

# Yukon Placer Mine Income Model

**DRAFT**

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## **Introduction**

An integrated regulatory regime for the environmental management of the Yukon placer mining industry – the Integrated Fish Habitat Management Regime for Yukon Placer Mining – is being implemented by the Yukon Placer Secretariat. As part of the new regime, the Economic Health Monitoring Protocol was developed to measure whether a balance between a viable placer industry and the conservation of fish and fish habitat supporting fisheries is being maintained over time. The focus of many of the measures in the Economic Health Monitoring Protocol is on the cost side of placer mine operations.

In 2007 Yukon Economic Development indicated interest in expanding the scope of Economic Health Monitoring Protocol implementation to include the revenue side of placer mine operations in the Yukon. With funding from Yukon Economic Development, conceptual and operating income models (at three scales of operation) were developed in consultation with the Klondike Placer Miner’s Association. The income model will provide additional information that can be used to inform decisions required by the Integrated Fish Habitat Management Regime. This report documents the development and features of the Yukon Placer Mine Income Model.

## **Model Development**

A generic income model framework was developed in the fall of 2007. The framework was presented to representatives of the Klondike Placer Miners’ Association on December 14, 2007. The framework (with headings for three different scales) was then circulated to the selected KPMA members. A copy of the generic income model framework for medium size enterprises is presented on the following page.

In addition to the meeting held on December 14, 2007, meetings were also held with representatives of the Klondike Placer Miners’ Association to further refine the cost of production variables on:

- February 29, 2008
- March 26, 2008

Key non-financial indicators were also identified and discussed at the meetings with Klondike Placer Miners’ Association representatives.

## **Yukon Placer Mine Income Model**

A screenshot of the conceptual Yukon Placer Mine Income Model may be found on page 6 of this report. A screenshot of the Yukon Placer Mine Income Model with estimated average costs filled in, may be found on page 7 of this report. The model proper may be found in a series of Excel spreadsheets which accompany this report.

### Sizing of Operations

Two variables were used to define the size of placer mine operations at each of the three scales: the number of claims mined per year and the volume of overburden/pay gravel moved per year.

Small scale operations are those that mine half a claim<sup>1</sup> and move less than 40,000 m<sup>3</sup> of overburden and pay gravel per year.

Medium scale operations are those that mine two claims and move between 40,000 m<sup>3</sup> and 200,000 m<sup>3</sup> of overburden and pay gravel per year.

Large scale operations are those that mine 10 claims and move more than 200,000 m<sup>3</sup> of overburden and pay gravel per year.

### Variable descriptions

#### ***Labour***

A total of five types of positions were identified:

- manager/foremen;
- equipment operators;
- laborers;
- mechanic/welders; and,
- cook expeditors.

As placer mining is a seasonal activity in the Yukon, cost estimates for labour were based on six consecutive months of full-time work (including overtime).

Small scale operations employ one manager, one cook/expediter through the whole season and one equipment operator for half of the season. The manager and equipment operator also perform duties that are delegated to laborers and mechanic/welders in large-scale placer operations.

Medium scale operations employ one manager, two equipment operators, one laborer and one cook/expediter. The manager and equipment operators also perform duties that are delegated to mechanic/welders in large-scale placer operations.

Large scale operations employ three manager/foremen, three equipment operators, two laborers, one mechanic/welder and one cook/expediter.

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<sup>1</sup> A placer claim is 500 feet by 2000 feet in size.

***Fuel***

Three types of fuel are consumed: diesel, gasoline and propane:

Small scale operations consume 65,000 litres of diesel, 1,000 litres of gasoline and 750 litres of propane per season.

Medium scale operations consume 130,000 litres of diesel, 5,000 litres of gasoline and 1,000 litres of propane per season.

Large scale operations consume 1,600,000 litres of diesel, 23,000 litres of gasoline and 5,000 litres of propane per season.

***Other operating expenses***

Cost estimates also include annual operating expenses related to shop supplies, lubricants, groceries, dry goods, office supplies and expenses and first aid equipment.

***Mine equipment***

The complete range of capital equipment needed to operate a placer mine in the Yukon was identified in consultation with the Klondike Placer Miners Association. By definition, capital equipment items are not completely consumed in a single year, that is, the useful life of a capital item extends for more than one year. While not completely consumed in a single year, the value of a capital item declines as it is put to use; the wear and tear on the item reduces its economic value.

To properly capture the annual value of “wear and tear”, the income model includes approximations of repair and maintenance costs necessary to keep the equipment in good working order. The maintenance costs are termed capital replenishment costs and calculated by applying one of four replenishment rates to the book value of each capital equipment item. The range of capital equipment identified and the associated capital replenishment rates are outlined in the table below.

25% Capital Replenishment Items	15% Capital Replenishment Items
Bulldozer(s)	Communication equipment
Excavator(s)	Wash plant
Loader(s)	Primary electricity generator
Rock truck(s)	Secondary electricity generator
All terrain vehicles (ATVs)	Gold room equipment
Fuel truck	Shop/storage
Flat deck truck w/HIAB	Town truck
20% Capital Replenishment Items	10% Capital Replenishment Items
Large water pumps	Water pipe
Small water pumps	Tools
Welding Unit A	Gold room
Welding Unit B	Fuel storage tank A
Oxy/Acetylene Rig	Fuel storage tank B
	Bunkhouse/mess hall/water storage

***Permitting costs***

Operation of a placer mine requires that certain regulatory approvals be granted by the Yukon Government, namely a Land Use Permit and a Water License. Application for both the Land Use Permit and Water License can only be made after undergoing a project evaluation by a designated office of the *Yukon Environmental and Socio-economic Assessment Board*. As the both approvals are typically "good" for several years the model allows for permit acquisition costs to be spread over several years. Determination of actual permitting costs requires further investigation; placeholder costs of \$1,000 for each type of permit/process currently appear in the model.

