2.2. SURFACE MINING--CAPITAL COSTS

2.2.4. MINE PLANT GENERAL OPERATIONS

2.2.4.1. COMMUNICATIONS SYSTEM

The communications system curve is based on installed costs for a radio network and surface telephone service. The radio system contains mobile and base units with one or more repeaters, depending on the size of the mine and the number of frequencies used, as well as portable radios. Telephone service costs are based on a complete telephone system, with installation by an outside agency.

BASE CURVE

The total capital cost is based on a single cost curve having an adjusted mine production rate (X), in metric tons ore and waste per day. The curve is valid for a production range of 1,000 to 400,000 mtpd, operating three shifts per day. The curve includes all costs associated with the acquisition and installation of telephones and telephone lines, mobile and base radio units, repeaters and repeater towers, control consoles, and portable radios.

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

Construction labor cost........	9%
Purchased equipment cost.......	91%

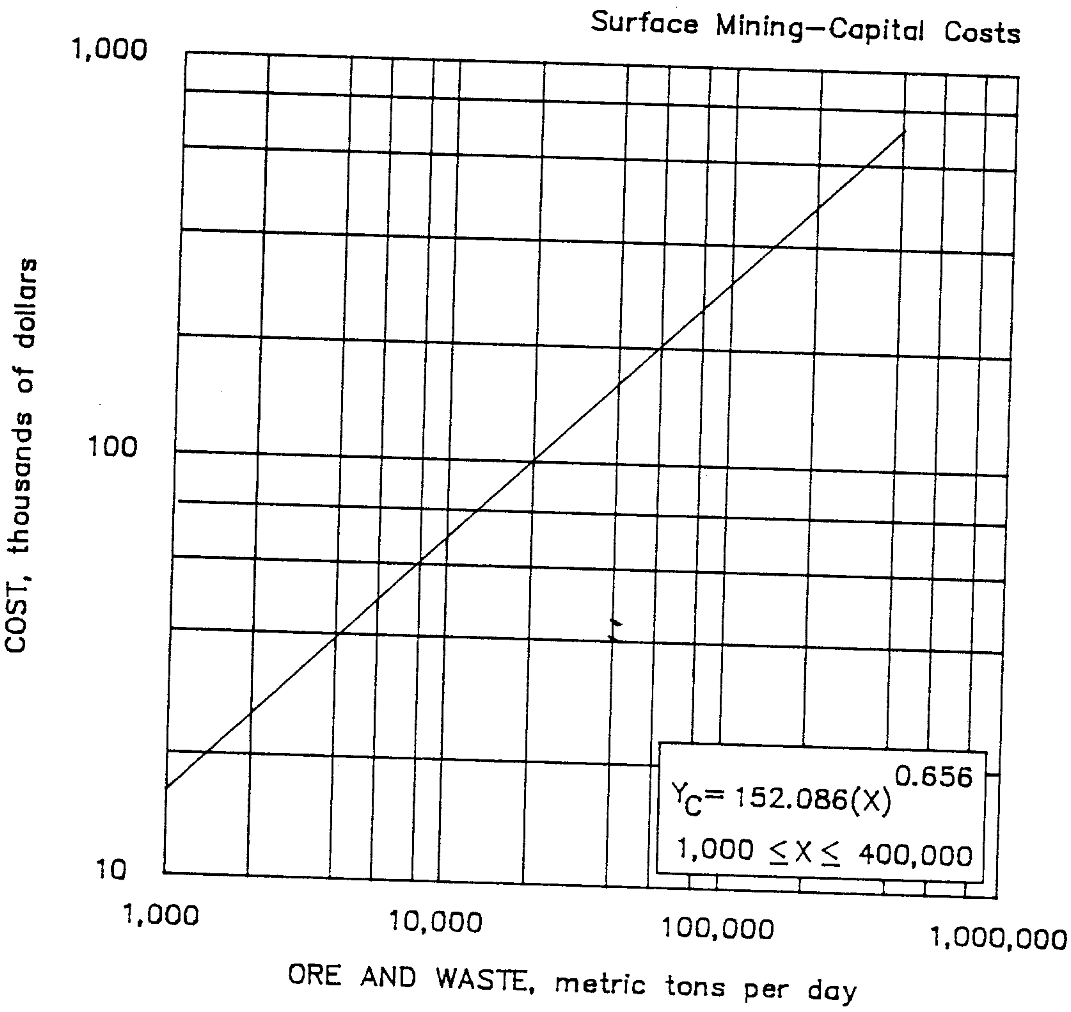
A typical breakdown of major cost components is

	Small (1,000 to 20,000 mtpd)	Large (200,000 to 400,000 mtpd)
Telephones...............	1%	1%
Telephone lines..........	2%	1%
Mobile radios............	53%	70%
Base radios..............	24%	6%
Control consoles.........	3%	1%
Repeaters................	5%	5%
Repeater towers..........	3%	2%
Portable radios..........	9%	14%

The total capital cost is $(Y_C) = 152.086(X)^{0.656}$ and is distributed as follows:

(L) <u>Construction Labor Cost</u> $(Y_L) = 13.687(X)^{0.656}$

(E) <u>Purchased Equipment Cost</u> $(Y_E) = 138.398(X)^{0.656}$



2.2.4.1. Communications system

2.2. SURFACE MINING--CAPITAL COSTS

2.2.4. MINE PLANT GENERAL OPERATIONS

2.2.4.2. ELECTRICAL SYSTEM

The cost shown is for the acquisition and installation of the primary skid-mount transformers dedicated to individual units of equipment, the necessary trailing cables, and ancillary pole-mount transformers (for mine shop, lighting, and/or pumping). The cost curves are based on total metric tons of ore and waste handled per day by an electric shovel-truck mining method or by a nonelectric shovel-truck mining method on a three-shift basis. All power is 25,000 V, 60 Hz, three-phase electricity to the transformer sites. To get power to the individual transformer sites, distribution lines, primary substations (if power demand is greater than 10 MW), and primary transmission lines (where location does not have close proximity to existing 115- or 230-kV lines for primary substation feed) must be accounted for (see section 2.2.6.2. Main Power Lines).

BASE CURVE

The total capital cost is based on two single cost curves having adjusted production rates (X), in metric tons ore and waste per day. The curves are valid for a production range of 1,000 to 500,000 mtpd, operating three shifts per day. The curves include all costs associated with the acquisition and installation of portable skid-mount transformers, pole-mount transformers, and trailing cables.

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

	Nonelectric shovel (1,000 to 10,000 mtpd)	Electric shovel (10,000 to 500,000 mtpd)
Installation labor cost[1]	47%	10%
Purchased equipment cost[2]	53%	89%
Freight cost	-	1%

A typical breakdown of major cost components is

	Nonelectric shovel (1,000 to 10,000 mtpd)	Electric shovel (10,000 to 500,000 mtpd)
Skid-mounted transformers	-	53%
Pole-mounted transformers	100%	2%
Trailing cable	-	45%

[1]Installation cost is composed of 90% labor and 10% equipment operation for nonelectric shovel mines and 97% labor and 3% equipment operation for electric shovel mines. The equipment operation cost is composed of 41% repair-maintenance labor, 34% repair parts, 23% fuel and lubrication, and 2% tires.
[2]Equipment costs include construction materials.

The total capital cost for nonelectric shovel mines is $(Y_C) = 146.854(X)^{0.412}$ and is distributed as follows:

(L) Installation Labor Cost $(Y_{L\ NONELECT}) = 69.021(X)^{0.412}$

(E) Purchased Equipment Cost $(Y_{E\ NONELECT}) = 77.832(X)^{0.412}$

The total capital cost for electric shovel mines is $(Y_C) = 245.054(X)^{0.660}$ and is distributed as follows:

