**GENCAPD PROJECT**

# MINERS' ENVIRONMENTAL OFFICER'S REPORT
# On
# FIELD TRIP TO AREMU MINING DISTRICT

***04 December to 18 December 2003***

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## 1.0 INTRODUCTION

The field trip to the Aremu (Mining District No. 4) was completed during the period 04 December to 18 December 2003, as scheduled.

GGMC's Mines Station, which was located at Middle Aremu, was utilized as the base camp for this field trip. Access to this location was gained in three phases: i). A one hour crossing with a wooden speed boat from Parika (located on the left bank of the Essequibo River) to Bartica (one of the main exit points and business centers for the hinterland gold and diamond mining industry) located at the confluence of the Essequibo and Mazaruni Rivers; ii). A twenty-minute road journey, along the Bartica-Issano road, to the pontoon crossing of the Mazaruni River located at Itaballi. This pontoon service for the short crossing (approximately five minutes) was operated by Meckdeci Mining Company; iii). A ninety-minute (fifty-five kilometers) journey, with a land cruiser, along fairly good all-weather road, to Aremu.

From this base camp, five mining areas (Baramalli, Quartz Stone, Arawak, Middle Aremu and Oko), all located within the Administrative Region No. 7 (Cuyuni-Mazaruni) of the Regional Democratic Council, were visited.

All Terrain Vehicles (ATVs) and 4X4 cruisers were the means of transportation (on sometimes difficult to deplorable road conditions) between mining areas, where a total of thirty-four (34) land-dredging gold operations were visited within the five general mining areas.

Except for Middle Aremu, where mining was concentrated on the flat lands (floodplains) of the Aremu Creek and its tributaries, mining operations at the other locations were centralized along ravines, most of them being fairly wide.

## 2.0 OBJECTIVES

The basic objectives of this field trip were:

To continue the programme of sensitizing gold and diamond miners of the environmental issues related to the industry, particularly on acceptable uses and handling of mercury and effective tailings management related to land dredging operations.

To inform miners of the thrust and expectations of the new mining/environmental regulations (pending authorization), especially as it relates to environmental issues related to tailings management and the use of mercury.

To have in-mine discussions with miners, claim owners and operators to enable effective problem identification and provision of acceptable solutions that will make a positive impact on the mining environment.

Where appropriate, to supplement miners' technical knowledge on "Tailings Management" and on the "Construction of Small Earth Dams" with evening group discussions sessions.

To investigate the degree to which the "Sluice Box Modifications", as suggested by Mr. Randy Clarkson, were being implemented.

To investigate the utilization of GGMC/GENCAPD Mercury Retort used to capture mercury when burning gold amalgam.

To further investigate the probability of establishing functional "Self-Monitoring Environmental Groups" within the mining district.

## 3.0 SUPPORT

Thanks to the office unit of GGMC's Mines Division for their usual support in preparation of his field trip.

Thanks to Mr. Vijay Deodatt (Mines Officer, Aremu Mines Station) and crew, for their strong support in making this field trip a success.

To Mr. Clement "Black Buddy" Martinborough, whose superior knowledge of the location of the mining operations and guidance through the Baramalli back-dam was so vital, thanks.

Appreciation must be expressed to the miners for their interest and support during the period, especially Mr. Jimmy Corneiro (Baramalli), Joseph Chan, Jose Amorim and Kathy Ross (Oko).

## 4.0 ACTIVITIES

Visits were made to five (5) general mining areas within this Mining District. During this period, thirty-four (34) active mining operations and two (2) mined-out sites were visited; two (2) small group discussion sessions and one (1) evening group discussion was held; and the formation of a "Self-Monitoring Environmental Group" was initiated.

| Date | Location | Operations Visited | Comments |
|---|---|---|---|
| 06-12 to 10-12-2003 | Baramalli | 14 | One evening group discussion session; initiated "Self-Monitoring Environmental Group"; visited two mined-out sites |
| 11-12-2003 | Quartz Stone | 3 | |
| 12-12-2003 | Arawak | 6 | |
| 13-12-2003 | Middle Aremu | 5 | |
| 15-12-2003 | Oko | 5 | |
| 16-12-2003 | Middle Aremu | 1 | One small group discussion Session |
| 17-12-2003 | Middle Aremu | - | One small group discussion Session |

**TABLE 1**: OPERATIONS VISITED ON FIELD TRIP

## 5.0 **METHODOLOGY**

The basic procedure during site visits was as follows:

1. Audience was sought with the owner, General Manager or senior operator on site.

2. An Explanation (as laid out in the objectives) was given for the general purpose of the site visit.

3. The fact-sheet on GGMC/GENCAPD's mercury retort was explained and distributed to miners. The importance of using mercury retorts was made explicit. Miners were made aware that it was illegal to spike pits and sluice boxes with mercury.