***Finance costs***

A significant quantity of capital equipment is required to placer mine at each of the three scales of operations. To properly recognize the cost of acquiring that capital, finance costs are calculated in the model as a percentage of the total book value of mine equipment. In the circumstance where the capital equipment is owned outright, the same percentage is applied to the total book value of mine equipment and represents the opportunity cost of having funds unavailable for alternate investments.

***Time horizon***

Cost efficiency of a placer mine is improved by stripping the black muck that covers placer claims well in advance of mining so overburden and paygravel may thaw before being moved. For large scale placer operations, this may mean stripping muck a year or more in advance of actual mining. While the income model recognizes that a certain amount of operating activity relates to future years, the associated costs do not figure into the model as it is currently structured.

***Claim costs***

The claim cost variable represents the economic rent that is paid for the right to extract of the gold resource. It is proxied by the lease costs equivalent to the value of 10% of raw gold production. Claim costs also include annual claim fees of \$10 per claim.

***Incremental compliance costs***

The income model also provides for three types of incremental compliance costs associated with three activities:

- construction of final restoration channels;
- minesite reclamation; and,
- water quality sampling and reporting.

As the new management regime is only now being implemented, the determination of actual costs requires further investigation. Placeholder amounts currently appear in the model and will be updated with benefit of input from panel survey findings.

## **Sensitivity Analysis**

Sensitivity analysis was undertaken for a range model variables. Single variable analysis was undertaken for:

- variations in gold price from \$500 to \$1,200 at \$100 increments
- variations in gold production, from minus 15% to plus 15% at 5% increments
- variations in fuel costs, from minus 15% to plus 15% at 5% increments
- variations in labour costs, from minus 15% to plus 15% at 5% increments
- variations in compliance costs, from minus 15% to plus 15% at 5% increments

Dual variable sensitivity analysis was undertaken for variations in gold prices (from \$500 to \$1,200 at \$100 increments) and variations in gold production (from minus 15% to plus 15% at 5% increments). The dual variable analysis was performed for each of the three scales of operation.

The sensitivity analysis results are presented in tabular and chart form on pages eight to thirteen of this report.

**Conceptual Income Model of a Yukon Placer Mine at Three Scales  
Counts, Volumes and Capacities**

		SMALL SCALE	MEDIUM SCALE	LARGE SCALE
<b>LABOUR (full time equivalent, 6 month season)</b>				
Manager/foremen		1	1	3
Equipment operators		0.5	2	3
Laborers		n/a	1	2
Mechanic/welder		n/a	n/a	1
Cook/expediter		1	1	1
<b>FUEL</b>				
Diesel (litres)		65,000	130,000	1,600,000
Gasoline (litres)		1,000	5,000	23,000
Propane (litres)		750	1,000	5,000
<b>OTHER OPERATING EXPENSES</b>				
Shop supplies, lubricants, etc.		✓	✓	✓
Groceries and dry goods		✓	✓	✓
Office supplies and expenses		✓	✓	✓
First aid		✓	✓	✓
<b>MINE EQUIPMENT (AMORTIZABLE) (%)</b>				
Bulldozer(s)	25	1: D7/D8	2: D9	3: D10
Excavator(s)	25	1: EX200	2: Case 220B	4: Hitachi EX700
Loader(s)	25	n/a	1: Cat 988B	1: Cat 988B
Rock truck(s)	25	n/a	1: Cat D44	3: Cat D44
All terrain vehicles (ATVs)	25	1	2	4
Fuel truck	25	n/a	1: 2,000 gal	1: 3,000 gal
Flat deck truck w/HIAB	25	1	1	2
Large water pumps	25	1: 4 cyl	2: 6 cyl diesel	3: 6 cyl diesel
Small water pumps	25	1: Honda	2: Honda	3: Honda
Welding Unit A	20	1: 200 amp Miller	1: 450 amp Miller	1: 650 amp Miller
Welding Unit B	20	n/a	1: 200 amp Miller	1: 200 amp Miller
Oxy/Acetylene Rig	20	✓	✓	✓
Communication equipment	15	sat phone	sat ph./internet	sat ph./internet
Wash plant	15	5' w/screen deck	1: trommel	2: HPC 200
Primary electricity generator	15	1: 5 kW	1: 25 kW	2: 30 kW
Secondary electricity generator	15	n/a	1: 5 kW	1: 5 kW
Gold room equipment	15	2 cell jig, long tom	2 cell jig, long tom	2 cell jig, long tom
Shop/storage	15	1: 8x8x20 seacan	1: 20x20 bldg	1: 20x20 bldg
Town truck	15	1: F250	1: F350	2: F350
Water pipe	10	1,000 feet	3,000 feet	10,000 feet
Tools	10	✓	✓	✓
Gold room	10	n/a	1: 8x8x20 seacan	1: 20 x 20 bldg
Fuel storage tank A	10	1: 5,000 gal	1: 10,000 gal	1: 50,000 gal
Fuel storage tank B	10	n/a	1: 1,000 gal	1: 5,000 gal
Bunkhouse/mess hall/water storage	10	1: travel trailer	1: 30 x 30 bldg	1: 40 x 40 bldg
<b>PERMITTING COSTS (AMORTIZABLE) (%)</b>				
YESAA process (10 year mine life)	10	✓	✓	✓
Land Use Permit	10	✓	✓	✓
Water License (10 year license)	10	✓	✓	✓
<b>FINANCE COSTS</b>				
Debt repayment/opportunity cost		3.5% of book value of mine equipment	3.5% of book value of mine equipment	3.5% of book value of mine equipment
<b>TIME HORIZON</b>				
% of work in current season for future seasons (e.g., stripping muck to allow thawing)		5	10	25
<b>VOLUME OF OVERBURDEN AND PAY GRAVEL MOVED PER YEAR</b>				
less than 40,000 cubic metres		✓	n/a	n/a
>40,000m3 and <200,000m3		n/a	✓	n/a
>200,000m3		n/a	n/a	✓
<b>CLAIMS MINED PER YEAR</b>				
Number of claims		0.5	2.0	10.0
<b>CLAIM COSTS</b>				
Number of claims owned		8	45	120
Annual claim fees (\$ per claim)		10	10	10
Lease costs (raw gold production royalty)		10%	10%	10%
<b>INCREMENTAL COMPLIANCE COSTS</b>				
Final restoration channels		factor x	factor x	factor x
Reclamation		factor y	factor y	factor y
Water quality sampling and reporting		factor z	factor z	factor z



