

## PURPOSE OF THE MISSION

The visit to the Solomon Islands was planned as one of a series of visits to SOPAC member countries with the objective of providing support to the development of project plans in the water and sanitation sector. The visit was co-ordinated by the Water Resources Division (WRD) of the Ministry of Energy, Water and Mineral Resources (MEWMR), Solomon Islands Government (SIG). Specific tasks planned for the visit included the following:

- Review and discuss existing data collection system,
- Carry out on-site staff training,
- Review progress on Guadalcanal Plains groundwater availability guide,
- Collect data on activities that may affect groundwater quality,
- Prepare recommendations for groundwater pollution study,
- Review current status of water resources legislation, and
- Preliminary discussions on SOPAC's water demand management project.

The planned activities for the visit is reproduced in Appendix 1. To some extent power cuts during the first week of the visit and unplanned activities interfered with that timetable. Nevertheless the visit provided sufficient time to address all the above tasks.

## RESULTS

The results of the visit achieved are summarised using the framework provided by the list of tasks as recorded below. Possible follow up actions are noted in italics:

### ***Review and discuss existing data collection system***

Results achieved were largely concerned with the organisation and archiving of data. The storage of hydrogeological data has now been modified to match the current organisation of surface water data. The system for off-site archiving of data should be extended to include this full range of types of data.

***It would be feasible for SOPAC to provide an off-site database archive facility for water resource authorities within the region. If the current WRD arrangement with NIWA becomes unsatisfactory for any reason this option should be explored.***

Computer viruses pose a potential threat for the data archive and a strategy for control of viruses has been recommended (Appendix 4).

***The current virus data files should be updated and a system established to keep them up-to-date in the future (Scott).***

### ***Carry out on site staff training***

On-site training with surface resistivity sounding surveys included field work, fault diagnosis and survey interpretation. Improvements to field procedure were suggested, equipment problems were traced to a cable fault and alternatives to the RESIST method were introduced (Appendix 5).

***Faulty cable carried to SOPAC for repair. Sample Schlumberger sounding provided for comment (Scott and Ricci)***

### ***Review progress on Guadalcanal Plains groundwater availability guide***

There has been almost no progress on this since Lekelalu's attachment at SOPAC in September. This has been largely due to his subsequent training visit to Japan as part of

JICA's assistance with water resources development for Honiara. It has been further constrained by the problems encountered with printing from MapInfo. That particular difficulty has been resolved.

***WRD should persevere with the project and forward a draft to SOPAC for review and comment (Lekelalu).***

***Collect data on activities that may affect groundwater quality***

Three different activities are of concern: mining at Gold Ridge, a possible new site for solid waste disposal for Honiara and a proposed new cemetery site for Honiara. Issues arising from Gold Ridge mining were largely dealt with by the establishment of a working group to plan and co-ordinate the necessary monitoring activities. Specialist technical assistance with the design and review of environmental monitoring may be requested from a variety of sources.

***Request advice from within SOPAC and Fiji MRD on approaches to environmental monitoring of mining impacts (Scott).***

Though future solid waste disposal may have impacts on groundwater quality the main difficulty at this stage appears to be the lack of co-ordination with the new landfill planning which does not appear to be co-ordinated. Honiara Town Council could benefit from the establishment of some sort of formal liaison with other concerned authorities. Case studies on the approach taken in other areas and technical assistance may be desirable.

***Supply copies of recent solid waste management plan and discuss issue with SPREP (Burke).***

A proposed cemetery site behind Henderson airfield was visited. Potential impacts on groundwater at this site should be approached by determining the natural quality of groundwater in that area and also by establishing other plans for land-use in the vicinity. The site may be within the area of saline groundwater and so productive uses of groundwater may be limited. On the other hand it is possible that high groundwater levels may compromise the use of the site as a cemetery.

***Surface resistivity and drilling to determine groundwater quality. Groundwater level monitoring (monthly through a wet season) to determine range of depth to groundwater (Lekelalu).***

***Prepare recommendations for groundwater pollution study***

This item was intended to address the question of possible pollution from a proposed landfill. However, since no firm sites have been selected detailed recommendations were not prepared.

***Review current status of water resources legislation***

A draft bill has been prepared which has been based on the work done by a UNDP legal advisor in 1988. There are a number of omissions from that draft (e.g. the question of ownership of water is not addressed). Experience with the preparation of mining legislation has demonstrated the importance of consultation. A draft Cabinet paper has been prepared recommending that MEWMR proceed with the consultation required to formulate new legislation.

Information about water legislation has already been obtained from PNG and Vanuatu. From discussion with John Chaniel (UNELCO) I understand that ADB is funding an Environmental Legislation Study in Vanuatu and useful insights may be gained by updating the information from Vanuatu (Contacts: George De Romilly, David Hill, Graham Roberts,

Local co-ordinator Peter Moodie (Kinhill Kramer), Ph +678 23457.  
The consultative process within Solomon Islands may gain considerable benefit from appropriate technical input. WRD may consider requesting that from the Commonwealth Fund for Technical Co-operation.

***Preliminary discussions on SOPAC's water demand management project***

Makini (SIWA) is interested in re-establishing the former effort on leakage control and would like to be involved in the planned Pacific Water Association workshop on demand management. It appears that previous efforts came to an end at about the time that SIWA was established and key staff took the option of redundancy. Those remaining did not have sufficient understanding of the underlying principles to maintain the operation.

