GUYANA ENVIRONMENTAL CAPACITY DEVELOPMENT PROJECT

(GENCAPD)

SMALL SCALE ALLUVIAL DEMONSTRATION PROJECT

MAHDIA SUMMARY REPORT

Prepared for

Canadian International Development Agency (CIDA)

Natural Resources Canada (CANMET)

Guyana Geology and Mines Commission

And

Guyana Gold and Diamond Miners Association

By

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SUMMARY

Two sluiceboxes were refitted with Canadian riffle systems at small alluvial mines in the White Hole (Bridge Mohan Bharrat) and St. Elizabeth (Charles DeSilva) areas near Mahdia, Guyana, South America. Radiotracer testing was conducted at Charles DeSilva's alluvial gold mining (land dredging) operation at St. Elizabeth.

Technical seminars were held in the Mahdia school for five evenings (September 17th through 21st, 1999) to help inform local miners and government officials in all aspects of alluvial mining including exploration, mine planning, gold recovery, safe mercury amalgamation and environmental mitigation. Several dignitaries including: Samuel Hinds (Prime Minister of Guyana); Jacques Crete (Canadian High Commissioner to Guyana); Kimoji Wachira (Canadian International Development Agency); Brian Sucre Commissioner of the Guyana Geology and Mines Commission); and Patrick Pereira (President of the Guyana Gold and Diamond Miners Association) inspected the operations at St. Elizabeth and at the White Hole and attended a community meeting in Mahdia on September 24, 1999.

Two days of similar seminars with demonstrations of Canadian sluicing technology and the use of mercury retorts were also held in Georgetown at the Institute of Applied Science and Technology's facilities in Turkeyen on September 27 and 28, 1999. Several other government and education employees and mining engineering students attended. Some of the course hand-out materials and photos are appended.

This program is part of the Guyana Environmental Capacity Development Project (GENCAPD) which is being sponsored by the Canadian International Development Agency (CIDA), and delivered by Natural Resources, Canada (CANMET) and its consultants. The refitting, radiotracer testing, and technical seminars were conducted by Randy Clarkson (NEW ERA Engineering Corporation) with the assistance of Jean-Marc Barbera and Carl Weatherell (CANMET), Mike Styles (British Geological Survey), John Simpson (Intermediate Technology), and several staff members of the Guyana Geology and Mines Commission (GGMC).

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1. CONCLUSIONS

At St. Elizabeth, miners were using hand-held water monitors to wash down a 60 feet (18 m) tall nearly vertical face and direct the 10 feet (3 m) deep layer of clay-rich gold-bearing gravels into a clay/bedrock sump. A dilute gravel slurry was pumped from this common sump to twin wooden sluiceboxes using five inch (120 mm) Brazilian gravel pumps.

At St. Elizabeth, the production from these land dredges (with a five inch pump) is only about 11 to 21 loose cubic yards per hour (8 to 16 cubic metres per hour). The pumps also pump from 500 to 750 Igpm or about 37 to 57 litres per second of water. The pumps only operate at full output for about 50% of the time. The daily production is about 75 cubic yards (57 cubic metres) per day. All of the soils including overburden are commonly processed through the pump and this creates excessive dilution of the gold grades. The author only observed the area for an eight day period, however, the results of the testwork also indicate that undiluted gold grades in this area are much higher than those commonly mined in North American alluvial gold mines.

The land dredges at the White Hole and at Red Hole processed from 280 to 425 Igpm or about 21 to 32 litres per second. Pay gravel feed rates varied from a low of 1 cubic yard per hour at Red Hole (where the gravels were very hard to wash with the monitors) to 14 cubic yards per hour at White Hole.

The wooden sluiceboxes were originally fitted with boil boxes, ribbed Brazilian matting and wooden riffles. One sluicebox at St. Elizabeth and one sluicebox at the White Hole were refitted with a Canadian riffle system. This conversion included one inch angle ron riffles and coarse expanded metal riffles fitted tightly over unbacked Nomad matting. At St. Elizabeth, two sluiceboxes (original and refitted) were tested using radioactive gold particles as tracers.

