EXECUTIVE SUMMARY

Hydro Tasmania Consulting has been commissioned by Fiji Electricity Authority to prepare an Environmental Impact Assessment for a proposed Biomass Power Plant to be located near Savusavu on the island of Vanua Levu.

The proposed power plant will consist of a wood fired steam boiler capable of producing up to 3MW of electricity. The boiler will be powered by sawmill off cuts from nearby licenced sawmills. There will be no activity in forests or plantations that are directly associated with the power station.

The site to be developed for the power station is located in the Valaga Bay Industrial Area, adjacent to the village of Jerusalemi near Savusavu on Vanua Levu.

Terms of Reference for this project were defined in consultation with World Bank and Fiji Ministry of Environment. Both organisations have an approval interest in the proposed project but have slightly differing input requirements. This document has been prepared to address specific World Bank requirements that are additional to Fiji Ministry of Environment requirements.

Conclusion

Power consumption in Fiji is rapidly increasing, placing greater pressure on the diesel fired generation capacity. The use of diesel for power generation is a significant cost impost, increasing more than 200% since 2001, and contributes to increasing consumption of hydrocarbons and emission of greenhouse gases. As Fiji continues down the path of economic development it is likely that hydrocarbon use will increase.

Power generation at Savusavu is provided by four small diesel units. The existing power supply at Savusavu is insufficient to meet expected demand and is becoming increasingly expensive. Without the installation of additional power this situation can be expected to deteriorate. Installation of additional generation at the Savusavu site is also expected to lower the occurrence of power outages by reducing pressure on the generation and distribution network.

By using sawmill waste the proposal will:

- contribute to, and enhance, current and future renewable energy programme development by Fiji Electricity Authority;
- utilise an otherwise unused waste;
- provide economic benefit to sawmills and trucking contractors;
- reduce the need for burning of waste at sawmills thus reducing fugitive emissions;
- contribute to a reduced reliance on diesel whereby contributing to international efforts to reduce hydrocarbon consumption;
- contribute to a reduction in greenhouse gas production in Fiji;
potentially contribute to an improvement in local area air quality;

provide economic benefit to Fiji by reducing reliability on diesel.

It considered that the site proposed is appropriate. Based on this assessment it is
considered that the project aspects of greatest environmental concern are noise and
thermal water pollution. Strategies to address all identified impacts have been
recommended based on the preliminary design.

This assessment concludes that the proposal to establish a wood fired power station is a
sustainable project that will provide benefit at a National and local level, and is in
accordance with Fijis obligations under the conventions and protocols to which it is
currently a signatory. The environmental impacts identified in this assessment are
manageable through the application of conventional controls, both technological and
procedural.

A consolidated table of recommended actions is provided in Appendix 2.

**Summary of Impacts**

**Ecological**

The site is predominantly cleared at the road side, the area to be developed. The
remainder of the site comprises grass, isolated trees, coconut palms and a small area of
regrowth on the sea side of the site and along side the drainage ditch. Other than
gaining access for piping of water, development of the site will not include the
foreshore. Terrestrial habitat values at the project site and surrounding land have been
substantially modified over an extended period by land use practices. It is considered
unlikely that the construction and operation of the power station would contribute to a
further degradation of terrestrial habitat values at the site.

Cooling of the power station system will be by sea water drawn from Valaga Bay. No
additives are used in the cooling water so there is little potential for chemical pollutants
to be discharged to the bay via the cooling water discharge. Water circulated through
the cooling system will leave the boilers approximately 12°C warmer than it went in. In
order to avoid thermal pollution impacting on the local marine environment the power
station has been designed to ensure water will only be discharged to the bay once it has
been cooled to within acceptable limits. There are no reef systems known to be in close
proximity to the proposed discharge site, however, it is recommended that further
assessment to characterise the marine environment in front of the site is required.

It is considered that conventional measures for ensuring environmental protection (e.g.
fuel storage and handling, erosion and sedimentation control and vegetation
management) at a work site will be adequate for the protection of habitat values.

Potential for impacts on aquatic and marine habitat during construction and operation
exist primarily through the accidental discharge of pollutants such as fuel and oil, and
transport and deposition of sediment, from the construction site into nearby aquatic and
marine habitat.
Erosion and Sedimentation

Substantial earthworks will be required to raise the low lying areas of the site above present levels. In order to ensure that sediments are not transported off-site and into nearby waterways, and whereby degrading aquatic habitats, it is recommended that sediment containment, such as silt traps and silt fencing, is required. Measures will be required in order to manage erosion and sedimentation.

Erosion potential is considered low given the largely flat nature of the area to be developed. Notwithstanding this it is recommended that erosion control measures are required at the site. It is considered that the scale of earthworks required for the project can be easily managed through the application of conventional erosion and sedimentation control measures.

Economic

Construction and operation of the power station has a low potential to impact on the economic well being of the local community. Once design and operation details have been finalised it is recommended that opportunities for local contractors to be utilised during operation should be discussed with the community.

Social

Development of the power station has potential to impact on the well being of the nearby communities as well as those near the sawmills. Concern has been expressed by the community with regard to traffic safety, noise, air quality and water quality. It is recommended that FEA ensure the public remain well informed of the project throughout project development.

The use of off-cut wood by the power station places a value on a previously unwanted resource, waste wood for fire wood. Consequently there is potential for people who currently obtain fire wood from the sawmills to have reduced access to firewood. It is recommended that sawmills contracted to supply off cuts be required to maintain adequate wood resources at the mill and to make it available as fire wood. Similarly it is recommended that a portion of the wood delivered to the power station be made available to villagers for fire wood.

Visual

The site will be fully visible from the road and nearby residences during the construction period. It is considered that visual impacts may be partially addressed through the use of screening vegetation. While it may not be possible to screen the site from residences situated up-slope form the site, the provision of screening vegetation at the road side will help to soften the visual impact from the these locations. It is recommended that screening vegetation be established along the road and boundary of the site.

Waste

Once operational the power station will generate small quantities of general and oily waste. It is recommended that formal waste containment be provided at the power
station to facilitate weekly rubbish removal. Where possible, oily waste should be recycled.

Biomass burning generates fly ash which requires disposal. Fly ash has commercial value in operations such as cement manufacture, road base and as fertiliser. It is recommended that commercial opportunities for re-use of fly ash are investigated by FEA.

**Water**

Cooling of the power station system will be by using sea water drawn from Valaga Bay. No additives are used in the cooling water so there is little potential for chemical pollutants to be discharged to the bay via the cooling water discharge. In order to avoid thermal pollution impacting on the local marine environment the power station has been designed to ensure water will only be discharged to the bay once it has been cooled to acceptable limits.

The specific biological elements of Valaga bay, in front of the proposed development are not well understood. There are no reef systems known to be in close proximity to the proposed discharge site, however, it is recommended that further assessment to characterise the marine environment in front of the site is required.