***SOPAC to provide SWIA with guidelines for workshop contribution and enter into discussions on possible project collaboration (Burke).***

***Miscellaneous***

The current concern about water shortages in parts of Solomon Islands (Appendix 7) led to discussion about drought management and options for dual water supplies. It may be helpful for SOPAC to collate and distribute information on those topics. Future work on drought mitigation and management could complement some of SOPAC's other hazards related work.

SOPAC's sanitation information should be disseminated to the RWSS Project and SIWA.

## **APPENDICES**

Appendix 1: Travel Itinerary and Activities

Appendix 2: Contacts

Appendix 3: References

Appendix 4: Controlling Computer Viruses

Appendix 5: Surface Resistivity Surveys

Appendix 6: Environmental Monitoring

Appendix 7: Newspaper cutting.

## **Appendix 1: Travel Itinerary and Activities**

### **TRAVEL ITINERARY**

**Tuesday, 25 November** - Suva to Honiara (via Nadi & Vila).

**Tuesday, 9 December** - Honiara to Suva (via Vila & Nadi).

### **ACTIVITIES OF THE TRIP**

#### **Wednesday, 26 November**

MEWMR Office all day in discussions with Charlie Bepapa, Isaac Lekelalu and Michael Maehaka reviewing current status of WRD activities. Discussed the "Integrated Water Resources Management Project Proposal" (prepared for submission to UNESCO); in particular the SIG commitments that would be involved and the related hydro-power planning issues.

Discussed the planned Water Resources Legislation and obtained background information to review prior to subsequent discussions.

Made an initial attempt to load updated Epson printer drivers but was confounded by apparent incompatibility with removable Zip drive and frequent power cuts.

Received invitation to briefing on Gold Ridge Mine and supplied with background project information relating to environmental impacts and monitoring.

#### **Thursday, 27 November**

Morning - Iron Bottom Hotel for briefing from Ross Mining on the Gold Ridge Mine. The meeting of SIG officials and advisors was given a report on project progress, an assessment of the implications of current low gold prices and an update on recent exploration drilling. Proposed variations to the project were outlined: changes to the tailings pipeline design and a redesign of the tailings dam. The latter resulting from the improved topographic data available after forest clearance.

Afternoon - MEWMR Office

Discussed proposed water resources legislation with Lekelalu and Bepapa, concentrating on the status of the current draft and the procedure to follow to advance.

Bepapa provided some background to the current drought problem within Solomon Islands. He had recently visited Bellona as a member of a SIG team to report to the National Disaster Council.

Examined the reported MapInfo printing problem. Confirmed that Forestry, Water and Geology Divisions all use MapInfo v3.0 and have not taken advantage of the 3.0.2 & 3.0.5 upgrades (Mapping had a copy on CD). Also established that earlier updates to the Epson printer drivers had not been loaded. This suggests that updates are being supplied without adequate instructions on how to install them. Learnt that MEWMR computers have been infected by a number of viruses and that control measures have either not been installed or not kept up to date.

#### **Friday, 28 November**

Morning - Visits with Lekelalu to Rural Water Supply & Sanitation (RWSS) Project Office,

Ministry of Health and Medical Services and Solomon Islands Water Authority. At RWSS met with Patterson & Ruku and were briefed on the status of the project. A representative from RWSS had attended the solar pumping workshop but little was known of SOPAC's role in water and sanitation. I provided a copy of the newsletter and undertook to supply some relevant literature. Next met with Beauchamp, Drew and Haikau and learnt about the RWSS efforts to establish a GIS. This appears to have been complicated by the changing village names and numbers. Nevertheless it will be useful for WRD to keep in touch with that part of the RWSS to share data and experience with MapInfo.

Met with Makini of Solomon Islands Water Authority (SIWA). He expressed support for the Pacific Water Association and would be interested in attending and contributing to a workshop on demand management. He also hoped that another person might be able to attend from SIWA. A loss control program had been established within the Water Supply Unit with technical assistance from the UNDP. However the loss of technical staff at the time SIWA was established brought this to an end. Makini felt that staff trained under the UNDP project had been trained in a particular method without being given an adequate understanding of the underlying principles. As a result when key pieces of equipment failed they were unable to improvise.

SIWA has a keen interest in water resources legislation, particularly if it helps to clarify the issue of ownership of water. They currently face large claims from landowners who claim ownership of groundwater and surface water resources within their land.

In addition to being responsible for urban water supply in the Solomon Islands, SIWA also has responsibility for sanitation and should be included on the distribution list for any appropriate information.

Afternoon - MEWMR Office.

Worked on cleaning viruses having discovered that Energy Division computer was clean (courtesy of the Forum Secretariat Energy Project which supplies updates of the McAfee Viruscan program). Prepared recommendations for WRD to follow in future (Appendix 4) and instructed Maehaka in procedures to clean other PC's in MEWMR. Once viruses were removed from the WRD Windows95 machine the problems with the CDROM drive and the removable Zip drive were resolved. Viruses encountered included the following: ANTIEXE, ANTICMOS, CONCEPT, NPAD, DENZUKO 1 and DULL BOY. In some instances the ANTICMOS, DENZUKO 1 and DULL BOY viruses were detected but not cleaned by the version of McAfee currently available within MEWMR. SOPAC could play a useful role by continuing and extending the Energy Program's initiative.