Successive mapping of the radiotracers in the sluiceboxes indicated that some of the gold particles recoverd in the Brazilian ribbed matting are being lost with further peration of the sluicebox. The radiotracers also indicated that shallow (4 inch, 100 mm deep) boil boxes work at least as good as the deeper boxes. The radiotracer gold travelled far down the sluiceboxes (30 to 40 feet, or 9 to 12 metres). This is probably due to the abundant clays which would make it difficult to wash and liberate gold particles; and due to the varying flow rates of slurry from the gravel pumps.

Most of the gold recovered by both sluiceboxes was between 150 and 48 mesh 150 and 300 microns). The nearly bell shape of gold size distribution histograms (see appended graphs) for both sluiceboxes (original and refitted) indicate that this is probably the most common size of gold particles in this alluvial deposit.

The results of the testwork indicate that approximately 59% of the liberated (washed) native gold was recovered in the main section of the original sluicebox. This is a much higher recovery than was previously estimated by other researchers for typical land-dredge operations. Approximately 87% of the washed native gold was being recovered in the main section of the refitted sluicebox.

The results indicate a significant (28%) increase in gold recovery. The standard error of these tests ranges from only (plus or minus) 3% to 5%. However, this is only the first set of radiotracer tests completed for this type of mining and sluiceboxes in Guyana, so the results should be treated with caution.

2. RECOMMENDATIONS

It is recommended that other sluiceboxes in various mining districts of Guyana be refitted and tested with radiotracers to verify and improve the gold recovery improvements. This should be done in conjunction with evening seminars to inform local small scale miners and government officials of efficient methods of alluvial exploration, mine planning, gold recovery, safe mercury usage and environmental mitigation.

In the future, the field demonstrations in the remote mining communities should be conducted with the author and a maximum of 3 to 4 Guyanese government and/or education (GGMC, IAST, U of Guyana, EPA) employees. This would facilitate the efficient transfer of alluvial mining training skills to local agency personnel and would ensure the adequacy of local lodging and other facilities in the remote mining districts. Larger training seminars should be held in Georgetown or other major centers where there are adequate facilities.

Randy Clarkson P.Eng.

3. INTRODUCTION TO ST. ELIZABETH

Charles DeSilva's alluvial gold mine is located in the St. Elizabeth area near Mahdia, Guyana, South America. The mining face was approximately 60 feet (18 metres) tall with the lower 10 feet (3 metres) containing gold-bearing clay-rich gravels. A decomposed clay/bedrock horizon was located below the pay gravels. The full face was washed down into a clay sump using several hand-held water monitors.

The pay gravels consisted of a white clay matrix with coarse quartz sand and rounded and semi-rounded white quartz cobbles/gravels. Pyrite and illmenite were abundant high density minerals and there were minor amounts of galena. The white clay was very durable and difficult to break-down with washing. Large clay balls with unwashed gravels were commonly discharged from the sluicebox.

The pay gravel slurry was pumped from a common clay (weathered bedrock) sump to two sluiceboxes using two 5 by 5 inch (120 mm) Dambrose (Brazilian) gravel pumps. The pumps were powered by four cylinder diesel-fired Perkins engines. About 110 feet (33 m) length of 6 inch (150 mm) diameter PVC piping conveyed the slurry to the sluiceboxes. A man in the sump operated a remote throttle on each gravel pump. The flow rate of slurry from the gravel pumps was varied depending on the depth of slurry in the sump. The gravel pumps operated at full output approximately 50% of the time. The miners worked from sunrise to sunset and the gravel pumps operated about 8 to 10 hours per day.

The two wooden sluiceboxes consisted of a 45 gallon (200 litre) steel drum as a deflector. The slurry was deflected into an upper sluicebox known locally as the "Pokey Man". The uppermost (Pokey Man) section of the sluicebox was about 6 to 7 feet (2 m) long and about 4 feet (1.5 m) wide and was sloped at about 12 degrees (2.5 in/ft). This uppermost section was originally fitted with a deep boil box and ribbed Brazilian carpet. The slurry dropped down and reversed direction over the main section of the sluicebox which was 20 to 22 feet (6.5 m) long, 4 to 6 feet (1.2-1.8 m) wide, and sloped at 10 degrees (2 in/ft). The middle and lower sections were originally fitted with ribbed Brazilian carpet and no riffles. The lowest section of the sluicebox (locally known as the "blood eye") was narrower (2 to 4 feet, 0.6 to 1.2 metres) and usually sloped at 7 degrees (1.5 in/ft).

