2.2. SURFACE MINING--CAPITAL COSTS

2.2.3. TRANSPORTATION

2.2.3.1. AERIAL TRAMWAY

The capital cost curve for the aerial tramway is for the acquisition and installation of equipment for transporting ore or waste material over a slope distance of 3 km at a slope angle of 15°. The bulk density of the material was assumed at 1,442.5 km/m^3 (92.0 lb/ft^3). The aerial tramway system includes loading bin, apron feeders, tram cars, track and haulage ropes, loading and unloading terminals, anchor towers, intermediate (pivoted), towers, and the driving unit(s).

The total capital cost is based on a single cost curve having a tramming rate (X), in metric tons of material moved per day. The curve is valid for a production range of 2,040 to 13,800 mtpd, operating three shifts per day. The curve includes all costs associated with the acquisition and installation of the equipment required for loading, unloading, tramming, and driving units.

BASE CURVE

The capital cost derived from the curve is a combination of the following costs:

Installation labor cost.....	19.0%
Installation materials cost.	4.8%
Equipment cost..............	73.5%
Transportation cost.........	2.7%

The total aerial tramway capital cost is $(Y_C) = 208{,}182.537(X)^{0.385}$ and is distributed as follows:

(L) Installation Labor Cost $(Y_L) = 39{,}554.682(X)^{0.385}$

(S) Installation Materials Cost $(Y_S) = 9{,}992.762(X)^{0.385}$

(E) Purchased Equipment Cost $(Y_E) = 158{,}635.093(X)^{0.385}$

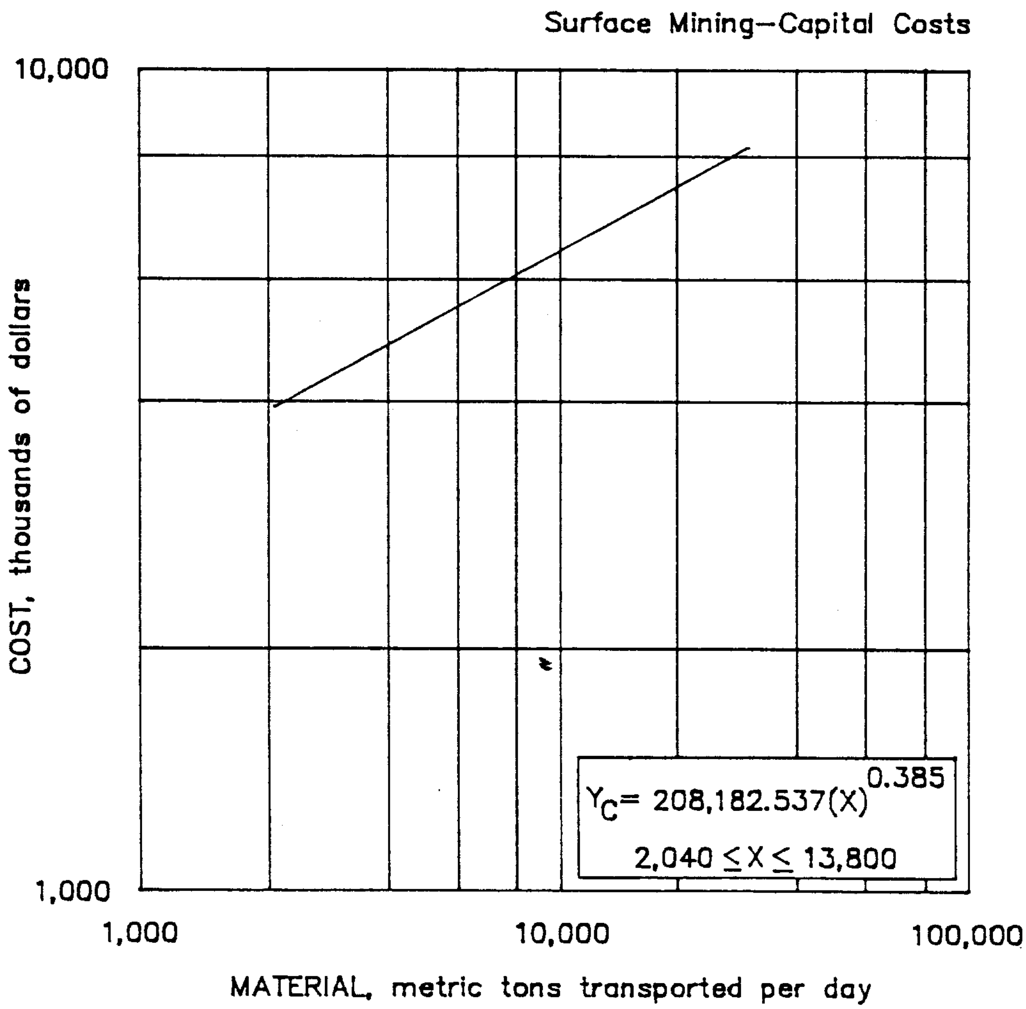
ADJUSTMENT FACTORS

Tramway Length Factor The curve is based on an aerial tramway of 3 km in slope length. To adjust for a different aerial tramway length, multiply the cost obtained from the base curve by the following factor:

Length factor $(Y_L) = 0.233(L)+0.302$
where L = slope length, in kilometers (not to exceed 20 km).

Bulk Density Factor The base curve was calculated with a material bulk density of 1,442.5 km/m^3 (92 lb/ft^3). To adjust the base curve for a different bulk density, multiply the base curve by the following factor:

Bulk density factor $(Y_D) = -0.00003(D)+1.043$
where D = bulk density, in kilograms per cubic meter.



2.2.3.1. Aerial tramway

2.2. SURFACE MINING--CAPITAL COSTS

2.2.3. TRANSPORTATION

2.2.3.2. AIRSTRIP CONSTRUCTION

Airstrip construction cost curves give the cost per meter length of basic utility airstrips varying in width from 10 to 40 m. The airstrip described accommodates light single-engine and small twin-engine airplanes used for personal and business purposes, plus a broader spectrum of small business and air taxi-type twin-engine airplanes. These aircraft include the Cessna 150 series, Piper PA-32-300 Commander Six, Rockwell International 114 Commander, Beech B55 Baron, Cessna 310, and Piper PA-23-250 Aztec.

