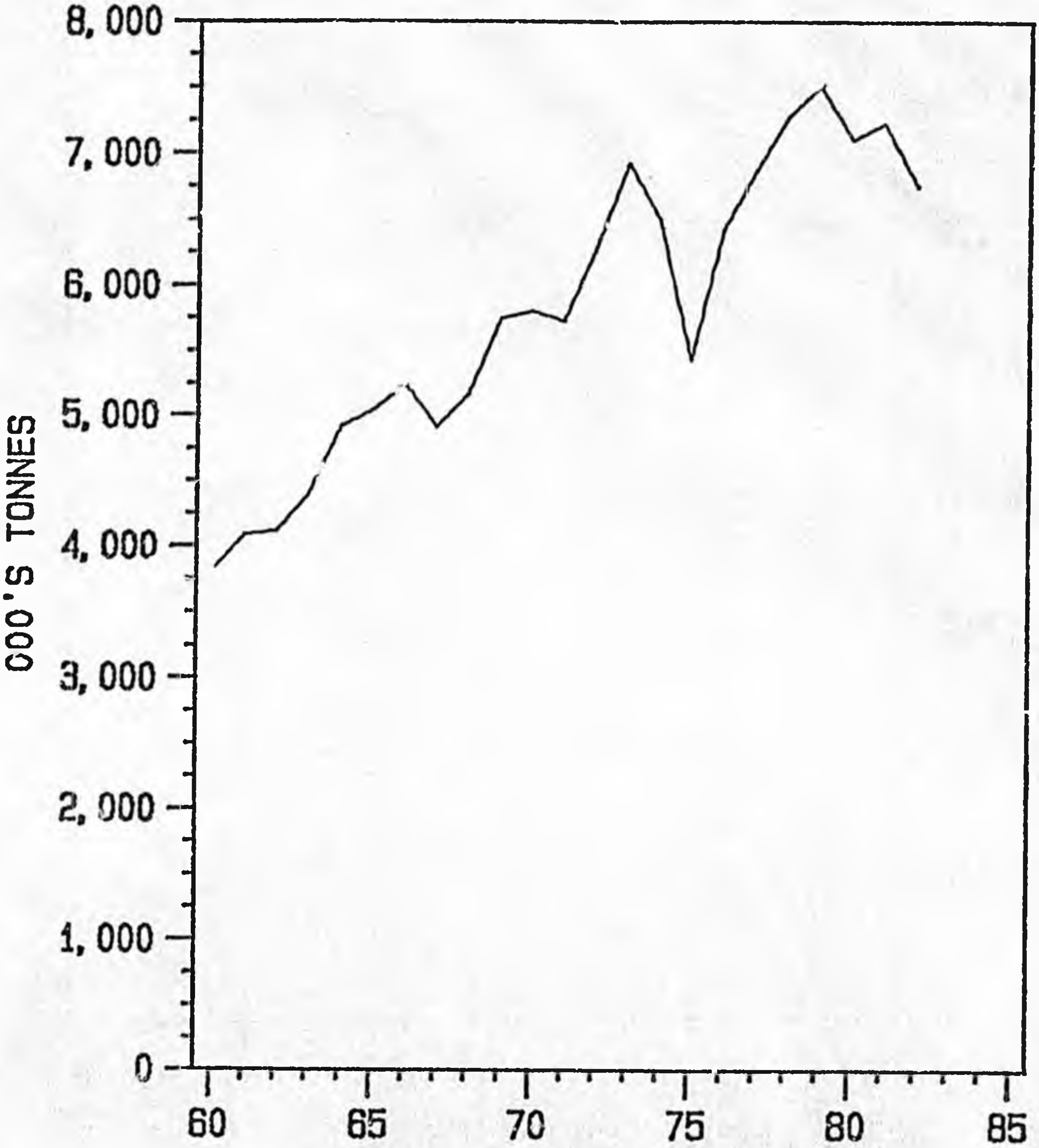
SLIDE 6
(MMRS)