The uppermost sluice (pokey man) of one of the twin sluiceboxes was refitted with a shallower boil box and one inch angle iron riffles (4 feet long by 4 feet wide) over Brazilian matting. This riffle section was a bit too wide but the slurry flows were still very turbulent in this area. This same sluicebox also had its main section narrowed to 4.5 feet (1.4 m) and the lower 12 feet (3.6 m) of length was refitted with coarse expanded metal riffles over unbacked thick Nomad matting. The upper section of the main sluice run and the lowest (blood eye) section were still fitted with ribbed Brazilian carpeting.

The lower section of the middle sluicebox was originally narrowed from 7.3 feet (2.2 m) to 3 feet wide (0.9 m) and refitted with coarse expanded metal riffles over unbacked Nomad matting.

However, after additional flow measurements were taken, it was widened to 4.5 feet (1.4 m) to reduce the slurry depth and velocity to values more suitable for expanded metal riffles.

The tailings were being discharged into a previous mined pit. The tailings discharge was redirected by moving the lowermost (blood eye) section of the sluice to create a dam which was reinforced with wooden stop boards. The process water was totally recycled from the edges of the water-filled pit/settling pond. Even though the processed gravels were very rich with clay, the recycled process water was remarkably clear and only very slightly discoloured.

Both the original and refitted sluiceboxes were tested with radiotracers. The tracer particles were mixed thoroughly with a sample of the pay gravels and added at the top of the sluiceboxes. The original sluicebox had operated about 6 days before and 1 day after tracer addition. The refitted sluicebox had operated about 1.5 days before and 0.5 days after tracer addition due to the refitting and a pump breakdown. The main gravel pump in the refitted sluicebox broke down while the tracers were being added and it was only able to operate for one half day after their addition. Both sluiceboxes were washed down on September 21st and 23rd respectively.

The mine operator upgraded the sluicebox concentrates by hand screening followed by mercury amalgamation in plastic buckets. The topmost (pokey man), middle and lower (blood eye) sections of the refitted sluicebox were washed down separately.

The slurry flows measured with the float method and separate samples were collected from the two sluice runs at various times with a small sample cutter to estimate the mass flows. The flowrate produced by the gravel pump was highly variable.

4. DATA – St. Elizabeth and White Hole

NOTE: PROCESSING EQUIPMENT DIMENSIONS (Imperial) 1m = 3.2808 feet

ORIGINAL TWIN SLUICEBOX AT ST. ELIZABETH

Description	Length ft	Width ft	Area ft2	Description
Top Sluice	2.7	4.3	11	Wooden Boil Box
Pokey Man	4.0	4.3	17	Ribbed Brazilian Carpet
Middle Sluicebox	12.0	6.0	72	Ribbed Brazilian Carpet
Bottom	10.0	4.0	40	Ribbed Brazilian Carpet
Blood Eye	5.0	2.0	10	Ribbed Brazilian Carpet
Combined	33.7	4.5	150	

REFITTED SLUICEBOX AT ST. ELIZABETH

Description	Length ft	Width ft	Area ft2	
Top Sluice	2.5	4.0	10	Wooden Boil Box
Pokey Man	4.0	4.0	16	One inch angle iron/Nomad
Middle	8.5	4.5	38	Ribbed matting
Sluicebox	12.0	4.5	54	Coarse Exp Metal/Nomad
Bottom	4.0	3.3	13	Raised Coarse Exp Metal/Nomad
Blood Eye	12.5	3.3	42	Ribbed matting
Combined	43.5	4.0	173	

ORIGINAL SLUICEBOX AT THE WHITE HOLE

Descripton	Length ft	Width ft	Area ft2	
Top Sluice	1.5	4.8	7	Wooden Boil Box
Pokey Man	7.5	4.8	36	Ribbed Brazilian Carpet
Middle Sluicebox	9.5	4.8	46	Ribbed Brazilian Carpet with Wooden Riffles
Bottom	8.8	2.8	25	Ribbed Brazilian Carpet
Blood Eye	11.0	3.0	33	with Wooden Riffles
Combined	38.3	3.8	147	