BASE CURVE

The total capital cost per meter length is based on a single cost curve having an airstrip width (X), in meters. The curve is valid for widths of 10 to 40 m, operating one shift per day. Two surface options are offered, aggregate and asphalt. Not included in this curve are costs for acquisition or clearing of airstrip site, and hauling or rough leveling of fill materials. Both aggregate and bituminous asphalt strips include base preparation (grading and rolling). The aggregate surface includes a base course of 1.9-cm stone, 15 cm deep followed by final grading and rolling. The asphalt surface consists of 31.9-cm stone, 10.2 cm deep, underlying 3.8-cm thick rolled asphalt. No equipment capital costs are incurred. A 5% contingency of total capital cost covers ancillary airstrip facilities such as gas storage and pump, airstrip end and lateral markings, wind direction apparatus, and one T-hangar as needed.

The capital cost derived from the curve is a combination of the following costs:

	Aggregate	Asphalt
Construction labor cost....	20%	16%
Construction supply cost...	80%	84%

The total asphalt airstrip capital cost is ($Y_{C\ ASPHALT}$) = $5.686(X)^{1.000}$ and is distributed as follows:

(L) Construction Labor Cost ($Y_{L\ ASPHALT}$) = $0.910(X)^{1.000}$

(S) Construction Supply Cost ($Y_{S\ ASPHALT}$) = $4.776(X)^{1.000}$

The total aggregate airstrip capital cost is ($Y_{C\ AGGREGATE}$) = $3.471(X)^{1.005}$ and is distributed as follows:

(L) Construction Labor Cost ($Y_{L\ AGGREGATE}$) = $0.694(X)^{1.005}$

(S) Construction Supply Cost ($Y_{S\ AGGREGATE}$) = $2.776(X)^{1.005}$

ADJUSTMENT FACTORS

Runway Length Runway length requirement is primarily dependent on anticipated aircraft use, temperature, and elevation. Aircraft type used in the cost curve was previously described. For convenience, an equation was derived to determine length requirement when the elevation of the airstrip is known. The equation is based on maximum temperature of 38° C (100° F). To determine different lengths at different elevations, use the following equation:

Runway length $L = 891.915e^{(0.0005)(E)}$
where L = length of airstrip in, meters,
and E = elevation, in meters.

Runway Width Runway width requirement varies with wingspan of anticipated aircraft using the airstrip. An 18-m wide landing strip will accommodate the aircraft previously described. This width is advised for airstrip predesign costing. Actual width should be used when calculating capital costs of existing airstrips.