COPPER MINE PRODUCTION

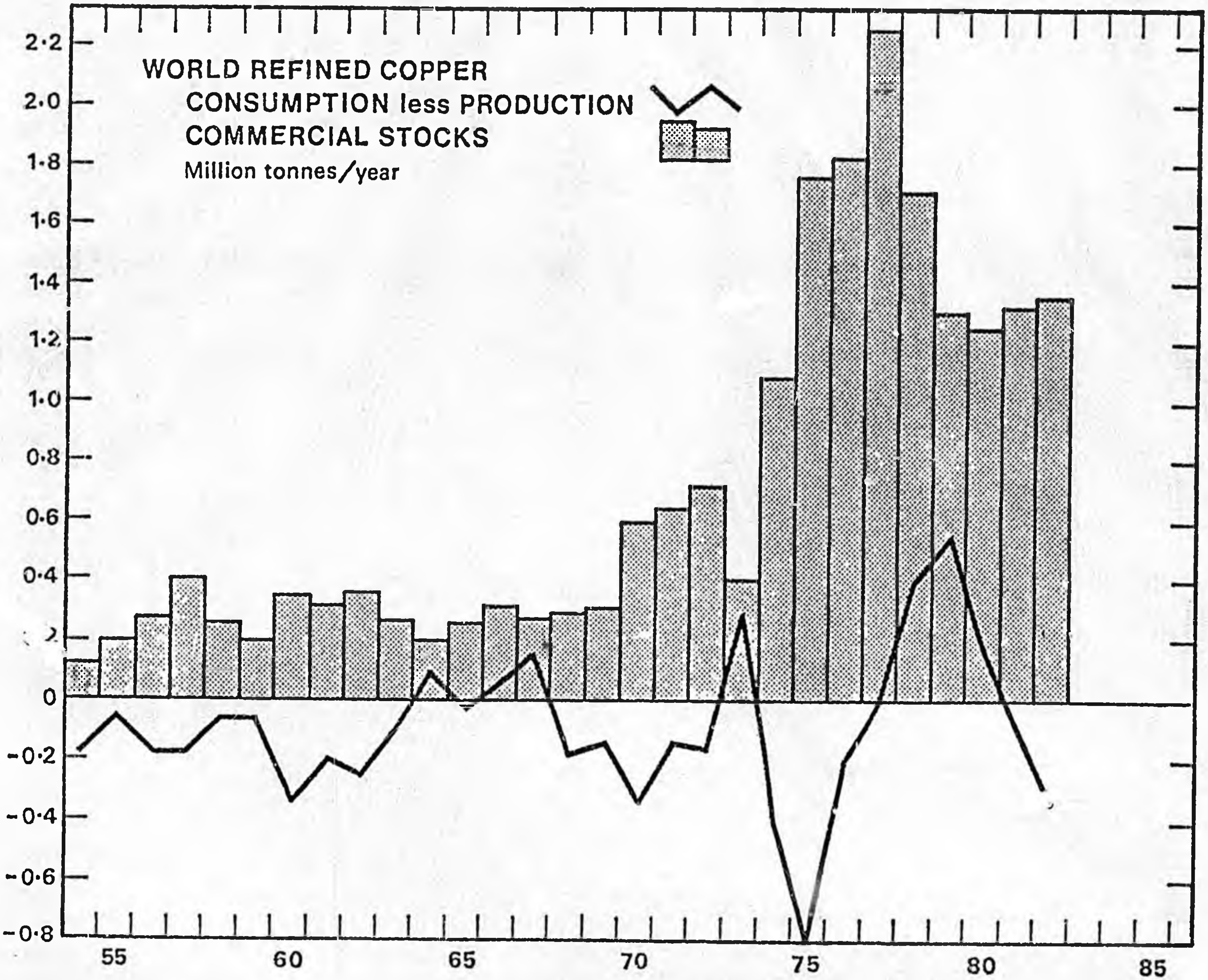



* ZAIRE, ZAMBIA, PHILIPPINES, CHILE, MEXICO, PERU, PAPUA NEW GUINEA

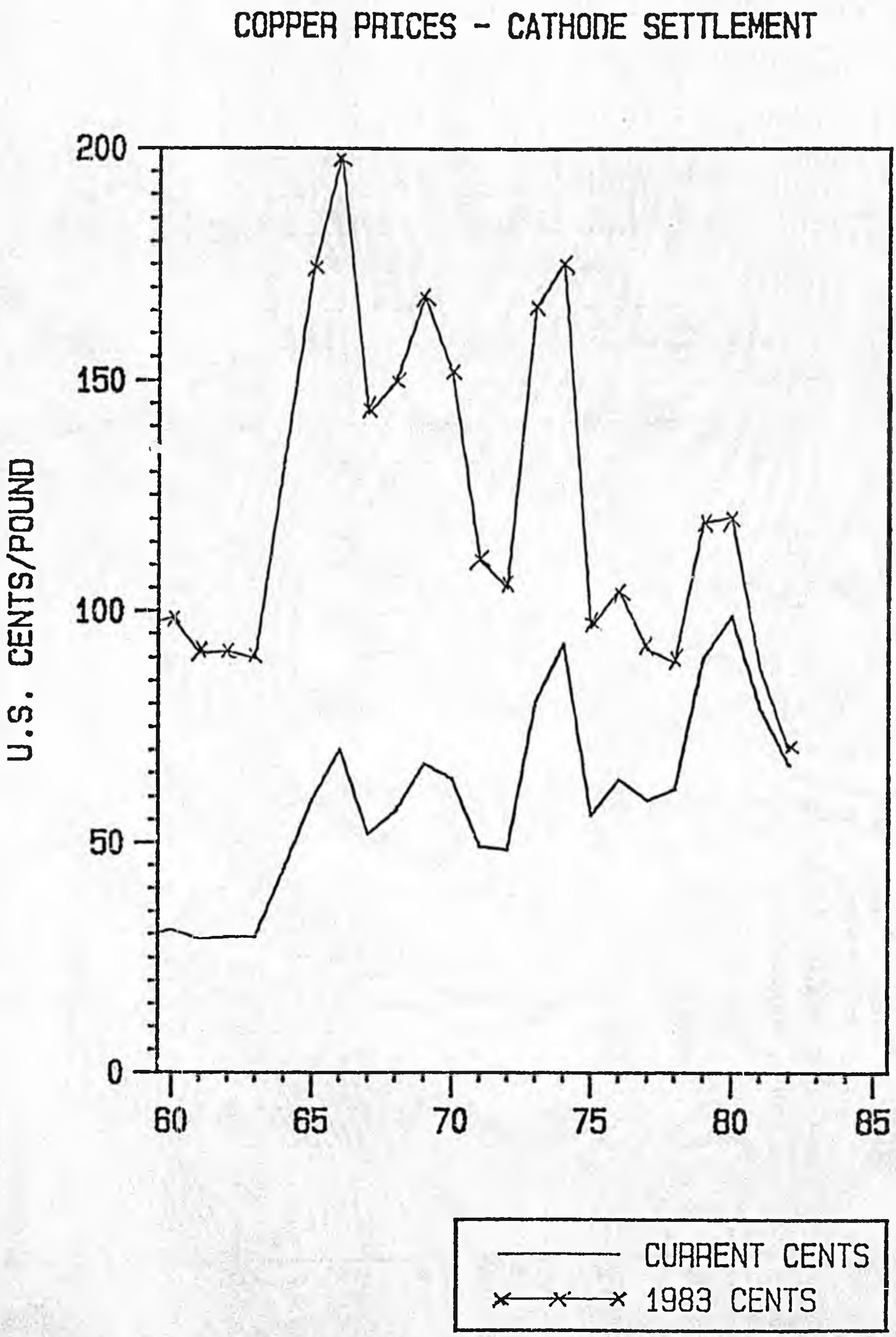
