Mitigation of Tailings ARD Potential by Separate Disposal of Bulk and Cleaner Tailings

Jennifer Parry, Huckleberry Mines Limited

Stephen Day, SRK Consulting

Acknowledgements

- Huckleberry Mines Limited
- Imperial Metals
- Teck - Pogo Inc
- The Pebble Partnership

SRK Consulting
Engineers and Scientists

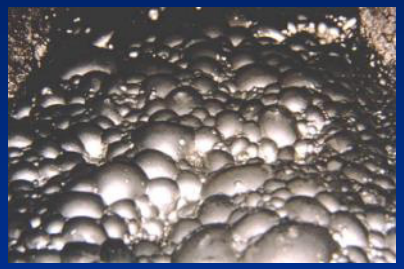
OUTLINE

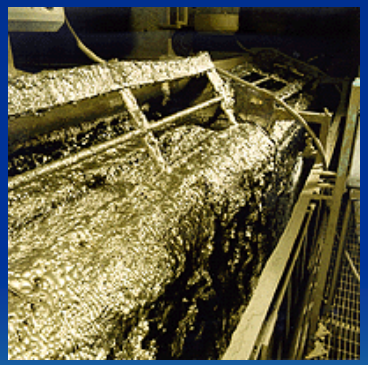
- Background
- Application at Huckleberry Mines
  - History
  - Process
  - TMF Operation
  - Comparative Costs
  - Results

Background

- Common flotation process flowsheets provide an opportunity for management of tailings ARD potential:
  - Low sulphide bulk tailings for conventional (beached disposal) if low ML/ARD potential.
  - Sulphide tailings managed to address ML/ARD potential.

Typical Flotation Flow Sheet





SRK Consulting
Engineers and Scientists

Benefits

- Benefits
  - Bulk tailings:
    - Typically 90 to 95% of tailings mass
    - Contain low levels of gangue sulphide minerals due to flotation to bulk concentrate.
    - Contain acid neutralizing gangue minerals because these tend not float.
    - May be suitable for beached disposal and dam construction.

Limitations

- Limitations
  - Challenging if neutralization potential is low.
  - Neutral pH leaching concerns may not be eliminated for potential contaminants associated with pyrite (e.g. sulphate, arsenic, selenium).

Examples of Separate Tailings Management

Mine/ Project	Location	Type	Status	Bulk Tailings
Huckleberry	BC	Open pit copper and molybdenum	Operating	95%
Red Chris	BC	Open pit copper and gold	Proposed	96%
Pogo	Alaska	Underground gold	Operating	90%
Crandon	Wisconsin	Underground zinc and copper	Proposed	
Pebble	Alaska	Open pit copper and gold	Proposed	90%