4. Critical observations of the mining operations were made, with special emphasis on proper usage and handling of mercury and the disposal of tailings, in such a manner, as to provide a safe and environmentally friendly operation. During this process, discussions were held with mine operators to identify problems and arrive at viable solutions. Analogies were made of methodologies successfully applied at other locals.

5. Generally, the benefits of dry-stripping methods and the "closed circuit" water recycle system were explained and their implementation encouraged.

6. Where appropriate, miners were informed of the availability and use of synthetic silt-fencing material to confine tailings.

7. The use of the turbidity wedge to monitor the quality of water returned to the environment was demonstrated to miners. The turbidity of surrounding waters was noted and where appropriate, turbidity readings and/or water samples were taken.

8. A few copies of Style's "Sluice box Design and Operations Booklet" were distributed as appropriate.

9. Other relevant information, including location of the mine pit, basic geology of the area, equipment utilized and safety concerns were noted.

## **6.0 OBSERVATIONS**

Some of the basic features of mining operations visited during the field trip are listed in Tables 2.

Table 3.summarizes the information listed in Table 2, for the different mining locations.

| Area | Owner / Operator | Type of operation | Tailings Pond Recycling (Y/N) | Silt fence or Trapping Device (Y/N) | Retort used (Y/N) | Sluice Box | | Drinking/Domestic Water | | Other |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Riffle Type(s) | Matting Types(s) | Source | Quality | |
| Baramalli | Da Silva Filhio | Jetting, backfilling old pits | Yes | Cocorite leaves & tree trunks | No | Expand-ed metal | Miracle | Rain | Good | Excess flowing to ravine |
| Baramalli | Carlito | Mined-out, relocating | | | | | | | | No English |
| Baramalli | G. Costa | Jetting, backfilling old pits | Yes | Cocorite leaves & tree trunks | No | | | Rain | Good | Excess flowing to ravine |
| Baramalli | Aliveira da Silva | Jetting | Closed circuit | Mined-out pits | No | Expand-ed metal | Brazilian mat | Rain | Good | Could improve feed water |
| Baramalli | Jimmy Corneiro | Jetting | Closed circuit | Old pits, Cocorite leaves & tree trunks | Made in Brazil | Expand-ed metal | Brazilian mat | Rain<br>Creek | Good<br>Murky | Could improve feed water |
| Baramalli | Leite Da Silva | Jetting, backfilling old pits | Yes | Old pits, Cocorite leaves & tree trunks | Made in Brazil | Expand-ed metal | Brazilian mat | Rain | Good | |
| Baramalli | Francisco Dias De Maria | Jetting | No | No | No | Expand-ed metal | Miracle mat | Rain<br>Creek | Good<br>Good | Tailings Polluting creek |
| Baramalli | J. Dejun | Backhoe stripping, jetting | No | Earthen dam & Cocorite leaves | No | Expand-ed metal | Magic mat and riffle mat | Rain<br>Stream | Good<br>Fair | Tailings on slope of ravine |
| Baramalli | Jaldo da Silva | Jetting, backfilling old pits | No | Old pits Cocorite leaves | No | Expand-ed metal | Brazilian mat | Rain | Fair | Tailings on slope of ravine |
| Baramalli | C. A. Almeida | Land prep. with backhoe, Jetting | Closed circuit | Earthen dam | No | Expand-ed metal | Brazilian mat | Rain<br>Well | Good<br>Fair | |
| Baramalli | Nihuse | Backhoe stripping, jetting | Closed circuit | Earthen dam | No | Expand-ed metal | Brazilian mat | Rain | Good | |
| Baramalli | Estvo De Sena | Backhoe stripping, jetting | No | No | Made in Brazil | Expand-ed metal | Brazilian mat | Rain | Good | Tailings among trees |
| Baramalli | Sebastian Dias | Jetting, backfilling old pits | Yes | No | No | Expand-ed metal | Brazilian mat | Rain | Good | |
| Baramalli | Carlito | Backhoe stripping, jetting | Closed circuit | Earthen perimeter dam | No | Expand-ed metal | Brazilian mat | Rain<br>Creek | Good<br>Fair | |
| Quartz Stone | Lennox Hopkinson | Jetting | Yes | Mined-out pits | No | Iron riffle | Nomad and Black mats | Rain<br>Stream | Good<br>Fair | Tailings to fill swamp |
| Quartz Stone | Neil Hopkinson | Jetting, backfilling old pits | Yes | Mined-out pits | No | Vertical riffle | Magic and riffle mats | Rain<br>Stream | Good<br>Fair | Could improve feed water |
| Quartz Stone | Collin Hopkinson | Jetting, backfilling old pits | Yes | Mined-out pits | No | Brazilian riffle mesh | Magic and riffle mats | Rain<br>Stream | Good<br>Fair | Excess flowing to ravine |