(L) Installation Labor Cost $(Y_{L\ ELECT}) = 24.505(X)^{0.660}$

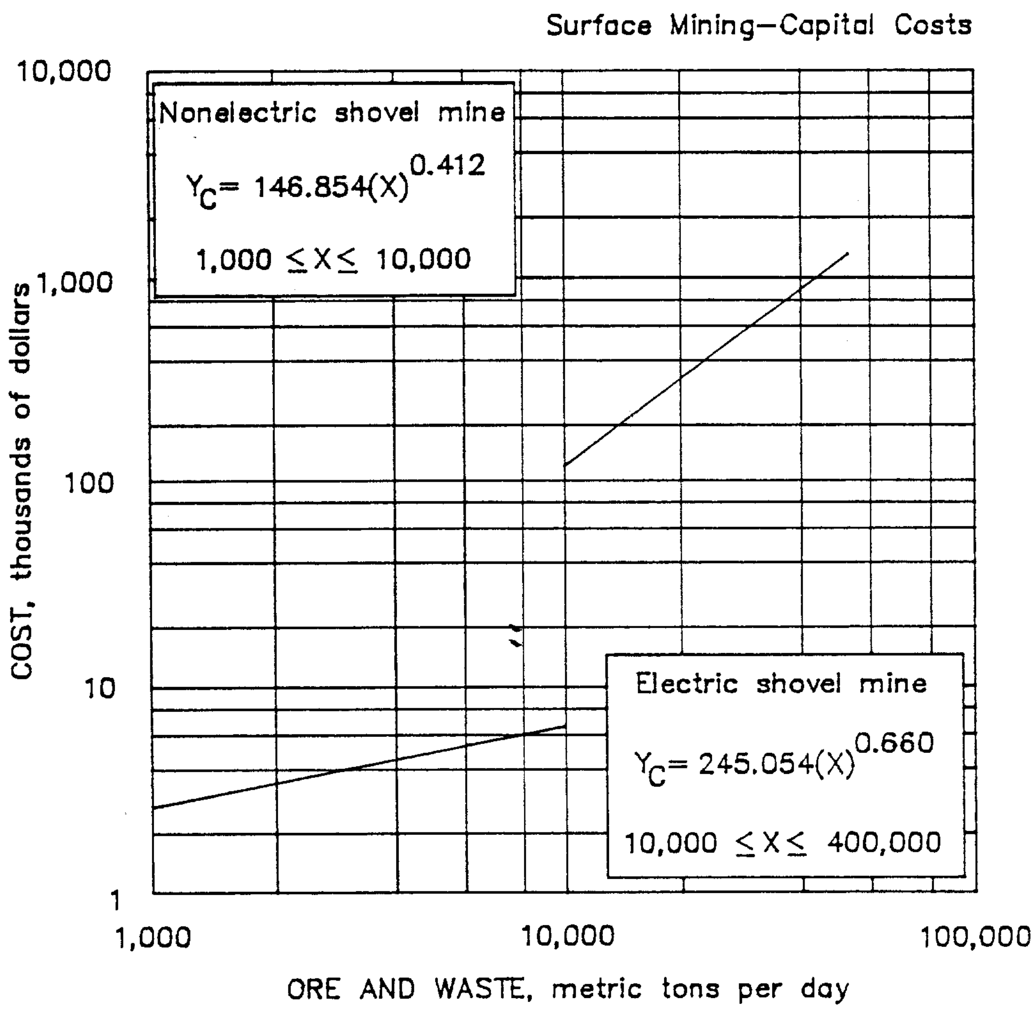
(E) Purchased Equipment Cost $(Y_{E\ ELECT}) = 220.548(X)^{0.660}$

ADJUSTMENT FACTORS

Self-Generated Power Electric Shovel Operations If the mine uses self-generated power from a central location, then the cost of portable power (section 2.2.4.6.) must be added to the cost from this section (power consumption ranges from 67 kW at 10,000 mtpd to 4,800 kW at 500,000 mtpd).

Self-Generated Power Nonelectric Shovel Operations If the mine uses self-generated power from a central location, then the cost of portable power (section 2.2.4.6.) must be added to the cost from this section (power consumption ranges from 1.9 kW at 1,000 mtpd to 20 kW at 10,000 mtpd).

Portable Power Nonelectric Shovel Operations If the mine uses portable, self-contained, light-generator or pump-generator units in the pit, then the portable power section (section 2.2.4.6.) should be used in place of this section for mine plant only (power consumption ranges from 0.64 kW at 1,000 mtpd to 6.7 kW at 10,000 mtpd).



2.2.4.2. Electrical system

2.2. SURFACE MINING--CAPITAL COSTS

2.2.4. MINE PLANT GENERAL OPERATIONS

2.2.4.3. FUELING SYSTEM

This curve is representative of the cost of fueling systems handling diesel fuel, gasoline, lubricants, coolants, and waste oil for truck haulage systems. It is based on one stationary fueling point and one or more mobile units. Any building required for fueling facilities is covered in section 2.2.4.9. (Surface Buildings). Tanks are sized on the basis of a weekly refilling.

BASE CURVE

The total capital cost is based on a single cost curve having a daily production rate (X), in metric tons ore and waste per day. The curve is valid for a production range of 1,000 to 400,000 mtpd, operating three shifts per day. The curve includes all costs associated with acquisition and installation of tanks, pumps, and mobile units.

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

Construction labor cost.......	8%
Construction supply cost......	3%
Purchased equipment cost......	89%

A typical breakdown of major cost components is

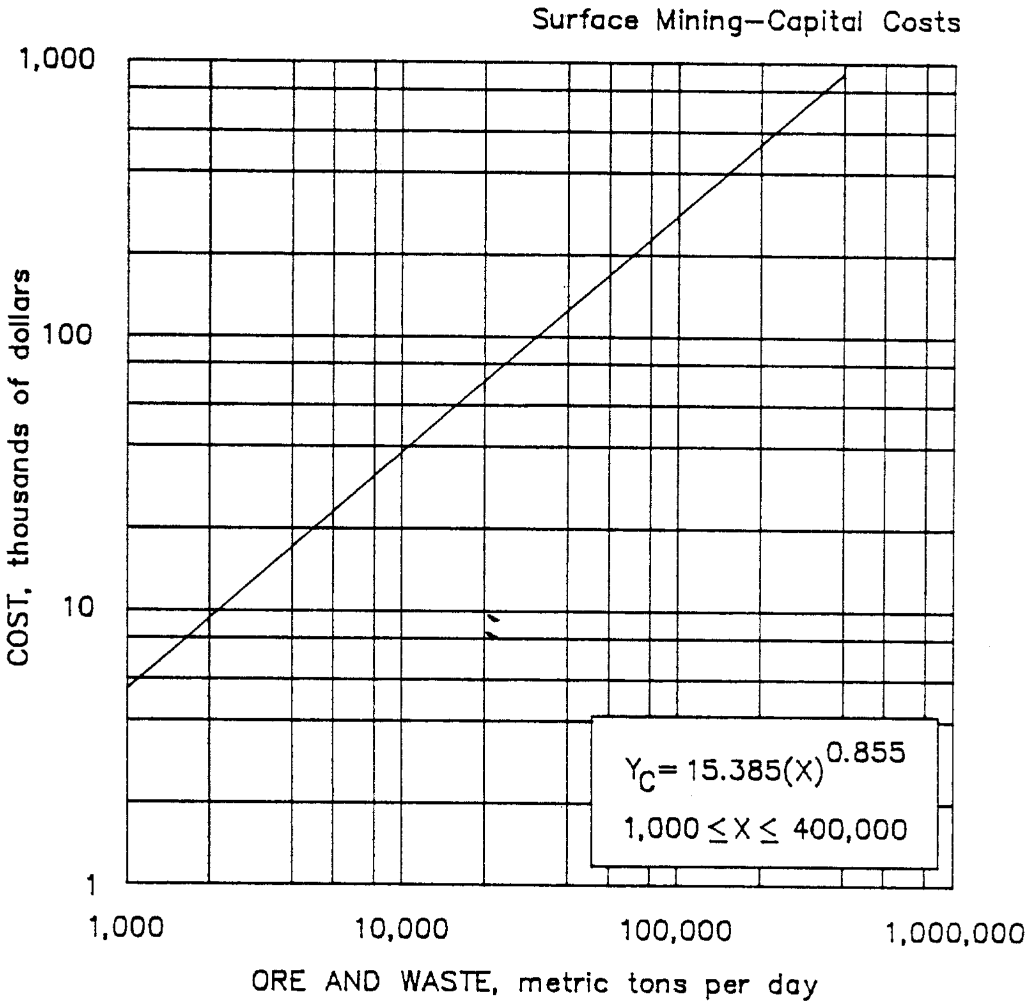
	Small (1,000 to 17,000 mtpd)	Large (17,000 to 400,000 mtpd)
Tanks......................	29%	50%
Pumps......................	10%	13%
Mobile units...............	61%	37%

The total capital cost is $(Y_C) = 15.385(X)^{0.855}$ and is distributed as follows:

(L) <u>Construction Labor Cost</u> $(Y_L) = 1.230(X)^{0.855}$

(S) <u>Construction Supply Cost</u> $(Y_S) = 0.462(X)^{0.855}$

(E) <u>Purchased Equipment Cost</u> $(Y_E) = 13.692(X)^{0.855}$



2.2.4.3. Fueling system

2.2. SURFACE MINING--CAPITAL COSTS

2.2.4. MINE PLANT GENERAL OPERATIONS

2.2.4.5. OFFICES AND LABORATORIES

The cost curves for offices and laboratories include construction of general offices, engineering and safety offices, and laboratories, including furnishings as well as all necessary assay equipment. Building costs are based on masonry two-story buildings. In this section, office and laboratory capital costs are presented separately.

BASE CURVE

The costs obtained from these curves are based on the assumption that these facilities will be used only for mining operations. If the mine and mineral processing plant are to share the same facilities, the user must determine, using a knowledge of the requirements, what can be jointly used and apportion the resulting costs to the mine and plant.

OFFICES

The total capital cost is based on a single cost curve having an area (X), in square meters of office space <u>or</u> on a single cost curve having a production rate (T), in metric tons ore and waste per day. The curve is valid for areas of 40 to 9,600 m^2, <u>or</u> 800 to 500,000 mtpd, operating one shift per day. The capital cost curve for offices includes construction of administrative, engineering, and safety office space, as well as office furnishings.

If office space requirements are known, the capital cost estimate may be made directly by consulting the cost curve; if space requirements are not known, they can be estimated from the following equation:

Square meters of office space = $0.511(T)^{0.746}$
where T = metric tons of ore and waste mined per day.