SRK Consulting
Engineers and Scientists

Huckleberry Mines Tailings

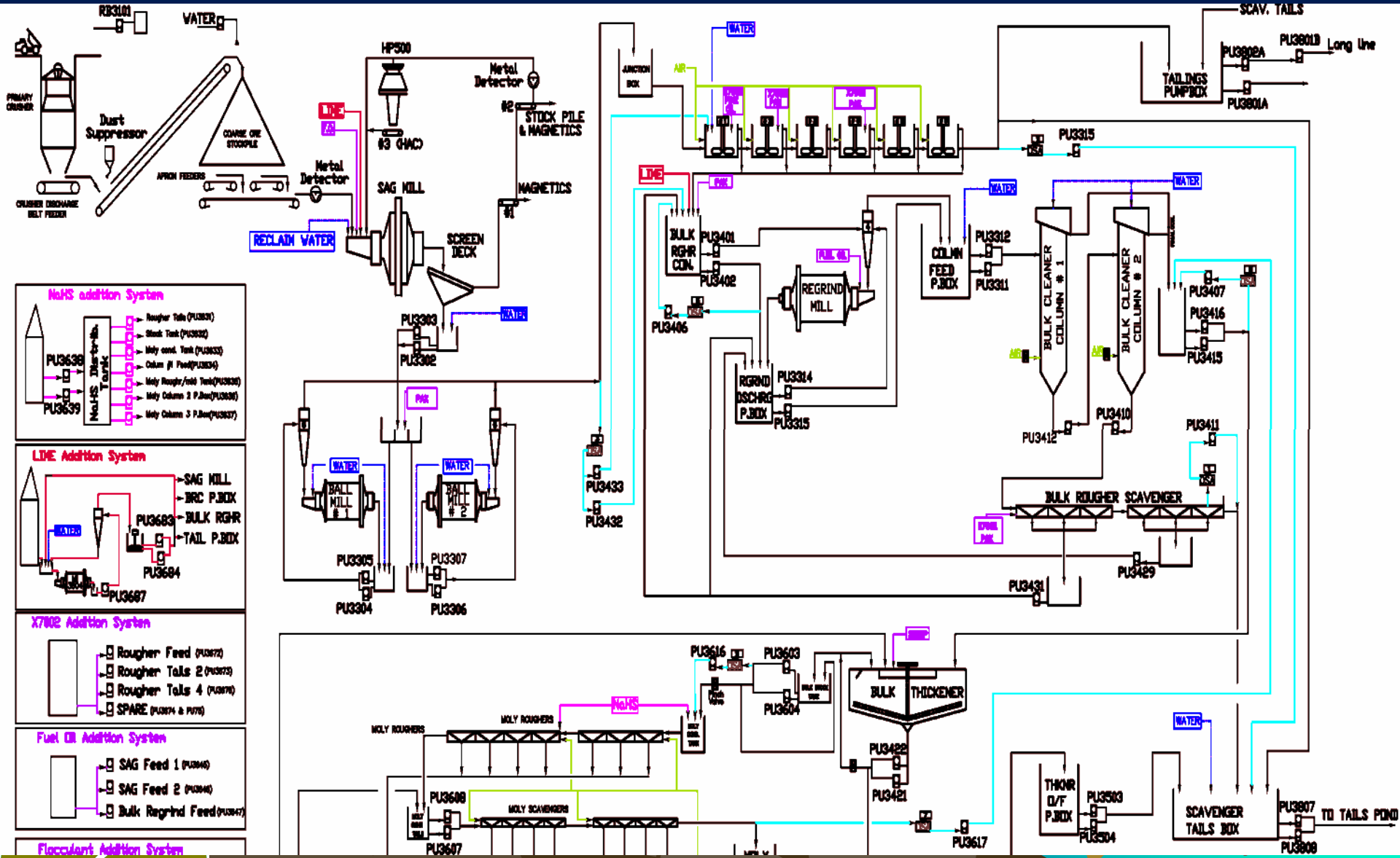
Overall objective:

- Produce a non-acid generating beach around the TMF2 tailings pond

Objective of separating tails streams:

- Minimize pyrite (%S) in the tailings sent to the NAG beach

Grinding and Bulk Flowsheet



Flotation Circuit Operation

- Collector: KAX51
  - 5-8g/t normal operation
  - 10-16g/t for NAG bulk rougher tailings
- Frother
  - X7002 (MIBC mix w/ PGEs and 2EH) on bulk roughers
  - Tennefroth 250 on NAG plant
- pH
  - 9.9-10.2 normal operation
  - 8.4-9 for NAG bulk rougher tailings

Tailings Operation (Summer ’08)

- ‘Short’ Rougher Tailings Line
  - Deposited underwater in TMF2
- ‘Long’ Rougher Tailings Line
  - Deposited on NAG beach. Could go through or bypass the NAG flotation plant
- Cleaner-Scavenger Tailings Line
  - Deposited underwater in TMF2 until July ’08.
  - Deposited in new East Pit tailings pond after July ‘08.

Tailings Operation (Summer ’08)

Mine Water Management Plan

SRK Consulting
Engineers and Scientists

Bulk Rougher Tank Cells

Bulk Cleaner Columns

Laboratory ABAs

- Operators determine %S using Leco analyzer
- Assayers determine acid neutralization potential and $\%SO_4$ for calculating the neutralizing potential ratio.

Extra Costs of Separate Tailings Stream

- Two cleaner-scavenger tailings pumps:
  - GIW 10x12-36 (used most often) + SRL-C 14x12-29. Both 250HP motors.
  - For a similar GIW pump now (LSA 10x12-32):
    - Pump = $52K + cost of motor (~$15K) = $67K

    x 2 = $134K
- Power:
  - Estimated energy cost to run ~ $40K/yr

SRK Consulting
Engineers and Scientists

Extra Costs of Separate Tailings Stream

- 2km of cleaner-scavenger tailings line (HDPE 16” DR26) at $12.36/ft = $81K + cost of fusing pipe. Fine particles in stream (after regrind mill) so would not need replacing often.
- Also maintenance costs assoc. w/ tailings line and pumps

NAG Plant

- ‘Summer-only’ flotation plant on long rougher tailings line. PAG concentrate sent to same place as old clnr-scav and short rougher tailings lines (underwater).

