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## **A general overview of the Scotia operation from August 2008 to August 2009**

In August 2008 the mining of the overburden had begun at the southern end of the Scotia lead and the modifications to the process plant on the site had commenced.

The mining exercise reflected the previous management's philosophy of treating the Scotia deposit as a conventional terrace type dry alluvial sediment mining process. The process plant had been partially installed on site at Scotia and was set up to process equal amounts of sapphire bearing gravels and tin bearing gravels.

Investigations on site revealed a lack of basic design parameters for both extraction in the mining phase and subsequent process requirements.

Development of the start point for mining in pit development revealed a more problematic type of overburden and wash containing basal sediments than was imagined at the beginning of the mining phase. The overburden horizon was far wetter than previously expected and proved to be difficult to work on with earthmoving equipment.

A review of the mining methodology was conducted in approximately the eighth month of 2008 and a range of pit dewatering options were introduced to minimise the lost time for earthmoving equipment removing overburden in the first mining block of ground.

The dewatering program generated a closer review of the proposed mining of the mineral containing basal sediment and this demonstrated some fundamental errors in the methodology. Consulting mining engineers reviewed the options available and the best option available at the time was a modern style of return to the hydraulic sluicing of sediment to a pump then on to the process plant.

This process was implemented and in December 2008 / January 2009 was trialled with low mineral bearing grade material with success.

The process plant had to be extensively redesigned to reflect the expected flow rates of finer materials and to focus on tin extraction whilst providing good recovery capacity for any sapphires that may be in the lower wash horizon. The rudimentary calculations done at the time demonstrated a far greater volume of material reporting to the finer tin bearing fractions than the coarser sapphire bearing fractions and process changes were brought about to reflect this.

This report will focus on the process changes required to effect the most efficient process plant with the equipment previously installed on the Scotia site. This work occurred during the period from August 2008 to January 2009.

## **The Scotia site mineral process plant as originally installed.**

In May 2008 I was asked to audit the technical merit of the Scotia process plant by the then Managing Director Ron Goodman and provide a report including a range of options for confidently moving to processing when ready.

The original process plant was designed and constructed by Goldfields Engineering in Linden Utah, USA. Two modules each of approximately 200 TPH solids were located adjacent to one another and shared a common ROM stockpile and feed arrangement. Each side had an individual belt feeder assembly aimed at pushing dry feed out onto a conveyor (one each side) for feed into a trommel scrubber unit for each module. The trommel underflow from each trommel screen was fed using gravity to a buried 8/6 E-AH Warman which in turn was to feed a bank of hydro cyclones over a vibrating screen to characterise the feed into respective size ranges for distribution to either sapphire, tin or oversize fractions. This material was reclassified then sent to either concentrates recovery or out to tailings for storage.

The focus of the original process plant was plainly on the recovery of sapphires. This was evidenced by the natural disposition of the flow circuit to recover coarse fraction materials within the range of marketable sapphires.

Sizing for process through jig plant

1. Trommel screen – 19mm
2. -19mm feed to vibrating screen
3. Top screen cloth – 12mm
4. Bottom screen cloth – 3mm

The trommel feed to the vibrating screen was thus split up for processing;

- +12mm -19mm was discharged from the top screen cloth to oversize circular jigs designed to recover coarse sapphire in the ROM plant feed. (jig capacity 75tph)
- -12mm +3mm was discharged to a bank of 2 x 4cell primary jigs for recovery of the main range of sapphires. (jig capacity 100tph)
- -3mm feed was discharged to 2 x 4cell primary jigs for tin recovery.(jig capacity 100 tph)

Work carried out on site indicated a discrepancy with jig capacity allocation and feed methodology.

Further work done on the process requirements for the Scotia lead indicated the need for extensive modifications to the process plant in order to meet the needs of the planned throughput work. Agreement was also reached that the primary focus for the plant was to be for tin recovery but providing the ability to recover sapphire if it was to be found in the basal sediments.



*Gravity mineral process design and equipment supply*

### **Subsequent modifications to the installed process plant at Scotia.**

As a consequence of research and various opinions it was decided to redesign the plant to suit the performance requirements and conditions as were unfolding with further development on the mine site. It was generally agreed that tin was to be the primary focus and that provision to recover all heavy minerals and gemstones be inclusive.

The pit development earthworks were demonstrating that it was unsuitable for the partly installed dry mining systems and that the installed process equipment would not meet design or capacity requirements.

A revised plan was developed driven by a decision to execute prewash requirements in the pit and eliminate the bins, feeders, conveyors, trommel / scrubber units and the entire feed system right to the vibrating screen. This resulted in a simpler process path to the screening element, by passing the need for dewatering hydro cyclones and a range of process equipment.