**TABLE 2**: BASIC INFORMATION ON MINE OPERATIONS VISITED

| Area | Owner / Operator | Type of operation | Tailings Pond Recycling (Y/N) | Silt fence or Trapping Device (Y/N) | Retort used (Y/N) | Sluice Box | | Drinking/Domestic Water | | Other |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Riffle Type(s) | Matting Types(s) | Source | Quality | |
| Arawak | Maurice Hopkinson | Backhoe, stripping, new ops. | No | No | No | Expand-ed metal | Magic and Black mats | Rain<br>Stream | Good<br>Good | To closed-circuit |
| Arawak | N. Munroe and Culpepper | Jetting | No | No | No | | | Rain<br>Stream | Good<br>Good | To make Stop-off dam |
| Arawak | Anthony David | To strip with Backhoe | Closed circuit | Mined-out pits | No | Iron riffle | Magic and Fur mats | Rain<br>Stream | Good<br>Fair | New operation |
| Arawak | Philbert Fraser | Backhoe stripping, jetting | No | No | No | Riffle, Expand-ed metal | Magic and Black mats | Rain<br>Stream | Good<br>Fair | Tailings polluting creek |
| Arawak | Joseph Prass | Backhoe stripping, jetting, | No | Mined-out pits | No | Riffle, Expand-ed metal | Miracle mat | Rain | Good | Back-filling old pits |
| Arawak | Dexter Bryan | Jetting, backfilling old pits | No | Mined-out pits | No | Expand-ed metal | Magic mat | Rain | Good | |
| Aremu | Moises de Olivera | Backhoe stripping, jetting, backfilling old pits | No | Mined-out pits | Not using his retort | Iron riffle and expand-ed metal | Nomad mats | Rain | Good | Effluent runoff to swamp |
| Aremu | Raimundo A. Costa | Backhoe stripping | Closed circuit | Mined-out pits | Rents a retort | Expand-ed metal | Nomad mats | Rain<br>Pond | Good<br>Clear | Good operation |
| Aremu | Raimundo de Araujo | Backhoe stripping | Closed circuit | Mined-out pits | Made in Brazil | Expand-ed metal | Nomad mats | Rain<br>Pond | Good<br>Clear | Good operation |
| Aremu | Clinton Alphonso | Backhoe stripping | Closed circuit | Mined-out pits | Fab-ricated device | Expand-ed metal | Rubberized and black mats | Rain<br>Pond | Good<br>Clear | Good operation |
| Aremu | Terry Singh | Backhoe stripping, backfilling old pits | No | Mined-out pits | No | Expand-ed metal | Magic mats | Rain<br>Pond | Good<br>Clear | Well defined pit |
| Aremu | Peter Robinson | Backhoe stripping, jetting | No | No | No | Iron riffle, Expand-ed metal | Magic mat | Rain<br>Creek | Good<br>fair | Tailings used to build new camp ground |

**TABLE 2 (Cont'd)**: BASIC INFORMATION ON MINES OPERATIONS VISITED

| Area | Owner / Operator | Type of operation | Tailings Pond Recycling (Y/N) | Silt fence or Trapping Device (Y/N) | Retort used (Y/N) | Sluice Box | | Drinking/Domestic Water | | Other |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Riffle Type(s) | Matting Types(s) | Source | Quality | |
| Oko | Joseph Chan | Jetting | No | No | No | None | None | Rain | Good | Guilty of mercury and tailings pollution |
| Oko | J. Amorim and K. Ross | Jetting | No | Plaited cocorite leaves | No | Brazilian mesh | Magic mat | Rain | Good | Guilty of mercury and tailings pollution |
| Oko | Getulio Da Silva Freire | Backhoe stripping, jetting, backfilling old pits | No | Mined-out pits | No | Expand-ed metal | Matting | Rain<br>Creek | Good<br>? | Clear feed water from old pit |
| Oko | Roy Mosanto | Backhoe stripping, jetting, | No | Mined-out pits | No | Expand-ed metal | Rubber matting | Rain<br>Creek | Good<br>? | To improve on tailings control |
| Oko | Joses M. G. Da Silva | Backhoe stripping, jetting, backfilling old pits | No | Mined-out pits | No | Expand-ed metal | Carpet matting | Rain<br>Creek | Good<br>? | Clear feed water from old pit |
| | | | | | | | | | | |