Sediments entering the drain on the boundary have potential to contribute to potential water quality impacts. Measures to control or prevent erosion and minimise the transport of an additional sediment load into the drain are required.

**Water for Production**

Water for use in the boilers will be obtained from the town water supply. Consultation with PWD has indicated that the reticulated supply is adequate to supply the power station needs and maintain town supply. Further investigations are required to confirm the adequacy of supply.

**Air**

Biomass power plants have been shown to reduce many key air emissions when compared to conventional generation technologies in particular diesel. Stack emissions from biomass power plants can be managed through the application of conventional technologies, and active management of fuel supply and the firing process.

Conventional stack technology will be used to remove a large proportion of pollutants from the exhaust emissions although there will always be some smoke and odour evident. Particulates will be removed via an electrostatic particulate remover (ESP). ESPs are the particulate emissions control technology which is most widely used on coal-fired power generating facilities. ESP technologies are highly efficient particulate removal devices with design efficiencies in excess of 99.5%.

The preliminary design of the power station is aimed at meeting the emission requirements of the World Bank Pollution Abatement and Prevention Handbook (1998) Thermal Power Guidelines for New Power Plants. Australian National Environmental Protection Measure (NEPM) standards have been used for ambient air quality.
Greenhouse Issues

Biomass plants release carbon dioxide (CO₂), the primary greenhouse gas. However, the cycle of growing, processing and burning biomass recycles CO₂. If this cycle is sustained, there is little or no net gain in atmospheric CO₂. In this context the use of mill waste for electricity production is seen as balanced.

Transport

During construction there will be regular heavy vehicle movement to and from the power station and will continue during operation. Once the power station is operational, heavy vehicle traffic will also be a feature at sawmills. It has been estimated that 35 truck loads of wood waste will be transported to the site every day, or 4.3 per hour. It has been recommended that construction and operational vehicle movements are limited to daylight hours only.

Land Use

The proposal utilises land within an area zoned Industrial. Re-zoning of the site to an appropriate use, such as Special Use Power Station, is required. No change to land use of the site or surrounding lands will be brought about by construction or operation of the power station.

The site is owned freehold by Coir Industries Ltd and is shown on Deposited Plan 7611 (Figure 7). Discussions regarding the purchase of the land are advanced with the landowner.

Cooling water will be required from the foreshore area adjacent to the site. Since there is no confirmed timeframe on construction of the proposed government jetty at this area, it is assumed at this stage that a deep water intake will be required. For this purpose, a foreshore lease will be required from the land owners which cover the cooling water intake.

Noise

Notwithstanding that nearby residences are accustomed to significant noise emitted from the nearby industry, the sawmill in particular, it is likely that noise emitted from the site during construction and operation would be intrusive to nearby residences. While some of this noise may be mitigated through design noise generated from the power station is likely to include low frequency rumble which is penetrating and will probably be noticeable. Background monitoring undertaken at the site has indicated a moderately low level of background noise during quiet periods (principally night time).

In addition to noise reduction design considerations it is considered that some operational constraints are warranted. To minimise the likelihood of generating excessive noise during quiet (night) periods it is recommended that delivery of wood waste, handling of materials and chipping should only be conducted during daylight hours. This will require that sufficient fuel is available in the boiler bunkers to ensure additional handling is not required.
Forest and Milling Operations

In order to gain access to American and European timber markets forest industries in Fiji are undergoing a process of certification. An independently certified standard of practice for the forest industries in Fiji will provide a high level of certainty that resources and products are managed within a sustainable framework that is acceptable in the international market. It is anticipated that by the time this project has been built all operations will be certified or in the process of certification.

It is considered that the biomass project will not promote an expansion of forest or milling operation to meet a demand for waste wood at the power station nor is it likely to promote unsustainable forest management practices. Notwithstanding this, it is recommended that World Bank undertake an annual due diligence assessment of sawmill operations to ensure that activities remain within expectations. This assessment would be appropriately conducted in partnership with MoFF and identified stakeholders. Ministry of Fisheries and Forests are currently hard pressed to keep up with current regulation demands and it is recommended that World Bank make some resources available to facilitate the due diligence exercise.

While the power station will be dependant on sawmills, the reverse is not the case. Milling of timbers obtained through the managed forest operations will continue and will continue to grow to meet export demand, irrespective of this proposal.

Wood waste at sawmills is currently heaped and burned. Utilising this waste resource for power generation provides an additional income stream to some logging operations and, in removing a local source of uncontrolled wood smoke emission, has potential to reduce the emission of unmanaged wood smoke in the vicinity of the sawmills.

Consideration of Alternative Development Options

A range of alternate energy generation options have been investigated in detail by FEA and are canvassed in reporting prepared by Barefoot Power Pty Ltd. This report identifies a range of biomass options available to FEA and has identified the use of sawmill waste, and other waste, as being sustainable and practicable.

The use of diesel for power generation is a significant cost impost and contributes to increasing consumption of hydrocarbons, a global issue. As Fiji continues down the path of economic development it is likely that hydrocarbon use will increase. Installation of additional generation at the Savusavu site will lower the likelihood of continued power outages by reducing pressure on the generation and distribution network.

The imperative to develop alternative electricity generation options in Fiji are predominantly associated with controlling the cost of energy production, improving generation reliability and reducing reliance on hydrocarbons. Failure to develop and implement alternate energy production options will perpetuate an on-going reliance on diesel fired power generation in Fiji, result in significant cost imposts and increase production of greenhouse gases. At the Savusavu site this imperative to develop alternative generation is reinforced by the inability of electricity generation to keep up with current demand.
In consideration of the options available for implementation at Savusavu it is considered that the option being pursued is practical, achievable and sustainable.

**Assessment of Institutional Capacity**

FEA currently employ an Environmental Engineer who has primary responsibility for ensuring environmental matters are appropriately addressed throughout FEA. The assessment has identified that this position has sole responsibility for a wide range of projects, including development and implementation of an Environmental Management System (EMS). Development and implementation of an EMS is considered to be of great value.

Development of an EMS and management of the design and construction process for projects of this nature, especially when considered in the context of the whole renewable programme currently being progressed by FEA, requires specialised and detailed consideration. In the context of this project, and the remainder of the renewable energy programme, it is considered that additional environmental resource is required. Making an additional resource available to the Environmental Engineer is highly recommended and would provide greater surety of environmental performance and outcome for this and other tasks. Doing this would allow the Environmental Engineer to manage the detailed design and construction of this, and other projects currently under development by FEA, or to continue with the development of the EMS.

Based on this assessment it is recommended that FEA give consideration to an additional environmental management resource, at least for the period this project.