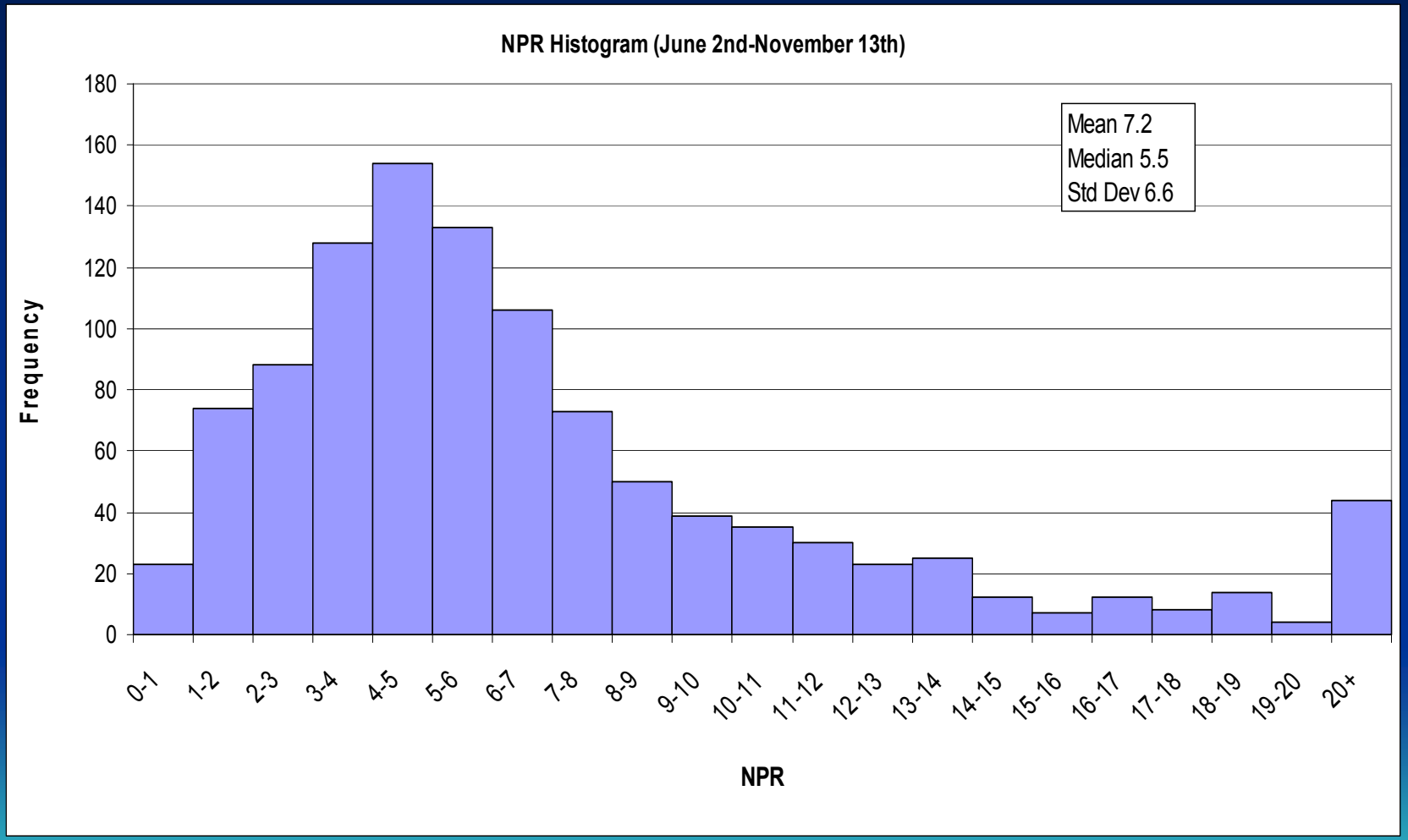
NAG Tailings

- Have produced NAG tailings over most of the past 6mos with and without the NAG plant.
- Combination of low pH, high xanthate and occasional extra frother in the bulk roughers to provide better feed for the NAG plant or to send tails directly to NAG beach.
- Reduction in cleaner recovery, but generally cleaner circuit handled extra pyrite well.