**TABLE 2 (Cont'd)**: BASIC INFORMATION ON MINES OPERATIONS VISITED

| Mining Location | Pits Visited | Backhoe | | Closed-Circuit | Back-filling | Recycling | Have Retort | Riffle Section | Expanded Metal |
|---|---|---|---|---|---|---|---|---|---|
| | | Stripping/ Mining | Land Prep. Others. | | | | | | |
| Baramalli | **14** | 4 | 1 | 5 | 6 | 4 | 3 | - | 12 |
| Quartz Stone | **3** | - | - | - | 3 | 3 | - | 2 | 1 |
| Arawak | **6** | 4 | - | - | 3 | - | - | 3 | 4 |
| Aremu | **6** | 6 | - | 3 | 5 | - | 2 | 2 | 6 |
| Oko | **5** | 3 | - | - | 3 | - | - | - | 4 |
| **Total** | **34** | **17** | **1** | **8** | **20** | **7** | **5** | **7** | **27** |

Approximately forty-eight fact sheets on GGMC/GENCAPD mercury retort were distributed.

**Please Note:** Operations listed as implemented backfilling or recycling activities, does not include those operations that utilized the "closed circuit" recycled water system of operation.

**TABLE 3**: SUMMARY INFORMATION ON FIELD TRIP

## 6.1 Impact Of The Environmental Awareness Programme

The lack of ownership and use of mercury retorts, illegal use of mercury for spiking the mining pits and/or sluice boxes, instances of the uncontrolled spread of tailings effluents through the forest; and poor condition of some of our waterways was observed. But, at the same time, some operators are making genuine efforts to control or prevent damage to the environmental due to their mining activities.

Mr. Cedric David (General Manager of Joseph Prass's operation at Arawak) and Mr. Darwin Thom (General Manager of Collin Hopkinson's operation at Quartz Stone) were both exposed to previous environmental awareness sessions facilitated by the previous Miners Environmental Officer at Oko. They had expressed knowledge of the use and purpose of the mercury retort but, unfortunately, neither operation was in possession of one.

The increasing implementation of closed-circuit recycled water system has made and where applicable, will continue to make a significant impact on the prevention of turbid effluents being discharged to our waterways. But this must be matched by a similar effort by miners in implementing rapid filtration systems for better conditioning of water released from mining pits.
The continued willingness of miners to interact with the Environmental Officer and GGMC's Mines Personnel is critical to the identification of tailings impoundment systems best suited to specific mining operations. This being so, the greatest responses are obtained when the operational and economic benefits are clearly evident.

The greatest benefit to be derived from this environmental awareness programme is the permanent change in mining culture, whereby, the appreciation of the environmental benefits, namely; saving of our rivers and creeks, the land and the mode of life of indigenous people are imbedded into operational plans, in the form of quality tailings management procedures, among others.

## 6.2 Expectations of the New Mining-Environmental Regulations

One of the objectives of the new mining/environmental regulations is to subject the mining industry to acceptable standards more on par with international expectations. For the small-scale gold and diamond industry, the most significant requirements pertain to the proper use and handling of mercury, acceptable tailings management systems and control of the resulting turbidity level of effluent discharges, and the need to reclaim the land.

Even though there was general understanding of these requirements, the following instances reflect the mood and apprehension of some miners:

i. Mr. Maurice Hopkinson, Dredge Owner at Arawak, had expressed fears that any stringent requirements of new regulations may make small-scale mining operations uneconomical.

ii. Doolaram, General Manager of Clinton Alphonso's operations at Oko, had expressed fears that the requirements of the new regulations might force small miners out of operation.

iii. Mr. Joseph Chan, Dredge Owner at Oko, was instructed (by the Mines Officer based at Aremu) to temporarily cease operation, in order to rectify the uncontrolled spread of tailings from his mining pit. Mr. Chan understandingly complied, but his workers expressed dissatisfaction in revealing that we were "trying to take bread out of their mouth" and felt that they "were just doing an honest job for a living".

## *6.3* Operating Systems and In-Mine Discussions

### 6.3.1 Mercury

**Miners were still using mercury in mining pits and sluice boxes**. Of the five mining operations visited at Oko, there was physical evidence of this illegal practice at one operation and disclosures of using mercury in the pit at two others.