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

Construction labor cost.......	38%
Construction supply cost......	48%
Purchased equipment cost......	14%

The total office capital cost is $(Y_{C\ \text{SQUARE METERS}}) = 651.940(X)^{0.968}$ and is distributed as follows:

(L) <u>Construction Labor Cost</u> $(Y_{L\ \text{OFFICES-SQ M}}) = 247.737(X)^{0.968}$

(S) <u>Construction Supply Cost</u> $(Y_{S\ \text{OFFICES-SQ M}}) = 312.931(X)^{0.968}$

(E) <u>Purchased Equipment Cost</u> $(Y_{E\ \text{OFFICES-SQ M}}) = 91.272(X)^{0.968}$

The total office capital cost is $(Y_{C\ MTPD}) = 336.202(T)^{0.723}$ and is distributed as follows:

(L) Construction Labor Cost $(Y_{L\ OFFICES\text{-}MTPD}) = 127.756(T)^{0.723}$

(S) Construction Supply Cost $(Y_{S\ OFFICES\text{-}MTPD}) = 161.376(T)^{0.723}$

(E) Purchased Equipment Cost $(Y_{E\ OFFICES\text{-}MTPD}) = 47.068(T)^{0.723}$

LABORATORIES

The total capital cost is based on a single cost curve having an area (X), in square meters of laboratory space or on a single cost curve having a production rate (T), in metric tons ore and waste per day. The curve is valid for areas of 40 to 1,200 m^2, or 800 to 400,000 mtpd, operating one shift per day. The capital cost curve for assay laboratories includes construction of sample preparation and analytical laboratory space as well as crushing and assaying lab equipment.

If laboratory space requirements are known, the capital cost estimate may be made directly by consulting the cost curve; if space requirements are not known, they can be estimated from the following equation:

Square meters of laboratory space = $1.760(T)0.475$
where T = ore and waste mined, in metric tons per day.

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

Construction labor cost.......	34%
Construction supply cost......	37%
Purchased equipment cost......	29%

The total laboratory capital cost is $(Y_{C\ SQUARE\ METERS}) = 1{,}296.566(X)^{0.885}$ and is distributed as follows:

(L) Construction Labor Cost $(Y_{L\ LABS\text{-}SQ\ M}) = 440.832(X)^{0.885}$

(S) Construction Supply Cost $(Y_{S\ LABS\text{-}SQ\ M}) = 479.729(X)^{0.885}$

(E) Purchased Equipment Cost $(Y_{E\ LABS\text{-}SQ\ M}) = 376.004(X)^{0.885}$

The total laboratory capital cost is $(Y_{C\ MTPD}) = 2{,}118.290(T)^{0.421}$ and is distributed as follows:

(L) Construction Labor Cost $(Y_{L\ LABS\text{-}MTPD}) = 720.218(T)^{0.421}$

(S) Construction Supply Cost $(Y_{S\ LABS\text{-}MTPD}) = 783.767(T)^{0.421}$

(E) Purchased Equipment Cost $(Y_{E\ LABS\text{-}MTPD}) = 614.304(T)^{0.421}$

ADJUSTMENT FACTORS

Shift Adjustment The square meters of laboratory space required is based on a three-shift operation. To adjust the capital cost for a different number of daily operating shifts, multiply the actual daily tonnage by the ratio of the base number of shifts (3) divided by the number of desired shifts. Then, use this modified production rate in place of actual daily tonnage in the above area versus tonnage equation to obtain the adjusted area. Then, enter the adjusted area in the cost equation to obtain the adjusted capital cost. The square meters of office space is not contingent on the number of shifts and requires no adjustment. If the number of square meters of laboratory space is known, do not use this adjustment factor.

Temperature Factor The buildings are based on temperature requirements for the Denver, CO, area. For milder areas multiply the costs obtained from the base curve by the following factor:

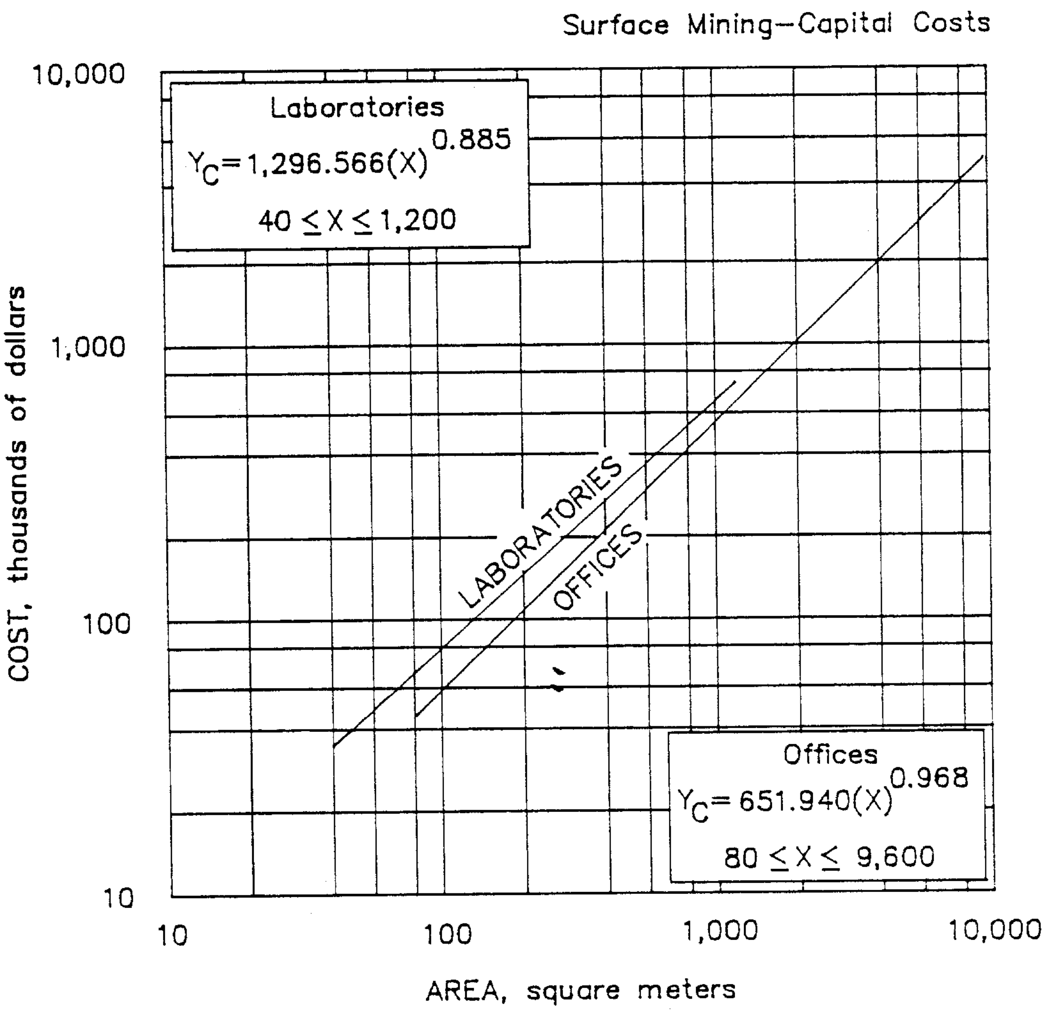
Temperature factor $(F_{T\ MILD}) = 0.94$

For more severe areas multiply the costs obtained from the base curve by the following factor:

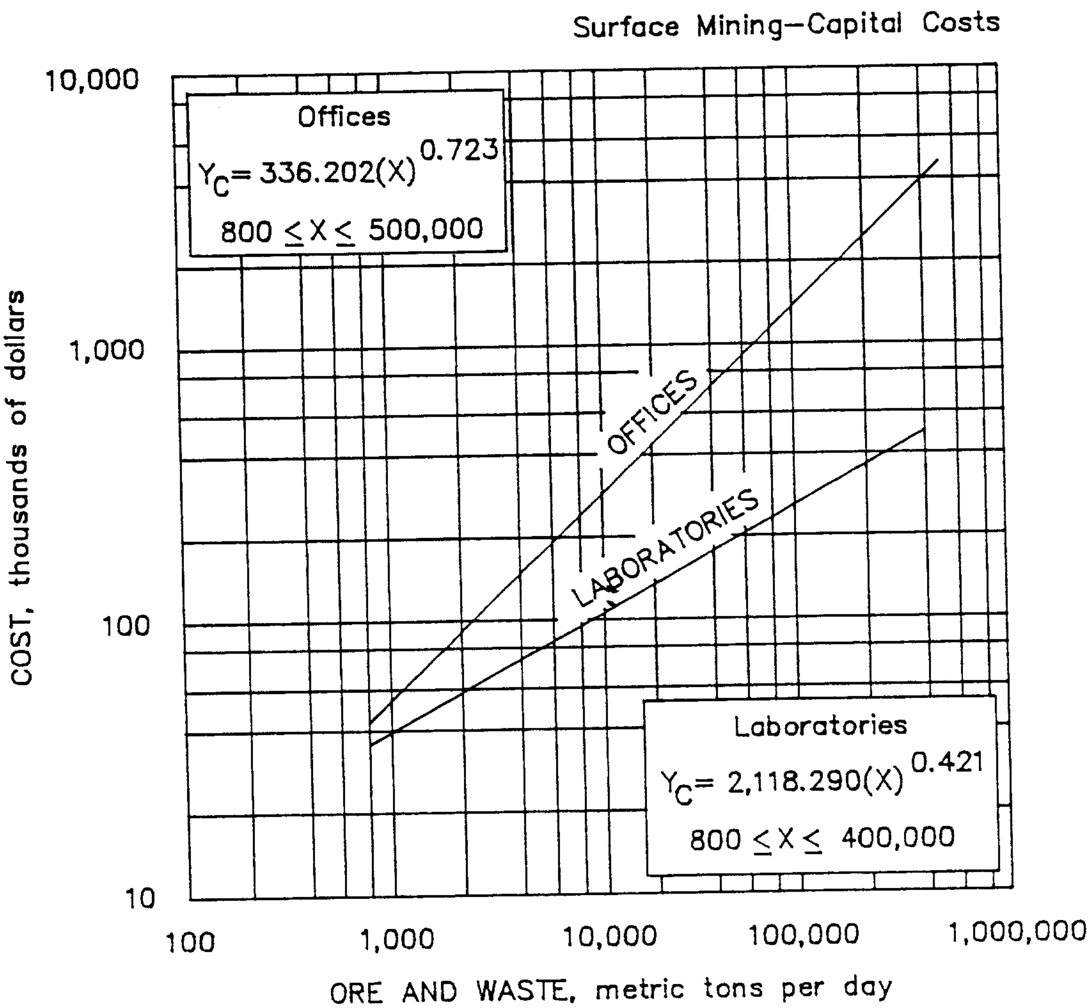
Temperature factor $(F_{T\ SEVERE}) = 1.08$