NAG Tailings

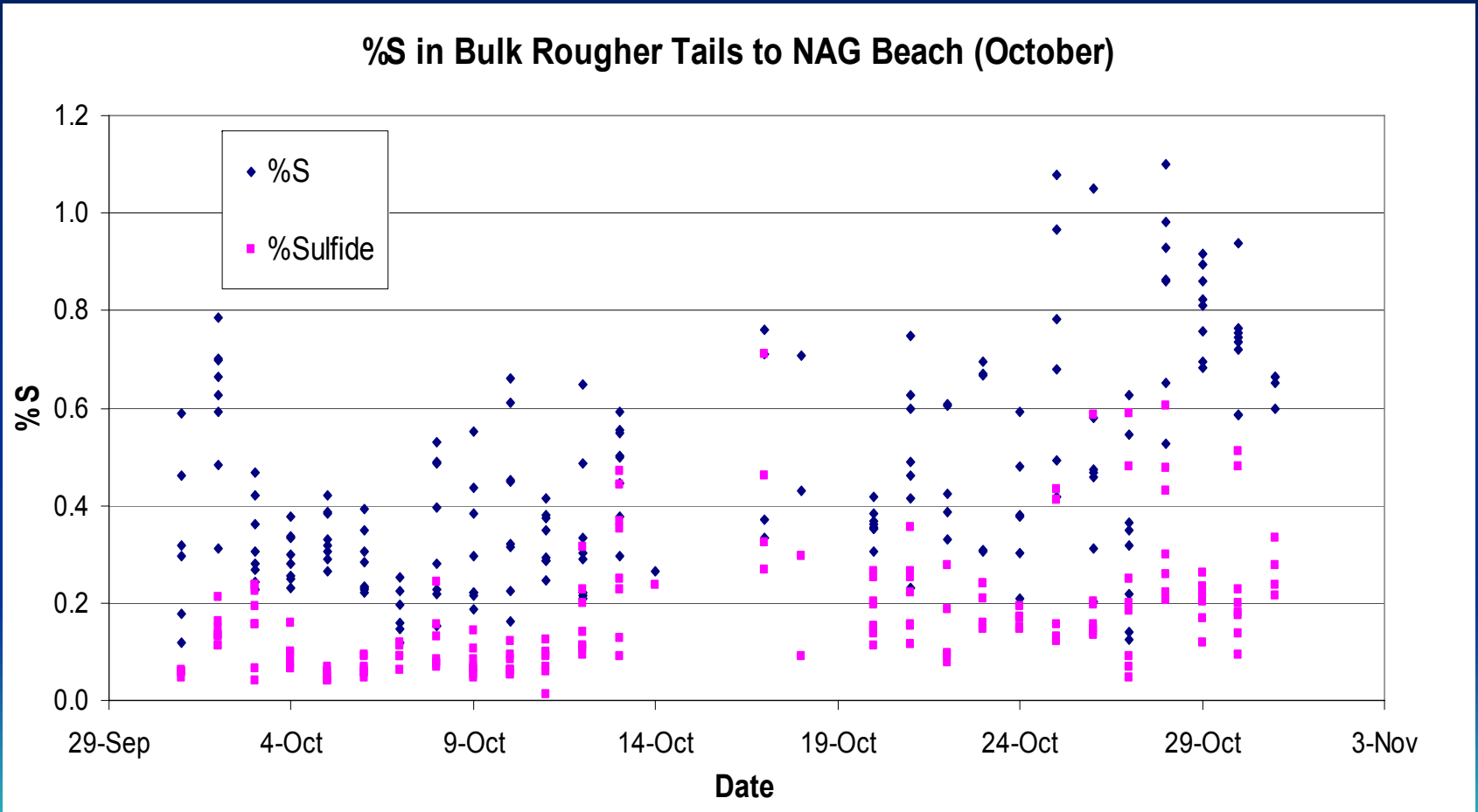
- Tailings analyzed for %S every 3hrs when depositing on NAG beach. If two samples in a row are over sulphur limit, send tailings to short line (underwater).
- Tonnage between samples recorded using SAG totalizer.
- 2.4M tonnes of NAG tailings to beach June 2nd to Nov. 13th. Average NPR of 7.2 based on 1082 samples taken. Tonne-weighted average NPR of 6.7.