REFITTED SLUICEBOX AT THE WHITE HOLE

Description	Length ft	Width ft	Area ft2	
Top Sluice	1.0	4.6	5	Wooden Boil Box
Pokey Man	8.0	4.6	37	Coarse Exp Metal/Nomad
Middle	4.0	4.6	18	Coarse Exp Metal/Nomad
Sluicebox	4.0	4.6	18	Only Nomad Matting
Bottom	8.0	2.2	17	One inch angle iron/Nomad
Blood Eye	11.0	3.0	33	Ribbed matting
Combined	36.0	3.6	128	

TYPICAL SLUICEBOX SLOPES AT ST. ELIZABETH

	Top Section	Middle Section	Bottom (Blood Eye)
Percent	19.8%	18.8%	12.5%
in/ft	2.4	2.3	1.5
degrees	12	10	7

TYPICAL SLUICEBOX SLOPES AT THE WHITE HOLE

	Top Section	Middle Section	Bottom (Blood Eye)
Percent	22.9%	20.8%	15.6%
in/ft	2.8	2.5	1.9
degrees	13	12	9

Note: Optimum sluice slopes normally range between 1.5 to 2.5 in/ft for expanded metal riffles and between 2.5 to 3.0 in/ft for one inch angle iron riffles. The slopes would change slightly from day to day because the miners would occasionally redirect the tailings from the sluiceboxes to form a tailings dam to impound the recycled process water.

5. CALCULATIONS

5.1 Mass Flows

The water and pay gravel feed rates were derived from sampler data and time sudies. These were compared to recommended values for expanded metal riffles derived from previous research: feed rate at 8 loose cubic yards per hour and water rate of
160 lgpm per foot of sluice width. (One inch angle iron riffles require 320 Igpm and can be loaded at 16 loose cubic yards/hr per foot of sluice width).

ST. ELIZABETH WATER FLOW RATES

1999 Description	Factor	Sept 18 Original Middle	Sept 18 Original Bottom	Sept 19 Refitted @ 3 feet	Sept 21 Refitted @ 3 feet	Sept 23 Refitted @ 4.5 ft	Averages
Slurry Speed m/s		1.5	1.6	1.8	1.8	1.9	1.7
Slurry Speed ft/s		5.0	5.3	5.9	5.8	6.2	5.6
Depth of Water cm		1.6	2.9	3.1	3.5	2.8	2.8
Depth of Water in		0.6	1.1	1.2	1.4	1.1	1.1
Width of Sluice m		1.9	1.0	0.9	0.9	1.4	
Width of Sluice ft		6.3	3.3	3.0	3.0	4.5	
Slurry cms	80%	0.037	0.037	0.040	0.045	0.057	0.043
Slurry Flow Igpm		493	495	529	600	747	573
% Recommended -Wid		49%	93%	110%	125%	104%	

Process water flows were measured with the float method and derated to 80% of their surface velocity. These flows were highly variable and ranged from almost nothing to 500 to 700 imperial gallons per minute (0.37 to 0.57 cms).

In general, the original sluiceboxes were too wide for this amount of water and were narrowed to 4.5 feet (1.4 m) when they were refitted. Water flow rates less than 100% or greater than 150% of recommended values usually lower gold recoveries. Note that a width of 4.5 feet (1.4 m) was more suitable for these flow rates.

ST. ELIZABETH PAY GRAVEL FEED RATES

1999 Description	Factor	Sept 18 Original Middle	Sept 18 Original Bottom	Sept 19 Refitted @ 3 feet	Sept 21 Refitted @ 3 feet	Sept 23 Refitted @ 4.5 ft	Averages
Solids %		6%	6%	7%	10%	7%	7%
Solids cms	1.00	0.0022	0.0022	0.0028	0.0044	0.0038	0.003
Sluice Solids Lyd3/hr		11	11	13	21	18	15
% Recommend -Feed		21%	40%	56%	86%	49%	50%

Solids volume densities were measured with a small sample cutter and they ranged from 3% to 13% (by volume). The feed rate was estimated at 11 to 21 loose cubic yards/hr (Lyd3/hr) for about 50% of the time, and for 8 to 10 hours per day. This totals about 75 loose cubic yards of soil per day for each five inch pump and sluicebox. The soils processed were mostly (83%) overburden (50 feet of a 60 feet tall section), therefore on average, only about 12 loose cubic yards of pay gravels were processed per day.