Wind and Snow Load Factor The building are based on typical Denver, CO, area requirements for an equivalent combined wind and snow load of 20 lb/ft^2. To adjust the costs for more severe conditions (greater than 40 lb/ft^2), multiply the cost obtained from the base curve by the following factor:

Wind and snow load factor $(F_{S\ SEVERE}) = 1.03$



2.2.4.5.a Offices and laboratories



2.2.4.5.b Offices and laboratories

2.2. SURFACE MINING--CAPITAL COSTS

2.2.4. MINE PLANT GENERAL OPERATIONS

2.2.4.6. PORTABLE POWER GENERATION

This section is to be used in conjunction with section 3.2.4.6. when electrical power is unavailable through a commercial power utility company or when it would be uneconomical to run power distribution facilities to the user. No adjustments are necessary for the mine (sections 2.2.4.2., 4.2.5.3.) or mineral processing plant (section 6.1.8.4, IC 9143) electrical system because output power matches the power input to the mine-processing plant transformer-switchgear substations.

The cost shown is for acquisition and installation of the primary power source, either a horizontal-diesel or a gas-turbine operated generator. The cost curve is based on a single 60-Hz, three-phase electrical generator providing all power at the rated kilowatt output. This section should be included in the mine and/or mineral processing plant capital cost totals.

BASE CURVE

The total capital cost is based on a single cost curve having an average continuous power output (X), in kilowatts. The curve is valid for generators between 18 to 23,600 kW. The curve includes all costs associated with the acquisition, transportation, and installation of single-unit generators.

To convert from kilovolt amperes (kV•A) demand to kilowatt (kW) power output, estimate power factor (PF). This may vary from 0.80 for electric motor circuits to 1.00 for electric light circuits. The kilowatt power output is then determined by kV•A X PF = kW.

The portable power generation costs derived from the curves are a combination of the following costs::

	Horizontal diesel (18 to 2,900 kW)	Gas turbine (2,900 to 23,600 kW)
Installation Labor Cost	21%	21%
Installation Materials Cost	20%	20%
Purchased Equipment Cost	58%	59%
Freight cost	1%	-

Installation is assumed to be half labor and half materials.

The total diesel-powered portable power generation capital cost is $(Y_{C\ DIESEL}) = 797.574(X)^{0.876}$ and is distributed as follows:

(L) Installation Labor Cost $(Y_{L\ DIESEL}) = 167.491(X)^{0.876}$

(S) Installation Materials Cost $(Y_{S\ DIESEL}) = 159.514(X)^{0.876}$

(E) Purchased Equipment Cost $(Y_{E\ DIESEL}) = 470.568(X)^{0.876}$

The total turbine-powered portable power generation capital cost is $(Y_{C\ TURBINE}) = 2{,}251.219(X)^{0.872}$ and is distributed as follows:

(L) Installation Labor Cost $(Y_{L\ TURBINE}) = 472.756(X)^{0.872}$

(S) Installation Materials Cost $(Y_{S\ TURBINE}) = 450.244(X)^{0.872}$

(E) Purchased Equipment Cost $(Y_{E\ TURBINE}) = 1328.219(X)^{0.872}$

Power Output Determination For surface mine power output (kW), see Electrical System (section 2.2.4.2.). For underground mine and mineral processing plant power demand (kV•A), see Electrical System (sections 4.2.5.3. and 6.1.8.4. (IC 9143)).

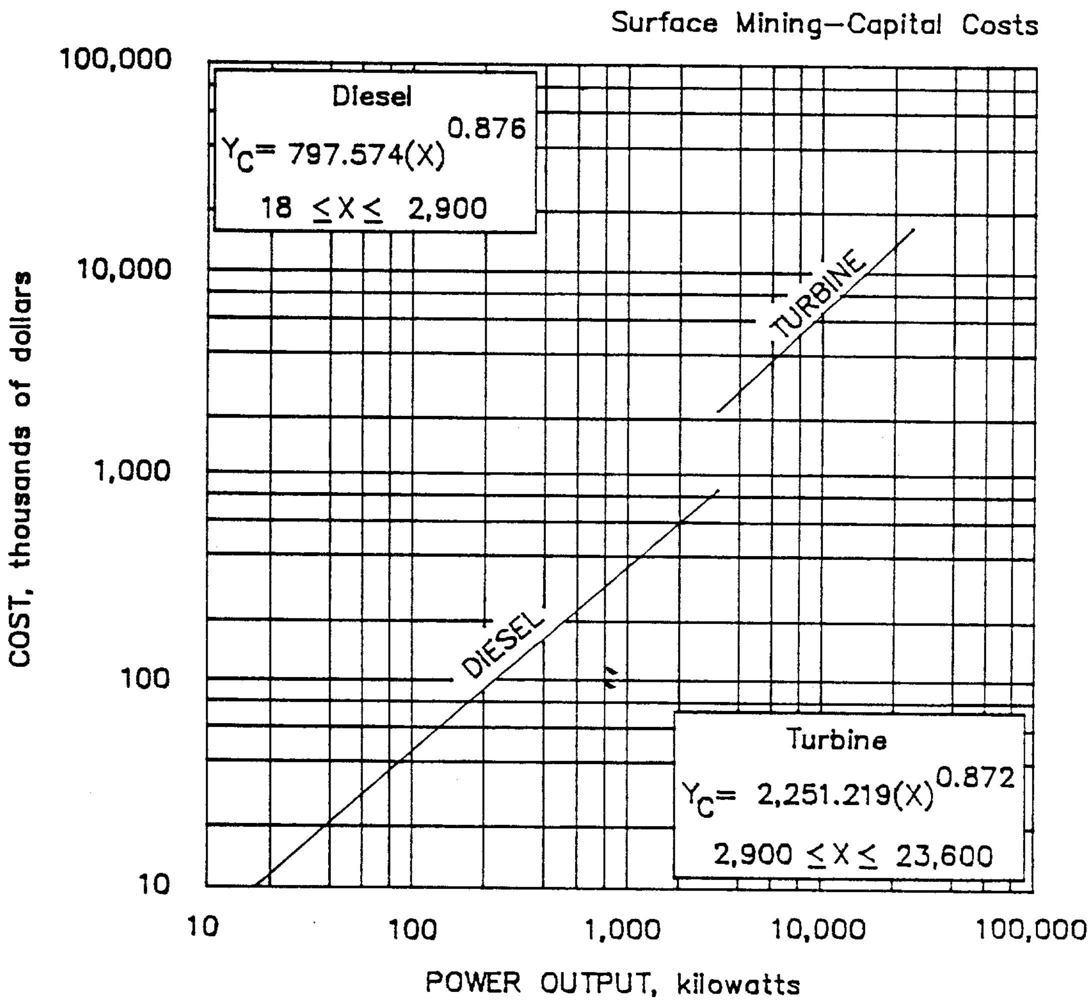
ADJUSTMENT FACTORS

Power Rate If power is to be supplied by more than one unit, the total power output should be divided by the number of required units to obtain the power output per unit (X) needed for entering the curve. After the unit cost has been calculated, the cost must be multiplied by the total number of units used.

Power Source If geography or economics necessitate multiple power sites to support mines and mineral processing plants, portable power cost should be estimated separately for each site using this section.

Shift Adjustment Adjustment for the number of operating shifts is implicit in the choice of the average continuous power output.

Economic Life The normal economic life for generators is 25,000 hr for units rated at 1,100-kW output or greater and ranges from 11,000 to 17,500 hr for units rated at less than 1,100-kW output. If the units are operated at standby rates, roughly 10 percent over capacity, the economic life would decrease by 50%. If high-sulfur fuels are used, the economic life would be decreased by 25%.



2.2.4.6. Portable power generation

2.2. SURFACE MINING--CAPITAL COSTS

2.2.4. MINE PLANT GENERAL OPERATIONS

2.2.4.7. REPAIR SHOPS AND WAREHOUSES

Repair shops and warehouses include buildings, equipment, floors, foundations, and aprons. Building costs are based on steel superstructure and concrete block exterior walls. Costs include all applicable equipment, and cover all types of surface mining operations and haulage. The buildings are based on weather requirements for the Denver, CO, area.