# WESTERN WORLD COPPER CONSUMPTION



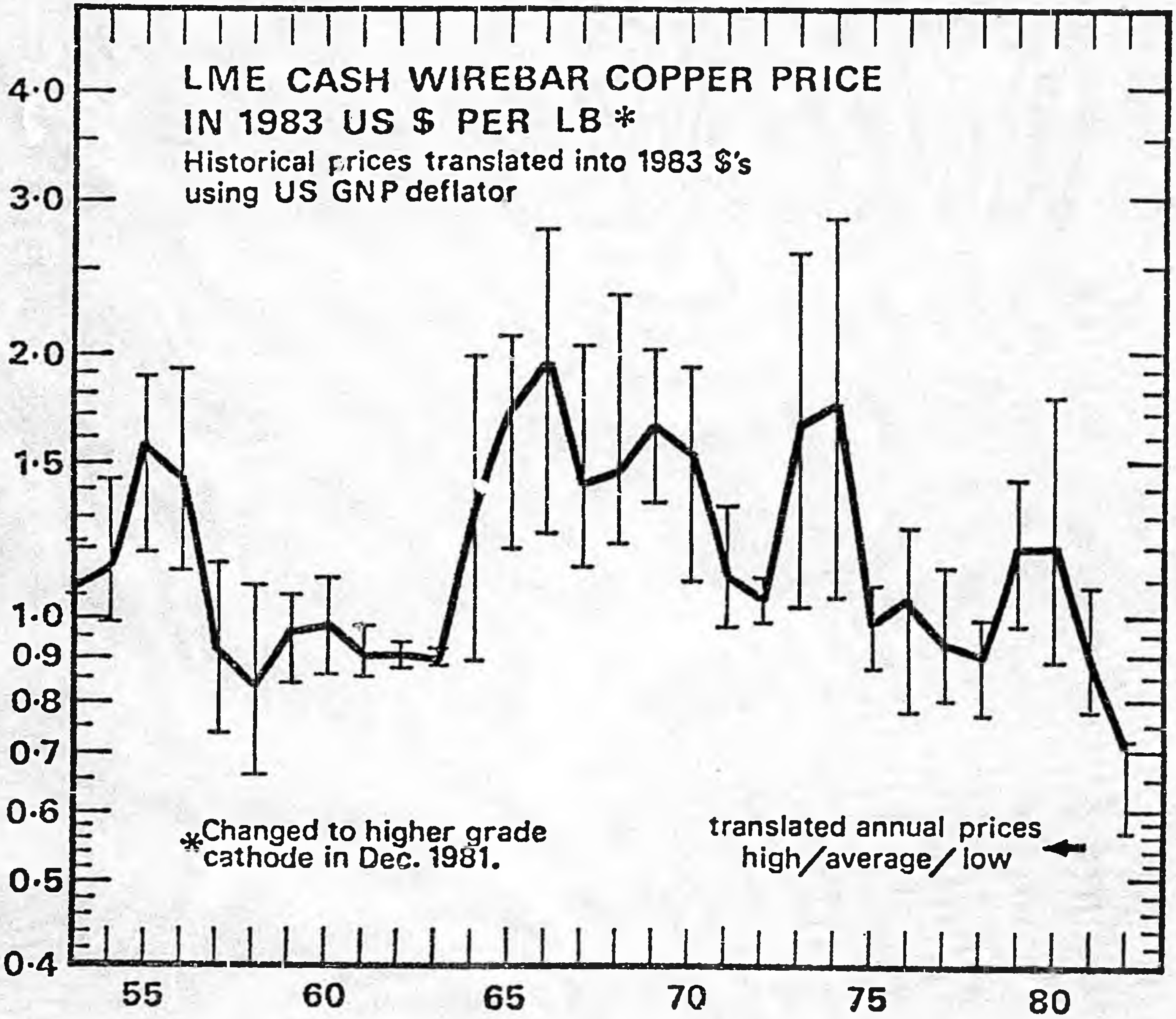

SLIDE 8



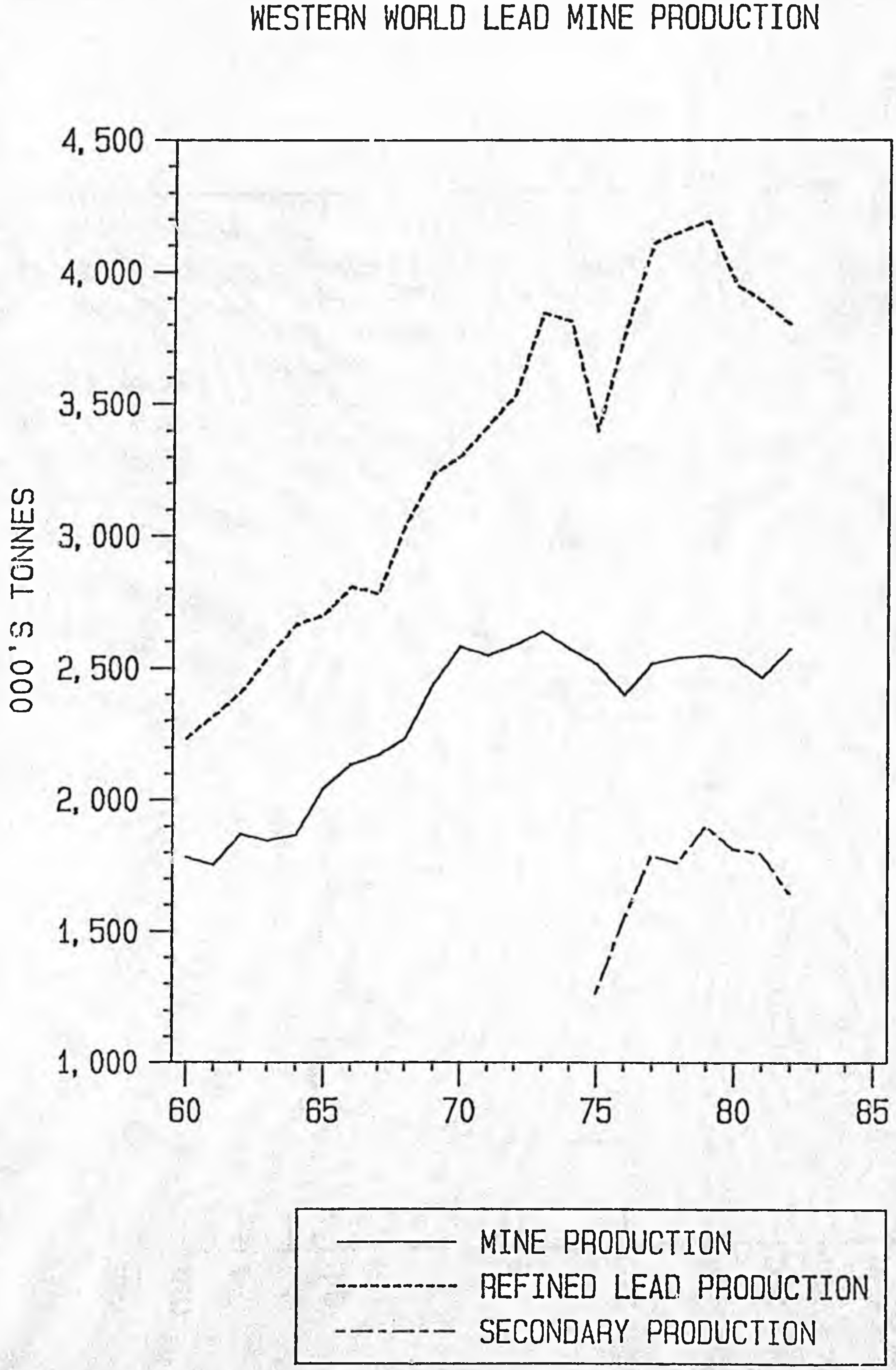

SLIDE 9 A-69
(MMRS)