Administration of the *Environment Management Act 2005*, including the regulation of industry, is undertaken by the Ministry of Environment (MoE). At present Fiji has a single environmental regulator. Interview with the regulator has identified that the ability of MoE to adequately regulate this project is significantly limited by a lack of resources. Additionally, the regulating officer has identified a requirement for additional experience and skills, in particular in auditing and environmental management systems.

It is recommended that additional MoE regulation capacity is desirable to ensure adequate regulation of this and other projects. The provision of additional training in auditing and environmental management systems is highly recommended.

An interview with Ministry of Fisheries and Forests (MoFF) staff has indicated that capacity to effectively regulate logging and sawmilling is limited by resources, both people and vehicles. While it is considered unlikely that sawmills will increase production of final products to satisfy the demand for waste material, it is recommended that additional MoFF regulation capacity is desirable to ensure adequate regulation.

It is recommended that a due diligence assessment of saw mill operations should be conducted on an annual basis. It is recommended that World Bank give consideration to facilitating an annual due diligence assessment of saw mill operations that may include identified stakeholders.

**Environmental Management Planning**

A Master Environmental Management Plan (MEMP) has been prepared to provide for the minimum requirements of environmental matters associated with construction works
for the Savusavu Biomass Plant. The MEMP requires that the contractor prepare a Construction Environmental Management Plan (CEMP) for the project. This approach has been taken to enable a greater level of responsibility, and therefore ownership, for environmental outcomes by the contractor. It is also expected that the contractor is best placed to identify practices that can be practicably undertaken to meet the requirements of the MEMP. The CEMP will address all the requirements of the EIA and any approval conditions.
## EXECUTIVE SUMMARY

Conclusion...

Summary of Impacts...

Ecological...

Erosion and Sedimentation...

Economic...

Social...

Visual...

Waste...

Water...

Water for Production...

Air...

Greenhouse Issues...

Transport...

Land Use...

Noise...

Forest and Milling Operations...

Consideration of Alternative Development Options...

Assessment of Institutional Capacity...

Environmental Management Planning...

## 1. INTRODUCTION

1.1 The Proponent...

1.2 Project Background Information...

1.3 Project Overview and Rationale...

1.4 Project Approvals Processes...

1.4.1 Other Government of Fiji statutory approvals process...

1.4.2 World Bank Requirements...

1.4.3 Requirement for EIA:...

1.5 Terms of Reference for This Project...

## 2. DESCRIPTION OF PROPOSED PROJECT

2.1 Non Technical Description of the Project...

2.2 Operation of the Power Station...

2.2.1 Resource Handling...

2.2.2 Connection to FEA Grid...

2.2.3 Indicative Methodology and Timetable...

## 3. REVIEW OF RELEVANT INFORMATION

3.1 Political Setting...

3.2 Physical Setting...

3.2.1 Environmental Regulation...
3.2.2 Forest Operations

3.3 Study Area

3.3.1 Location

3.3.2 Land Tenure

3.3.3 Zoning

3.3.4 Site History

3.4 Collection of Baseline data

3.4.1 Description of Existing Environment

3.4.2 Public Utilities

3.4.3 Archaeological sites

3.4.4 Saw Milling Operations

4. ANALYSIS OF IMPACTS

4.1 Construction Phase Impacts

4.1.1 Ecological

4.1.2 Erosion and Sedimentation

4.1.3 Economic

4.1.4 Social

4.1.5 Visual

4.1.6 Waste

4.1.7 Water

4.1.8 Air

4.1.9 Transport

4.1.10 Land Use

4.1.11 Noise

4.1.12 Archaeology

4.2 Construction Mitigation and Abatement Measures

4.3 Operation Phase Impacts

4.3.1 Ecological

4.3.2 Erosion and Sedimentation

4.3.3 Economic

4.3.4 Social

4.3.5 Visual

4.3.6 Waste

4.3.7 Water Quality

4.3.8 Water for Production

4.3.9 Air

4.3.10 Greenhouse

4.3.11 Transport

4.3.12 Land Use

4.3.13 Noise

4.3.14 Forest and Milling Operations

4.4 Operations Mitigation and Abatement Measures

5. ALTERNATIVE DEVELOPMENT OPTIONS

6. PUBLIC CONSULTATION
7. **ASSESSMENT OF INSTITUTIONAL CAPACITY** 61
   7.1 Fiji Electricity Authority 61
   7.2 Ministry of Environment 61
   7.3 Ministry of Fisheries and Forests 62

8. **ENVIRONMENTAL MANAGEMENT PLAN** 63

9. **SUMMARY AND CONCLUSION** 63

10. **REFERENCES** 65

APPENDICES 66

Appendix 1: Terms of Reference
Appendix 2: Consolidated Table of Recommended Actions
Appendix 3: Community Consultation
Appendix 4: Noise Assessment Report
Appendix 5: Desk Top Air Quality Assessment Report
Appendix 6: Master Environmental Management Plan
INTRODUCTION

The Proponent

The project proponent is the Fiji Electricity Authority. The Fiji Electricity Authority (FEA) was established under the terms of the Electricity Act 1966.

Members of the Authority are appointed by the Minister of Energy. The Chief Executive is an ex-officio member and is responsible to the Members for the Authority’s management and for execution of its policies. The powers, functions, and duties of FEA are the provision and maintenance of a power supply that is financially viable, economically sound and consistent with the required standards of safety, security, and quality of power supply.

The Authority is entrusted with enforcing the Electricity Act and Regulations, setting standards, examining and registering electricians, and is empowered to approve and license suppliers to serve certain areas.

The Authority is also governed by the requirements of the Public Enterprises Act.

The FEA has a total installed capacity of 170 MW, comprised of approximately 57% diesel and 43% hydro.

Fiji Electricity Authority
2 Marlow St
Suva
Fiji

Project Background Information

Biomass is generally defined as organic matter that is available on a renewable basis (excluding old growth timber) and may include the utilization of dedicated energy crops such as agricultural food and feed crop residues, aquatic plants, wood and wood residues. Biomass can be used for the production of electricity, heat, or both.

Domestic power consumption in Fiji is increasing at a rate of 5-8% per annum. Strong load growth, and a continuing trend towards decreasing rainfall, has resulted in a greater proportion of electricity production on Viti Levu being provided by diesel generation. Since 2001 diesel consumption has increased by more than 200%. Year to date figures (January to July 2006) for diesel consumption at the power stations is 50,967,193 litres. Year to date figures (January to July 2006) indicate a diesel cost of FJD $ 49,597,449.

Generation at Savusavu is provided by four diesel generator units. Year to date (January to July 2006) figures indicate the units have generated 4000 MWH and consumed 175,700 litres of diesel at a cost of approximately $194,500.

With diesel at record high prices and continuing strong load growth, within the residential market alone, there is an urgent need for the development of alternative energy generation capacity from renewable energy sources. In developing a Renewable Power Development...
Project, Fiji Electricity Authority (FEA) has undertaken an assessment of renewable generation options. A number of options were identified including the use of biomass.