BASE CURVE

The total capital cost is based on a single cost curve having an area (X), in square meters of repair shop and warehouse space <u>or</u> having a production rate (T), in total metric tons of ore and waste per day. The curve is valid for areas of 150 to 10,000 m^2, <u>or</u> 1,000 to 400,000 mtpd, operating three shifts per day. The cost obtained from this curve assumes that these facilities will be used only for mining operations. If the mine and mineral processing plant are to share the same facilities, the user must determine, using a knowledge of the requirements, what can be jointly used and how much, if any, increase to the cost must be made for joint usage.

If the space requirements are known, the capital cost estimate may be made directly by consulting the cost curve; if space requirements are not known, they can be estimated from the following equation:

Total square meters = 2,703+0.016(T)
where T = ore and waste mined, in metric tons per day.

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

	Shops	Warehouses
Construction labor cost........	36%	6%
Construction supply cost.......	31%	5%
Purchased equipment cost.......	22%	-

The total surface mine repair shops and warehouse facilities capital cost is $(Y_{C\ \text{SQUARE METERS}}) = 447.814(X)^{1.000}$ and is distributed as follows:

(L) <u>Construction Labor Cost</u> $(Y_{L\ \text{SHOPS-SQ M}}) = 161.213(X)^{1.000}$
(S) <u>Construction Supply Cost</u> $(Y_{S\ \text{SHOPS-SQ M}}) = 138.822(X)^{1.000}$
(E) <u>Purchased Equipment Cost</u> $(Y_{E\ \text{SHOPS-SQ M}}) = 98.519(X)^{1.000}$

(L) <u>Construction Labor Cost</u> $(Y_{L\ \text{WAREHOUSES-SQ M}}) = 26.869(X)^{1.000}$
(S) <u>Construction Supply Cost</u> $(Y_{S\ \text{WAREHOUSES-SQ M}}) = 22.391(X)^{1.000}$

The total surface mine repair shops and warehouse facilities capital cost is: $(Y_{C\ \text{MTPD}}) = 31{,}103.546(T)^{0.373}$ and is distributed as follows:

(L) Construction Labor Cost $(Y_{L\ SHOPS\text{-}MTPD}) = 11{,}197.277(T)^{0.373}$
(S) Construction Supply Cost $(Y_{S\ SHOPS\text{-}MTPD}) = 9{,}642.099(T)^{0.373}$
(E) Purchased Equipment Cost $(Y_{E\ SHOPS\text{-}MTPD}) = 6{,}842.780(T)^{0.373}$

(L) Construction Labor Cost $(Y_{L\ WAREHOUSES\text{-}MTPD}) = 1{,}866.213(T)^{0.373}$
(S) Construction Supply Cost $(Y_{S\ WAREHOUSES\text{-}MTPD}) = 1{,}555.177(T)^{0.373}$

ADJUSTMENT FACTORS

Temperature Factor The buildings are based on temperature requirements for the Denver, CO, area. For milder areas multiply the costs obtained from the base curve by the following factor:

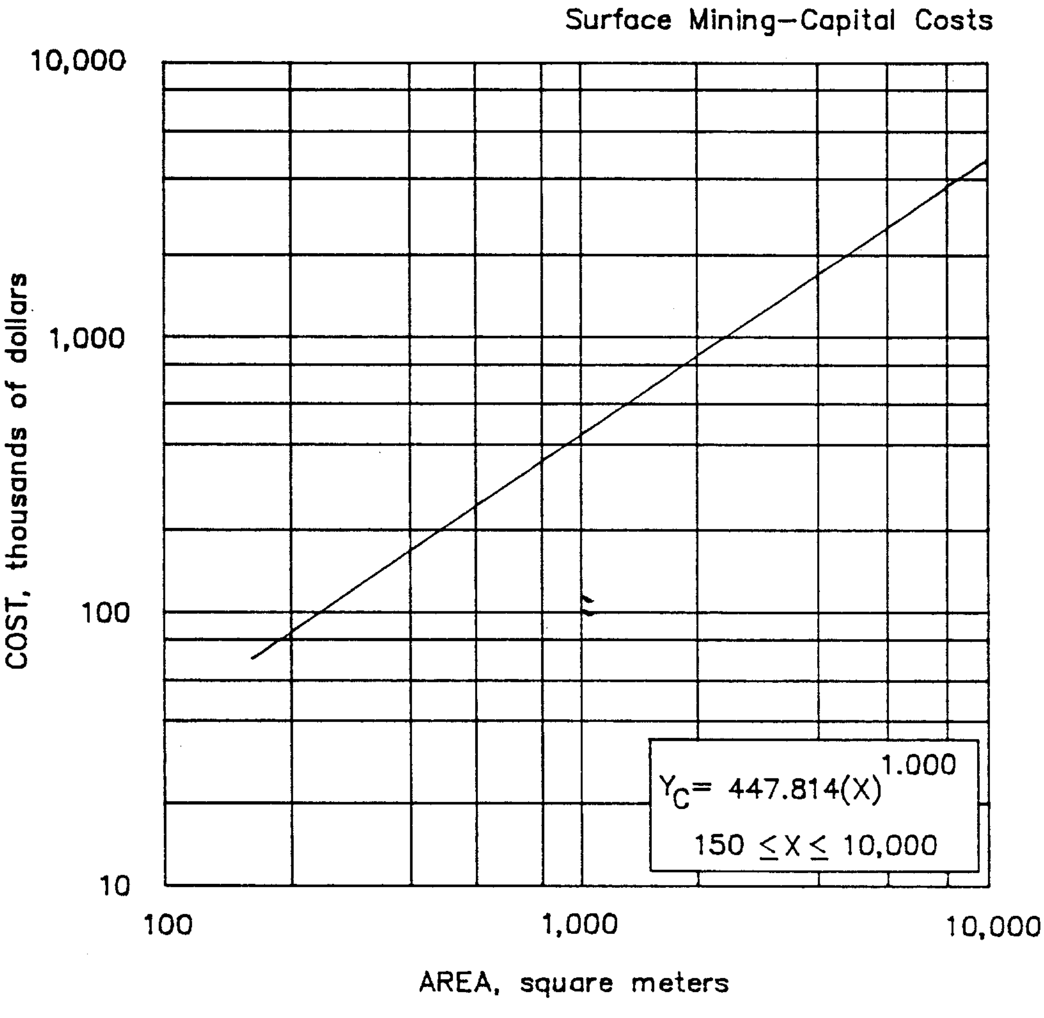
Temperature factor $(F_{T\ MILD}) = 0.94$

For more severe areas multiply the costs obtained from the base curve by the following factor:

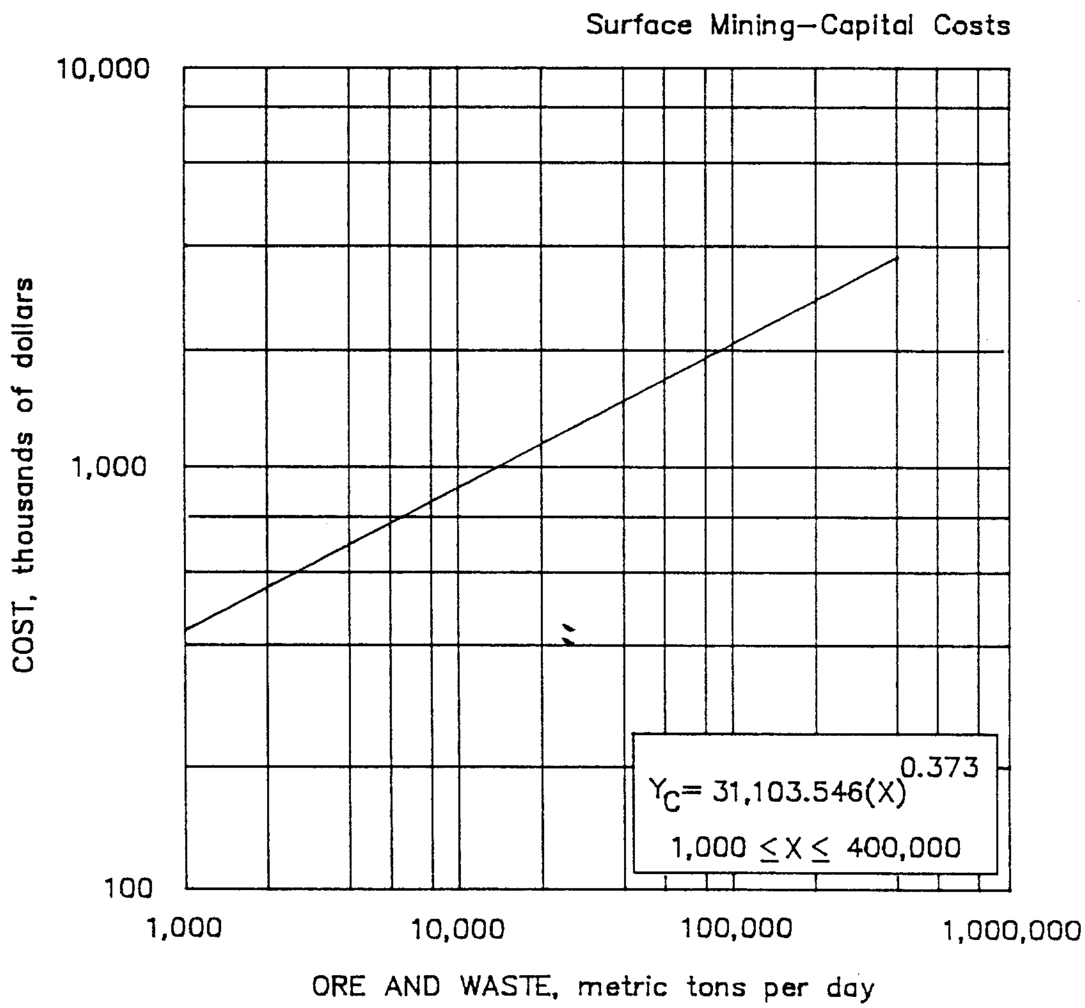
Temperature factor $(F_{T\ SEVERE}) = 1.08$