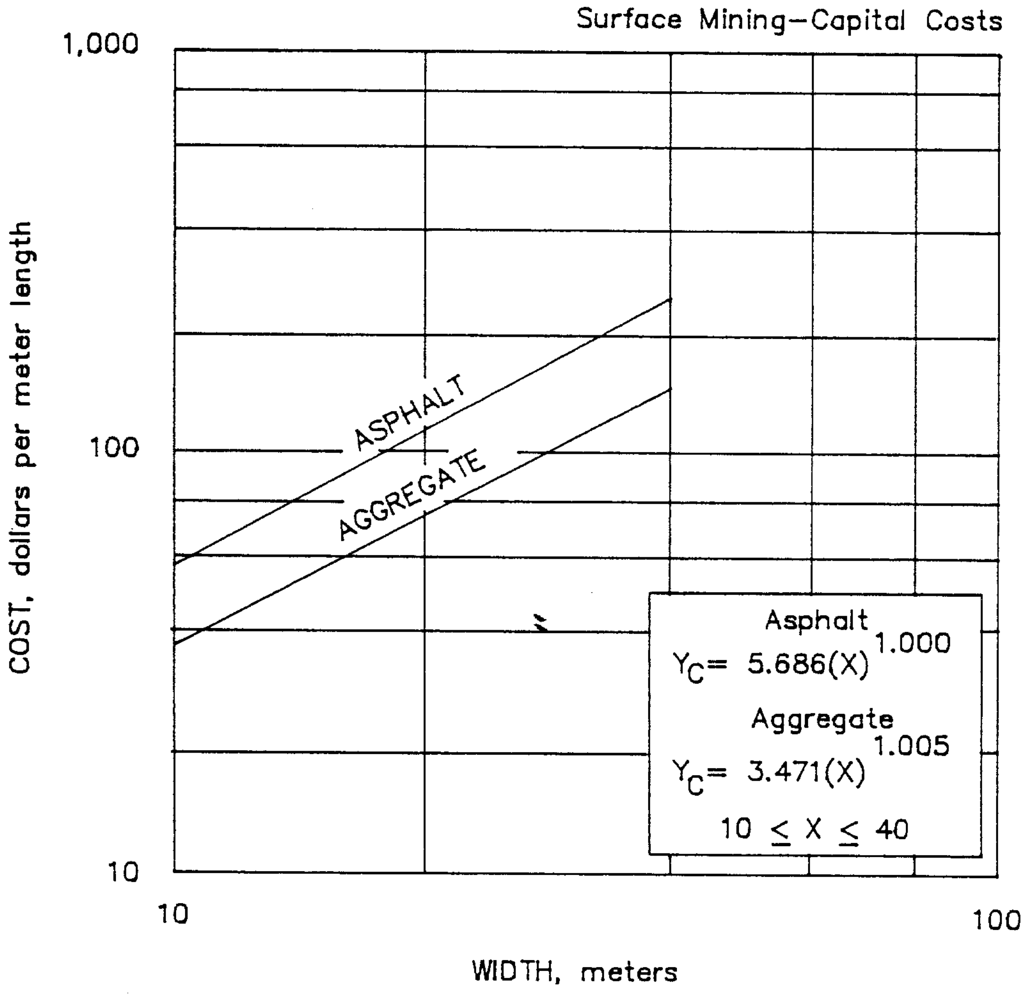
Land Requirements Factor For estimation of land acquisition and clearing requirements for airstrip landing area (includes airstrip pad and lateral-terminal clearances), use the following equation:

Land area requirement in hectares $A = 0.012(L)+1.820$
where L = airstrip length, in meters.

Subcontractor Factor If a subcontractor is used, multiply the curves by the following factors:

Labor factor $(Y_L) = 1.50$

Supply factor $(Y_S) = 1.20$



2.2.3.2. Airstrip construction

2.2. SURFACE MINING--CAPITAL COSTS

2.2.3. TRANSPORTATION

2.2.3.4. RAILROAD CONSTRUCTION

The cost in this section covers the capital expense for laying standard-gage trackage for main lines and spurs. The cost reflects railway installation by a crew that works on a one-shift-per-day schedule; furthermore, the cost is based on trackage that is fully ballasted.

BASE CURVE

The total capital cost is based on a single cost curve having a railroad length (X), in total kilometers. The curve is valid for a length range of 1 to 60 km, operating one shift per day.