### ***Monday, 1 December***

Morning - Visit with Bepapa and other staff of WRD to Lungga Village and the Gold Ridge project area. The village has been established as part of the Gold Ridge project on 500 ha of freehold land allocated by the SIG. Over 800 people have been moved from the site of the mining lease and most have chosen to relocate to Lungga Village. Reticulated water supply derives water from boreholes with consumption in excess of 100 litres per person per day being reported. Sanitation is largely by ventilated pit latrine. Evaporation pits for grey water are being trailed in some areas. At Gold Ridge we were given a presentation on the mining and gold recovery processes and shown the area being prepared for tailings storage, the access road and the actual mine and plant site areas where crushing and treatment facilities are under construction. Earthwork operations appeared to be well managed and contained. Measures to control runoff and stabilise slopes by temporary cover and planting are testimony to the mining company's commitment to environmental standards. The company has undertaken to contain all waste and tailings material.

Afternoon - MEWMR Office. Discussion with Lekelalu & Maehaka on the organisation of

archives and other computer files. Revised the current system so that surface water and groundwater data were handled in a consistent way.

***Tuesday, 2 December***

MEWMR Office all day. Completed re-organisation of archives, data and user files. Dealt with the MapInfo printing problem with the co-operation of the RWWS project. The problem appears to have been an incompatibility between MapInfo v3.0 and Windows95. Discussions with Tolia & Bepapa about the status of plans to get a training to assist with the establishment of Gold Ridge monitoring. Established that it would be appropriate for SIG to begin before that happens.

***Wednesday, 3 December***

MEWMR Office all day. Met with Tolia, Bepapa & Lekelalu to discuss legislation and environmental monitoring for Gold Ridge. Bepapa agreed to prepare a Cabinet paper on the legislation and to arrange a meeting to discuss monitoring with other SIG officials on Monday 8 December. Also discussed the Honiara Town Council's solid waste disposal problems and confirmed that Lekelalu and I would meet with officials from the Council on Friday 5 December.

Set up and demonstrated Excel based method for processing Offset Wenner Data (details in Appendix 5).

***Thursday, 4 December***

Morning - Surface resistivity trials at Henderson airfield. Offset Wenner and Schlumberger soundings undertaken. Offset Wenner system proved to be faulty. Inspected existing Honiara Rubbish Dump at Ranadi. This is an open dump which was burning freely at the time of our visit. Waste handling does not appear to have improved at all since the WHO assignment in 1990. At that time Ogawa (1990) recommended that, if necessary, the area could continue to be used by adding an additional layer of refuse but that the area should not expand horizontally. In fact the area has been expanded and former fill areas which could have been used to take additional material have been allocated for other uses, probably prematurely considering Ogawa's advice to leave the area unused for at least 5 years (preferably more than 10). The reduced area now available is increasingly encroaching on Burns Creek.

Afternoon - MEWMR Office. Surface resistivity equipment testing.

***Friday, 5 December***

Morning - Visit with Lekelalu to Honiara Town Council. Discussed approach to planning for new landfill with HTC staff and visited possible site behind Betikama High School. Already objections have been raised by the school and by parties concerned that it is on the flight path to Henderson airfield. There is an obvious need for better co-ordination and communication if this matter is going to be dealt with in an effective way and Pallay (HTC Planner) suggested that THC could establish a working group or committee to promote that

Also visited a proposed cemetery site which was located beyond Henderson Airfield near Alligator Creek. Apart from the distance from Honiara the site may have the additional problem of high groundwater levels. WRD have been asked to comment on the suitability of the site in relation to its potential to contaminate groundwater.

Afternoon - MEWMR office. Briefing from Bepapa about meeting with National Disaster Council who are looking for some sort of methodology for measuring drought severity to assist with prioritisation. Drought is a class of hazard which could gain more specific attention within SOPAC's future work program.

Continued with Offset Wenner equipment testing and established that the problem is in one

of the multicore cables (details in Appendix 5).

***Monday, 8 December***

Morning - Meeting at MEWMR Office (Tolia, Natoga, Magu, Bepapa, Lekelalu, Mahoa) on the Environmental Management and Monitoring Programme for Gold Ridge. Resolved to form a working group with the objective of monitoring the impacts on the physical environment of the Gold Ridge Project and to report to the Government's Environment and Social Impact Committee. Membership of the working group was decided and the immediate requirements for on-going monitoring discussed.

Afternoon – debrief with Bepapa and Lekelalu. Arranged to bring faulty Offset Wenner cable to SOPAC for repair. Obtained copies of monthly and daily rainfall data for SOPAC study of rainwater catchment systems. Read and commented on a draft Cabinet Paper proposing work on the formulation of new water resources legislation.