Generation capacity at Savusavu is insufficient to meet strong load growth and power outages as a consequence of system overload are common. High diesel prices have created an opportunity in Savusavu, on the island of Vanua Levu, to increase the generation capacity and convert the current 100% diesel powered system to at least 50% renewable through the installation of a biomass plant.

The Government of Fiji (GoF) and Fiji Electricity Authority (FEA) have asked the World Bank to partly finance its Renewable Power Development Project (RPDP).

The RPDP’s components are:

- **Component A: Wailoa Power Station.**
- **Component B: Deuba Biomass power plant.**
- **Component C: Biomass Power Plants in Vanua Levu (this project).** The FEA proposes to construct biomass power plant of up to 3MW capacity at Savusavu.

This Environmental Impact Assessment (EIA) has been prepared to address impacts identified in association with a proposal to develop small biomass fuelled electricity production. The EIA is based on information provided to Hydro Tasmania Consulting by Fiji Electricity Authority, as well as the outcomes of a feasibility assessment for the Savusavu project prepared by Sinclair Knight Merz. The EIA is required to be a stand alone document so there is by necessity some duplication of material from the feasibility assessment. Duplication has been minimised wherever possible.

**Project Overview and Rationale**

A major commitment of FEA is the development of clean and environmentally friendly renewable energy in place of Fiji’s reliance on diesel fuel. This will not only reduce greenhouse gas emissions, but will also save significant foreign exchange leakages out of Fiji when purchasing expensive and highly price-volatile diesel oil (FEA Annual Report 2006).

In order to achieve this commitment FEA has commenced a number of renewable energy projects and investigations including, but not limited too, wind power, geothermal, biomass conversion and solar. By developing a range of alternative energy options FEA will be well placed to address pressures on diesel power generation.

The capacity of the existing diesel generation at Savusavu is currently marginal. Power outages are common and are predominantly caused by the system being unable to keep up with demand. Strong load growth and high diesel prices have created an opportunity in Savusavu to increase the generation capacity and support the diesel powered system with renewable energy.

**Project Overview**

The following is provided as an overview of the project. A more detailed description is provided in Section 2 of this document. It is noted that when the feasibility and environmental impact assessment works commenced the project was aimed at providing two 1MW boiler units at the site. Since commencement this has been revised to a single unit of up to 3MW.
The FEA propose to construct a 3MW biomass power plant at a site in Savusavu (Vanua Levu). The power house would be constructed at the Valaga Bay Industrial Area on freehold land adjacent to a sawmill and a copra mill to the north of the township.

Fuel supply to a new biomass plant will be provided by a number of sources including:

- Lumber Processing;
- Hanshine;
- Palmwood (coconut palm waste);
- CIDA (coconut palm waste).

Mill off cuts will be used in the biomass plant. In addition some shavings and sawdust can be used as fuel. No forest wastes will be utilised for energy production by the project.

The technology used for the biomass power plants will be thermal generation, by a steam-boiler setup. The steam boiler setup involves combustion of the biomass which heats water to steam to drive the steam turbine for electricity generation. This process needs water for feeding the boiler and for the cooling water in the condenser.

The power plant is expected to utilise approximately 20,000t/year of woody off cut waste with the consumption of mill waste estimated at 2t/MWh. Lumber Processing estimate 10,000 t/yr of mill off cuts can be made available and with current expansions underway expects to produce up to 20,000 t/yr. A detailed assessment of wastes available from Palmwood has not been completed. Palmwood have estimated that their waste production at 5,000 t/yr. The Coconut Industries Development Association (CIDA) aims to process approximately 5000 lower trunk stems per year, producing approximately 3,000 t/yr of waste. At present off cuts are burnt on site or utilised by the local community as firewood.

Fresh water required steam production will be provided at this site through the Public Works Department town water supply, available at the power station. Sea water drawn from Valaga Bay will be used to provide once through cooling water.

Project Approvals Processes

The draft Sustainable Development Bill 1998, which later became the Environment Management Act 2005, provides a blueprint for action to achieve sustainable development in Fiji. The Act provides for the:

- Consolidation, integration and updating of over eighty pieces of existing environmental and resources management legislation; and

- Implementation and enforcement of over two dozen international agreements to which Fiji is a party; and

The creation of a new legal framework for:

- Environmental impact assessments;
- Pollution and waste management;
- Conservation and national parks management;
Concerning proposed developments, the *Environment Management Act 2005* requires:

- All development proposals to be submitted to an approving authority (a Ministry, department, statutory authority, local authority or person authorised under a written law to approve the proposal) to enable an assessment of whether or not the proposal is likely to cause significant environmental or resource management impacts.

- The authority must take into account:
  - The nature and scope of the activity or undertaking in the proposed development;
  - The significance of any environmental or resource management impacts;
  - Whether there exists any technically or economically feasible measures that would prevent or mitigate any adverse environmental or resource management impacts; or
  - Any public concerns relating to the activity or undertaking.

- Proposed projects are subject to determination of their need for an EIA under Schedule 2, Parts 1, 2 and 3, which relate to the type of project and the degree of potential impact.

The Ministry of Environment (MoE) through the Environmental Management Act 2005 utilises a screening process to assess whether a project requires an EIA. The EIA process must meet the requirements specified under the Environmental Management Act 2005, in particular, Part 4 Environmental Impact Assessment.

The EIA will be publicly advertised for comment, which will be considered by the MoE when assessing the project.

Once the project has been assessed by the MoE, under the Environmental Management Act 2005 appeal rights exists for the proponent should the proposal be refused or conditions of approval be considered inappropriate. Such an appeal must be lodged with the Environmental Tribunal.

**Other Government of Fiji statutory approvals process**

Upon submission of the Terms of Reference (TOR) MoE reviews them against project information provided to assess its accuracy and completeness of all the likely environmental impacts that would be associated with the project, and that need to be included in the EIA process. The MoE may consult the Ministry of Energy on specific areas for expert energy advice.

**World Bank Requirements**

This project is part funded by the World Bank. The activities to be funded under Component C of the RPDP trigger World Bank safeguards policy OP 4.01 Environmental Assessment. The RPDP is therefore required to be compliant with the provisions of this, and other, relevant policies.
Requirement for EIA:

The Environment Management Act 2005 of Fiji requires that an environmental impact assessment is required for this project. It is expected that the proposed Savusavu Biomass Plant project will fall under Part 1(w) - a proposal financed by an international or local development finance institution and which requires an EIA as a condition of the finance, and Part 1(k) - the introduction of pollutants or properties to the air that are disagreeable or potentially harmful to people and wildlife.

World Bank Operational Policy, OP4.01 on Environmental Assessment, requires environmental impact assessments of projects proposed for funding to help ensure that the projects are environmentally sound and sustainable, and thus to improve the decision making process.