COPPER PRICES - CATHODE SETTLEMENT
U.S. CENTS/POUND
200
150
100
50
0
60
65
70
75
80
85
CURRENT CENTS
1983 CENTS

A-70



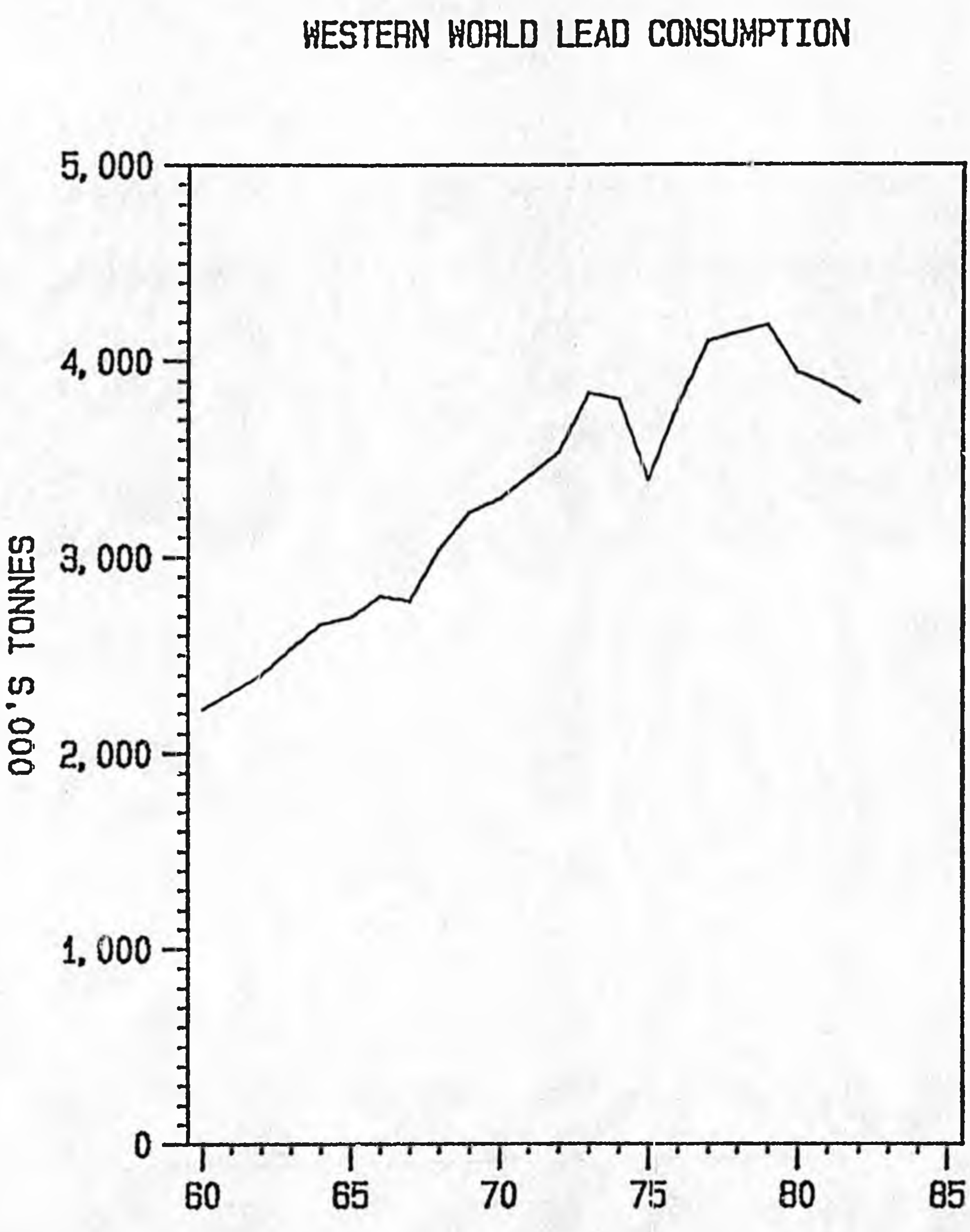

SLIDE 11
(MMRS)

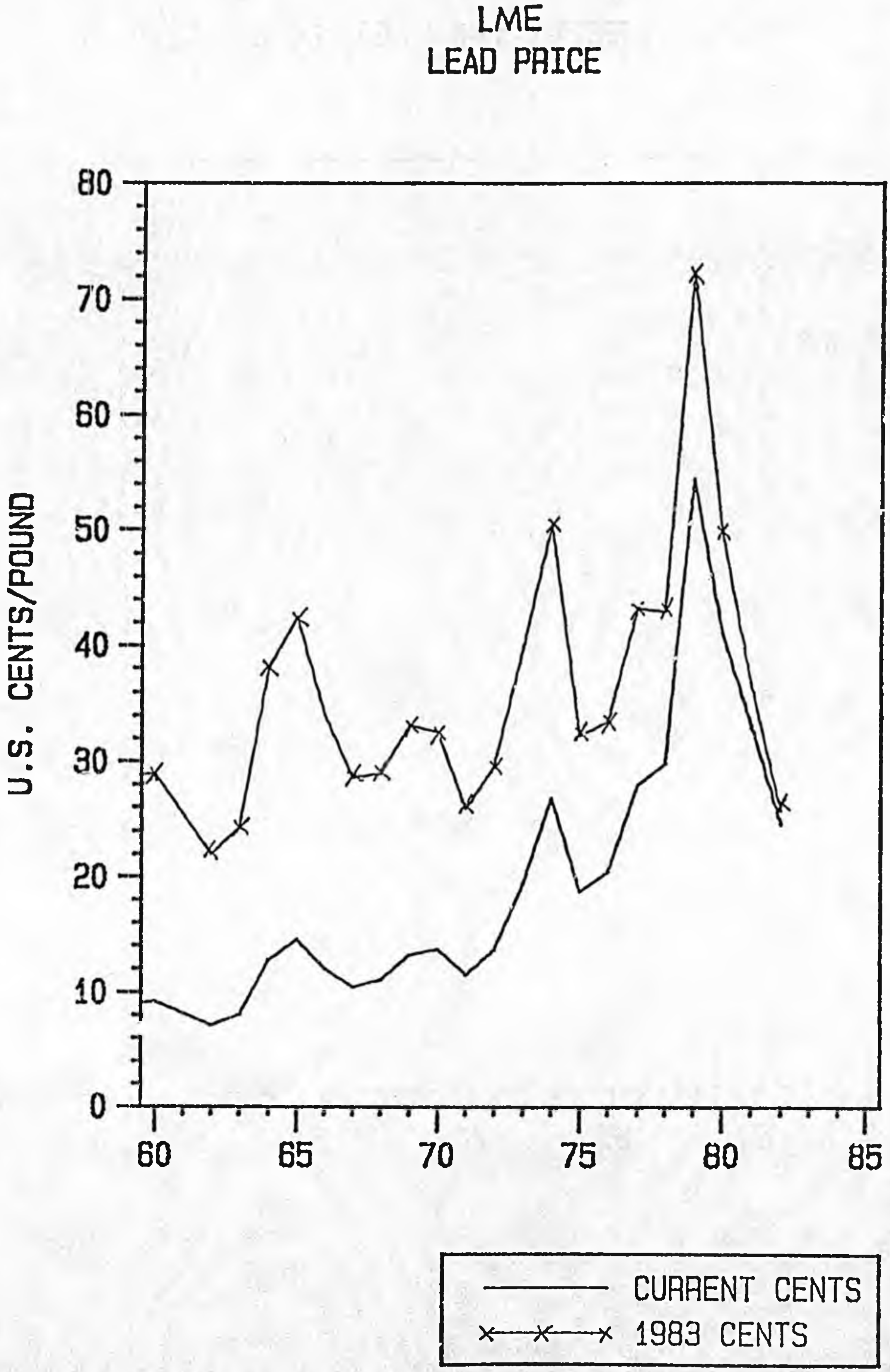


WESTERN WORLD LEAD MINE PRODUCTION
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
000'S TONNES
60
65
70
75
80
85
MINE PRODUCTION
REFINED LEAD PRODUCTION
SECONDARY PRODUCTION