## **Appendix 2: Contacts**

Mr Mike Beauchamp, Project Coordinator/Australian Team Manager, Solomon Islands Rural Water Supply and Sanitation Project, Coffey MPW Pty Ltd

Mr Charlie Bepapa, Chief Water Resources Officer, Water Resources Division, MEWMR

Ms Methilda Boli, Assistant Health Inspector, Honiara Town Council

Mr John Chanel, UNELCO, Vila, Vanuatu

Mr Stephen Danitofea, Permanent Secretary, MEWMR

Mr Geoff Drew, Coffey MPW Pty Ltd

Mr Ken Ferris, Gold Ridge Mining Ltd

Mr John Gorosi, Director, Energy Division, MEWMR

Mr Martin Haikau, RWWS Project, MHMS

Mr Isaac Lekelalu, Principal Hydrogeologist, Water Resources Division, MEWMR

Mr Michael Maehaka, Database Manager, Water Resources Division, MEWMR

Mr Rennel Magu, Chief Geochemist, Geology Division, MEWMR

Mr Henry Mahoa, Principal Geochemist, Geology Division, MEWMR

Mr Donald Makini, General Manager, Solomon Islands Water Authority

Mr David Natoga, Mines Section, MEWMR

Mr Matthew Orr, Environmental Manager, Ross Mining N.L.

Mr Amon Pallay, Physical Planner, Honiara Town Council

Mr Bob Patterson, Project Manager, RWWS Project, MHMS

Mr Bruce Robertson, Executive Director, Ross Mining N.L.

Mr Buddley Ronnie, Physical Planner, Honiara Town Council

Mr Chris Ruku, Chief Health Inspector, MHMS

Mr Donn Tolia, Director, Mineral Resources Division, MEWMR

### Appendix 3: References

Fraser Osborn (Qld) Pty Ltd Dewatering of Open Pits

Gold Ridge Mining Ltd 1997, Environmental Management Plan, May 1997

Ross Mining N.L. Gold Guideline for Ridge Project, Environmental Impact Study

Ross Mining N.L. 1997 Gold Ridge Project, Tailings and Return Water Dams, Water Balance Modelling.

Tickell. S.J. 1985 Geology of the Honiara Urban Area. Report RI/85 (waiting for publication and missing a map). Ministry of Energy, Water and Mineral Resources.

Commonwealth Science Council 1990 Water Resources Management Techniques for Small Island Countries. Report of an Inter-regional Seminar, Fiji. CSC(90)WMR-14, PD282.

United Nations 1993 Computer Applications for Groundwater Assessment and Management. Water Resources Series No. 73, ESACP.

Lawrence, J.H., Smith, D.G. 1983 Water and Soil Guideline for Mining. Water & Soil Management Publication No. 9, Water and Soil Division, Ministry of Works and Development.

Curry, R.J. 1997 Solomon Islands Water Resources Project 1982-1996: Project Completion Report. Report prepared for New Zealand Ministry of Foreign Affairs & Trade, Overseas Development Assistance.

Solanes, M.R. 1988 Mission report to the Solomon Islands 3 to 9 September 1987.

*Executive summary provides useful summary of the following:*

*Assessment of Water Legislation*

*Recommendations for Future Water Legislation*

- *Relationships between land and water legislation*
- *Customary Law*
- *Water ownership and rights of use*
- *Drinking water supply*
- *Drainage and sanitation*
- *Restrictions to private ownership*
- *Protection of water resources*
- *Sanctions and penalties*
- *Procedural aspects*
- *Financial aspects*

*The Structure of the Government*

- *Water Resources Council*
- *Allocation of functions amongst Ministries*

Solomon Islands Government 1997 Statement of Policies by Solomon Islands Alliance for Change (SIAC) 1997 - 20001.

*In relation to Water Resources states that "Government recognises the importance of available water resources, both for human consumption and industrial development, as well as provision of energy".*

*Policies with respect to land states that "...a review will be carried out on all legislation*

*[water, minerals, fisheries, timber etc] that affect our indigenous people's concept of ownership ie. 'ownership of the whole' under ground, surface, living things, non-living things, water, air, sky and spirit, with the view to minimise government's statutory ownership of our people's natural resources."*

*Consistent with that the Legislative Programme includes "review and/or amend Rivers and Water Act".*

White, P.A. and D.M. Scott 1991 RESIST: A program for interpreting Offset Wenner Soundings, Geophysics Division Technical Report No. 115, DSIR Geology & Geophysics, New Zealand.

## Appendix 4: Controlling Computer Viruses

### CONTROLLING COMPUTER VIRUSES RECOMMENDATIONS FOR WATER RESOURCES DIVISION

#### Introduction

The IPC 486 PC (Windows v3.1) and the Compaq Pentium (Windows95) have been infected by computer viruses. Traces of the CONCEPT, NPAD and ANTIEXE viruses were found on both machines and it is likely that the majority of floppy disks in the Division are also infected. These viruses appear to have been responsible for the failure of the CDROM on the Compaq and the incompatibility with my Iomega Zip drive. Both these problems disappeared once the viruses were cleaned from the PC. The ANTIEXE virus also infected SOPAC's laptop computer and interfered with the hard disk drive. Virus protection software was installed on that computer but its use was optional. That problem was also corrected once the virus was cleaned from the PC.

Two PC's in the Geology Division (Mapping & Geochemistry) are also infected by viruses. This is despite the fact that the VirusShield program has been installed on the Mapping PC. By contrast the PC in the Energy Division appears to be free of viruses. That PC also has the VirusShield program installed but, in addition, arrangements are in place to keep the virus data files up to date.