Miners were informed of the dangers to human and the environment of using mercury in this manner. They were also strongly advised against these illegal practices.

It should be noted that the owner/operator of the mining operation, where there was evidence of the use of mercury in the sluice box and mining pit, claimed ignorance of knowledge pertaining to the proper use and handling of mercury. The fact that this operation was faulted for inadequate tailings management and operated a sluice box without any matting did indicate a level of inexperience. The positive from this experience, was the operator's appreciation for all information shared, his willingness to cooperate, his valuable assistance for the rest of the day, and an open invitation for a follow up visit.

### 6.3.2 Tailings Management (Photographs 1 to 5)

Of the thirty-four (34) mining operations visited, twenty-eight (28) were utilizing mined-out pits to trap tailings solids (backfilling). Of this amount, eight (8) operations had employed closed-circuit recycle water systems; thirteen (13) were backfilling with effluents decanted from settling ponds while feed water for jetting was drawn from another source; and seven (7) operations had established a system where recycled water was constantly being diluted with an inflow thus have a corresponding outflow of effluents.

These observations augur well for the confinement of tailings solids, but the reduction of total suspended solids from effluents discharges merging with our waterways (as evident by condition of Oko and Aremu Rivers) remains a key issue.

To address this problem, efforts must be made to maximize the implementation of closed-circuit systems, to implement systems to contain tailings produced from the

inception of mining activities, and to employ more efficient settlement ponds aided by rapid filtration systems for effluent discharges to the environment.

Of the operations visited, three were not, at the minimum, effectively confining their tailings solids. At the one such operation at Aremu, the tailings were being used to build up soggy ground for relocating the camp, while at Oko the two operations were faulted due to inefficiency and/or lack of purpose.

There was limited use of indigenous materials, such as plaited cocorite leaves and trunks, branches and fibrous roots of tree used to direct tailings flows as required or to confine the tailings solids.

As was the case with Joseph Chan's operation, at Oko, located at the lower extreme of the ravine, the feed water was of poor quality due to the accumulation of suspended solids from operations higher up the ravine.

Except at Aremu, the source of water for the operations were mainly small streams flowing down these ravines.

The implementation of backhoe stripping encourages the possibility of land reclamation primarily due to the fact that the overburden is stripped and overcastted close to the mine pit.

### 6.3.3 Mechanization (Photographs 6 to 8)

Of the operations visited, fifty (50%) percent (17 of 34) utilized backhoes for stripping of overburden. This may be directly related to ease of access to this mining district via an established ferry service from Parika to Bartica then by fair condition all weather road from Itaballi to Aremu. It should be noted, that at Aremu, all the operations visited had employed backhoe stripping.

The thickness of the overburden cover will also influence a decision to employ a backhoe for stripping or not.

The most positive effect of the utilization of backhoes, in the small-scale gold and diamond mining industry, is the tremendous reduction of tailings generated due to the dry method of overburden removal. The associated benefits are, better pit configurations, increased productivity, cleaner and safer mine pits, and greater flexibility of configuring operations for closed-circuit recycle water systems.

The number of large settling ponds or mined-out pits, left after backhoes had worked in an area, highlights the need for progressive land reclamation. The acquisition of small dozers will greatly enhance this process.

Except for a few bad patches, areas such as Arawak and Oko were readily accessed using trucks and four wheeled cruisers. The same mode of transportation was normal for Quartz Stone via a combination of good and traitorous road conditions. All Terrain Vehicles

(ATVs) and tractor-trailer were increasingly becoming the means of transportation, on deplorable road condition, to Baramalli.

### 6.3.4 Health and Safety (Photographs 9 to 11)

The basic health and sanitary conditions around camps and the general mining area was good. This was reflected in mostly clean campgrounds.

The utilization of backhoes for ground preparation and overburden stripping eliminated the problem of inadequate de-bushing of these work grounds. But adequate clearance around campground and instances of mining pits littered with tree trunks and roots (at operations where overburden was removed by jetting) was still a problem.

It should be noted that the utilization of backhoes for overburden stripping allows good pit definition and clean pit faces. But, the stability of vertical pit faces with our weak overburden types reduces with; increase in overburden thickness; overloading of pit faces by stacking excavated overburden in piles too high and too close to the edge of mining pit; and from the seepage of water, especially through porous materials such as sand, which could result in failures due to the undercutting hence collapsing of overlying strata or slumping of mine faces.