The capital cost derived from the curve is a combination of the following costs:

Construction labor cost.......	26%
Construction supply cost......	69%
Purchased equipment cost......	5%

The total railroad construction capital cost is $(Y_C) = 188{,}530.000(X)^{1.000}$ and is distributed as follows:

(L) <u>Construction Labor Cost</u> $(Y_L) = 49{,}017.800(X)^{1.000}$

(S) <u>Construction Supply Cost</u> $(Y_S) = 130{,}085.700(X)^{1.000}$

(E) <u>Purchased Equipment Cost</u> $(Y_E) = 9{,}426.500(X)^{1.000}$

ADJUSTMENT FACTORS

<u>Ballast Factor</u> For the installation of standard-gage trackage without ballast, multiply the cost obtained from the base curve by the following factor:

Ballast factor $(F_B) = 0.85$

<u>Roadbed Construction</u> For construction expenses resulting from roadbed clearing, excavation, and drilling and blasting, refer to Access Roads sections (2.2.6.1.1.-2.2.6.1.5.) and apply a roadway width of 6.1 m to the applicable cost equations; the additional railway expenses so derived should then be added to this section's capital cost.

<u>Equipment Factor</u> When it is necessary to purchase equipment or to have a subcontractor perform the work, multiply the equipment operation value by the following factor in order to obtain the total value of equipment expense for ownership and operation:

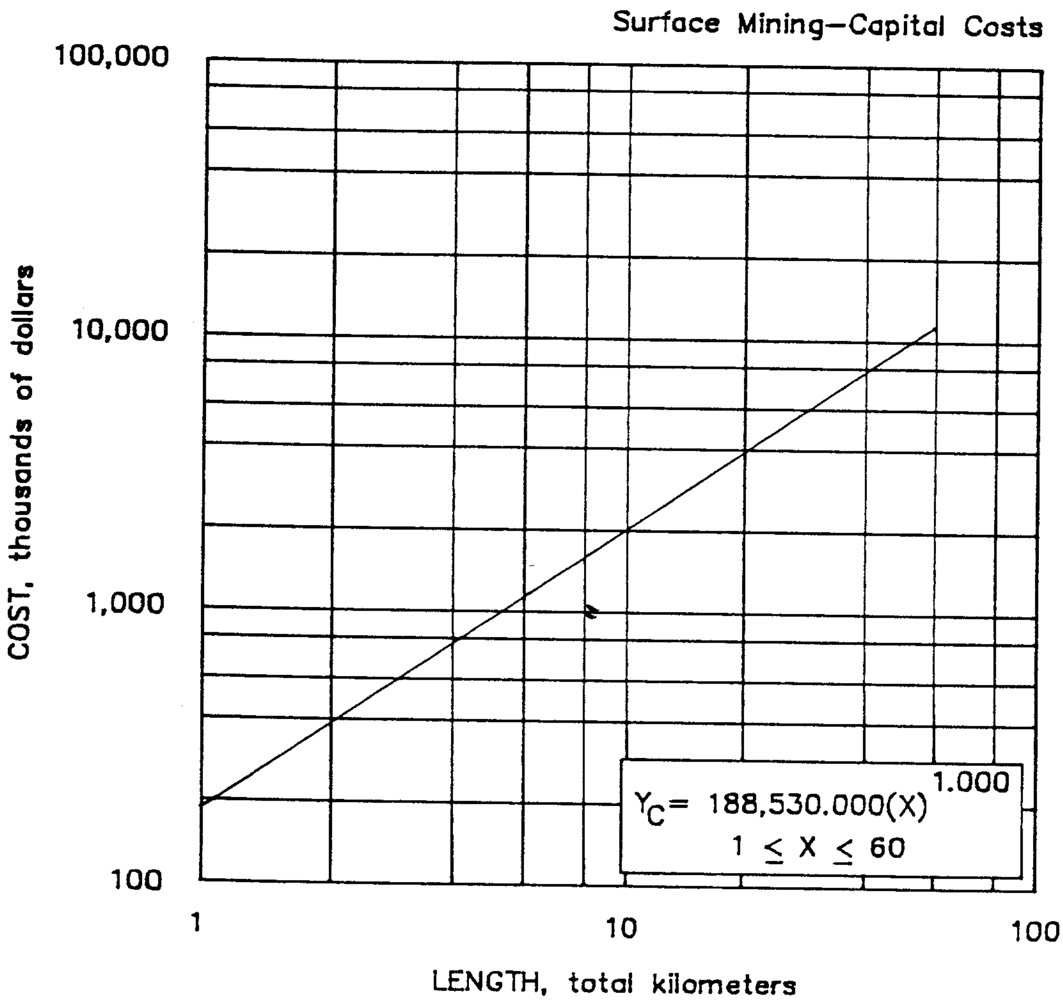
Equipment operation factor $(Y_E) = 1.70$