Since the computers were infected by a boot sector virus it was necessary to boot the computer from a virus free floppy disk. No clean bootable floppy disks could be located within the Ministry. Fortunately, because the Energy Division PC appeared to be virus free, it was possible to reformat a disk and copy the operating system files to it.

Though it appears that no data or program files have been permanently damaged this is simply because the systems have not been exposed to viruses which have those effects. Without safeguards in place the systems are at risk of infection from more damaging viruses.

There are some obvious lessons to be learnt from this situation:

- Computer viruses, though sometimes benign, can have serious effects and should be guarded against
- The VirusShield program is of limited use if the virus data files are not kept up to date or if its use is optional
- Recovery disks should be created for all PC's and kept, along with distribution copies of software, away from other disks

#### Recommendations

I recommend that the Water Resources Division should implement a strategy designed to protect their systems from future infection. This should involve an initial cleanup (already partially completed) and on-going measures

#### *Initial Cleanup*

- 1) Clean viruses from WRD computers and install VirusShield system (already done for IPC 486 & Compaq Pentium. NB there is some sort of conflict with the VirusShield on the IPC PC which still has to be resolved)
- 2) Create recovery disks for each computer and store with distribution copies of software apart from other disks
- 3) Check for viruses all WRD floppy disks in current use
- 4) Identify all PC's in the Ministry with which files are exchanged and check for viruses

#### *On-going Measures*

- 1) Maintain procedures which ensure that computers are operated with the VirusShield active (i.e loaded in the standard startup)
- 2) Scan all incoming disks for viruses
- 3) Keep the virus data up to date (NB The Forum Secretariat Energy Program is transferring to SOPAC and it may be possible to extend the service previously provided to the Energy Division)

David Scott  
CFTC Hydrogeologist, SOPAC  
30 November 1997

## **COMPUTER VIRUSES - Excerpts from the McAfee VirusShield Help Document**

### **What is a computer virus**

A computer virus is a software program that attaches itself to another program in computer memory or on a disk, and spreads from one program to another. Viruses can damage data, cause computers to crash, display offending or bothersome messages, or lie dormant until such time they are set to "awaken."

### **Why do I need to scan for viruses?**

In today's industry, scanning is no longer considered to be an extravagance - but a necessity. Computer viruses no longer attack your computing environment but all other computing environments which you contact. Computer viruses can attach and later propagate themselves through disks and files. Important information and hardware losses could plague your computing environment should you not take the proper precautions. McAfee's anti-virus line of products heads up the list of proper precautions. Scheduled periodic scans of your computing environment can offer you that added assurance that you are practicing "safe computing."

### **Preventing Viruses**

Although McAfee VirusScan is designed to offer you the highest degree of virus protection, detection and eradication available, no anti-virus program can prevent all computer viruses. Even with frequent updates, new viruses currently appear at a rate of three to four a day, and this number may certainly grow even higher in the future.

Keeping your anti-virus software current is one way to prevent the overwhelming majority of computer viruses from infecting your system. However, by following the steps listed below, you can greatly reduce the chance of becoming infected.

Never boot your PC with a floppy diskette in Drive A:

Although boot viruses only account for approximately 10% of the total number of computer viruses, they account for over 90% of reported virus infections. This is because all formatted diskettes, even data diskettes, contain a boot sector that the computer attempts to execute when started. Even if this attempt is unsuccessful, a virus in the boot sector is read into memory and executed, at which point it can infect the hard disk.

Use software only from reputable sources

When purchasing commercial software, be sure that the software is in its original packaging and has not been previously used and returned.

When using BBSs, check with the Systems Operator about their scanning procedures. Many System Operators scan for viruses before making files available for downloading.

Most commercial electronic services such as CompuServe and America Online scan files for viruses before making them available for downloading.

Scan all incoming disks and files for viruses

You should scan all diskettes and files you receive for viruses before using them. This includes: purchased programs, downloaded programs, demonstration diskettes, diskettes from friends and coworkers, and your diskettes after they have been used in another computer.

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## Appendix 5: Surface Resistivity Surveys

### Background

The Water Resources Division has been undertaking surface resistivity soundings for many years using the Offset Wenner array (ABEM Terrameter SAS 300 together with BGS256 Offset Wenner system). The JICA project, which used geophysics to explore for groundwater around Honiara, introduced the use of the Schlumberger array and left the Division with the cables and electrodes required to do Schlumberger soundings. When the Offset Wenner system began to report errors the BGS switch box was suspected to be at fault and, as a consequence, the Division has been using the Schlumberger array in recent months. The suspect switch box was sent to SOPAC for inspection. It was cleaned and returned without any repair being deemed necessary.

A reliable system for Offset Wenner sounding data processing and interpretation (RESIST) had been developed by White and Scott (1991). That system does not support interpretation of Schlumberger soundings and, by modern standards, provides rather crude graphics output. After my last NZ ODA funded Hydrogeological Training Mission to Solomon Islands I noted that the RESIST program was becoming increasingly difficult to support and that it may be more cost effective to replace it with an alternative commercial program rather than to continue to support a program with an extremely limited user base.

### Offset Wenner system faults

Field testing of the WRD Offset Wenner system replicated earlier error messages. Substitution of the BGS256 switch box with the SOPAC unit did not eliminate the errors and suggested that the WRD unit was not faulty. Subsequent testing has confirmed that the two units are operating in the same way. Details of the test are recorded in the following Table 1.