**Income Model - Yukon Placer Mine at Three Scales  
Costs (\$ CDN)**

		<b>SMALL SCALE</b>	<b>MEDIUM SCALE</b>	<b>LARGE SCALE</b>
<b>LABOUR (full time equivalent, 6 month season)</b>				
Manager/foremen		50,000	50,000	300,000
Equipment operators		30,000	110,000	900,000
Laborers		-	30,000	35,000
Mechanic/welder		-	20,000	68,000
Cook/expediter		12,000	24,000	63,000
<b>FUEL</b>				
Diesel (\$/litre)	1.40	91,000	182,000	2,240,000
Gasoline (\$/litre)	1.30	1,300	6,500	29,900
Propane (\$/litre)	0.90	675	900	4,500
<b>OTHER OPERATING EXPENSES</b>				
Shop supplies, lubricants, etc.		2,500	6,000	20,000
Groceries and dry goods		8,500	20,000	90,000
Office supplies and expenses		2,500	5,000	10,000
First aid		500	1,000	3,000
<b>MINE EQUIPMENT (AMORTIZABLE) (%)</b>				
Bulldozer(s)	25	45,000	200,000	1,500,000
Excavator(s)	25	35,000	220,000	1,500,000
Loader(s)	25	-	45,000	45,000
Rock truck(s)	25	-	50,000	150,000
All terrain vehicles (ATVs)	25	5,000	10,000	28,000
Fuel truck	25	-	15,000	20,000
Flat deck truck w/HIAB	25	10,000	20,000	45,000
<i>Subtotal</i>		95,000	560,000	3,288,000
<i>Capital replenishment (25% items)</i>		23,750	140,000	822,000
Large water pumps	20	7,500	42,000	150,000
Small water pumps	20	2,500	5,000	7,500
Welding Unit A	20	1,500	3,500	5,000
Welding Unit B	20	-	2,000	3,500
Oxy/Acetylene Rig	20	1,000	3,000	5,000
<i>Subtotal</i>		12,500	55,500	171,000
<i>Capital replenishment (20% items)</i>		2,500	11,100	34,200
Communication equipment	15	750	3,000	6,000
Wash plant	15	45,000	165,000	750,000
Primary electricity generator	15	10,000	25,000	60,000
Secondary electricity generator	15	-	5,000	5,000
Gold room equipment	15	3,500	7,000	10,000
Shop/storage	15	2,000	25,000	50,000
Town truck	15	15,000	35,000	70,000
<i>Subtotal</i>		76,250	265,000	951,000
<i>Capital replenishment (15% items)</i>		11,438	39,750	142,650
Water pipe	10	10,000	30,000	10,000
Tools	10	5,000	30,000	90,000
Gold room	10	-	4,000	20,000
Fuel storage tank A	10	10,000	12,000	55,000
Fuel storage tank B	10	-	2,000	6,500
Bunkhouse/mess hall/water storage	10	5,000	25,000	50,000
<i>Subtotal</i>		30,000	103,000	231,500
<i>Capital replenishment (10% items)</i>		3,000	10,300	23,150
<i>Total book value of mine equipment</i>		213,750	983,500	4,641,500
<b>PERMITTING COSTS (AMORTIZABLE) (%)</b>				
YESAA process (10 year mine life)	10	100	100	100
Land Use Permit	10	100	100	100
Water License (10 year license)	10	100	100	100
<b>FINANCE COSTS</b>				
Debt repayment/opportunity cost	3.5%	7,481	34,423	162,453
<b>TIME HORIZON</b>				
% of work in current season for future seasons (e.g., stripping muck to allow thawing)		5	10	25
<b>VOLUME OF OVERBURDEN AND PAY GRAVEL MOVED PER YEAR</b>				
less than 40,000 cubic metres		✓	n/a	n/a
>40,000m3 and <200,000m3		n/a	✓	n/a
>200,000m3		n/a	n/a	✓
<b>CLAIMS MINED PER YEAR</b>				
Number of claims		0.5	2.0	10.0
<b>CLAIM COSTS</b>				
Number of claims owned		8	45	120
Annual claim fees		80	450	1,200
Lease costs (raw gold production royalty)		10%	10%	10%
<b>INCREMENTAL COMPLIANCE COSTS</b>				
Final restoration channels	tbd	10,000	30,000	200,000
Reclamation	tbd	8,000	24,000	160,000
Water quality sampling and reporting	tbd	1,000	3,000	20,000