Subcontractor Factor If a subcontractor is used, to compensate for the subcontractor's markup, multiply the costs obtained from the curves by the following factors:

Labor factor $(Y_L) = 1.50$

Supply factor $(Y_S) = 1.20$

Equipment operation factor $(Y_E) = 1.20$



2.2.3.4. Railroad construction

2.2. SURFACE MINING--CAPITAL COSTS

2.2.3. TRANSPORTATION

2.2.3.5. LONG DISTANCE SURFACE CONVEYOR

The cost curve shown is for the acquisition and erection of a long-distance surface conveyor. The conveyor is a single-flight belt conveyor made with high-strength steel belting. The conveyor is designed for a 10° slope and 1-km distance. Usually, the material is crushed or screened at the mine site before being conveyed. Screen and crusher capital costs are not included in this cost but are covered in separate sections.

BASE CURVE

The total cost is based on a single cost curve having a daily production rate (X), in metric tons material transported per day. The curve is valid for production rates of 15,000 to 150,000 mtpd, operating three shifts per day. The curve includes all costs associated with acquisition, installation of the belt, idlers, motors, channel, and frame, and site preparation.

The long-distance surface conveyor capital cost derived from the curve is a combination of the following costs:

Construction labor cost.......	31%
Construction supply cost......	5%
Purchased equipment cost......	64%

A typical breakdown of a long distance surface conveyor major cost components is:

Conveyor belt......................	36%
Idler assembly units...............	44%
Motors, drive trains, belt cleaners, and other mechanical items.........	20%

The total long distance surface conveyor capital cost is $(Y_C) = 81{,}292.281(X)^{0.309}$ and is distributed as follows:

(L) <u>Construction Labor Cost</u> $(Y_L) = 25{,}200.607(X)^{0.309}$

(S) <u>Construction Supply Cost</u> $(Y_S) = 4{,}064.614(X)^{0.309}$

(E) <u>Purchased Equipment Cost</u> $(Y_E) = 52{,}027.060(X)^{0.309}$

ADJUSTMENT FACTORS

<u>Belt Life</u> The conveyor belt, 36% of equipment cost, has an average wear life of 8 to 10 yr of use, based on three shifts per day, 350 operating days per year, and depending on the abrasiveness of the material. The total replacement of the belt is standard procedure after excessive wear.