The final EIA report will be reviewed and cleared by both the Ministry of Environment and the World Bank, and will be disclosed locally in Fiji and also at the World Banks Infoshop. According to the World Bank’s Disclosure Policy, the date of disclosure of the EIA reports must be prior to the commencement of World Bank appraisal of the project.

The latest World Bank disclosure date set for the EIA reports is **October 8, 2006**.

The EIA is to be carried out in parallel and close collaboration with the feasibility study for the Savusavu Biomass plant, i.e. the project, thereby ensuring that the feasibility design is integrated into the EIA process so as to inform the feasibility design in a timely and effective manner. This is a pre-requisite for the EIA process.

Terms of Reference for This Project

The full Terms of Reference (ToR) for the EIA are provided in Appendix 1. The TOR has been prepared by the Fiji Electricity Authority in consultation with Ministry of Environment and World Bank. Both organisations have an approval interest in the proposed project. This document has been prepared to address specific World Bank requirements that are additional to Fiji Ministry of Environment requirements.

Broadly the TOR comprise the following:

- The EIA to be undertaken concurrently, simultaneously and interactively with the Feasibility Study for this project, to ensure that the EIA and feasibility study inform each other.

- The identification and review of:
  - the project against World Banks Safeguards Policies OP 4.01 Environmental Assessment with reference to others where appropriate;
  - relevant Government of Fiji environmental, land, water and other relevant laws, regulations, policies and strategies; and
  - Fiji’s administrative framework at both the national and sub national levels that will govern the preparation of the EIA and implementation of the project;

- Assessment of available credible baseline data for the project impact zones;

- Analysis of both the positive and adverse impacts of the project;

- Analysis of the alternatives to the proposed project;
Development of Impact Management Measures;

Participatory public consultation with all stakeholders affected by the project;

Assessment of the institutional capacity of the FEA (as owner and operator of the project) and the Ministry of Environment (as custodians of the *Environment Management Act 2005* as well as the agency responsible for management of the environment) to manage and monitor the project;

Assessment of the likelihood that the saw mill might increase its production of final products to satisfy the demand for waste material. In other words would the project have an impact on the management and/or development of the plantation from which the Sawmill will obtain its raw material; and

Development of an Environmental Management Plan, to cover both the construction and operational phases, including monitoring and mitigation of the impacts of the project.

**DESCRIPTION OF PROPOSED PROJECT**

The following is a description of the technical and operational aspects of the project. A detailed technical description can be obtained from the Sinclair Knight Merz Feasibility Study. A conceptual process flow diagram of the operation has been provided by Sinclair Knight Merz and is shown in Figure 1.

The site is a green field site located in the Valaga Bay Industrial Area near Savusavu.
Figure 1: Process Flow Diagram.
Non Technical Description of the Project

The biomass power plants will be thermal generation by steam-boiler. The steam boiler involves combustion of the sawmill waste (biomass) which heats water to steam to drive the steam turbine for electricity generation.

Fuel supply to the new biomass plant will be predominantly provided by sawmills in the vicinity of the power station. Mill off cuts and some saw dust and shavings will be used in the biomass plant as fuel. The wood must be dry before it can be used and it must also be chipped to a particular size before it can be burned. Some sawmills have their own chippers and will be required to deliver wood that has already been chipped. Waste wood that has not been chipped by the mill will be chipped at the power station.

Mill waste will be delivered by truck to the power station. Waste will then be stock piled in a dry area from where it will be fed into the burners so that steam can be made.

Superheated steam leaving the boiler then powers the turbine and connected generator to make electricity. After the steam exits the back end of the turbine it is cooled and condensed back to water. This condensate is then returned to the boiler through high-pressure feed pumps for reuse. A schematic of a boiler-turbine system is shown in Figure 2.

![Figure 2: schematic of a typical boiler-turbine system](image)

Based on a maximum 24 hour operation, water demand generated by the installations at this site is estimated as follows:

- Cooling Water Demand: 10,000 L/hr
- Other site use including boiler makeup: 3,500 L/day

Investigation and discussions with DWS indicate that the existing water supply network in Savusavu will not be able to cater for the full demand. The existing network is meeting current consumer demands satisfactorily; however the system cannot cater for the additional demand.
due to the total demand from this site. DWS is embarking on major capital works projects in the
near future based on recommendations of the Savusavu Regional Water Supply Scheme
Master Plan, December 1992. Whilst the implementation of these projects will realise a
significant increase in the production and supply of treated water for the area, there are a
number of other development projects which will significantly increase the total demand for
water in the very near future. DWS have however indicated that they would be able to cater for
the additional supply of 3,500L/day required for other site use from the existing supply network.

Water obtained from the town water supply will be subject to further refinement to remove trace
impurities. The material left over from this process is referred to as brine or concentrate. It is
conventional practice to dispose of the brine by trickle feeding it into the cooling water
discharge.

With the constraints of the existing water supply network seawater, will be used for cooling
requirements. An intake structure with a standby and duty pump would be constructed along the
foreshore adjacent to the site. A wharf structure is expected to be constructed as part of a
government project near this location. It is envisaged that the intake structure would be mounted
off the wharf structure which would provide a deep and sheltered location. A rising main laid
along the proposed access road to the wharf will convey water to the site.

When compared to conventional generation technologies, biomass power plants are known to
reduce many key air emissions. Biomass resources do generate air emissions such as nitrogen
oxides (NO and NO₂, collectively known as NOx), sulphur oxides (SOx) and carbon monoxide
(CO). Another air quality concern associated with biomass plants is particulates and smoke
odour. The composition of exhaust gases depends upon the quality of the fuel used and specific
equipment used to treat stack emissions.

Conventional stack technology will be used to remove a large proportion of pollutants from the
exhaust emissions although there will always be some smoke and odour evident. Particulates
will be removed via an electrostatic particulate remover (ESP). ESPs are the particulate
emissions control technology which is most widely used on coal-fired power generating facilities.
ESP technologies are highly efficient particulate removal devices with design efficiencies in
excess of 99.5%.

Biomass plants also release carbon dioxide (CO₂), the primary greenhouse gas. However, the
cycle of growing, processing and burning biomass recycles CO₂. If this cycle is sustained, there
is little or no net gain in atmospheric CO₂.

The combustion of biomass resources normally results in the generation of ash that is high in
alkaline materials like potassium, sodium, calcium, and magnesium. Biomass burning generates
fly ash which requires disposal. Fly ash has commercial value in operations such as cement
manufacture, road base and as fertiliser.

**Operation of the Power Station**

It is anticipated that this facility will provide 24 hour base load generation into the electricity
distribution network.