Because the plant structure housing the jig components also supports the screen module, it was decided to leave the main process plant module intact. This decision was driven by existing infrastructure and civil works and a time line to reach production readiness. Redesign of the screen module so that all primary jigs received a minus 6mm feed effectively doubled the available tin process recovery capacity and redeployment of the circular jigs processed the +6mm feed material as a check feed process for sapphire. A new tailings system was implemented as a result of the need to process a large volume of tailings (900m<sup>3</sup>/hr) with a new sump constructed, process flow control automating the sump level management and a revised tails line to assist with LDV and total available power for this line.

The jig circuit was extensively redesigned with new stainless steel wedge wire panels replacing the mild steel woven wire panels. The wedge wire panels are 3mm aperture replacing 2mm woven wire panels. This was important given a large volume of near size high definition material in the 1.6mm - 3mm size range and the need to keep the sizing jig panels as free and clean as possible in operations mode. All jigs were re speeded to reflect the correct duty speeds and were powered appropriately with transmission equipment suitable for long term operations.

The equipment from USA did not provide access to the plant for operators so ladder and walkways were installed during the rebuild phase as best allowed by the existing structure. In the interests of power efficiencies, a high and low pressure system was implemented to provide more process water control and reduced power consumption.

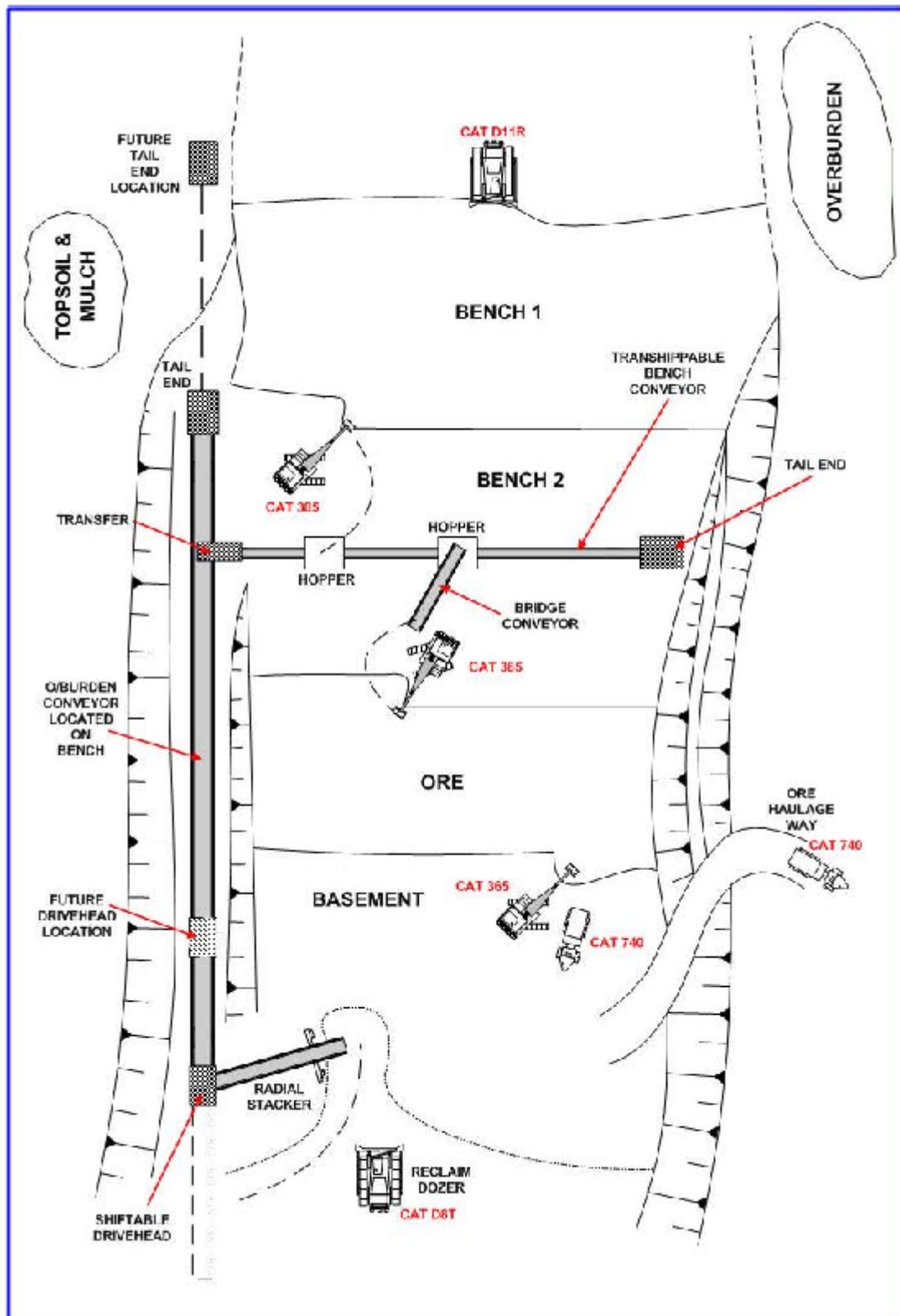
Electrically, a rework of the control system was implemented to simplify an overly complex control philosophy for such a simple plant. This involved the removal of many unnecessary VF drives on all but the most necessary of motors, removal of expensive fuse systems and replacement with more conventional circuit breakers and removal of extensive wiring from the plant.