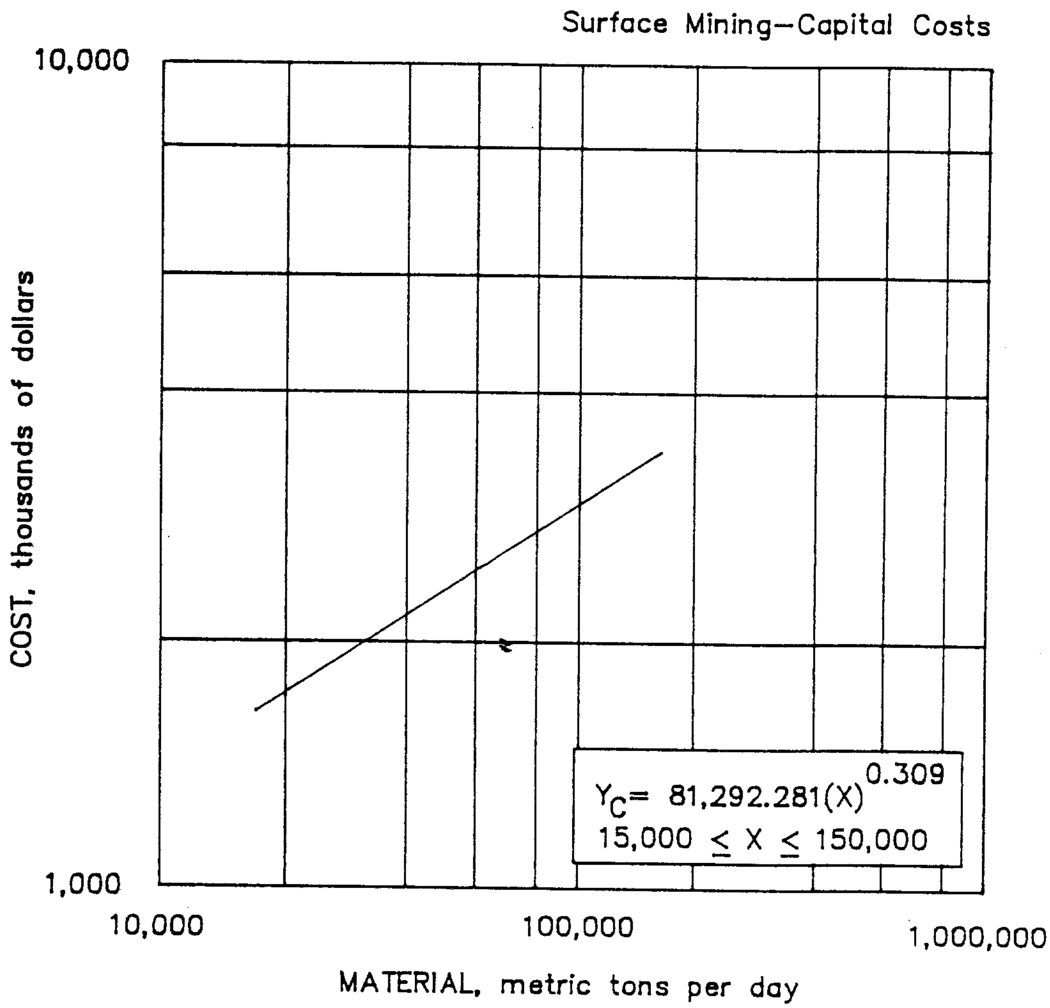
<u>Conveyor Length and Slope Factor</u> The conveyor is 1-km long and has a 10° slope.

For other lengths and slopes, multiply the cost obtained from the base curve by the following factor:

Conveyor length and slope factor $(F_L) = [0.917+0.00940(S)][L/1]$
where L = length, in kilometers,
and S = slope, in degrees, between 0^o and 15^o.

The cost for a decline conveyor is equal to that for a horizontal conveyor (0^o slope).

Stacker-Tripper Factor If the material is conveyed to a processing plant or other end point such as a port facility, the capital cost for unloading from the conveyor is included in those sections. If the material is waste rock, then the cost for a tripper or stacker should be added to the estimated capital cost. Costs for these items vary greatly but can range from $600,000 for a stacker or tripper that handles 15,000 mtpd waste material to $5,000,000 for a stacker or tripper that handles 150,000 mtpd of waste rock.



2.2.3.5. Long distance surface conveyor

2.2. SURFACE MINING--CAPITAL COSTS

2.2.3. TRANSPORTATION

2.2.3.8. SLURRY PIPELINE

The capital cost curve for the slurry pipeline is for the acquisition and installation of equipment for pumping a slurry 10 km at a lift of 150 m with a specific gravity of the solids of 4.3. The slurry pipeline circuit includes slurry storage tanks, booster and high-pressure slurry pumps, and the pipeline.

The total capital cost is based on a single cost curve having a daily adjusted feed rate (X), in metric tons material transported per day. The curve is valid for a production range of 900 to 32,000 mtpd, operating three shifts per day. The curve includes all costs associated with the acquisition and installation of the required pumps, agitators, slurry tanks, and pipeline.

BASE CURVE

The slurry pipeline capital cost derived from the curve is a combination of the following costs:

Installation labor cost.....	11.8%
Installation materials cost.	32.9%
Purchased equipment cost....	54.6%
Transportation cost.........	0.7%

The capital cost is $(Y_C) = 21{,}021.709(X)^{0.546}$ and is distributed as follows:

(L) Installation Labor Cost $(Y_L) = 2{,}480.562(X)^{0.546}$

(S) Installation Materials Cost $(Y_S) = 6{,}916.142(X)^{0.546}$

(E) Purchased Equipment Cost $(Y_E) = 11{,}625.005(X)^{0.546}$

ADJUSTMENT FACTORS

Slurry Pipeline Lift Factor The base curve was calculated for a slurry pipeline with a lift of 150 m. To adjust the base curve for a different lift, multiply the cost obtained from the curve by the following factor:

Lift factor $(F_L) = 0.0009(L)+0.871$
where L = length, in meters.