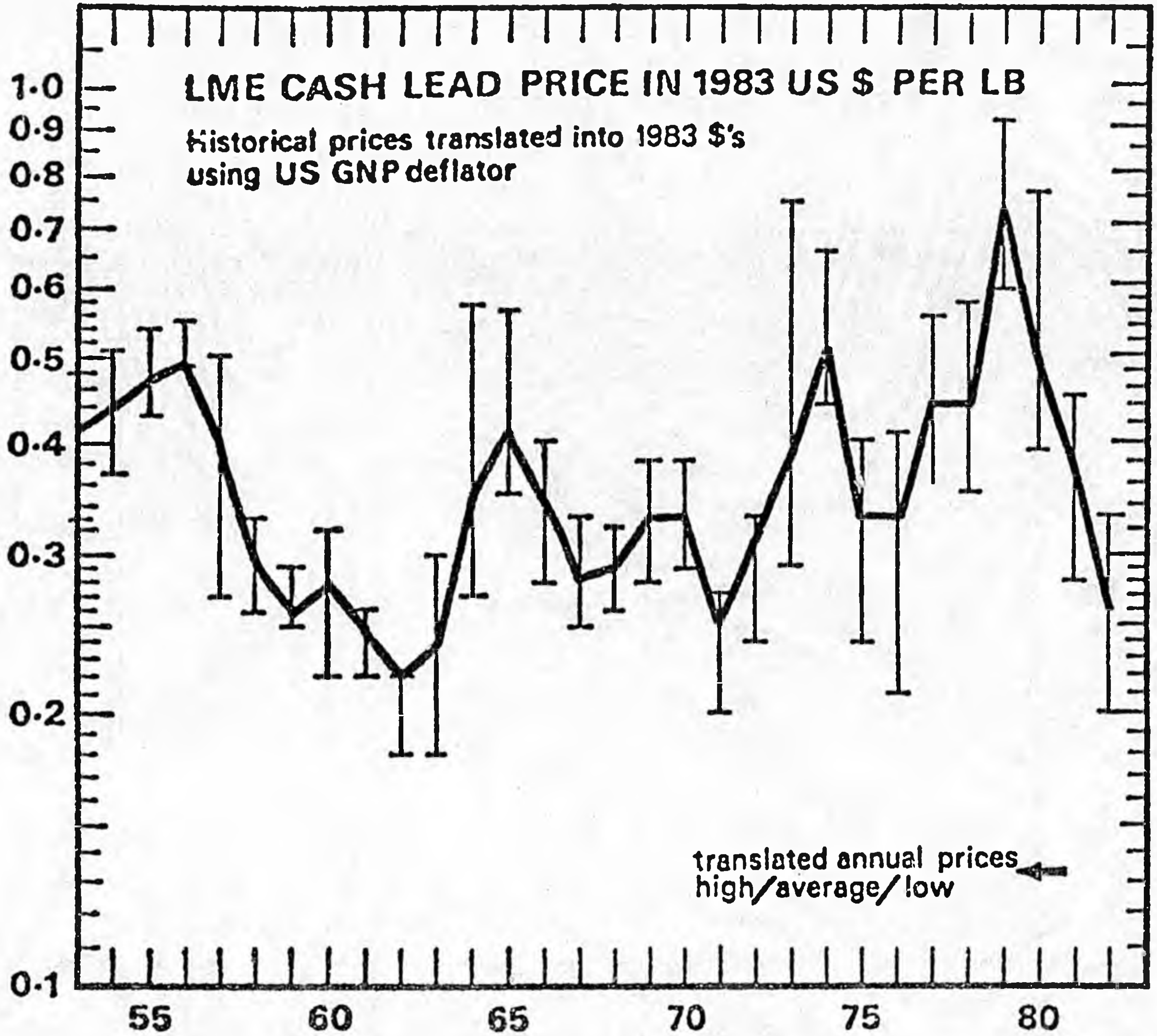

SLIDE 12


WESTERN WORLD LEAD CONSUMPTION
000'S TONNES
5,000
4,000
3,000
2,000
1,000
0
60
65
70
75
80
85

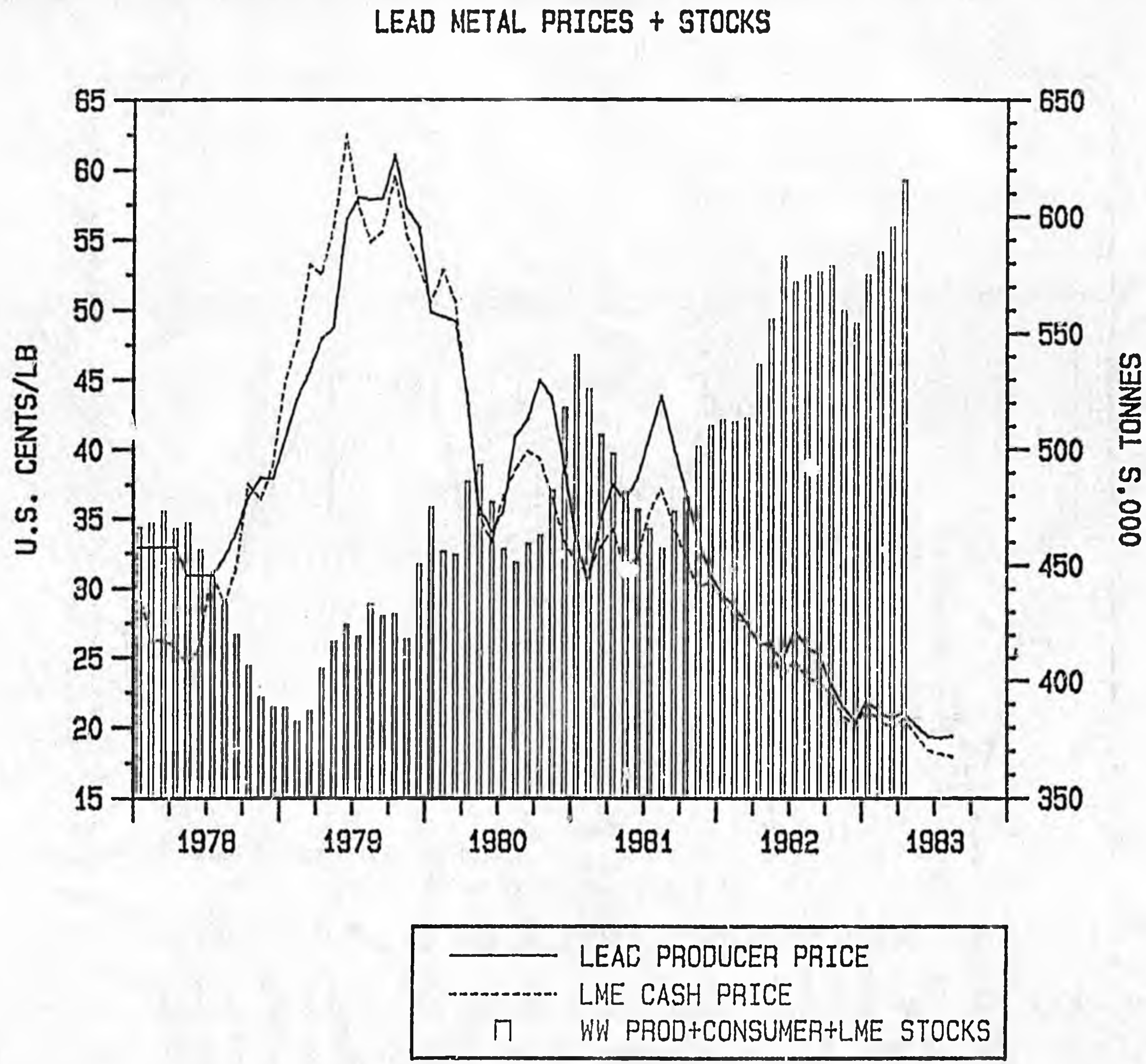

LME
LEAD PRICE
U.S. CENTS/POUND
0
10
20
30
40
50
60
70
80
60
65
70
75
80
85
CURRENT CENTS
1983 CENTS



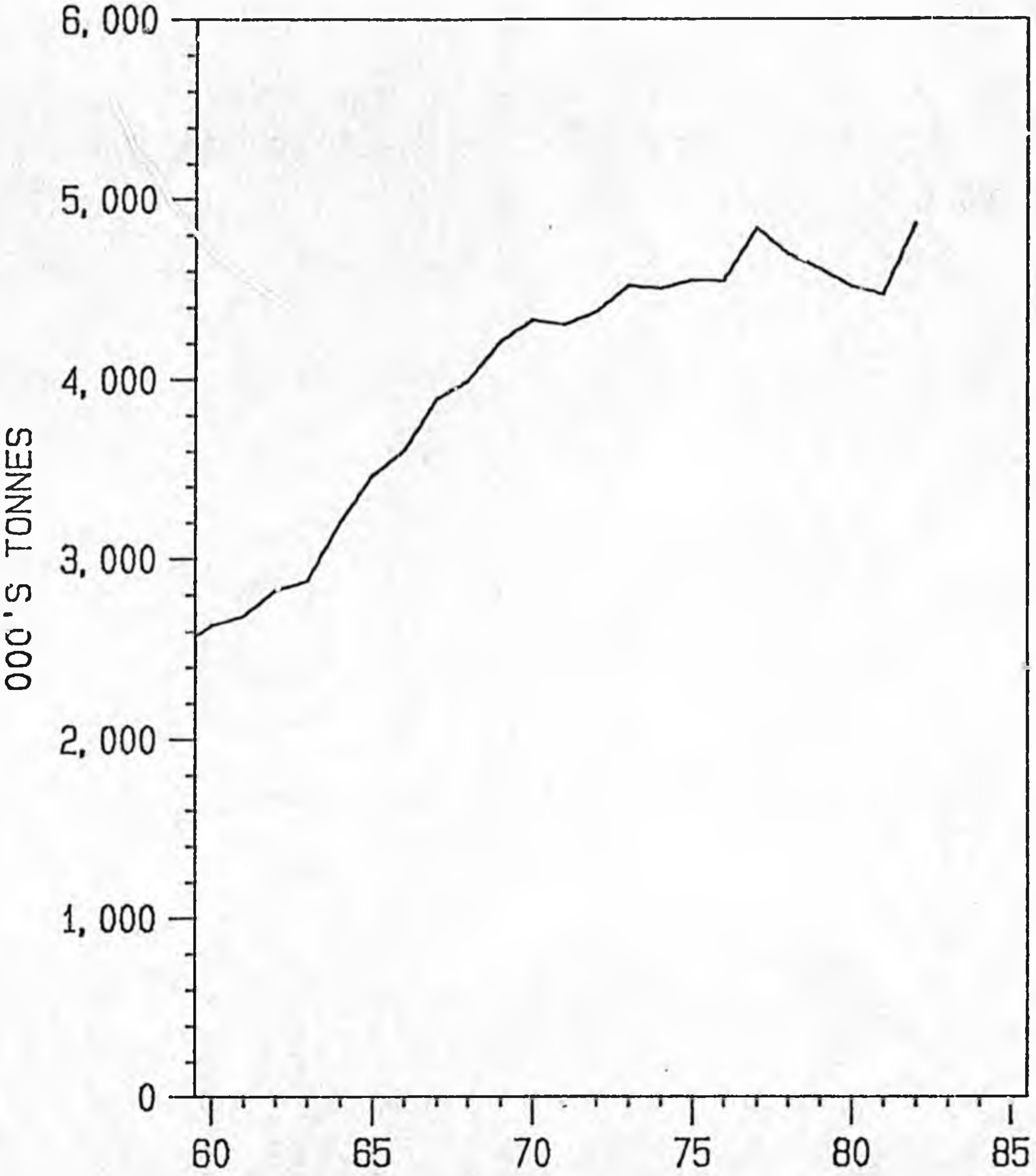
SLIDE 14




SLIDE 15
(MMRS)