Wind and Snow Load Factor The building are based on typical Denver, CO, area requirements for an equivalent combined wind and snow load of 20 lb/ft^2. To adjust the costs for more severe conditions (greater than 40 lb/ft^2), multiply the cost obtained from the base curve by the following factor:

Wind and snow load factor $(F_{S\ SEVERE}) = 1.03$



2.2.4.7.a Repair shops and warehouses



2.2.4.7.b Repair shops and warehouses

2.2. SURFACE MINING--CAPITAL COSTS

2.2.4. MINE PLANT GENERAL OPERATIONS

2.2.4.8. STOCKPILE STORAGE FACILITIES

A stockpile storage facility provides sufficient storage capacity for a material until it can be further processed. A storage facility may also provide adequate reserve material to dampen surges in the material supply. Examples of materials stockpiled are smelter flux, coal, and coarse ore. For this base curve, capital cost is correlated to the live storage capacity of the stockpile facility. Live storage capacity of a stockpile is normally about 25% of the total stockpile capacity and 150% of the daily stockpile reclaim rate. The stockpile storage facility capital cost includes all costs associated with acquisition and installation of stockpiling conveyors, reclaim tunnels, reclaim feeders, and reclaim conveyors.

BASE CURVE

The total capital cost is based on a single cost curve having a live storage capacity (X), in metric tons. The curve is valid for 3,000 to 300,000 mt, operating two shifts per day.

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

Construction labor cost.......	13%
Construction supply cost......	36%
Purchased equipment cost......	51%

A typical breakdown of the major cost components is

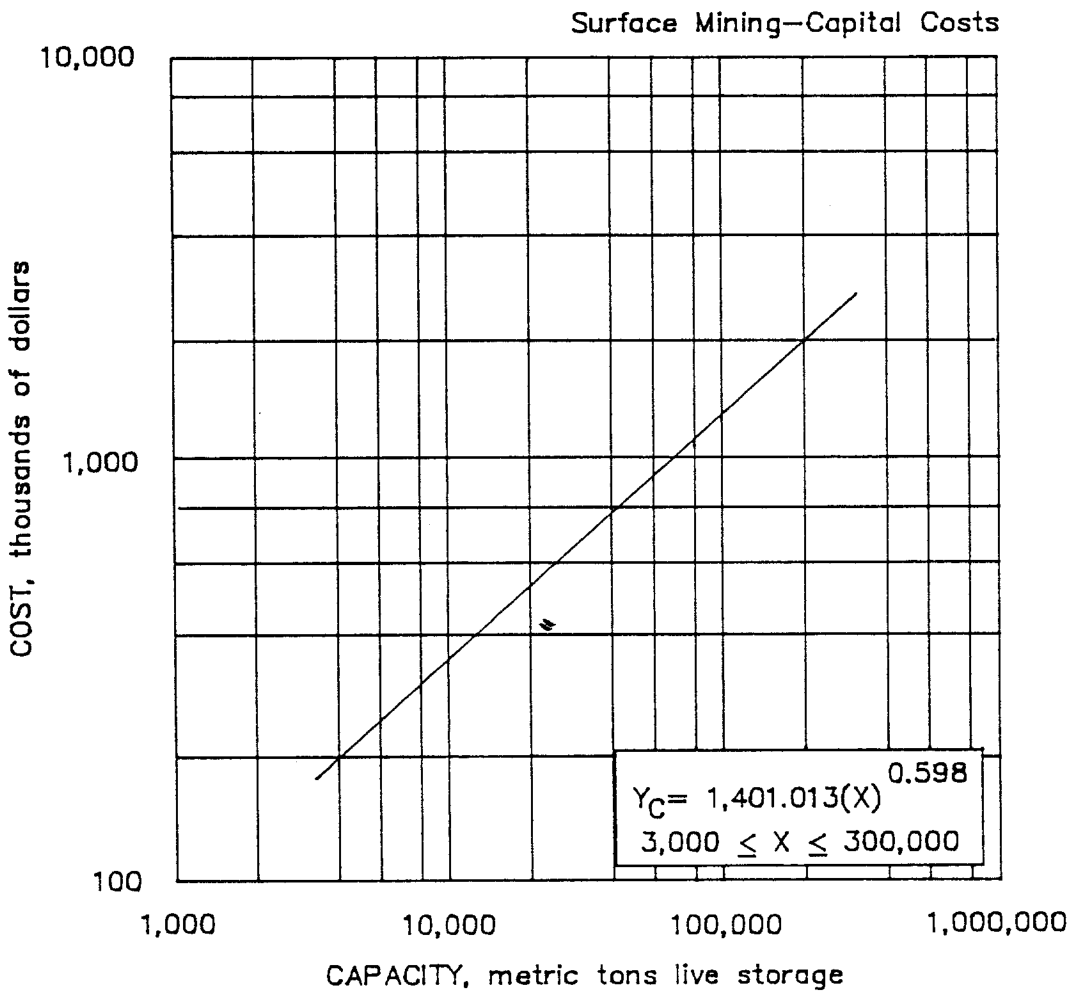
Reclaim feeders..............	14%
Stockpiling conveyor..........	23%
Reclaim tunnels..............	31%
Reclaim conveyors............	32%

The total stockpile storage facility capital cost is $(Y_C) = 1{,}401.013(X)^{0.598}$ and is distributed as follows:

(L) <u>Construction Labor Cost</u> $(Y_L) = 182.132(X)^{0.598}$

(S) <u>Construction Supply Cost</u> $(Y_S) = 504.365(X)^{0.598}$

(E) <u>Purchased Equipment Cost</u> $(Y_E) = 714.516(X)^{0.598}$



2.2.4.8. Stockpile storage facilities

2.2. SURFACE MINING--CAPITAL COSTS

2.2.4. MINE PLANT GENERAL OPERATIONS

2.2.4.9. SURFACE BUILDINGS

The cost curve for surface buildings covers the general support facilities for the mining operation, including change house, powder magazine, tool sheds, guard houses, fencing, etc. Buildings are furnished and are of concrete block construction. The buildings are based on weather requirements for the Denver, CO, area. The installation is based on a three-shift mining operation. Total cost is based on the combined floor space, in square meters, for the included buildings assuming single-story construction.

BASE CURVE

The total capital cost is based on a single cost curve having a building area (X), in square meters of space or having a production rate (T), in total metric tons of ore and waste per day. The curve is valid for areas of 20 to 2,400 m^2, or 14,000 to 55,000 mtpd, operating three shifts per day. The costs obtained from this curve are based on the assumption that these facilities will be used only for mining operations. If the mine and mineral processing plant are to share the same facilities, the user must determine (using a knowledge of the requirements) what can be jointly used and apportion the resulting cost to the mine and plant.

If the total number of needed square meters is not known, the following equation can be used to estimate the area required for surface buildings:

Total square meters = 10.7+0.00616(T)
where T = metric tons ore and waste mined per day.

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

Construction labor cost.......	51%
Construction supply cost......	49%

The total capital cost is $(Y_{C\ SQUARE\ METERS}) = 23{,}587.146(X)^{0.422}$ and is distributed as follows:

(L) Construction Labor Cost $(Y_{L\ SQUARE\ METERS}) = 12{,}029.444(X)^{0.422}$

(S) Construction Supply Cost $(Y_{S\ SQUARE\ METERS}) = 11{,}557.701(X)^{0.422}$

The total capital cost is $(Y_{C\ MTPD}) = 3{,}417.367(T)^{0.403}$ and is distributed as follows:

(L) Construction Labor Cost $(Y_{L\ MTPD}) = 1{,}742.857(T)^{0.403}$

(S) Construction Supply Cost $(Y_{S\ MTPD}) = 1{,}674.51(T)^{0.403}$

ADJUSTMENT FACTORS

Shift Adjustment To adjust the capital cost for a different number of daily operating shifts, multiply the actual daily tonnage by the ratio of the base number of shifts (3) divided by the number of desired shifts. Then, use this modified production rate in place of actual daily tonnage in the preceding tonnage-square meter equation to obtain the adjusted building area. This factor need not be applied if actual building areas are known.