### 6.3.5 Water Sampling and Analyses (Photographs 12 to 13)

Turbidity readings, with a Triton Turbidity Wedge, were taken at selected points. Those readings with equivalent NTU, scaled from the Log/log Conversion Graph, are listed below. Also included, are the Total Suspended Solids (TSS) results of water samples taken to the GGMC's chemical laboratory for analyses.

| Sample | | | | Date | Turbidity Wedge Read. | | Lab. TSS (mg/L) |
|---|---|---|---|---|---|---|---|
| Location | Ref. ID | GPS Coordinates 21 N | UTM | | (cm) | NTU | |
| Aremu Ck. by Benn's shop, (Baramalli) | Bm1 | 0266906 | 0714639 | 06/12/2003 | 4 | 240 | - |
| Overflow from Filhio's Operation, (Baramalli) | Bm2 | 0265435 | 0715086 | 06/12/2003 | 0 | >1350 | - |
| Aremu Ck., ~ ¾ mile below Benn's shop | Bm7 | 0266389 | 0715211 | 06/12/2003 | 3 | 310 | 142.5 |
| Aremu Ck. above De Maria's operation, (Baramalli) | Bm8 | 0266256 | 0711658 | 07/12/2003 | 21 | <38 | 7.0 |
| Aremu Ck. ~ ½ mile below De Maria's operation, (Baramalli)* | Bm10 | No position | | 07/12/2003 | 2 | 450 | 114.5 |
| Ck. Through L. Hopkinson's operation, (Quartz Stone) | Bm17 | 0252742 | 0734001 | 11/12/2003 | 2 | 240 | - |
| Above Fraser's operation, (Arawak) | Bm24 | 0286581 | 0715876 | 12/12/2003 | 21 | <38 | 4.5 |
| Below Prass's operations, (Arawak) | Bm29 | 0287038 | 0716777 | 12/12/2003 | - | | 236.0 |
| Aremu Creek at Main Road Bridge | | No position | | 13/12/2003 | - | | 159.0 |
| Feed water for Chan, (Oko) | Bm35 | 0275092 | 0704274 | | - | | 768.0 |
| Above Robinson's, (Aremu) | Bm40 | 0274172 | 0723956 | 11/12/2003 | 6 | 160 | 42.0 |

**TABLE 4**: RESULTS OF WATER SAMPLING

**Key**

TSS – Total Suspended Solids Ck. – creek * - Dredge was not operating

Examination of the turbidity wedge readings confirms with field observations, in that the quality of water, surrounding most mining locations, is generally poor (above the expected maximum allowable NTU value of 100, for tailings released to the environment). This becomes even more vivid when compared to readings of (<38 NTU, 4.5 and 7.0 mg/L) obtained from points in our waterways, above the influence of mining operations.

For the five (5) water samples, on which both wedge and laboratory analyses were done, there was general correlation, in that, the TSS values increased with increasing NTU (approximated) values.

Filhio, who operated a land dredge, at Baramalli, had implemented a recycle water system, with a small flow of excess water routed through an indigenous contraption of tree trunk, branches and leaves. Even though this setup would have trapped some solids, zero reading on the turbidity wedge (>1350 NTU) indicated the inefficiency of this system, for trapping finer suspended solids.

Turbidity Wedge readings (with the corresponding TSS value) along the Aremu River of <38 NTU (7.0 mg/L) obtained above any mining operation to successive NTU values of 450 (114.5 mg/L), 240 and 310 (142.5 mg/L) down the river shows the accumulative effect of tailings effluents entering our waterways. It should be noted that if De Maria's dredge was operational, the point value of 450 NTU would have been much higher.

### *6.4* Evening Group Discussion Session

Evening group discussion sessions serve as a valuable medium for information exchange, exchange of views on critical issues, a reliable feedback system to GGMC (as the regulator) and GGDMA, disseminating of general information and opportunities to arrive at a common consensus on important issues.

Evening discussion sessions should not be meant to replace those of smaller audiences or the one-on-one discussion sessions on visits to individual mining operations.

Evening group discussion sessions are planned based on need, the centralization of mining operations within a specific location and where there is not a language barrier with the intended audience.

Two important developments resulted from this session;

i. A core group of persons, from within the Baramalli mining area, had volunteered their services for the formation of a "Self-Monitoring Environmental Group", the structure and operation of this body will be refined on consultation with the Commissioner (GGMC) and staff.

ii. Dredge owner, Mr. Lindon Jordan expressed an interest in acquiring a portion of a series of large mined-out pits (settling pond) for aquaculture farming. An interesting idea for the authorities, in relation to utilization of land in reclamation plans.