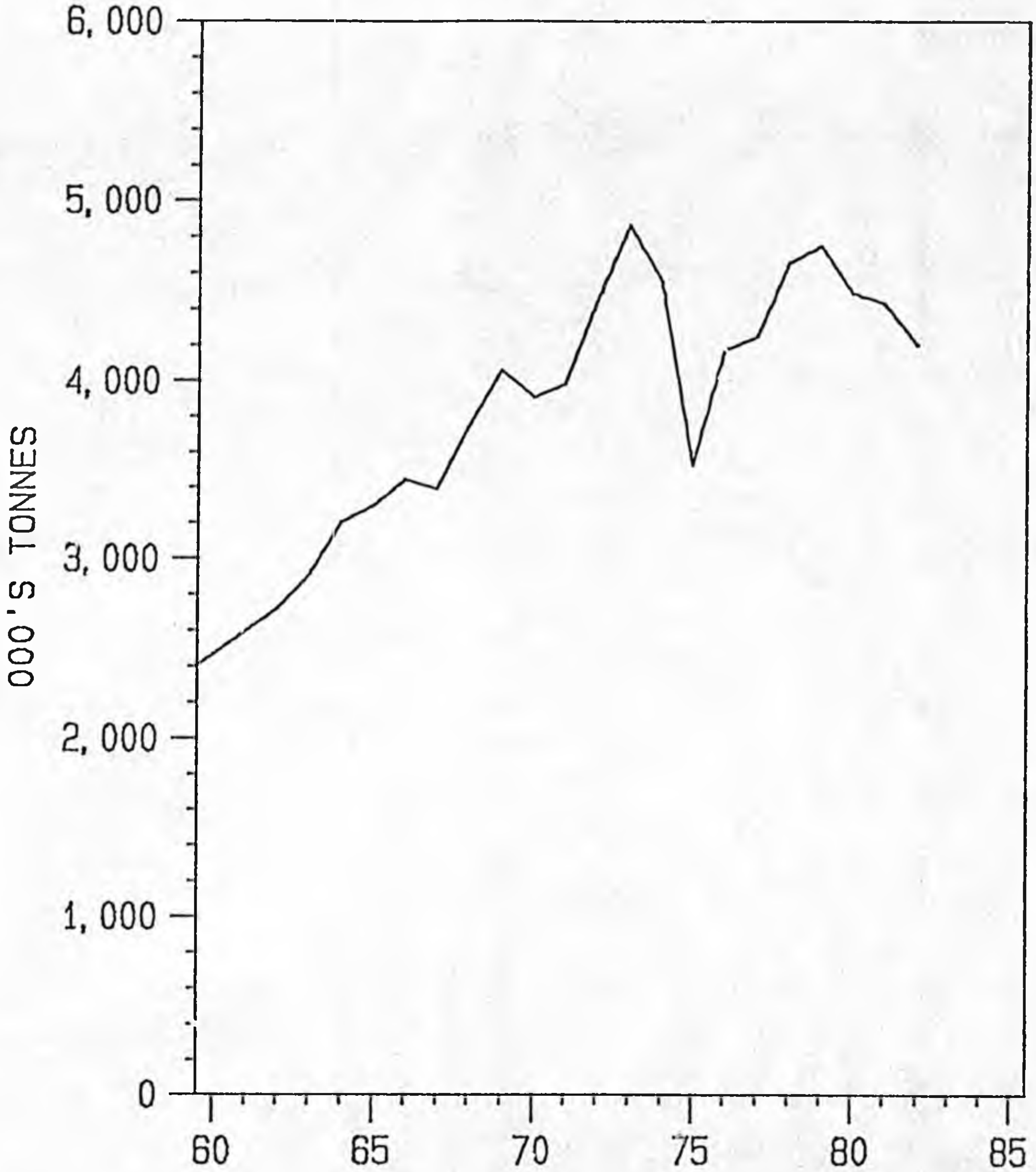

LEAD METAL PRICES + STOCKS
U.S. CENTS/LB
65
60
55
50
45
40
35
30
25
20
15
000'S TONNES
650
600
550
500
450
400
350
1978
1979
1980
1981
1982
1983
LEAD PRODUCER PRICE
LME CASH PRICE
WW PROD+CONSUMER+LME STOCKS