Setting	A	C	D1	D2	B
1	D1(6) - D2(6) D1(9) - D2(9)	D1(6) - D2(9) D1(9) - D2(6)	D1(9) - D2(6)	D1(6) - D2(9)	D1(6) - D1(9) D2(9) - D2(6)
2	D1(9) - D2(9) D1(10) - D2(10)	D1(9) - D2(10) D1(10) - D2(9)	D1(10) - D2(9)	D1(9) - D2(10)	D1(9) - D1(10) D2(9) - D2(10)
3	D1(8) - D2(8) D1(10) - D2(10)	D1(8) - D2(10) D1(10) - D2(8)	D1(8) - D2(10)	D1(10) - D2(8)	D1(8) - D1(10) D2(8) - D2(10)
4	D1(5) - D2(5) D1(8) - D2(8)	D1(5) - D2(8) D1(8) - D2(5)	D1(5) - D2(8)	D1(8) - D2(5)	D1(5) - D1(8) D2(5) - D2(8)
5	D1(2) - D2(2) D1(5) - D2(5)	D1(2) - D2(5) D1(5) - D2(2)	D1(2) - D2(5)	D1(5) - D2(2)	D1(2) - D1(5) D2(2) - D2(5)
6	D1(1) - D2(1) D1(2) - D2(2)	D1(1) - D2(2) D1(2) - D2(1)	D1(1) - D2(2)	D1(2) - D2(1)	D1(1) - D1(2) D2(1) - D2(2)
7	D1(1) - D2(1) D1(3) - D2(3)	D1(1) - D2(3) D1(3) - D2(1)	D1(3) - D2(1)	D1(1) - D2(3)	D1(1) - D1(3) D2(1) - D2(3)
8	D1(3) - D2(3) D1(7) - D2(7)	D1(3) - D2(7) D1(7) - D2(3)	D1(7) - D2(3)	D1(3) - D2(7)	D1(3) - D1(7) D2(3) - D2(7)
9	D1(4) - D2(4) D1(7) - D2(7)	D1(4) - D2(7) D1(7) - D2(4)	D1(4) - D2(7)	D1(7) - D2(4)	D1(4) - D1(7) D2(4) - D2(7)

Table 1: Multicore plug pin combinations with BGS256 switch in test mode with Terminals C1 & C2 connected and P1 & P2 connected.  
(NB: pin numbering scheme shown in Figure 1)

Further testing has now suggested that one of the multicore cables may be faulty. The fault could be within the multicore plug (which may be possible to repair at SOPAC). Alternatively the fault could be along the cable length or at the connection with the electrode connector point. Advice on the most likely fault and possible remedies should be available from Birmingham Geophysical Systems.

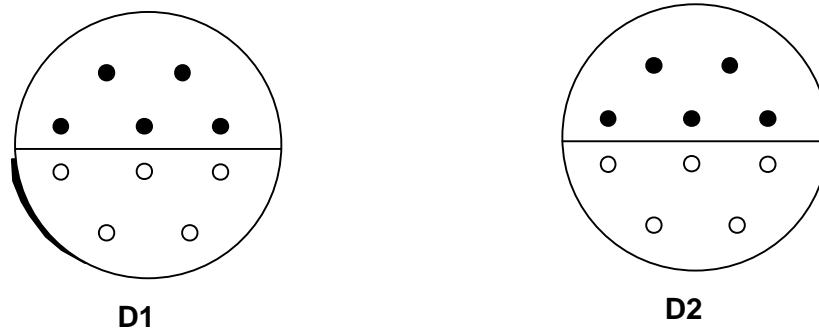


Figure 1: Multicore connector pin numbering scheme used in Table 1.

**\*Alternatives to RESIST**

The RESIST program provides for the processing of field data collected using the Offset Wenner System and subsequent interpretation. If WRD finds an alternative to RESIST which caters for Wenner and Schlumberger soundings (such as RINVERT) it will still be desirable to have a system for the processing of Offset Wenner data. I have prepared an Excel workbook (OFFSET.XLS) to undertake that function of the RESIST program. That workbook calculates and plots observation errors and Wenner resistivities (Table 2 and Figures 2 and 3). Spacing and resistivity data can be simply pasted into the Windows Notepad application to facilitate its import into a sounding interpretation package.

Site:	Ref No:	Weather
Observers:	Bearing:	Topography:
Date:	Soil Condition:	Geology

Setting (n)	Observed Measurements					Errors			Spacing (metres)	Wenner Resistivity
	RA	RC	RD1	RD2	RB	Obs	Offset	Lateral		
1	65.5	60.9	42.6	51.5	4.42	0.28	-18.92		0.5	147.812
2	38.6	36.3	25.7	29.7	2.36	-0.16	-14.44	-0.605	1.0	174.044
3	23.9	22.7	15.3	17.5	1.36	-0.67	-13.41	-4.534	1.5	188.327
									2.0	206.088
									3.0	244.522
4	16.8	15.6	11	12.1	1.25	-0.30	-9.52	-7.780	4.0	290.283
									6.0	384.255
									8.0	454.902
5	13.3	12.5	8.5	9.6	0.773	0.20	-12.15	11.009	12.0	556.110
									16.0	668.530
									24.0	755.673
6	9.31	8.78	6.35	6.95	0.53	0.00	-9.02	-4.141	32.0	776.098
									48.0	767.797
									64.0	659.483
7	5.03	4.68	3.75	3.97	0.325	0.50	-5.70	-10.363	96.0	429.626
									128.0	120.637
8	1.87	1.7	1.63	1.65	0.142	1.51	-1.22	-1.422		
9	0.95	0.87	0.15	0.15	0.105	-2.60	0.00	2.902		
					<b>RMS</b>	1.05	11.06	6.12		

Table 2: Data form from OFFSET.XLS. Only the sounding description fields and the columns in the Observed Measurements part of the form can be modified by the user.