<b>REVENUE</b>				
Crude gold extracted (troy ounces)		500	1,500	10,000
Fineness		800	800	800
Recovery rate (%)		95	95	95
Fine gold extracted		380	1,140	7,600
% variation in fine gold extracted	0%	0%	0%	0%
actual fine gold extracted		380	1,140	7,600
Gold price (\$US)	800	800	800	800
exchange rate (\$1 US = ___\$CDN)	1.00	1.00	1.00	1.00
gold price (\$CDN)		800	800	800
Revenue		304,000	912,000	6,080,000

<b>COST SUMMARY</b>				
Labour		92,000	234,000	1,366,000
% variation in labour costs	0%	0%	0%	0%
actual labour costs		92,000	234,000	1,366,000
Fuel		92,975	189,400	2,274,400
% variation in fuel costs	0%	0%	0%	0%
actual fuel costs		92,975	189,400	2,274,400
Other operating expenses		14,000	32,000	123,000
Finance costs		7,481	34,423	162,453
Capital replenishment		40,688	201,150	1,022,000
Amortizable permitting costs		30	30	30
Claim costs		30,480	91,650	609,200
Incremental compliance costs		19,000	57,000	380,000
% variation in compliance costs	0%	0%	0%	0%
actual compliance costs		19,000	57,000	380,000
Total Costs		296,654	839,653	5,937,083

<b>INCOME BEFORE TAXES</b>		7,346	72,348	142,918
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**SENSITIVITY ANALYSIS: INCOME BEFORE TAXES**

		500	600	700	800	900	1,000	1,100	1,200
<b>Gold Price (\$US)</b>		500	600	700	800	900	1,000	1,100	1,200
Small	7,346	-95,254	-61,054	-26,854	7,346	41,546	75,746	109,946	144,146
<b>Gold Price (\$US)</b>		500	600	700	800	900	1,000	1,100	1,200
Medium	72,348	-235,453	-132,853	-30,253	72,348	174,948	277,548	380,148	482,748
<b>Gold Price (\$US)</b>		500	600	700	800	900	1,000	1,100	1,200
Large	142,918	-1,909,083	-1,225,083	-541,083	142,918	826,918	1,510,918	2,194,918	2,878,918
<b>Gold Volume (% variation in gold production)</b>		-15%	-10%	-5%	0%	5%	10%	15%	
Small	7,346	33,694	20,014	6,334	7,346	21,026	34,706	48,386	
<b>Gold Volume (% variation in gold production)</b>		-15%	-10%	-5%	0%	5%	10%	15%	
Medium	72,348	50,773	9,733	31,308	72,348	113,388	154,428	195,468	
<b>Gold Volume (% variation in gold production)</b>		-15%	-10%	-5%	0%	5%	10%	15%	
Large	142,918	677,883	404,283	130,683	142,918	416,518	690,118	963,718	
<b>Fuel Price (% variation in fuel price)</b>		-15%	-10%	-5%	0%	5%	10%	15%	
Small	7,346	21,293	16,644	11,995	7,346	2,698	1,951	6,600	
<b>Fuel Price (% variation in fuel price)</b>		-15%	-10%	-5%	0%	5%	10%	15%	
Medium	72,348	100,758	91,288	81,818	72,348	62,878	53,408	43,938	
<b>Fuel Price (% variation in fuel price)</b>		-15%	-10%	-5%	0%	5%	10%	15%	
Large	142,918	484,078	370,358	256,638	142,918	29,198	84,523	198,243	
<b>Labour Cost (% variation in labour costs)</b>		-15%	-10%	-5%	0%	5%	10%	15%	
Small	7,346	21,146	16,546	11,946	7,346	2,746	1,854	6,454	
<b>Labour Cost (% variation in labour costs)</b>		-15%	-10%	-5%	0%	5%	10%	15%	
Medium	72,348	107,448	95,748	84,048	72,348	60,648	48,948	37,248	
<b>Labour Cost (% variation in labour costs)</b>		-15%	-10%	-5%	0%	5%	10%	15%	
Large	142,918	347,818	279,518	211,218	142,918	74,618	6,318	61,983	
<b>Compliance Costs (% variation in compliance cost)</b>		-15%	-10%	-5%	0%	5%	10%	15%	
Small	7,346	10,196	9,246	8,296	7,346	6,396	5,446	4,496	
<b>Compliance Costs (% variation in compliance cost)</b>		-15%	-10%	-5%	0%	5%	10%	15%	
Medium	72,348	80,898	78,048	75,198	72,348	69,498	66,648	63,798	
<b>Compliance Costs (% variation in compliance cost)</b>		-15%	-10%	-5%	0%	5%	10%	15%	
Large	142,918	199,918	180,918	161,918	142,918	123,918	104,918	85,918	