The feed rates to the sluices were low enough to promote good gold recovery. Pay gravel feed rates which exceed 100% of recommended values are one greatest factors contributing to gold losses. Pay gravel feed rates below 100% of recommended values may improve gold recovery slightly.

WHITE HOLE AND RED HOLE WATER FLOW RATES

		White Hole				Red Hole
		Sept 20	Sept 22	Sept 22		Sept 18
Description	Factor	Original	Expanded	Angle Iron	Average	Original
Slurry Speed m/s		1.3	1.7	1.6	1.5	1.7
Slurry Speed ft/s		4.2	5.5	5.3	5.0	5.4
Depth of Water cm		2.9	1.7	3.6	2.7	0.9
Depth of Water in		1.1	0.7	1.4	1.1	0.4
Width of Sluice m		0.8	1.4	0.7	1.0	1.8
Width of Sluice ft		2.8	4.5	2.2	3.1	5.9
Slurry cms	80%	0.025	0.032	0.031	0.029	0.021
Slurry Flow Igpm		324	425	405	385	283
% Recommended -Width		74%	59%	58%		30%

Process water flows were measured with the float method and derated to 80% of their surface velocity. These flows were highly variable and ranged from almost nothing to 283 to 425 imperial gallons per minute (0.21 to 0.32 cms).

In general, the original White Hole sluiceboxes were too wide for this amount of water and were narrowed to 4.5 feet (1.4 m) when they were refitted. Unfortunately this appears to still be too wide. Water flow rates less than 100% or greater than 150% of recommended values usually lower gold recoveries.

WHITE HOLE AND RED HOLE PAY GRAVEL FEED RATES

		White Hole				Red Hole
		Sept 20	Sept 22	Sept 22		Sept 18
Description	Factor	Original	Expanded	Angle Iron	Averages	Original
Solids %		9%	9%	9%	9%	1%
Solids cms	1.00	0.002	0.003	0.003	0.003	0.0002
Sluice Solids Lyd3/hr		11	14	13	13	1
% Recommended -Feed		49%	39%	39%		2%

5.2 White Hole and Red Hole Pay Gravel Feed Rates

Solids volume densities were measured with a small sample cutter and they ranged from 7% to 11% (by volume). The feed rate was estimated from 1 to 14 loose cubic yards/hr (Lyd3/hr) for about 50% of the time, and for 8 to 10 hours per day. This totals from 5 to 70 loose cubic yards of soil per day for each five inch pump and sluicebox. The soils processed were mostly overburden (especially at the White Hole).

The feed rates to the sluices were low enough to promote good gold recovery. Pay gravel feed rates which exceed 100% of recommended values are one of the greatest factors contributing to gold losses. Pay gravel feed rates below 100% of recommended values may improve gold recovery slightly.

The operation at Red Hole used 1/2 inch (12 mm) iron rebar welded in a square grid at 2.5 inches (64 mm) on center over Nomad matting for gold recovery. Both the feed rates and water flow rates were extremely low. The author has no experience with this type of riffle, but it appeared to be working well at the extremely low feed rates.

6. DISTRIBUTION OF RADIOTRACERS ALONG THE LENGTH OF THE SLUICES

6.1 Original Twin Sluicebox at St-Elizabeth

The three different sizes of tracers 100, 48 and 28 mesh (150, 300 and 600 microns) were added separately while the sluicebox was operating. The 100 mesh (150 micron) radiotracers were added first, followed by the 48 mesh (300 micron) and then the 28 mesh (600 micron). The locations at which they were recovered in the sluicebox were mapped each time. The locations of the 28 mesh (600 micron) radiotracers were estimated by subtraction of the previous mapping. The following table displays the distance from the top of the sluicebox (in feet) versus the total counts per second of gamma and x-ray radiation from each interval. These data can be examined to determine the effectiveness of each type of riffle and matting configuration.