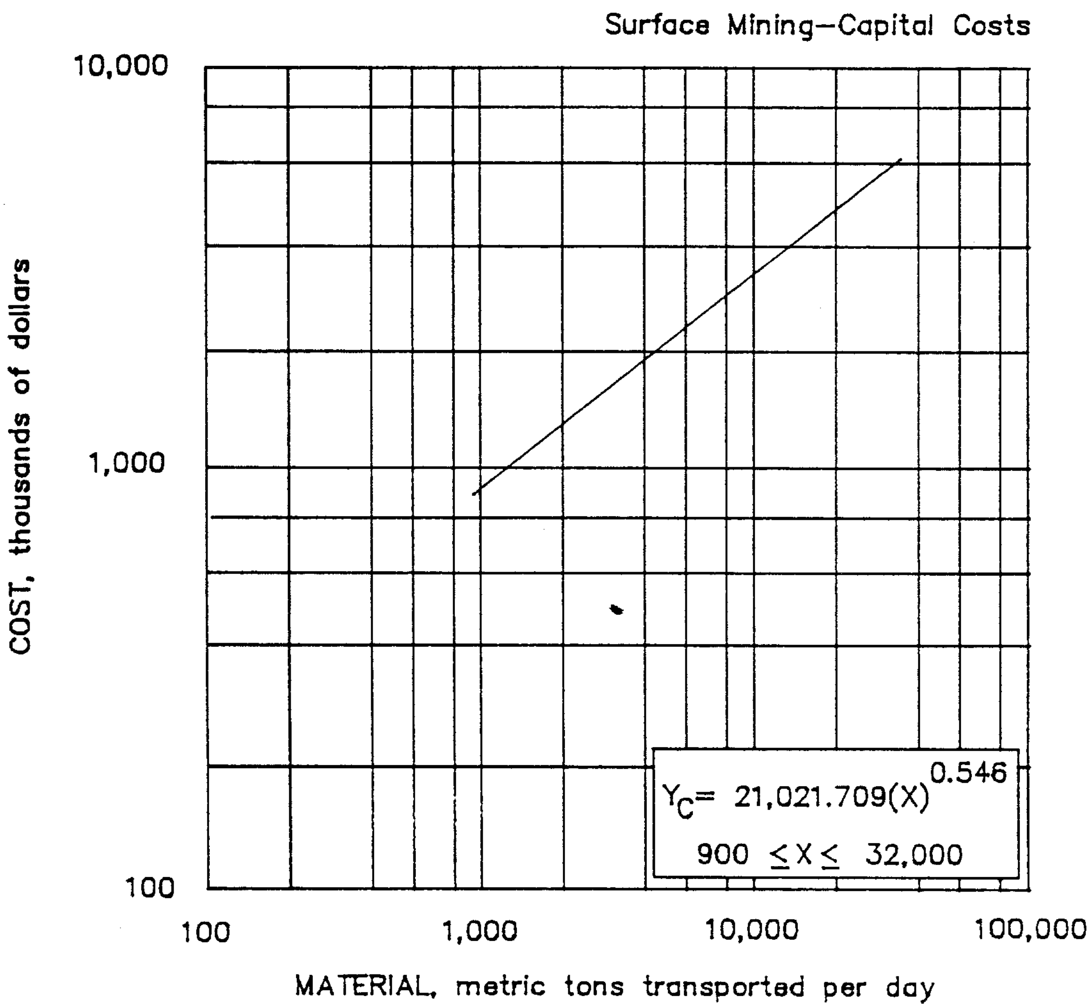
Pipeline Length Factor The curve is based on a slurry pipeline 10 km in length. To adjust the base curve for different slurry pipeline lengths, multiply the cost obtained from the curve by the following factor:

Length factor $(F_K) = 0.026(K)+0.741$
where K = length, in kilometers.

An estimate of average pipeline length can be made from table A-3 in the appendix.

<u>Specific Gravity Factor</u> The base curve was calculated for a slurry pipeline pumping solids with specific gravity of 4.3. To adjust the curve for a different specific gravity, multiply the cost obtained from the curve by the following factor (an estimate of average specific gravity can be made from Table A-3 in the appendix):

Specific gravity factor $(F_S) = 0.023(S)+0.903$
where S = new specific gravity.



2.2.3.8. Slurry pipeline