The moisture content of the fuel is a critical element of efficient energy production. Optimal
moisture content is less than 25%. Moisture content will be determined by hand held meter on
delivery. A sliding scale of payments will be made to fuel suppliers based on moisture content. A
second sample will be retained in a sealed container if a second analysis of moisture content is
required. Wood will be placed into a roofed area for stockpiling and drying.
From this stockpile wood will be moved by front end loader to a hogger which will cut larger pieces into smaller pieces to facilitate chipping to the required size. Chipped material will be moved by conveyor belt to a bunker bay where it will be feed into the burner units. Wood deliveries, handling and chipping are noisy operations and will only be conducted during daylight hours.

A fluidised bed system has been proposed for Savusavu. Fluidised-bed systems comprise a combustion chamber containing a sand bed that acts as the heat-transfer medium (Figure 3). The bed is fluidised by blowing air through a perforated bottom plate. This forces the sand upward. Depending on the air velocity, a bubbling fluidised bed or a circulating fluidised bed is created. In a bubbling fluidised bed, the reactor is divided into an area of freely moving sand particles supported by up streaming air and a freeboard zone above the fluidised bed. In a circulating fluidised bed, the air velocity is so high that a bed and fuel particles flow upwards with the gas stream, are separated from it in the cyclone, and then re-channelled into the reactor (Barefoot Power Pty Ltd, 2005).

Figure 3: Fluidised bed system

Heat from this process is harvested to generate steam that is piped to a steam turbine which in turn drives a generator unit. During power generation, steam that leaves the turbine is condensed in a ‘condenser’ at very low pressures and temperatures. The lower the temperature, the more power generated. In practice, this temperature is between 40-60°C, depending on the available cooling media (air or water) and their temperatures. Water cooled condensers rely on water that is heated then discharged to a waterway. For environmental reasons, the return temperature must not be so high as to harm the ecosystem. The water can also be recycled in a cooling tower, where part of it is evaporated, causing the rest to cool.

Clean fresh water must be used in steam cycles to prevent malfunctioning that could damage the boiler, the turbine sections, or both. Water will be taken from the PWD supply. Water obtained from the town water supply will be subject to further refinement to remove trace impurities. The left over brine will be disposed of by trickle feeding it into the cooling water discharge.

In addition to this makeup water additional water is required for cooling of the power station. Cooling usually requires a much larger quantity of water than make up water. For this project it is anticipated that the required water demand for cooling will be drawn from Valaga Bay. This water is usually filtered to remove larger particles that may become lodged or build up on surfaces but will receive no other treatment. Once it has been through the cooling system the water is warmer than it was when it was first taken up. For environmental reasons, the return temperature must not be so high as to harm the ecosystem so it is cooled to acceptable levels before it is discharged. For environmental reasons, the return temperature must not be so high as to harm the ecosystem. A temperature range of 3-6°C is anticipated. This is well inside the environmentally
acceptable discharge temperature range.

Water will be returned offshore via a discharge pipe. The pipe is designed such that water discharged does not mobilise any bottom sediments.

**Resource Handling**

Fuel wood will be delivered to the site from sawmill operations that have signed resource agreements with the power station. These agreements give direction on the type of fuels to be delivered, as well as the quality and quantity. A maximum delivery schedule has been provided to ensure a sustainable supply is maintained. Resource Agreements also provide a pricing schedule based on fuel moisture and quality, whereby a higher quality dry fuel receives a larger payment than wet wood with a large bark component. Wood deliveries will only be accepted during the nominated daylight hours.

The moisture content of the fuel is a critical element of efficient energy production. Optimal moisture content is less than 25%. Moisture content will be determined by hand held meter on delivery. Delivered material will be stored on-site in a roofed area. It is important that a small fuel stockpile is maintained at the power station to provide some backup of resource in the event that wood supplies are disrupted.

The fuel received from the mills will be delivered from sawmills in a chipped form or as flitch’s requiring chipping. Most boilers systems require fairly uniform woodchips of a small size. This will require on-site processing of the material to ensure it is of a suitable size. Wood will be processed through a coarse cutting machine (the hogger) and then into a fine chipping machine. This is a noisy operation. Wood processing and handling will only be conducted during daylight hours.

In addition to this stockpile storage, the boiler units will be constructed with sufficient bunker storage for refined wood chips to run the boilers overnight, or longer, without the need to undertake noisy fuel handling and chipping operations overnight.

**Connection to FEA Grid**

Connection to the FEA power grid will be via the existing 3-phase power poles adjacent to the proposed power station site along Transinsular Road.

**Indicative Methodology and Timetable**

It is anticipated that works, comprising design, construction, pre-commissioning and commissioning, would be completed over a period of approximately 14 months.

**Construction**

- Form access from the road and placement of fill in low lying to bring the site up the approximate level of the road.
- Construction of water intake and discharge facilities.
- Construction of stock pile and materials handling area.
- Construction of new generation facilities.
Commissioning

- Commission cooling water system.
- Commission and synchronise generation.
REVIEW OF RELEVANT INFORMATION

Political Setting

Fiji is a democratic republic, whereby the Prime Minister of Fiji is the head of government, and of a multi-party cabinet. Executive power is exercised by the government. Legislative power is vested in both the government and the Parliament of Fiji. The Judiciary is independent of the executive and the legislature.

Fiji is divided into four parts, called divisions:

- Central Division (Suva)
- Northern Division (Labasa)
- Eastern Division (Levuka)
- Western Division (Lautoka)

Divisions are subdivided into fourteen provinces. Municipal governments, with City and Town Councils presided over by Mayors, are established in Suva and some other towns.

Physical Setting

The Republic of the Fiji Islands consists of more than 320 islands, about one-third of which are inhabited. Although many islands are low-lying coral structures with limited soil and water, the majority of the land is on continental-like volcanic islands that rise to well over 1000 metres in elevation.

The larger volcanic islands are characterised by steep, mountainous country, deeply incised by rivers and streams, supporting a wide variety of ecosystems with significant areas of natural forest and coastal and marine ecosystems including mangrove forests and coral formations. The islands are bordered by an extensive system of fringing and barrier reef including the Astrolabe Reef, the third largest barrier reef structure in the world. The climate is tropical with an average annual temperature of 26°C and relatively heavy annual rainfall, especially on the windward sides of the larger islands. The average annual rainfall ranges from 1800 - 2600 mm.

Fiji is considerably richer in natural resources than its Polynesian and Micronesian neighbours. There are areas of tropical rainforest containing valuable timbers, alluvial plains rich in soil, cool high uplands suitable for temperate produce, and commercially viable mineral deposits, fish, and other marine resources.

The environment is a vital resource for all nations, and especially for small island nations such as Fiji. The people of Fiji have always had a high degree of dependence on the environment. The land and its forests, the rivers, coasts and sea provide a major source of livelihood, security and culture for the community. Any threat to the environment is a threat to their way of life. In the past, a traditional system for managing those resources existed, which helped the community to use them on a sustainable yield basis. While the dependence on natural resources continues, the nature of that dependence has, to a large extent, changed through the introduction of a cash economy. The traditional resource management system has not been
able to fully adjust to the increasing demands of the ‘modern’ way of life\(^1\). Traditional conservation and generally sustainable resource use is increasingly being pushed aside in favour of active and unsustainable resource exploitation for cash revenue. With development and increasing urbanization have come associated environmental problems such as pollution, over-exploitation of natural resources and loss of biodiversity.