Temperature Factor The buildings are based on temperature requirements for the Denver, CO, area. For more moderate areas multiply the costs obtained from the base curve by the following factor:

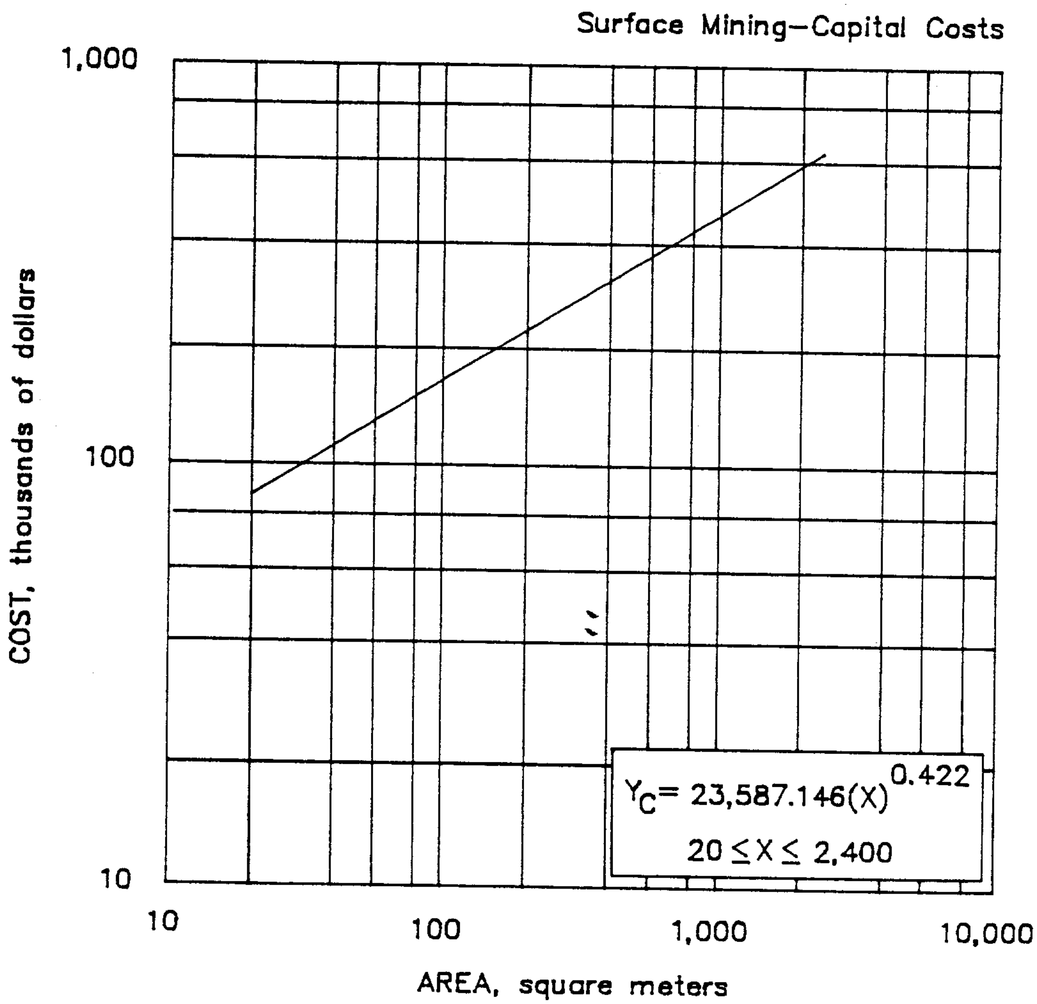
Temperature factor $(F_{T\ MILD}) = 0.94$

For more severe areas multiply the costs obtained from the base curve by the following factor:

Temperature factor $(F_{T\ SEVERE}) = 1.08$

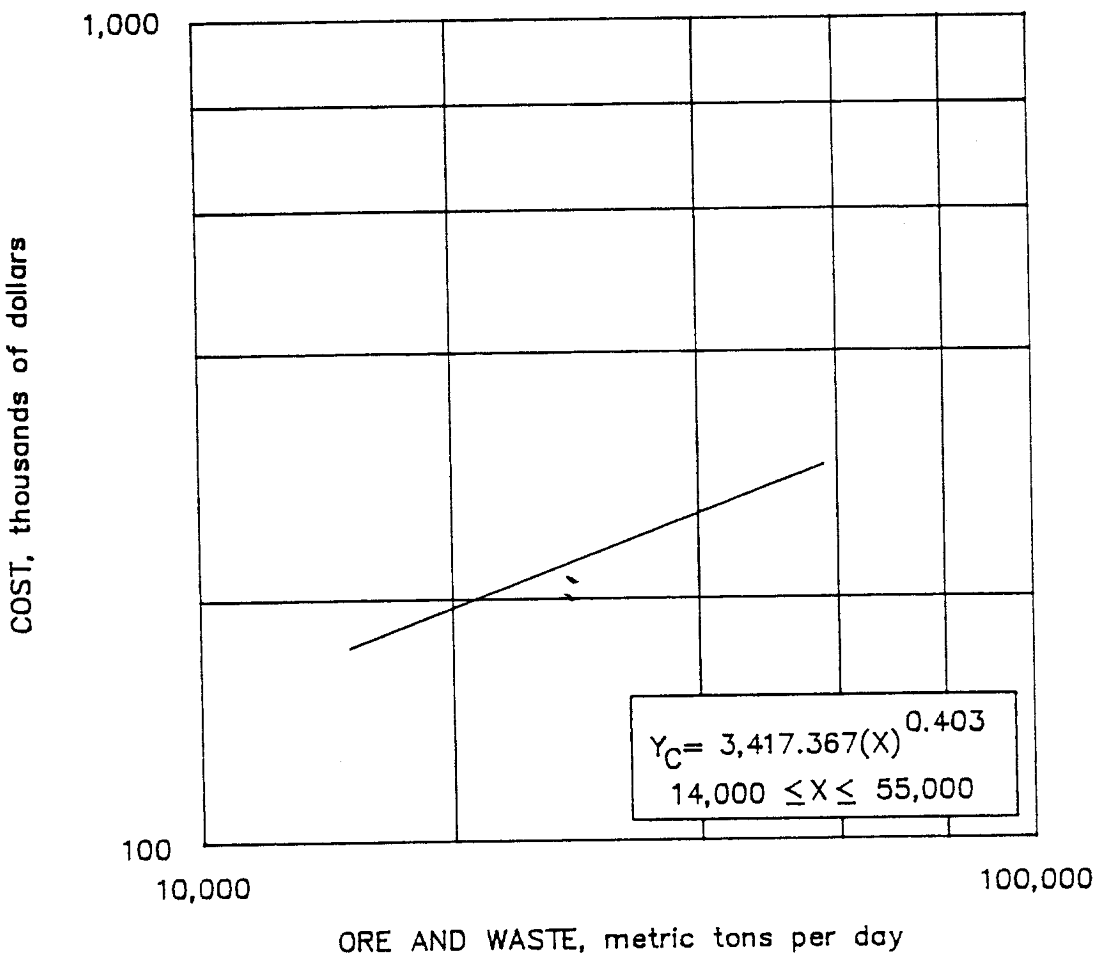
Wind and Snow Load Factor The buildings are based on typical Denver, CO, area requirements for an equivalent combined wind and snow load of 20 lb/ft^2. To adjust the costs for more severe conditions (greater than 40 lb/ft^2), multiply the costs by the following factor:

Wind and snow load factor $(F_{S\ SEVERE}) = 1.03$



2.2.4.9.a Surface buildings

Surface Mining—Capital Costs



2.2.4.9.b Surface buildings

2.2. SURFACE MINING--CAPITAL COSTS

2.2.4. MINE PLANT GENERAL OPERATIONS

2.2.4.10.1. WATER AND DRAINAGE SYSTEM
DRAINAGE SYSTEM

The curve applies to the most common dewatering method, which consists of pumping water out of the mine.

BASE CURVE

The total capital cost is based on a single curve for a water-pumping volume (X), in cubic meters per day. The curve is valid for pumping volumes of 100 to 60,000 m^3/d, operating three shifts per day. The curve is predicated on an adjustable head of 110 m and an adjustable pumping distance of 1.18 km. This curve covers all costs associated with acquisition and installation of ditches, sumps, pumps, pipe lines, and fittings needed to drain the surface area around the mine.

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

Construction labor cost.......	16%
Construction supply cost......	30%
Purchased equipment cost......	54%

A typical breakdown of major cost components is

	Small (100 to 10,000 m^3/d)	Large (10,000 to 60,000 m^3/d)
Pumps and motors..........	56%	55%
Pipe, valves, and fittings.	44%	45%

The total capital cost is $(Y_C) = 4,947.052(X)^{0.426}$ and is distributed as follows:

(L) Construction Labor Cost $(Y_L) = 791.528(X)^{0.426}$

(S) Construction Supply Cost $(Y_S) = 1,492.216(X)^{0.426}$

(E) Purchased Equipment Cost $(Y_E) = 2,685.988(X)^{0.426}$

ADJUSTMENT FACTORS

Pumping Head Factor The capital cost curve is based on 100-m static head (lift) and 10-m friction head. This friction head applies to a 1.18-km standard steel pipe line. For actual heads (H), multiply the cost obtained from the base curve by the following factor:

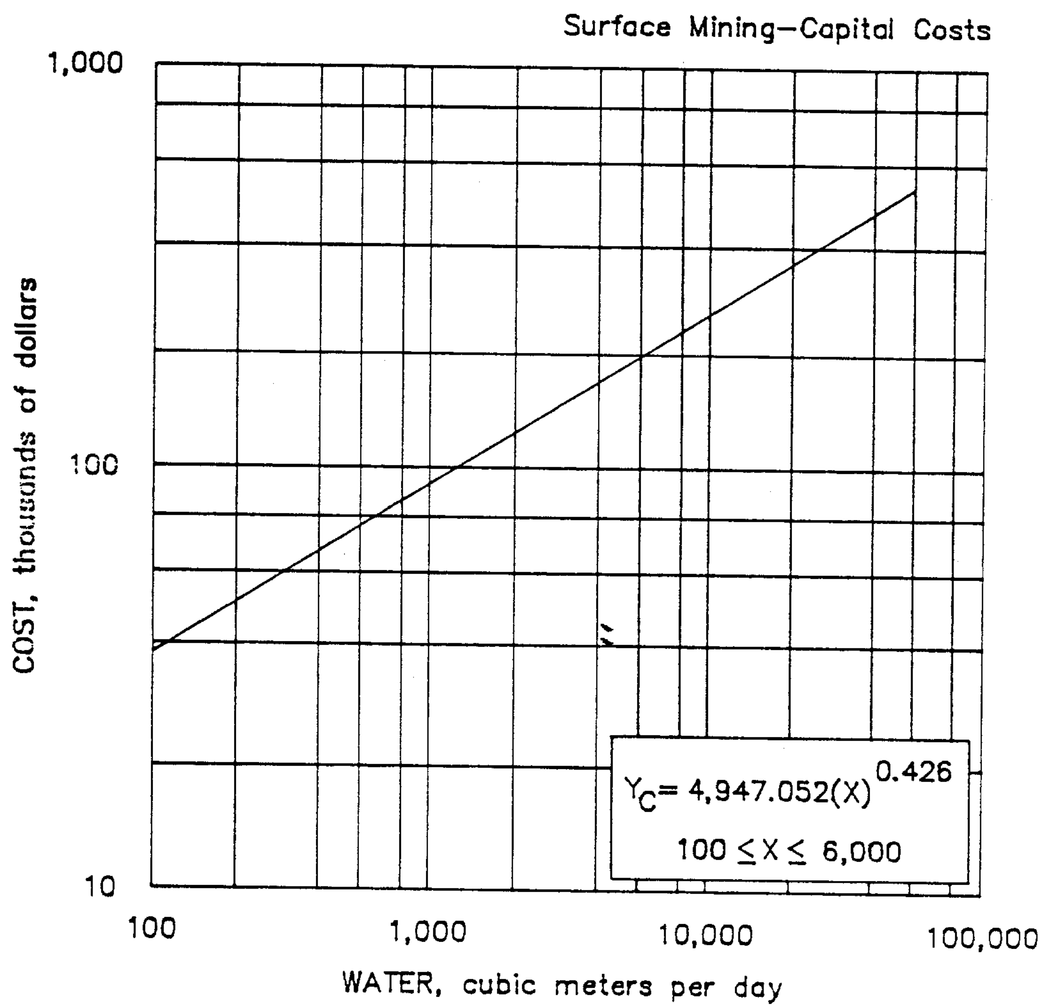
Pumping head factor $(F_P) = 0.65+[0.00318(H)]$
where H = actual head (static, friction, velocity, and fitting), in meters.

For preliminary estimates of H, add to the actual static head (lift) 8 m for each kilometer of new steel pipe line through which pumping is done.

For accurate determinations of H, add to the actual static head the sum of friction, velocity, and fitting heads obtained from hydraulics handbooks for actual pipe quality, pipe diameter, and pipe line pumping distance.

Pumping Distance Factor The capital cost curve is based on a 1.18-km pumping distance (0.18 km in the mine and 1 km outside). For actual distances, multiply the cost obtained from the base curve by the following factor:

Pumping distance factor $(F_D) = 0.490+0.431(D)$
where D = actual pumping distance, in kilometers.



2.2.4.10.1. Water and drainage system
DRAINAGE SYSTEM

2.2. SURFACE MINING--CAPITAL COSTS

2.2.4. MINE PLANT GENERAL OPERATIONS

2.2.4.10.2. WATER AND DRAINAGE SYSTEM
WATER SUPPLY SYSTEM (MAKEUP WATER)

Water is supplied from aquifers or surface sources to surface mines for dust control on haulage roads and for equipment cooling. The water supply system capital cost for a surface mine (and/or an adjoining mineral processing plant (section 6.1.8.14., IC 9143) is based on daily water consumption.

If total daily volume (mine and mineral processing makeup water) is known, the manual user should enter this volume in the equation given below (unless the processing plant is supplied with water from an independent source). The total cost may be allotted as follows[1]:

a) 9% to section 2.2.4.10.2. (surface mine).

b) 91% to section 6.1.8.14. (mineral processing plant IC 9143).

To estimate mine water demand, multiply the daily mine capacity (ore and waste) by 0.07. The 0.07 factor is the approximate number of cubic meters of water required per metric ton mined.

BASE CURVE

The total capital cost is based on a single curve for a water volume (X), in cubic meters per day and is valid for volumes of 1,000 to 150,000 m^3/d, operating three shifts per day. The curve is predicated on an average pumping head of 291 m, and pumping distances ranging from 3 to 53 km, and consists of wells, storage tanks, pipelines, distribution piping, pumps, and fittings.

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

Construction labor cost.......	54%
Construction supply cost......	13%
Purchased equipment cost......	32%
Freight cost..................	1%

A typical breakdown of equipment major cost components is:

Pipe line.....................	58%
Pumps.........................	26%
Storage tanks.................	16%

[1]Percentages derived from U.S. Bureau of Mines IC 8285 dealing with water consumption for U.S. mines and mineral processing plants. Different percentages may be obtained if an actual breakdown of water consumption for the mine and mineral processing plants is known.

The total capital cost is $(Y_C) = 848.677(X)^{0.893}$ and is distributed as follows:

(L) Construction Labor Cost $(Y_L) = 458.286(X)^{0.893}$

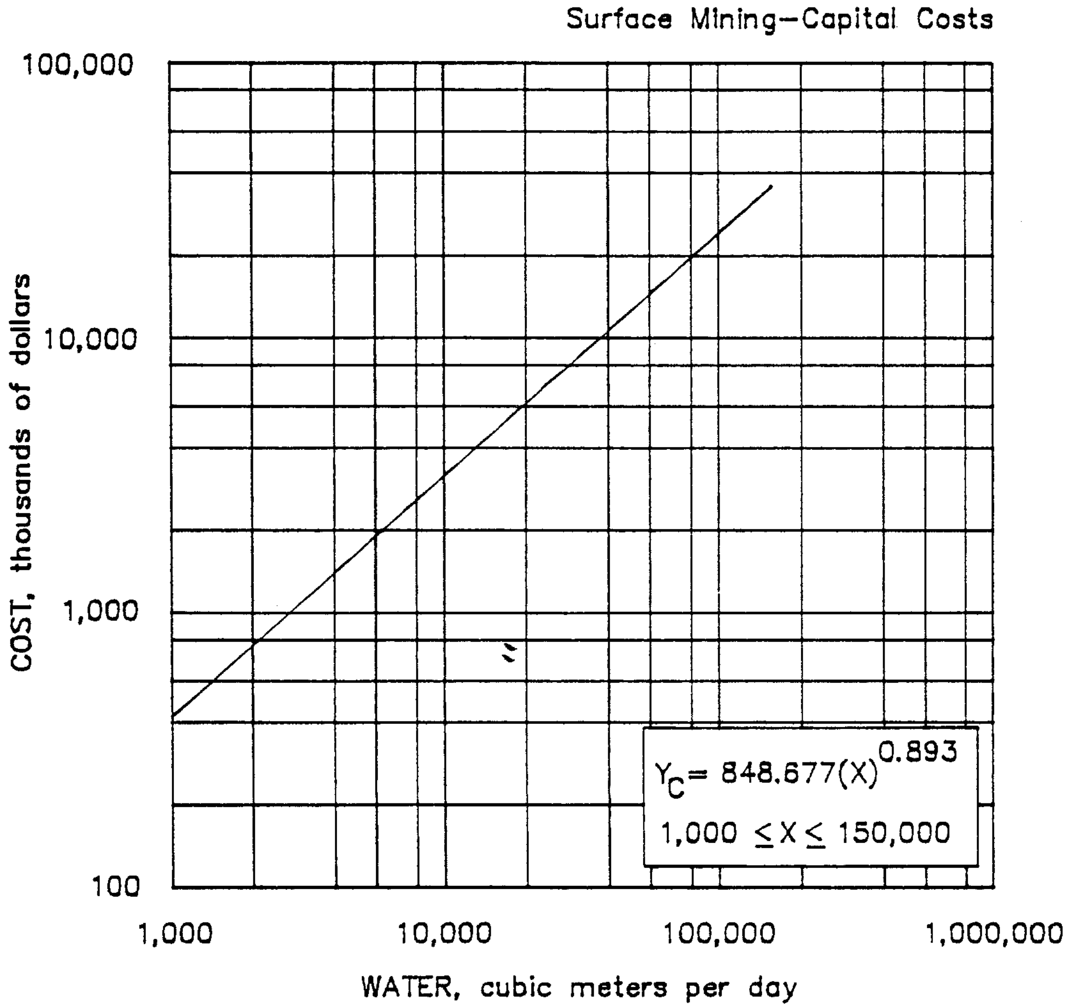
(S) Construction Supply Cost $(Y_S) = 110.328(X)^{0.893}$

(E) Purchased Equipment Cost $(Y_E) = 280.063(X)^{0.893}$

ADJUSTMENT FACTORS

Pumping Distance Factor To adjust the capital cost for the actual pumping distance, multiply the cost obtained from the base curve by the following factor:

Pumping distance factor $(F_D) = 0.030+[12.516(D)(X)^{-0.549}]$
where D = actual distance, in meters,
and X = daily volume, in cubic meters per day.



2.2.4.10.2. Water and drainage system
WATER SUPPLY SYSTEM (MAKEUP WATER)