# WESTERN WORLD ZINC MINE PRODUCTION




SLIDE 17

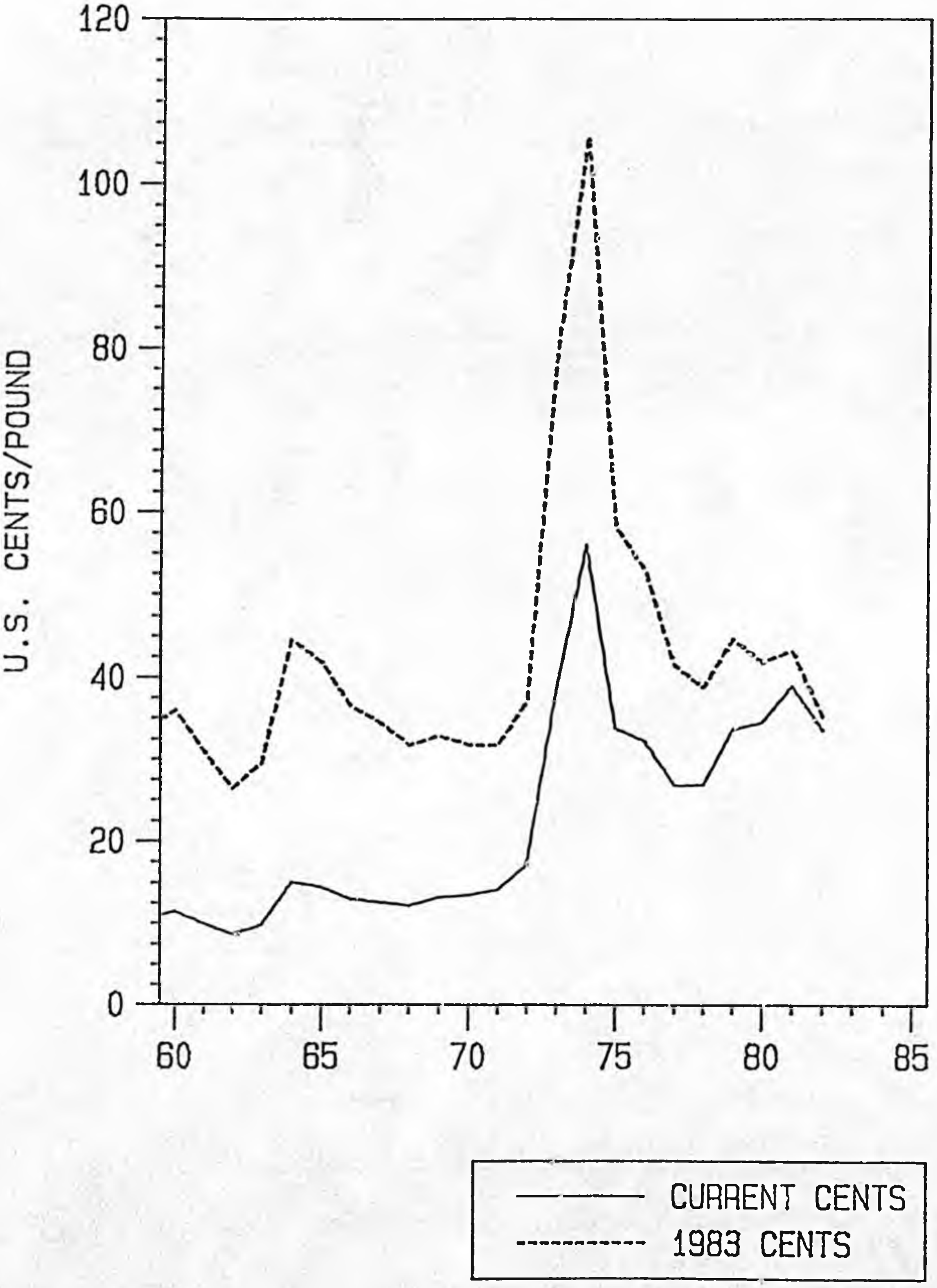
WESTERN WORLD ZINC CONSUMPTION

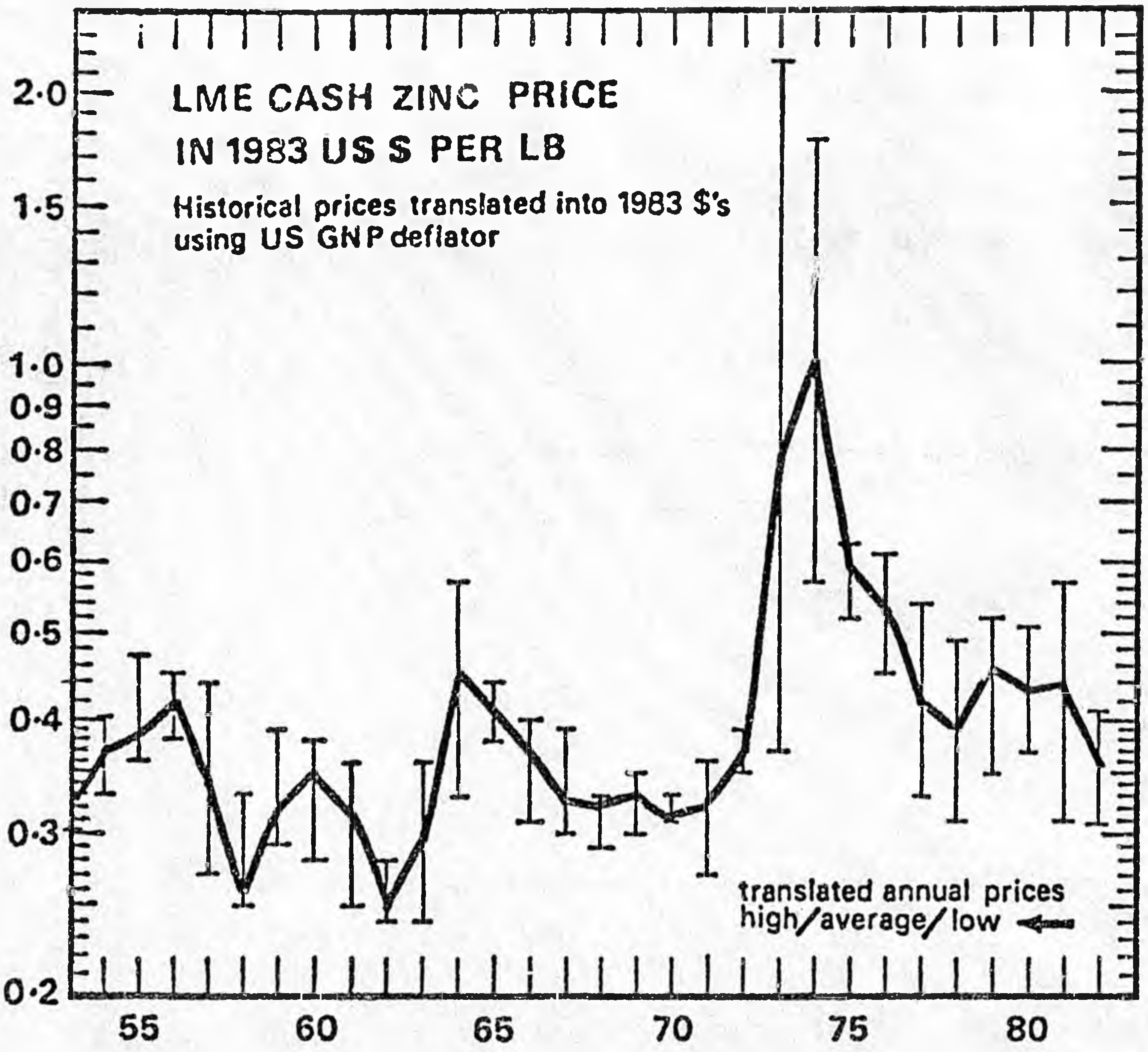




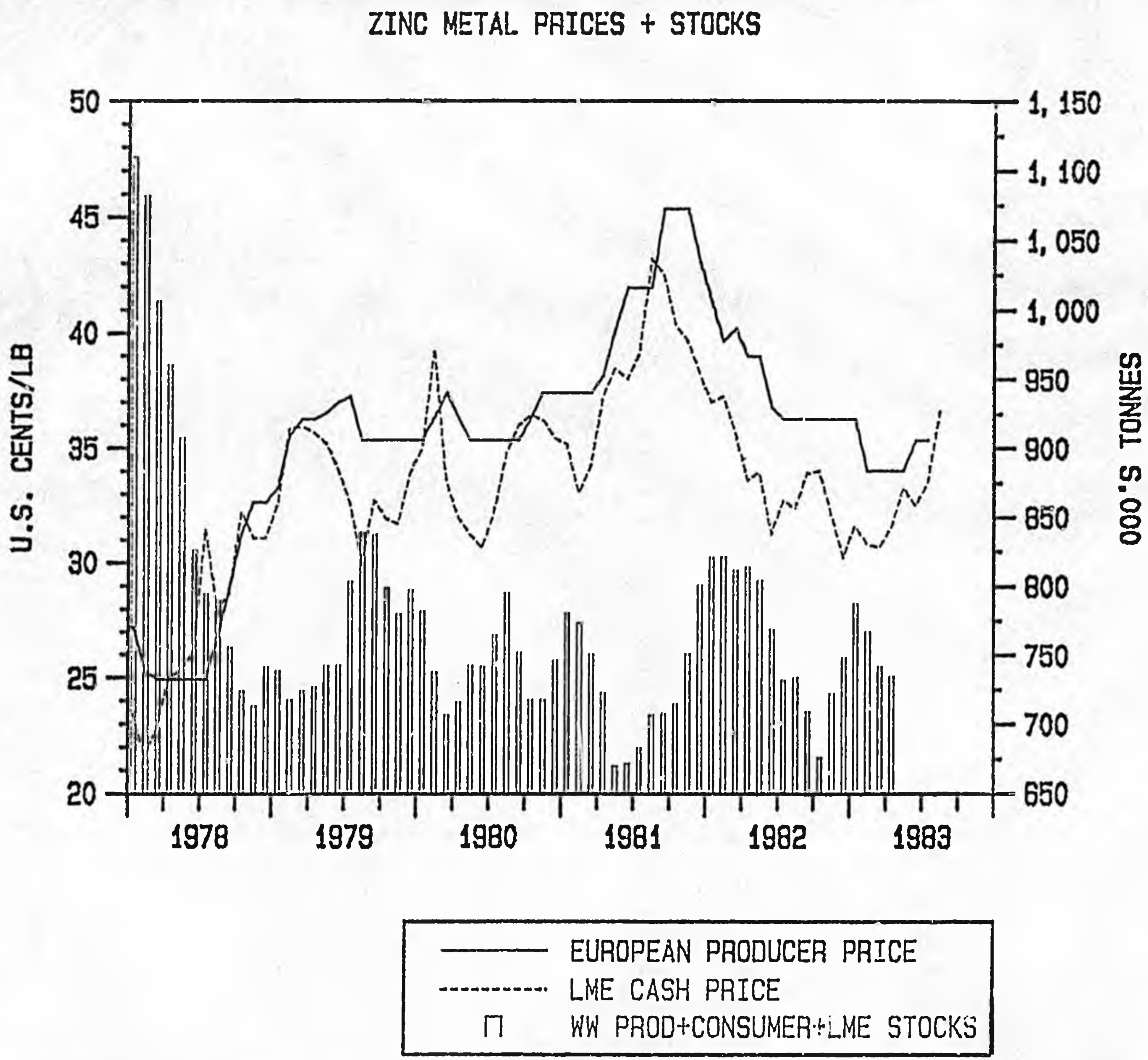

SLIDE 18

LME CASH ZINC PRICE






SLIDE 20
(MMRS)


ZINC METAL PRICES + STOCKS
50
45
40
35
30
25
20
U.S. CENTS/LB
1, 150
1, 100
1, 050
1, 000
950
900
850
800
750
700
650
000'S TONNES
1978
1979
1980
1981
1982
1983
EUROPEAN PRODUCER PRICE
LME CASH PRICE
WW PROD+CONSUMER+LME STOCKS

SLIDE 21 A-81