ORIGINAL TWIN SLUICEBOX AT ST. ELIZABETH
DISTRIBUTION OF RADIOTRACERS (Original)
(see appended graphs)

Distance	(100 mesh radiotracers)			(Net 50 mesh tracers only)			(net 28#)
From Top	Reading	% Total	Cumulate	Reading	% Total	Cumulate	Cumulate
feet	CPS	84%		Net	64%		56%
2	0	0.0%	0.0%	0	0.0%	0.0%	0.0%
4	700	4.6%	4.6%	1200	5.4%	5.4%	-2.0%
6	2900	19.0%	23.6%	2200	10.0%	15.4%	17.5%
8	1200	7.9%	31.5%	-500	-2.3%	13.2%	29.4%
10	500	3.3%	34.8%	5900	26.8%	39.9%	36.5%
12	2000	13.1%	47.9%	0	0.0%	39.9%	40.1%
14	700	4.6%	52.5%	2700	12.3%	52.2%	36.5%
16	0	0.0%	52.5%	1000	4.5%	56.7%	42.9%
18	2500	16.4%	68.9%	0	0.0%	56.7%	33.0%
20	800	5.3%	74.2%	0	0.0%	56.7%	34.2%
22	0	0.0%	74.2%	0	0.0%	56.7%	34.2%
24	0	0.0%	74.2%	0	0.0%	56.7%	34.2%
26	0	0.0%	74.2%	0	0.0%	56.7%	38.5%
28	0	0.0%	74.2%	800	3.6%	60.4%	35.3%
30	0	0.0%	74.2%	400	1.8%	62.2%	36.5%
32	0	0.0%	74.2%	700	3.2%	65.4%	36.5%
34	500	3.3%	77.4%	200	0.9%	66.3%	37.7%
36	0	0.0%	77.4%	500	2.3%	68.5%	37.7%
38	0	0.0%	77.4%	0	0.0%	68.5%	37.7%
40	0	0.0%	77.4%	0	0.0%	68.5%	39.7%
42	1000	6.6%	84.0%	-1000	-4.5%	64.0%	39.7%
44	0	0.0%	84.0%	0	0.0%	64.0%	44.5%
Total	12800	84.0%		14100	64.0%		

Notes:
In any sluicebox, most of the gold which is recovered is usually in the top section of the sluice runs. However, if significant numbers of gold particles travel more than 3 m or 10 feet down the runs this may indicate improper riffle action, surges of water or gravel, and/or inadequate washing of pay gravels.

Most of the recovered 100 mesh (150 micron) radiotracers were located in the first 20 feet (6 m) of the sluicebox, however, others continued to the end of the box. Some of the gold particles recovered in the ribbed matting are being lost with further operation of the sluicebox. It appears that at least two of the 100 mesh radiotracers were lost from the ribbed mat between the first and second mapping. At least another five to ten radiotracers appear to be lost from the ribbed mat between the second and final mapping.

The next day, the original box had lost two more radiotracers from the lowest section of its sluicebox. More of the gold particles recovered in the ribbed matting may be lost with further operation of this sluicebox.

It appears as if the 48 mesh (300 micron) radiotracers have travelled further down the sluicebox. This may be due to the absence of riffles which would otherwise recover this coarser gold in the sluicebox.

One radiotracer which was lost to the tailings was recovered by panning the tailings. It had amalgamated with a small ball of mercury and rolled out the sluicebox.

DISTRIBUTION OF RADIOTRACERS ALONG THE LENGTH OF THE SLUICES

6.2 A Comparison Of The Original & Converted Sluice-Box

Due to problems with its gravel pump, the three different sizes of tracers 100, 48 and 28 mesh (150, 300 and 600 microns) were added at the same time to the refitted sluicebox. The final locations at which they were recovered in the sluicebox was mapped. The following table displays a comparison of the distance from the top of the sluicebox (in feet) versus the total counts per second of gamma and x-ray radiation from each interval. These data can be examined to compare the effectiveness of each type of riffle and matting configuration.