**Gold volume and gold price - small scale**

	7,346	500	600	700	800	900	1,000	1,100	1,200	gold price
-15%	(120904)	(91834)	(62764)	(33694)	(4624)	24446	53516	82586		
-10%	(112354)	(81574)	(50794)	(20014)	10766	41546	72326	103106		
-5%	(103804)	(71314)	(38824)	(6334)	26156	58646	91136	123626		
0%	(95254)	(61054)	(26854)	7346	41546	75746	109946	144146		
5%	(86704)	(50794)	(14884)	21026	56936	92846	128756	164666		
10%	(78154)	(40534)	(2914)	34706	72326	109946	147566	185186		
15%	(69604)	(30274)	9056	48386	87716	127046	166376	205706		

gold volume

**Gold volume and gold price - medium scale**

	72,348	500	600	700	800	900	1,000	1,100	1,200	gold price
-15%	(312403)	(225193)	(137983)	(50773)	36438	123648	210858	298068		
-10%	(286753)	(194413)	(102073)	(9733)	82608	174948	267288	359628		
-5%	(261103)	(163633)	(66163)	31308	128778	226248	323718	421188		
0%	(235453)	(132853)	(30253)	72348	174948	277548	380148	482748		
5%	(209803)	(102073)	5658	113388	221118	328848	436578	544308		
10%	(184153)	(71293)	41568	154428	267288	380148	493008	605868		
15%	(158503)	(40513)	77478	195468	313458	431448	549438	667428		

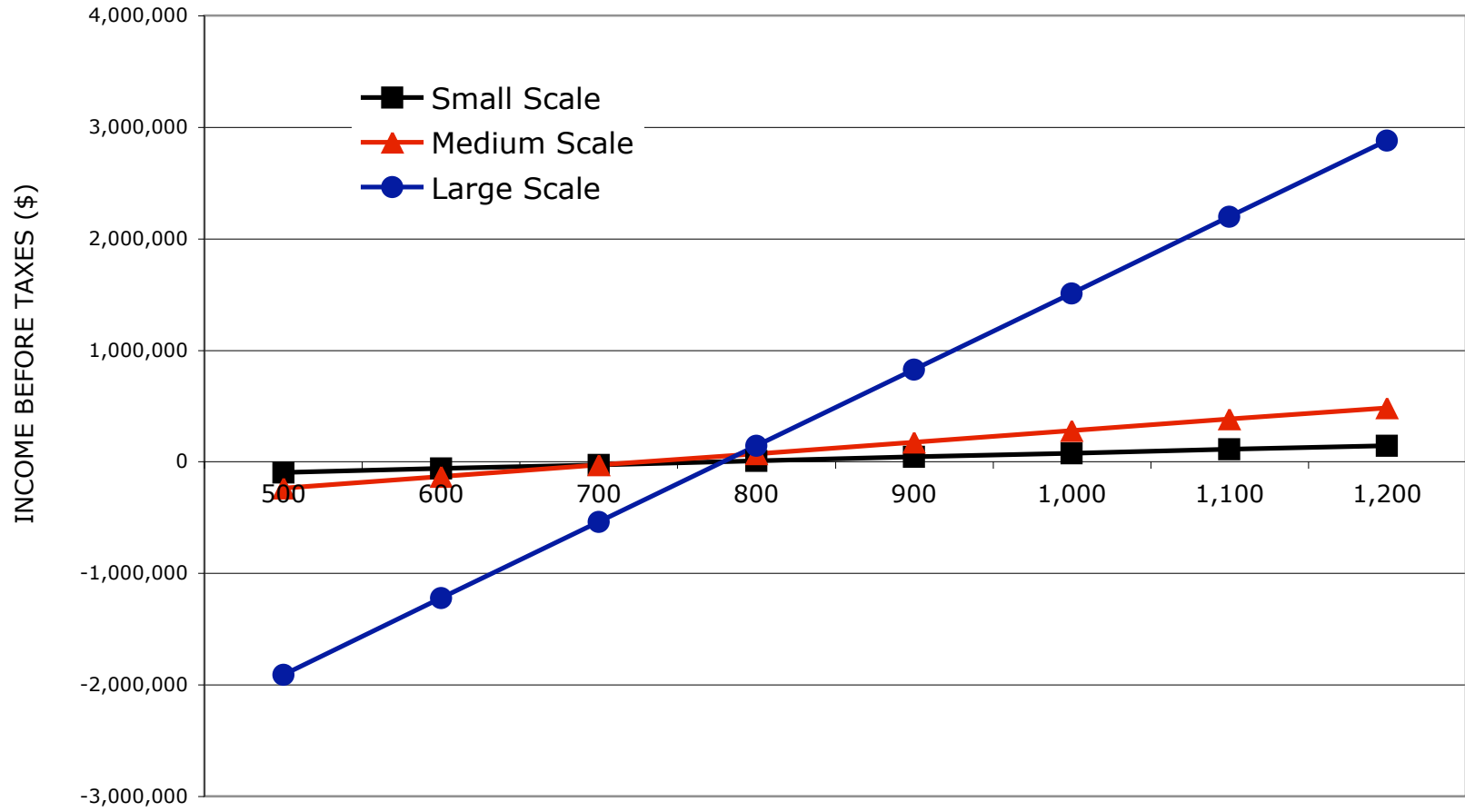
gold volume

**Gold volume and gold price - large scale**

	142,918	500	600	700	800	900	1,000	1,100	1,200	gold price
-15%	(2422083)	(1840683)	(1259283)	(677883)	(96483)	484918	1066318	1647718		
-10%	(2251083)	(1635483)	(1019883)	(404283)	211318	826918	1442518	2058118		
-5%	(2080083)	(1430283)	(780483)	(130683)	519118	1168918	1818718	2468518		
0%	(1909083)	(1225083)	(541083)	142918	826918	1510918	2194918	2878918		
5%	(1738083)	(1019883)	(301683)	416518	1134718	1852918	2571118	3289318		
10%	(1567083)	(814683)	(62283)	690118	1442518	2194918	2947318	3699718		
15%	(1396083)	(609483)	177118	963718	1750318	2536918	3323518	4110118		