### 6.5 Implementation of Randy Clarkson's "Sluice Box Modifications" (Photographs 14 to 15)

Clarkson[1] had made some standard recommendations on, the design and construction of sluice boxes, on completion of his investigative work on the small-scale gold and diamond industry, in Guyana. The physical components of these recommendations include:

i. Every sluice run should have a section of expanded metal riffles and a section of angle iron riffles in series;
ii. The expanded metal section should consist of coarse expanded metal mesh fitted tightly on top of Nomad matting;
iii. The expanded metal section should preferably be at least 16 feet long and followed or preceded by an 8 feet long section of angle iron riffles;
iv. The angle iron riffle section should be approximately one half the width of the expanded metal riffle section.
v. 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)

Styles, et al.[2] states that if more than one riffle type is being used, a smooth, riffle-free section (known as a "slick plate") is inserted between each riffle section, to allow the slurry stream to re-stratify.

Styles, et al[3] further states that angle iron riffles are mainly used for trapping coarse gold and expanded metal, used as shallow riffles, are more suitable for trapping fine gold.

| | **4 inch Pump** | | **6 inch Pump** | |
|---|---|---|---|---|
| | Contents | Size | Contents | Size |
| **Top Box** | 1 * 4ft sheet expanded metal | Length = 6ft<br>Width = 3ft | 1 * 4ft sheet expanded metal | Length = 6ft<br>Width = 4ft 6ins |
| **Middle Box** | 2 * 4ft sheets expanded metal | Length = 10ft<br>Width = 3ft | 2 * 4ft sheets expanded metal | Length = 10ft<br>Width = 4ft 6ins |
| **Bottom Box** | 8ft angle iron riffles | Length = 10ft<br>Width = 1ft 6ins | 8ft angle iron riffles | Length = 10ft<br>Width = 2ft |

**TABLE 5**: Guidelines for the Sizes of Sluice Boxes Fed by Slurry Pumps (after Styles[3])

Various sluice box design and construction were observed during this field visit, including single section boxes, two and three section boxes, and boxes with varying combination of riffles and matting, to a plain wooden box without any riffle or matting. But generally sluice boxes did confirm with some of the basic recommended design criteria.

Basically 6inch diameter gravel pumps fed sluice boxes varying in width from 4ft to 6ft, while 4inch diameter gravel pumps were matched with sluice boxes varying in width from 2ft 6inches to 3ft 6 inches.

Sluice box varied from 7ft to 12ft in lengths, but were more commonly found in sections 8ft to 10ft in length.

There were a few operations that utilized a combination of angle iron and expanded metal riffles, but the preference was for expanded metal sections fitted with Nomad matting. Whether this directly related to gold size distribution rather than proven successful trials were not confirmed.

It was noted that section widths of sluice boxes were basically the same when a section of angle iron riffles was followed or preceded by a section of expanded metal riffles.

### 6.6 Utilization of GGMC/GENCAPD Mercury Retort

Of the thirty-four (34) mining operations visited only five (5) were in possession of a mercury retort, though all were Brazilian manufactured. There was one operation that possessed a device that they had fabricated.

Even though most miners were aware of some of the dangers associated with use of mercury, there was a lack of knowledge of the corresponding procedures and precautions required for proper handling of mercury. This was quite evident from discussions with miners, where there was the impression that during gold amalgam in a saucepan, with a cover, away from the camp was an adequate handling procedure.

### 6.7 Establishment of "Self-Monitoring Environmental Groups"

From discussions, the concept of having groups of individuals (from within the mining community) monitoring the effect of the mining activities on the environment is adoptable.

The formation of these groups are dependent on: the centralization of mining activities within a local area, as greater opportunities exist where there are larger concentrations of miners within a specific area; the proximity of mining activities to the local community, since residence, other than miners, could be more conscious of possible effects of mining activities on the environment, especially if it affects their way of life; the environmental awareness of the miners and the local community; and teaching of the concept of sustainable mining.

## 7.0 CONCLUSION

There was evidence of some miners and residence being aware of the environmental issues surrounding the small-scale gold and diamond industry. This was mainly expressed as a concern over the amount large mined-out pits or settling ponds and the poor

condition of some streams (especially if they had previously been the source of water for domestic purposes or if individuals had developed skin rashes after using the water). On occasions, miners expressed appreciation for the discourse and the information divulged during field visits. The fact that there are miners still operating in an environmentally unfriendly manner, due to lack of information or commitment, dictates the need for the continuation of this awareness programme.

In-mine discussions with miners were often encouraging. With increasing evidence of totally enclosed "closed circuit" recycle water system and overburden removal by backhoes (maybe a function of greater accessibility), the main pollution problems remain the development of acceptable techniques (applicable to all situations) to confine the tailings from the first mining pits and the development of rapid filtration systems to achieve the desired quality of effluents released to the environment.