DISTRIBUTION OF RADIOTRACERS (Comparison)
(see appended graphs)

Distance From Top feet	Original Sluicebox Final Reading CPS	% Total 68%	Cumulative	Converted Sluicebox Final Reading CPS	% Total 97%	Cumulative
2		0.0%	0.0%	11800	25.0%	25.0%
4	1400	2.5%	2.5%	2900	6.1%	31.1%
6	10000	17.8%	20.3%	3000	6.3%	37.5%
8	3700	6.6%	27.0%	5000	10.6%	48.0%
10	8200	14.6%	41.6%	2700	5.7%	53.7%
12	2900	5.2%	46.8%	3000	6.3%	60.1%
14	2500	4.5%	51.2%	2500	5.3%	65.4%
16	2600	4.6%	55.9%	0	0.0%	65.4%
18		0.0%	55.9%	2160	4.6%	70.0%
20	1100	2.0%	57.8%	3360	7.1%	77.1%
22		0.0%	57.8%	0	0.0%	77.1%
24		0.0%	57.8%	4320	9.1%	86.2%
26	1100	2.0%	59.8%	1560	3.3%	89.5%
28		0.0%	59.8%	0	0.0%	89.5%
30	700	1.2%	61.0%	0	0.0%	89.5%
32	700	1.2%	62.3%	600	1.3%	90.8%
34	1000	1.8%	64.1%	700	1.5%	92.3%
36	500	0.9%	65.0%	0	0.0%	92.3%
38		0.0%	65.0%	600	1.3%	93.5%
40	500	0.9%	65.9%	0	0.0%	93.5%
42		0.0%	65.9%	1800	3.8%	97.3%
44	1200	2.1%	68.0%	0	0.0%	97.3%
Total	38100	68.0%		46000	97.3%	

Notes:

In any sluicebox, most of the gold which is recovered is usually in the top section of the sluice runs. However, if significant numbers of gold particles travel more than 3 m or 10 feet down the runs this may indicate improper riffle action and/or inadequate washing pay gravels. In this case, the long length of travel is probably due to the presence of bundant clays and the subsequent difficulty with washing and gold liberation from the lays.

The modified boil box nugget trap and one inch angle iron riffles in the converted box recovered more radiotracers closer to the top of the sluicebox than the deeper boil box and ribbed matting in the original box.

The expanded metal riffles in the converted box recovered more radiotracers than the same section of ribbed matting in the original box. The four foot section of expanded metal in the lowest section (blood eye) of the refitted sluice was resting well above the ribbed matting and did not recover any radiotracers. This is a common problem when expanded metal riffles lift up off of the matting.

One 100 mesh (150 micron) radiotracer which was lost by the refitted sluicebox to the tailings was recovered from the tailings. However, it was lost again while a local miner was panning it.

6.3 Gold Recovered By Original Sluice During Test Period

The following table lists the weights (%) of recovered natural gold and radiotracers in the two main sections of the original sluicebox and in the lowest (blood eye) section. The gold recoveries are totaled for both sections.

Original Sluicebox Gold Recovery

Mesh Size	Recovered gold dist %	Main tracers	Blood eye tracers	Total tracers	Corey Shape	Diameter mm
+8						2.380
+14						1.190
+28	3.2%	48%	8%	56%	0.3	0.595
+48	27.5%	56%	8%	64%	0.4	0.297
+100	52.4%	80%	4%	84%	0.4	0.149
-100	16.8%					
Total	100.0%	61%	7%	68%		
Weighted Recovery of Gold		59%	5%	63%		

Notes:

About 61% of the gold radiotracer particles and about 59% of the liberated (washed) native gold is recovered in the two main sections of the sluicebox.

An additional 7% of the radiotracers or 5% of the native gold is recovered in the lowest (blood eye) section of the sluicebox.

Most of the recovered gold is between 100 and 48 mesh (150 to 300 microns) in size. There will be higher gold losses if the gold is contained in unwashed clay balls.

The Corey Shape Factor is a measure of the flatness of alluvial gold. It is the ratio of the thickness of a gold flake to the square root of its area. For example, the C.S.F. of a sphere is 1 and of a dime is 0.05. Gold particles, which have low C.S.F., may be more difficult to recover in gravity recovery devices such as sluiceboxes.