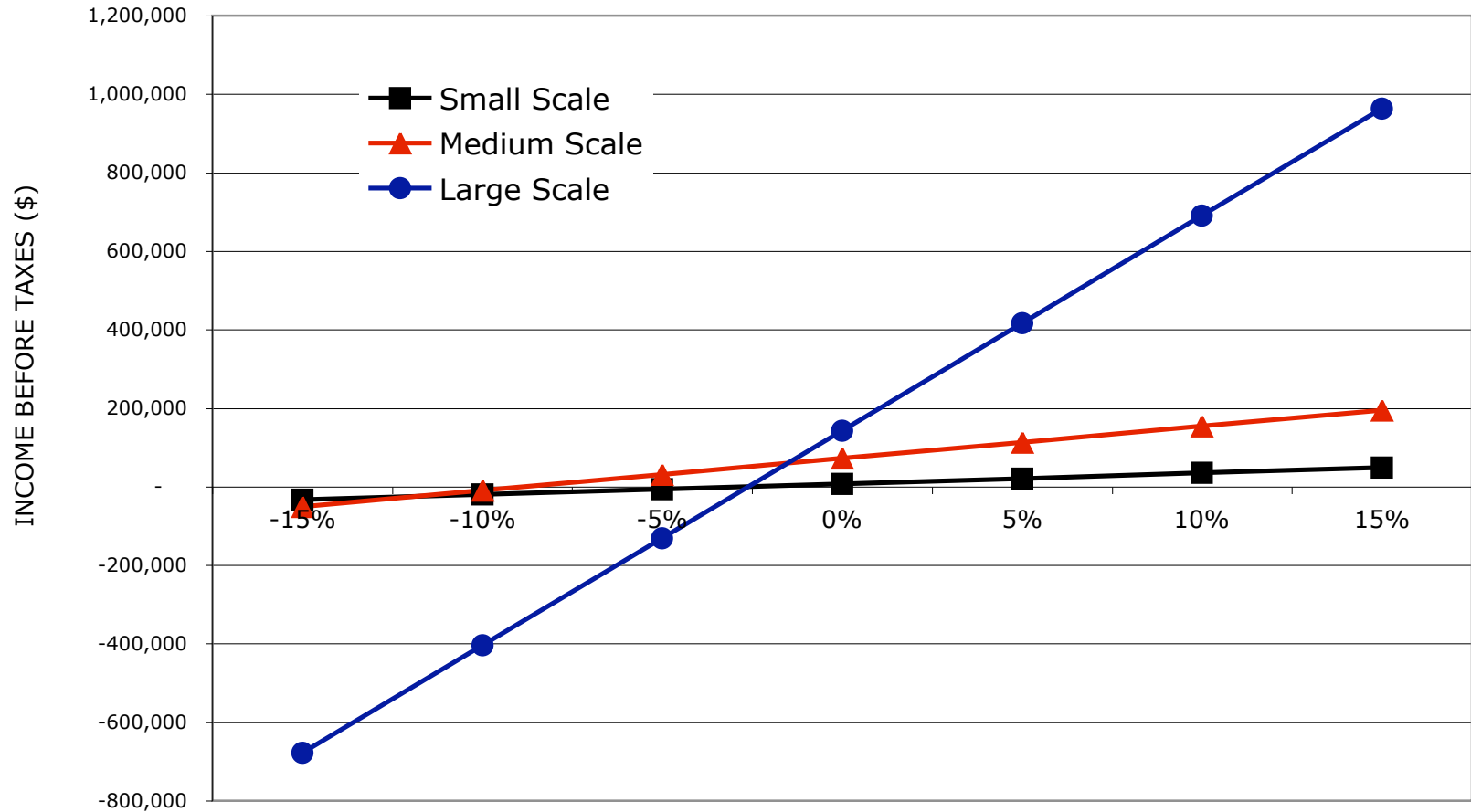
gold volume

### Sensitivity Analysis: INCOME BEFORE TAXES Gold Price (\$US)



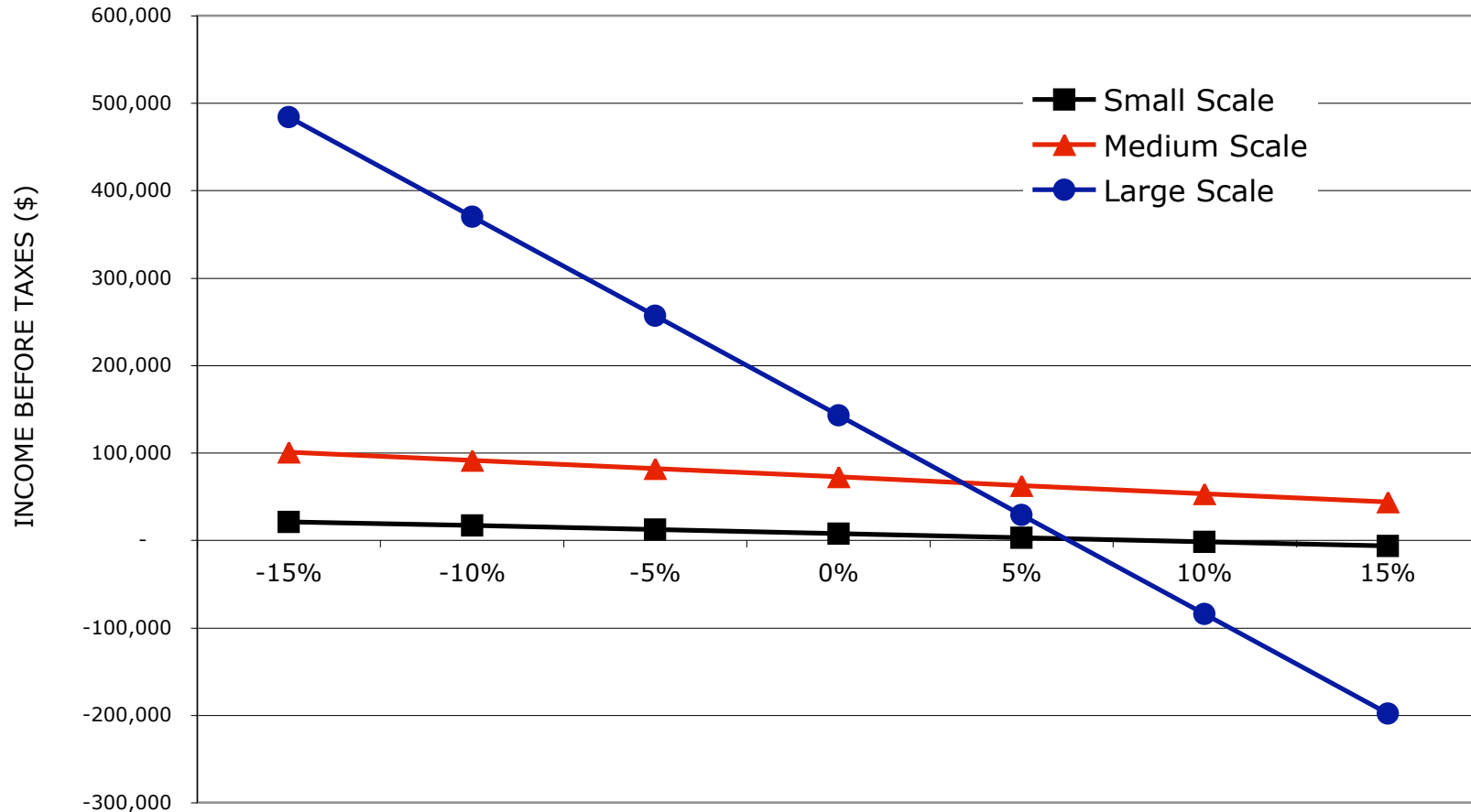
Conceptual Income Model of a Yukon Placer Mine at Three Scales