NAG Tailings



SRK Consulting
Engineers and Scientists

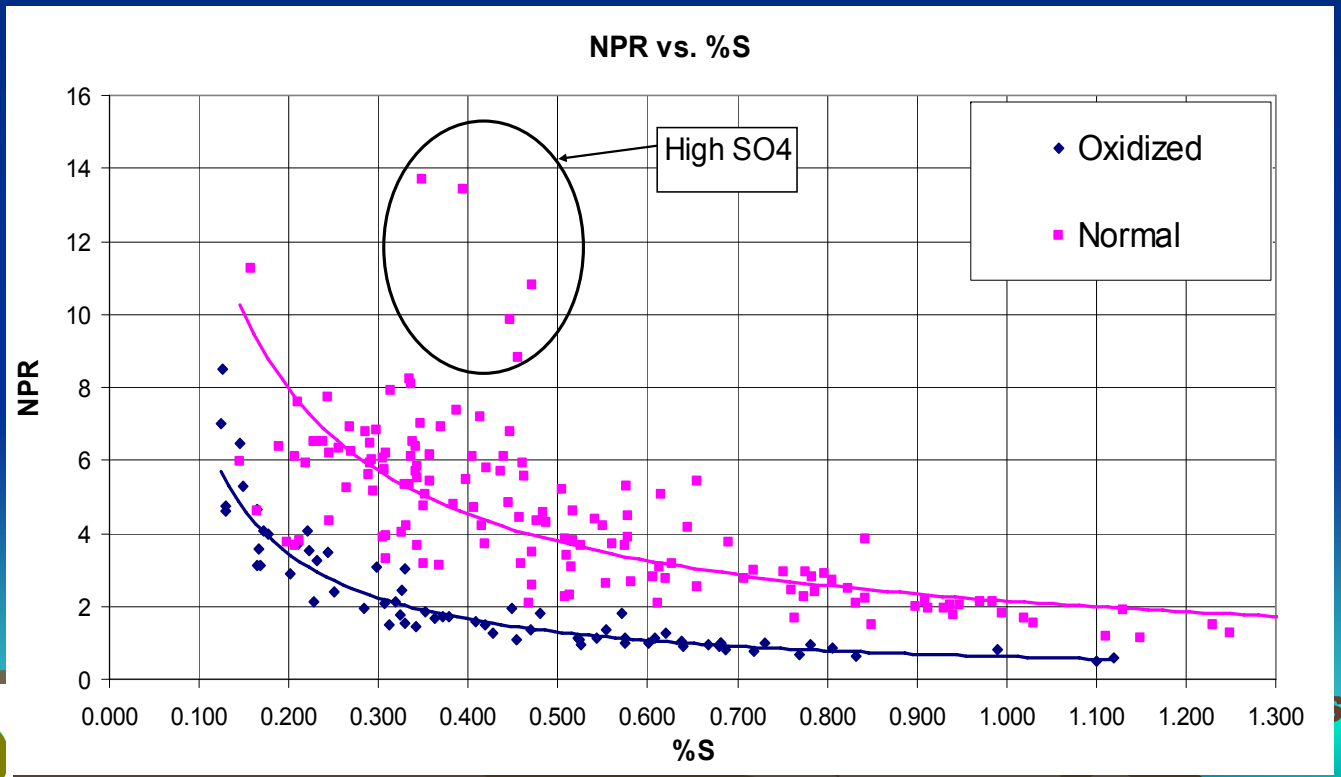
Sulphur and Sulphide Variability



SRK Consulting
Engineers and Scientists

NAG Tailings Issues

- Fluctuations in $\%SO_4$ and neutralizing potentials (NP). Had to categorize by oxidized (low NP) vs. non-oxidized ore types.
- Mechanical issues with the NAG plant.



SRK Consulting
Engineers and Scientists

Conclusions

- Separating tailings streams has allowed HML to produce a NAG tailings stream directly from the mill.
- Control of tails NPR based on %S can present challenges with variation in the ore body
- Further flotation (NAG plant) sometimes necessary to produce NAG tails; e.g. not able to produce NAG tails from stockpiled East Zone ore without the NAG plant.

QUESTIONS?