6.4 Gold Recovered By Refitted Sluice During Test Period

The following table lists the weights (%) of recovered natural gold and radiotracers in the two main sections of the refitted sluicebox and in the lowest (blood eye) section. Each section of the sluicebox was washed down separately including:

The top (pokey man) which was fitted with one inch angle iron riffles;

The upper main sluice which was fitted with ribbed Brazilian matting;

The lower main sluice which was fitted with coarse expanded metal riffles over unbacked Nomad matting; and

The lowest (blood eye) sections of the sluice which was fitted mostly with ribbed Brazilian matting.

The gold recoveries are totalled for all sections.

Refitted Sluicebox Gold Recovery

Mesh Size	Recovered gold dist %	Top tracers	Ribbed tracers	Expanded tracers	Total Main	Blood eye tracers	Size mm
+8	1.2%						2.380
+14	1.4%						1.190
+28	3.3%	4%	64%	24%	92%	4%	0.595
+48	33.9%	4%	72%	8%	84%	16%	0.297
+100	56.3%	56%	28%	12%	96%	0%	0.149
+200	3.8%						0.074
-200	0.2%						
Total	100.0%	21%	55%	15%	91%	7%	
Weighted Recovery of Gold		33%	42%	10%	86%	6%	

Note:

About 91% of the radiotracers or 87% of the liberated (washed) native gold particles are recovered in the three main sections of the sluicebox. This is about 30% higher than with the original sluicebox.

An additional 7% of the radiotracers or 6% of the native gold is again recovered in the lowest (blood eye) section of the sluicebox.

Most of the recovered gold is still between 100 and 48 mesh (150 to 300 microns) in size, however it does appear to be coarser than in the previous (original) test. This coarseness may be due partially to the refitting of the sluicebox and due to a change in the gold size distribution in the pay gravels.

There will be higher gold losses when the gold is contained in unwashed clay balls.

6.5 Accuracy Of These Results

The relative errors from these metallurgical tests are estimated with the theory of binomial distribution. The standard error of this experiment = {(n*p*q)^0.5}/n.
Where n is the total number of radiotracers added, p is the proportion recovered and q is the proportion lost.

For the radiotracer test conducted on the original box:
n= 75 p= 0.68 and q= 0.32
and the standard error = 5%.

For the radiotracer test conducted on the refitted box:
n= 75 p= 0.91 and q= 0.09
and the standard error = 3%.

Therefore these overall recovery estimates will usually be within 3 to 5 percent of the true value (14 times out of 20) and almost always within 6 to 10 percent (19 times out of 20).

Feed rate estimates are based on sampler cuts and timed flow measurements as indicated. Variations could result from surging or varying feed rates. Water and slurry flow rates are estimated by measuring the speed of the slurry in the sluice runs and their cross sectional areas.

The previous conclusions are based on the pay material processed during the sampling period. Pay gravels which are significantly different in character, gold content and particle size distribution may require different processing considerations.

7. STANDARD RECOMMENDATIONS

Field and laboratory testwork has indicated that sluicebox runs should be designed to the following specifications for optimum recovery levels:

every sluice run should have a section of expanded metal riffles and a section of angle iron riffles in series;

the expanded metal section should be sized to handle 8 loose cubic yards per foot of width and consist of coarse expanded metal mesh (4 to 6 lbs/ft2) fitted tightly on top of Nomad matting;

optimum slurry velocities for the expanded metal riffles section will range from 5 to 6 feet per second (1.5 to 1.8 m/s);

the expanded metal section of the sluicebox should preferably be at least 16 feet long and followed or preceded by an 8 feet long section of angle iron riffles;

the angle iron riffle section should be approximately one half the width of the expanded metal riffle section and may have to be set at a steeper gradient of up to 3 inches/foot to achieve a slurry velocity of 6 to 8 feet per second (1.8 to 2.4 m/s), care must be taken to reduce rooster tails where runs are narrowed;

the one inch angle iron riffles should be aligned at 15 degrees from the sluicebox's vertical towards to top of the box and they should be located with a clear distance of 2 to 2.5 inches (50 to 65 mm) between each riffle;

the angle iron riffles should be fitted tightly on top of Nomad matting (light expanded metal may be inserted between the riffles and the matting to prolong the life of the matting); and

nuclear tracers indicated that the gold particles can migrate down the sluice run (especially during start up periods) therefore sluice runs that are easily washed down will allow more frequent clean ups (preferably every 24 hours) to further reduce gold losses.