### Sensitivity Analysis: INCOME BEFORE TAXES Gold Resource (% variation in gold production) Gold Price = \$US800



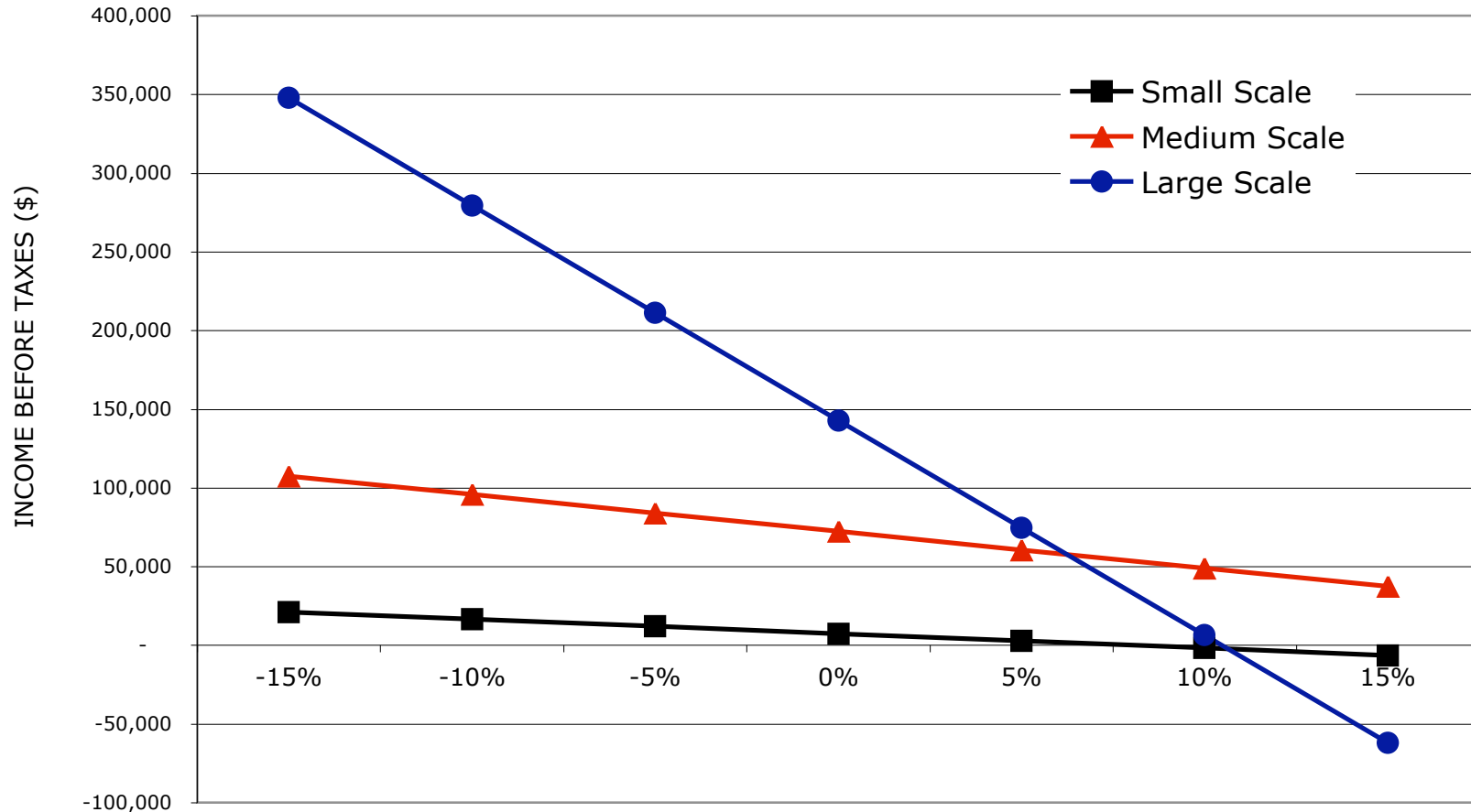
Conceptual Income Model of a Yukon Placer Mine at Three Scales