Evening group discussion sessions is an effective means of information transfer and provides a forum for reinforcing issues that are applicable to a wider cross-section of individuals. Even though attendance at the one evening session held at Baramalli was below expectation, due to the inclement weather, discussions were purposeful. Two of the main developments from this session were:

i). Pertinent information, for miners, must be circulated in both English and Portuguese.

ii). Enough interest was generated among the attendees, for the selection of a core of individuals, for the formation of a "Self-Monitoring Environmental Group".

There was no evidence of GGMC/GENCAPD mercury retort being used at locations visited. A few miners were utilizing the Brazilian type mercury retort, but the majority was burning amalgam in some form of contraption that does not meet the basic safety requirements. Having stated this, it was noted that a few miners were exposed to previous environmental awareness sessions hence were aware of the purpose of having a mercury retort.

There was a wide variety in design and construction of sluice boxes in this district, but generally most will include a section of expanded metal secured over some type of matting.

## 8.0 RECOMMENDATIONS

The environmental awareness programme should be continued with the intention of meeting as many individuals, connected with the small-scale gold and diamond industry, as possible. Special sessions should be arranged for concession and claim holders, rangers and dredge owners in order to have their support.

Available literature, for example, fact sheets on mercury, mercury retort, tailings management and sluice box operation should be made available to miners as this would improve there knowledge and support new concepts and requirement.

The authorities (GGMC and GGDMA) should ensure that mercury retorts are available to miners at affordable prices.

Pilot projects on the implementation of progressive land reclamation systems and appropriate tailings management systems should be undertaken to demonstrate to their viability to the miners. With the increasing utilization of the more capable and productive backhoe excavators, this need is now urgent.

Lloyd Stephen
Miners' Environmental Officer

## LIST OF REFERENCE


1. Clarkson, R. (1999). **Mahdia Summary Report**, Small Scale Alluvial Demonstration Project, GENCAPD, Georgetown, Guyana, pp 22.

2. Styles, M. T., Simpson, J. and Steadman, E. J. (2002). **Commissioned Report CR/02/029N, DFID KAR Project R7120**, Good Practice In The Design And Use Of Large Sluice Boxes, British Geological Services, pp 17-23.

3. Styles, M. T., Simpson, J. and Steadman, E. J. (2002). **Commissioned Report CR/02/029N, DFID KAR Project R7120**, Good Practice In The Design And Use Of Large Sluice Boxes, British Geological Services, pp 39.

# APPENDIX A

## EXPENDITURE

This expenditure does not include the cost of administrative overheads.

| | |
|---|---|
| Budgeted cost for trip | - G$244,020.00 |
| Amount received for trip | - G$245,000.00 |
| Actual cost | - G$185,155.00 |
| Cash returned | - G$ 59,845.00 |

**APPENDIX B**

**Photo 1 –** A closed-circuit recycled water system established at Nihuse's hydraulicking operation at Baramalli.


**Photo 2 –** Uncontrolled flow of tailings into bushes, Philbert Fraser's operations at Arawak.

**Photo 3 –** Old mined-out pit being backfilled, N. Hopkinson's operations at Quartz Stone.

**Photo 4 –** Crude system of indigenous material used to confine tailings solids at Filhio's operation, Baramalli.

**Photo 5 –** A series of partly filled mined-out pits at Aremu

**Photo 6 –** Carlito's mining operations at Baramalli consisting of clean min pit, good pit definition and mine configuration and a closed-circuit recycle water system all totally enclosed within an outer perimeter dam.


**Photo 7 –** Part of a series of mined-out pits (filled with water) at Baramalli.


**Photo 8 –** The deplorable main access to route Baramalli.

**Photo 9 –** A fully covered water well with perimeter drainage, De Almeida's operation at Baramalli.

**Photo 10 –** Aliveira da Silva's operation at Baramalli, with need for improved safety, through debushing and pit clearance.


**Photo 11 –** Good pit configuration with, well defined pit faces at Araujo's operation, Middle Aremu. Note, vertical pit faces (25 to 30ft.) deep with overburden Overcastted close to the edge of the mining face.

**Photo 12 –** Good water quality of the Aremu River above De Maria's (the upper most) operation.


**Photo 13 –** Extremely turbid water of Aremu River, at bridge before GGMC's camp.

**Photo 14 –** Typical sluice box set, G. Costa's operation at Baramalli.

**Photo 15 –** Operation of Robinson's unique sluice box at Aremu.