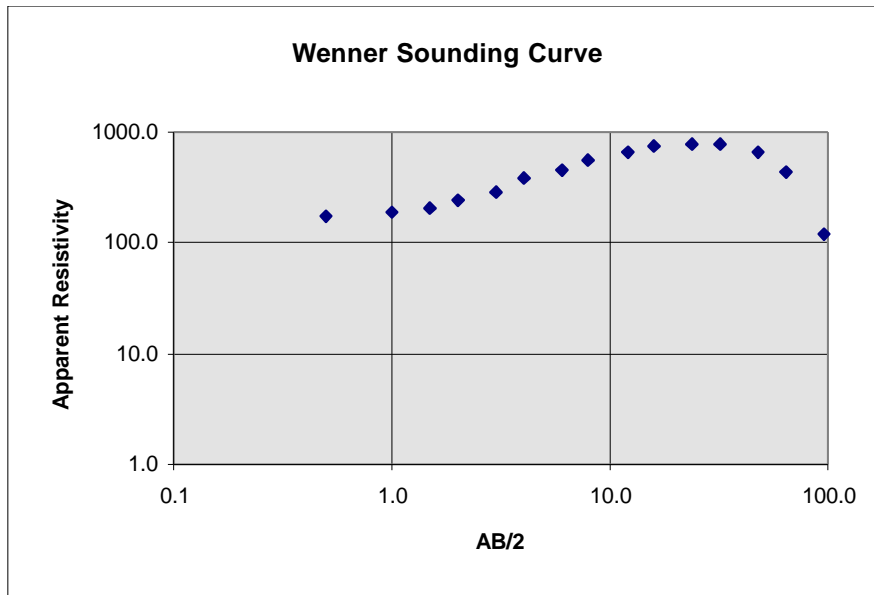


Figure 2: Wenner Sounding curve as produced by OFFSET.XLS

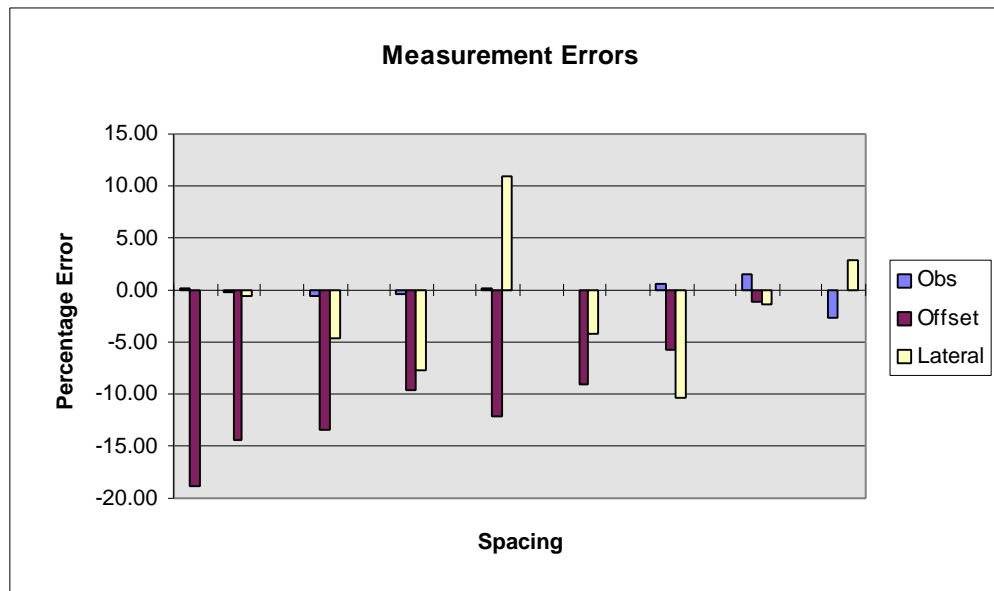


Figure 3: Measurement errors displayed by OFFSET.XLS.

### Guidelines for processing of Schlumberger soundings

Previous training on surface resistivity soundings has largely concentrated on the Offset Wenner system and the interpretation of the Wenner resistivity data. The Schlumberger array requires some pre-interpretation adjustment of calculated apparent resistivities to take account of the effects of changes in potential electrode spacing. If equipment problems continue to limit the use of the Offset Wenner system it could be useful for WRD to have interpretations checked in order to ensure that a sound understanding is developing. In the past Paul White of the NZ Institute of Geological & Nuclear Sciences has provided that sort of input on an informal basis. It may be possible to repeat that arrangement. Alternatively the SOPAC Water Resources Unit could undertake to provide that assistance.