### Sensitivity Analysis: INCOME BEFORE TAXES Fuel Cost (% variation in total fuel cost) Gold Price = \$US800



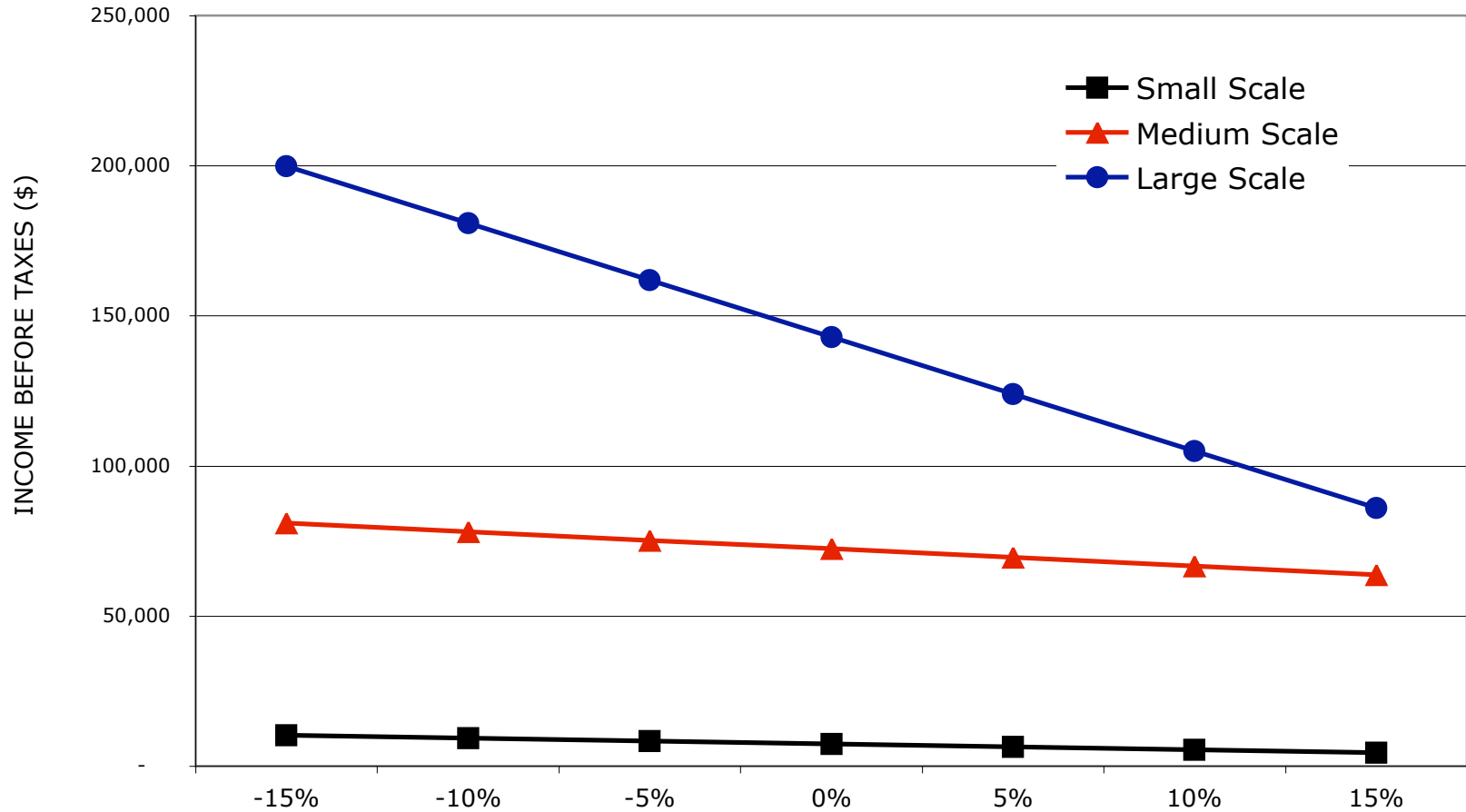
Conceptual Income Model of a Yukon Placer Mine at Three Scales

### Sensitivity Analysis: INCOME BEFORE TAXES Labour Cost (% variation in total labour cost) Gold Price = \$US800



Conceptual Income Model of a Yukon Placer Mine at Three Scales

### Sensitivity Analysis: INCOME BEFORE TAXES Compliance Costs (% variation in compliance costs) Gold Price = \$US800



Conceptual Income Model of a Yukon Placer Mine at Three Scales