A plant process supply dam was installed adjacent to the plant so that more appropriately powered pumps could be used to provide circuit water and the main supply pumps can operate as make up water pumps rather than process demand pumps, saving power.



*Gravity mineral process design and equipment supply*

As a result of the need to modify the mining process from a dry exercise as shown in the figure below, a simple wet recovery process was developed.



*Gravity mineral process design and equipment supply*

This involved the construction of a wet feed bin which is to be left on a level slightly above the tin bearing basal sediments and dragged along the pit as mining advances through the channel. The methodology is to use the wet conditions prevailing at this level in the pit to work for the mining process rather than against it. As the Malaysian and Indonesian tin miners use a sump with a gravel pump to draw from the sump, so we will use a pump attached to the dip stick on a 30 tonne excavator to

- a. Drive the hydraulic gravel pump, and
- b. Advance along the channel mining the wash zone.

This pump utilises a low static head condition, maintaining excellent wear characteristics and pumps to the in pit feed module where it is fluidised to pump up to the plant using a Warman D- AH slurry pump. This pump is designed for high wear loads and is easily maintained. In simple terms, the mining method as shown on the previous page is no longer relevant, never was cost efficient and will be replaced by a single small excavator and a sump, advancing along the channel stripping the wet wash out and pumping the wash directly to the plant. **See the photos below.**

This work was done in the commissioning phase and shows the in pit feed bin module adjacent to the plant during capacity test trials.

In future work this method will be utilised in this or a number of configurations but the underlying simplicity and effectiveness of the method will sustain a reliable mining approach. The water addition in the in pit feed bin controls feed density and at approximately 30% w/w send around 600m<sup>3</sup>/hr of slurry to the plant with approximately 900m<sup>3</sup>/hr returning to tailings, the additional being LP process water.

The pit feed module has been heavily constructed to withstand the rigours of being dragged by dozer or excavator along the entire line of mining for the life of mine and carries dedicated tagged chain gear for towing.

The company has researched pump options for the wash recovery phase and has chosen the Italian Drag flow hydraulically driven pump as the most suitable of type for the application. The pump has good operating efficiencies at low speed to maximise wear life and is ideally suited to swinging on a dip stick for operational flexibility.

Caterpillar can supply a suitable 30 tonne excavator for deployment with the pump. This unit has more than adequate hydraulic capacity to supply power to the pump throughout the range of operational duty required, at the same time being able to operate efficiently on an independent basis.



**Photo;** Shows dry feed feeding into the bin with water manifolds aiming at the drop point to slurry the feed as it passes the top sizing grizzly. The excavator in the background is feeding the bin as an interim measure to manage the top size limit on feed going into the main slurry feed pump.

## ***Current Position.***

### Care and maintenance

The Scotia site is currently on a care and maintenance regime, looking after the pit and maintaining a dewatering program to keep the pit floor and development work to date in good shape. The plant has been decommissioned so that pumps, electrical, steelwork and equipment have been removed from water where required, lubricated and placed in storage where applicable. There is a daily / weekly / monthly checklist controlling the program. A strict and relevant OHS program has been installed on site and this is both managed and monitored by a professional and the company responsible officer on site is also trained specifically for the task.

Equipment not core to the plant operations have been auctioned to allow for an ongoing care & maintenance program but there are items such as pumps that would need to be re purchased for a start up. These items are short lead time items so it is envisaged that a start up could effectively commence through a six to eight week program.

There are three people currently employed. These people are key members of the original team covering the areas of earthmoving, plant operations / maintenance and administration.

### Ongoing work

Management are currently investigating alternative options to the previous mining arrangement in an effort to reducing earthmoving costs. These investigations are encouraging and will provide a range of viable alternative mining methods while still retaining the planned system of mineral bearing basal sediment removal.

Subject to approval, the board of Gladstone tin Pty Ltd will undertake a bulk sample of basal sediment material to assist in defining elements of the mineralogy and providing confirmation of current grade assessments.

Peter Campbell 27<sup>th</sup> August 2009