

## A4. Equations and Example Calculations

### i. Gold Calculations

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#### Correcting Impure Gold to 24K or 100% Pure Equivalence

$$\text{mass pure gold} = (\text{mass impure gold}) \times \frac{(\text{purity of impure gold})}{(\text{purity of pure gold})}$$

If the purity of your gold is stated in karats:

$$\text{mass pure gold} = (\text{mass impure gold}) \times \frac{(\text{karatage impure gold})}{24}$$

If the purity of your gold is stated as percentage:

$$\text{mass pure gold} = (\text{mass impure gold}) \times \frac{(\% \text{ purity of impure gold})}{100}$$

**e.g.1. 50 g of 18K gold = (50 g) x (18/24) = 37.5 g of 24K gold**

**e.g.2. 70 g of 80% pure gold = (70 g) x (80/100) = 56 g of 100% pure gold**

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#### Gold Yield from Ore (Gold Production)

$$\text{gold yield} = (\text{mass ore}) \times (\text{recoverable ore grade})$$

**e.g. 1.** How much gold is yielded from 30 T of ore that has a recoverable grade of 5 g/T?

$$\text{gold yield} = 30 \text{ T} \times 5 \text{ g/T} = 150 \text{ g of gold}$$

**e.g. 2.** The average bag extracted by miners on site weighs 10 T. The recoverable ore grade is 6 g/T. How much gold is in each bag?

$$\text{gold yield per bag} = 10 \text{ T/bag} \times 6 \text{ g/T} = 60 \text{ g of gold per bag}$$

## ii. Mercury Calculations

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### Mercury recovery

#### Mercury-to-gold (Hg:Au) Ratio

See guidebook Chapter 1, 7.4. Mercury-to-Gold (Hg:Au) Ratio (p.73)

And Chapter 2, 4.3.6. Research Steps to Measure a Hg:Au Ratio at a Processing Unit (p. 124)

## iii. Throughput Calculations

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### Sluice Throughput

$$\text{throughput rate} = (W \times L \times \text{water depth}) \times (\text{water velocity})$$

$$\text{daily slurry throughput} = (\text{throughput rate}) \times (\text{hrs operating})$$

$$\text{daily ore throughput} = (\text{daily slurry throughput}) \times (\text{mass of sediment per m}^3 \text{ of slurry})$$

*e.g.*

Field researchers measure the dimensions of a sluice and the velocity of the ore slurry passing through it by timing the passage of a floating object. They interview the processors to find out how many hours per day the sluice is operating. They also fill a 1L soda bottle with the slurry entering the sluice and weigh it. They then drain the water out of the 1L bottle of slurry and weigh the sediment. They find:

Sluice length = 14 m

Sluice width = 0.8 m

Water depth = 0.01 m

Water velocity = ~1.25 m/s

Hours operating = 20 hr/d

1 L slurry = 1285 g

Mass of sediment in 1L of slurry = 0.463 kg

What is the daily ore throughput of the sluice?

**Throughput rate** = 0.8 m x 0.01 m x 1.25 m/s = **0.01 m<sup>3</sup>/s**

**Daily slurry throughput** = 20 hr/d x 3600 s/hr x 0.01 m<sup>3</sup>/s = 720m<sup>3</sup>/d

**Daily ore throughput** = 720 m<sup>3</sup>/d x 463 kg/m<sup>3</sup> = 333360 kg/d = 333 T/d

## *iv. Equations and Calculations for Processing Sites*

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### **Calculations**

#### **Single Processing Unit (Daily)**

*\* important: each of these calculations is for one specific processing unit type. Calculate this information for each unit type (e.g., unit 1 = sluice, unit 2 = rastra, unit 3 = panning).*

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#### **Daily 24K gold production (g/R/d)**

Daily throughput (T/unit/d) x ore grade (g/T)

*Correct karatage to 24K (as in Section 9.1.1.)*

#### **Daily mercury loss (g/R/d)**

Unit-specific daily 24K-Au production (g/unit/d) x unit Hg:Au ratio

#### **Daily number of active processors (workers/unit/d)**

Shift count (workers/shift) ÷ shift length (hrs/shift) x 24hrs

#### **Daily active miners required to produce the daily throughput (workers/unit/d)**

Daily throughput (T/unit/d) ÷ miner ore prod (T/workers/d)

## Calculations

### Site-level Information (Daily)

*\* once calculations are made for each type of processing unit on the site, the averages for each processing unit can be combined into site-level information.*

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#### **Daily 24K gold production (g/site/d)**

Average of unit type 1 daily 24K gold prod (g/unit1/d) x #unit1/site

*Also calculate for unit type 2, type 3, etc. and then sum production values for all unit types.*

#### **Daily mercury loss (g/site/d)**

Average of unit type 1 daily Hg loss (g/unit1/d) x #unit1/site

*Also calculate for unit type 2, type 3, etc. and then sum production values for all unit types.*

#### **Daily number of active processors (workers/site/d)**

Average unit 1 daily number of active processors (workers/unit1/d) x #unit1/site

*Also calculate for unit type 2, type 3, etc. and then sum production values for all unit types.*

#### **Daily number of active miners (workers/site/d) – Option 1**

Average unit 1 daily active extractors (workers/unit1/d) x #unit1/site

*Also calculate for unit type 2, type 3, etc. and then sum production values for all unit types.*

#### **Daily number of active miners (workers/site/d) – Option 2**

Average site-level daily throughput (T/site/d) ÷ average miner ore production rate (T/workers/d)

## Calculations

### Regional-level Information (Daily)

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**Daily 24K gold production (g/region/d),**

**Daily number of active processors per region (workers/region/d), and**

**Daily number of active miners per region (workers/region/d).**

Extrapolation from site-level data using a known piece of regional information, e.g., number of processing units in the region. (see Section 7.2: Extrapolating Regional Estimates).

**Daily mercury loss (g/region/d)**

Daily 24K gold production (g/unit1/d) x (% of production yielded by unit type 1) x (Hg:Au Ratio for unit type 1)

*Also calculate for unit type 2, type 3, etc. and then sum production values for all unit types.*

### Regional-level Information (Annual)

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**Annual 24K gold production (g/site/y)**

Daily 24K gold production (g/region/d) x active days per year (d/y)

*Convert to kg/region/y by dividing by 1000.*

**Annual mercury loss (g/site/y), Option 1**

Daily Hg loss (g/region/d) x active days per year (d/y)

*Convert to kg/region/y by dividing by 1000.*

**Annual Hg loss (kg/site/y), Option 2**

Annual 24K gold production (kg/region/y) x (% of production yielded by unit type 1) x (Hg:Au Ratio for unit type 1)

*Also calculate for unit type 2, type 3, etc. and then sum production values for all unit types.*

**Number of active processing workers (worker/region/y)**

assumed equal to the daily statistic

**Number of active extraction workers (workers/region/y)**

assumed equal to the daily statistic

## Calculations

### National-level Information (Annual)

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#### **Annual 24K gold production (kg/country/y)**

Sum all 24K gold production (kg/region/y) for each of the major ASGM mining regions in the country

#### **Annual mercury loss (kg/country/y)**

Sum all Hg loss (kg/region/y) for each of the major ASGM mining regions in the country

#### **Number of active processors (workers/country)**

assumed equal to the daily statistic

#### **National active extraction workers (workers/country)**

assumed equal to the daily statistic