The environment in Fiji does not face the same demographic and economic pressures as in many other parts of the world. In relative terms, Fiji does not have the same level of land degradation as many of its Asian neighbours, the rate of deforestation such as in western Melanesia, the industrial pollution associated with heavy manufacturing, the level of agricultural pollution common in Europe, or the congestion and air pollution associated with large Third World cities.\(^2\)

To prevent further environmental degradation, Fiji’s development plan (2003-2005) emphasised proper management of the environment and sustainable use of natural resources as critical for sustainable development. The plan lists key national environmental issues as land degradation, air and water pollution, refuse disposal, and the expected effects of climate change and sea level rise. Planned actions include better enforcement of legislation, and increased public awareness of environmental issues legislation to minimise environmental damage, while facilitating the development of a resource efficient, cost effective and environmentally sustainable energy sector.

The research paper, “Sustainable Development in Fiji”, prepared in 2003 for general distribution to Senators and Members of the Parliament of Fiji, outlines the need for both ‘sustainable development’ in dealing with environmental issues as they relate to national development and ‘sustainable human development’ in meeting the needs of the people, with both aiming to ensure that the needs of future generations are not compromised by the present generation. Key challenges were seen to be limiting the potential for conflict between freedom of individuals and the national interest, and balancing national interests with international obligations.

**Relevant International and Regional Conventions and Protocols**

Fiji is currently a signatory to the following Conventions and Protocols:

- Convention for the Protection of the Natural Resources and Environment of the South Pacific Region
- Convention on Biological Diversity (CBD Convention)
- The Cartagena Protocol on Bio-safety to the CBD Convention
- The Montreal Protocol
- The Stockholm Protocol
- The Kyoto Protocol

\(^1\) United Nations Economic and Social Commission for the Asia Pacific, 2003; *Integrating Environmental Decisions into the Economic Decision-making Process*.

\(^2\) United Nations Economic and Social Commission for the Asia Pacific, 2003; *Integrating Environmental Decisions into the Economic Decision-making Process*. 
Fiji has incorporated its obligations under the above conventions and protocols into the Environmental Management Act 2005. Further, being a Non-Annex I Party, Fiji’s obligations under Kyoto are limited to reporting emissions.

**Existing Information**

No published material or records held by FEA, or other institutions, that describes the environmental conditions at the site has been identified.

**Environmental Regulation**

Regulation of environmental matters is conducted by Ministry of Environment under the terms of the Environment Management Act 2005.

Development proposals submitted to an approving authority (a Ministry, department, statutory authority, local authority or person authorised under a written law to approve the proposal) are assessed as to whether or not the proposal is likely to cause significant environmental or resource management impacts.

**Forest Operations**

The proposed power plant will utilise only sawmill waste from surrounding sawmill operations. There will be no activity in forests or plantations that are directly associated with the power station. While the power station will be dependant on sawmills the reverse is not the case. Milling of timbers obtained through the managed forest operations will continue and will continue to grow irrespective of this proposal.

Forestry is managed by the Ministry of Fisheries and Forests (MoFF). The MoFF is responsible for the sustainable development and management of the fisheries and forest resources and the industry it supports (MoFF Annual Report 2004). The current Forest Policy was enacted in 1953 and has recently undergone a review. Statutory support for forest management is via the Forest Decree 1992, and the National Code of Logging Practice (1990).

A *Draft Fiji Forest Certification Standard* has been developed along the guidelines of the Forest Stewardship Council, selected by the multi-interest stakeholder National Forest Certification Steering Committee. The Standard has been formulated by elected representatives of the social, economic and environmental interest groups that formed the National Forest Certification Standards Committee in October, 2005. The Standard is currently undergoing public consultation and field testing before it will be submitted to the Forest Stewardship Council for accreditation. The *Draft Fiji Forest Certification Standard* states the level of performance required and the type of evidence that should be provided by the forest manager for verification by the Certification Body, to show the compliance of forest operations to the Standard. The standard is due for release at the end of 2006. Once implemented Fiji’s logging and timber production industry will be actively managed in accordance within international market requirements.

Logging operations are conducted by contractors who hold a licence for logging within a defined area. The licence provides regulation of all aspects of the operations. Further, all logging coupes are required to have an approved Harvest Management Plan. Forest and saw milling operations are monitored by Forest Officers.
Commercial Harvesting

The Ministry of Fisheries and Forestry (2004) estimate that 47% of Fiji’s land mass is forested (Figure 4). Barefoot Power (2005) report that between 1994 and 2003 approximately 71,000 ha of indigenous forest were logged. This report documents the opinion of the International Tropical Timber Organization and Barefoot Power that current logging practice within indigenous forest in Fiji is sustainable.

In addition to indigenous forest cover, plantations account for an additional 5% of indigenous forest cover. Pine coverage was reported in the MoFF Annual Report (2004) as approximately 46,000 ha of plantation on a total lease of 86,000 ha, while mahogany and other hardwoods covered 53,000 ha from a total lease of 67,000 ha. Pine coverage and production has been reasonably steady over the last 10 years. Mahogany production is also increasing rapidly as plantation stock matures.

A draft assessment of sawmill waste completed by SOPAC (2006) has not assessed biomass at Savusavu but concludes that the sustainable use of wood waste for fuel on a regular basis will depend on ensuring a regular availability of the resource and keeping the cost of the resource as low as possible. The two mill operations identified to supply fuel to the project receive their timber from Viti Levu.

The power plant is expected to utilise approximately 24,000t/year of woody off cut waste with the consumption of mill waste estimated at 2t/MWh.

Lumber Processing estimate 10,000 t/yr of mill off cuts can be made available and with current expansions underway expects to produce up to 20,000t/yr. A detailed assessment of wastes available from Palmwood has not been completed, however, Palmwood have estimated that their waste production at 5,000 t/yr. Similarly the Coconut Industries Development Association (CIDA) does not have figures for waste wood production, however, they aim to process approximately 5000 lower trunk stems per year, producing approximately 3,000 t/yr of waste. At present off cuts are burnt on site or utilised by the local community as firewood.

Fiji Electricity Authority Electrical Distribution Network

Fiji’s existing electrical distribution network is shown in Figure 5.
Figure 4: Vanua Levu forest function (courtesy of ministry of Fisheries and Forests)
Fiji Electricity Authority

Environmental Impact Assessment for the Savusavu Biomass Power Plant
Figure 5: Electrical Distribution
Study Area

Location

The proposed biomass power station will be located in the Valaga Bay Industrial Zone to the north of Savusavu Township, on the south coast of Vanua Levu. The site is immediately adjacent to Transinsular Road and the coastal foreshore. The site is in close proximity to residences in the nearby settlements of Nabaci and Jerusalem (Figure 7).