Regardless of what is done it would be desirable to re-introduce the practice of plotting sounding data in the field; ideally before cables are rewound as this provides an opportunity to check any suspect recorded measurements. Some of the present difficulties in interpreting Schlumberger soundings may be the result of observation errors.



## **Appendix 6: Environmental Monitoring**

### **GOLD RIDGE MINING - ENVIRONMENTAL MONITORING Notes for meeting on Monday 8 December 1997**

#### **Strategy**

Given Ross Mining's voluntary commitment to high environmental standards for the Gold Ridge Project it may be appropriate for SIG to monitor the project's performance by using the company's monitoring programme together with its own independent surveillance.

#### **Review of Project Literature**

Ross Mining's Environmental Impact Study (EIS) provides details of the pre-operational environment and the anticipated effects of the project on the physical and biological environment. The report summarises available information on climate, meteorology, hydrology, water quality, soils, terrestrial flora and fauna and aquatic fauna.

#### **Project stages & related impacts**

##### **p124 Water Management**

Tailings water - to be recycled via pontoon pump and underdrain submersible pump to return water dam. Presumption is that catchment area containing railings will be watertight (including the tailings dam). Inspection downstream of the dam for seeps (measure pH) may be a useful strategy). Confirmation that the submersible pumps are yielding the expected flows would be useful to confirm that (1) tailings are draining and therefore are likely to be consolidating and (2) that underdrains are intercepting the expected flow.

##### **Rainwater**

Main strategy is diversion from potential contaminants. Direct inspection of the site may be the best way to monitor this aspect of water management since downstream monitoring is likely to raise questions of the source of sediment.

##### **p126 Dam construction**

The variation to the tailings dam design (one dam instead of three) may create some initial difficulties with topsoil management. There is likely to be a higher risk of sediment discharge in the early mine operation phase as disturbed areas are first exposed to rainfall.

##### **p127 Deposition**

Water storage and balance modelling has ignored pit inflows  
What happens if the system consistently yields more water than required?

Fax message to Charlie Bepapa on return to SOPAC (dated 15 Dec 97)

### **Environmental Monitoring**

I have spoken to Jackson Lum of SOPAC about the environmental monitoring for the Gold Ridge project. Jackson managed the development of environmental monitoring for one of Fiji's gold mines while working for the Fiji Mineral Resources Department. He also assisted with some aspects of the Gold Ridge project and so has some useful insights to offer.

Jackson recommended that SIG should require the company to carry out a period of intensive water quality monitoring once the mine goes into production. For example, this might involve sampling at a number of sites within and outside the mining lease every hour for a week or two. The purpose of this period of monitoring would be to characterise the nature (quality and timing) of releases from the operation. Once that is done it should be possible to develop a schedule for future monitoring which is most likely to detect problems. Jackson may be visiting MEWMR early next year and it would be very desirable for the Environmental Monitoring Working Group to meet with him. I suggest that you should check that possibility with Donn Tolia. Apparently Jackson is still waiting for confirmation from Donn about the visit.

Whether or not Jackson visits he would be happy to comment on whatever proposals the working group develops. If you send me minutes of meetings and any other relevant information I will undertake to discuss them with Jackson and provide a reply. Please note that I will be on leave from 22 December to 5 January.

My discussion with Jackson confirmed my impression that it would be very useful to have 1 or 2 people from Solomon Islands visit Fiji to review experience with environmental monitoring of gold mining operations. I am not sure how that could be arranged but I do know that the Commonwealth Fund for Technical Cooperation (which funds my position within SOPAC) is very keen on what they call South-South Cooperation (ie. Technical cooperation amongst developing countries) and it may be worthwhile preparing a proposal for a study tour. It could be presented as a small but critical input to ensure that a large development project does not create an environmental hazard.

Regardless of that it remains important for SIG to continue or resume monitoring of the impacts of the project site development prior to the start of mining. The site development earthworks will have created potential sources of sediment which are likely to be mobilized in the next wet season. This could have a significant impact on the surrounding environment if the control measures do not operate correctly. As we discussed a combination of water quality and sediment sampling would be desirable. It is difficult to know what frequency of monitoring should be proposed. It may be most effective to plan to monitor responses to specific rainfall events.

I hope these comments are of some assistance and look forward to hearing from you shortly.

Appendix 7: Newspaper cutting.

SOLOMON STAR  
3 Dec '97

# Bellona Island is declared disaster area

**The island of Bellona was declared by the Minister of Home Affairs, Rev Leslie Boseto as the worst affected area of the current dry weather experienced in parts of the country.**

Rev. Boseto appealed to the public for donations to assist the victims of the drought on Bellona.

He said the immediate needs are for food, water and medicine.

"The water, which is mainly from wells, is contaminated and

there has been a dramatic increase in the case of diseases such as diarrhoea, eye infection and chest infection."

The National Disaster Council through the National Disaster Management Office has been monitoring the situation through the Provincial Disaster Committees and by direct contact with the affected areas.

A technical assessment team which visited the island to assess the food, water and health situa-

tion concluded that the people on the island urgently need assistance with food, water and medicine.

Donations should be sent through the National Disaster Management Office in Honiara, Rev. Boseto said.

The National Disaster Council will continue to monitor through Provincial Disaster Committees, the effect of the dry weather on other parts of the country and appropriate action what appropriate action needed to be taken.