The site is located on the narrow coastal strip at the base of the steeply rising ranges. In constructing the site it will be necessary to undertake substantial earthworks to raise the site to the approximate level of the road. The site has been used for plantation and agricultural purposes and the surrounds of the site are grass with some minor areas of re-growth (Figure 6).

Figure 6: View of site from the road looking towards the boundary with Lumber Processing.
Figure 7: Site location.
Land Tenure

The site is owned freehold by Coir Industries Ltd and is shown on Deposited Plan 7611 (Figure 8). Discussions regarding the purchase of the land are advanced with the landowner.

Jerusalemi Village has about 200 acres of Yavusa land divided amongst the four mataqalis that reside in the village.

Cooling water will be required from the foreshore area adjacent to the site. Since there is no confirmed timeframe on construction of the proposed government jetty at this area, it is assumed at this stage that a deep water intake will be required. For this purpose, a foreshore lease will be required from the land owners which cover the cooling water intake.

Zoning

The site is located in Valaga Bay and is zoned Industrial.

Site History

The site has been utilised in part as coconut plantation. Some coconut is still present as are some areas of taro. At present the site is vacant. Land on either side of the site is used for lumber and copra production. A fuel farm, operated by BP, is located on the northern side of the copra mill. Offshore mooring and transfer facilities for re-supply vessels are located approximately 100 metres from the foreshore.

Pearl farming operations are located several kilometres south of the site on the southern end of Savusavu town.
Fiji Electricity Authority

*Environmental Impact Assessment for the Savusavu Biomass Power Plant*

Figure 8: Location plan showing Deposited Plan numbers
Collection of Baseline data

Description of Existing Environment

In view of the fact that the site to be developed is located within an area that has been developed in the past, the Terms of Reference call for an assessment to be made of credible available data that may be used to characterise the environment and make an assessment of the level of any impact that may arise from the proposal.

No published material or records held by FEA, or other institutions, that describes the environmental conditions at the site has been identified. An EIA, prepared for a proposed resort development at Nawi Island (Savusavu) was reviewed in order to identify particular issues and relevant baseline information. This document little that was applicable to this development. However, of interest, supplementary documentation identified concern over water quality aspects of the construction and operation of the resort had been expressed by Hunter Pearls. This concern was associated with local effects resulting from mobilisation of fine sediments from proposed dredging and construction of over water burres. No information of direct relevance to the biomass project was identified in this document. However, it was identified that an EIA is in preparation for a deep water wharf facility at Valaga Bay. It is understood that this facility is to be located adjacent to the proposed biomass site.

Site inspections have been conducted by Hydro Tasmania Consulting in order to gain an understanding of the biological, physical and social aspects of the site and to determine the nature of potential environmental impacts. Additional site visits were undertaken as part of a noise assessment conducted for the project. The noise assessment has been conducted by Vipac Engineers & Scientists in order to gain an understanding of background noise levels.

Noise monitoring was conducted over a 24hr period to establish background noise levels. During the monitoring period a period of heavy rain was experienced and this has influenced the levels measured. Noise emissions measured at the site indicate an emission range of approximately 27 dBA to 40 dBA. Vipac reporting is provided in Appendix 4. Data obtained from this noise monitoring exercise has been utilised as a plant design consideration and to formulate management strategies for the Environmental Management Plan.

A desk top assessment of air quality issues has been conducted as a desk top by William Wood and Associates to identify potential air quality issues associated with the operation of the biomass plant (Appendix 5).

Social impact assessment and community consultation has been undertaken by Dev Associates, Fiji based socio-economic and environmental consultants (Appendix 3).

Biological Environment

World Bank OP4.04 Annex A (June 2001) defines a natural habitat as land and water where (i) the ecosystems biological communities are formed largely by native plant and animal species, and (ii) human activity has not essentially modified the areas primary ecological functions.

The site has been substantially modified over a number of years for agricultural and plantation practices. Some residual evidence of this practice is evident in the remains of a barbed wire fence, old plantation coconut palms and a small area of dalo planting. At the time of the site visit the site was being grazed by cattle. Vegetation within the site is predominantly grass and residual plantation species with some localised regrowth of native vegetation along the course of a
drainage ditch at the southern boundary of the site. Isolated trees are present on the site towards the foreshore. The land is substantially modified and does not meet the criteria of natural habitat. Other areas that may be impacted by construction and operation may qualify.

Land surrounding the power station has been cleared for industrial purposes, including sawmilling and copra processing. Land on the opposite side of the road has been purchased for development in association with a proposed deep water wharf facility. Some localised regrowth of native vegetation with isolated trees and plantation species is evident at the site.

Valaga Bay is a deep water bay reaching depths of 30 metres a short distance offshore in front of the proposed site. Two mooring facilities for fuel re-supply of the BP fuel farm are located within 100m of the foreshore (Figure 9).

Figure 9: Offshore mooring in front of the BP tank farm, for fuel transfer.

The drain on the southern side of the site currently receives silt from informal drainage from the neighbouring sawmill site and the road side. Excess silt is regularly excavated from the drain by sawmill personnel (Figure 10).

Figure 10: Silt removal from the drain is undertaken regularly by Lumber Processing.
Physical Environment

The south-central part of Vanua Levu is composed of late Cenozoic lavas, breccias and volcanic sediments of the Natewa Volcanic Group. The site is located in Valaga Bay, a deepwater bay. Coral reef does not feature in Valaga Bay, although the coastal plain on the northern side of Savusavu Bay is underlain by a relict coral reef. Breaks in the reefs occur in embayments and are related to outflows of muddy fresh water at river mouths, especially off the Nasekawa Delta and in Valaga Bay. Marine sediments extend landward beneath the coastal plain and are overlain by sandy and gravely clays (Roy 1998).

The site is located on a mostly cleared area (Figure 11) on the narrow coastal strip, at the base of the steeply rising ranges. Industrial operations, Lumber Processing and Copra Mill, are located on either side of the site. Drainage ditches to direct water to the foreshore are common.

Figure 11: Site looking towards Lumber Processing on the southern boundary.
Climate

At all seasons the predominant winds over Fiji are the trade winds from the east to south-east. On the coast of the two main islands, Viti Levu and Vanua Levu, day-time sea breezes blow with great regularity.

Winds over Fiji are generally light or moderate; strong winds are far less common and are most likely to occur in the period June to November when the trade winds are most persistent. However, tropical cyclones and depressions can cause high winds, especially in the period November to April.

Fiji enjoys a tropical maritime climate without great extremes of heat or cold. Temperatures at the lower levels are fairly uniform. In the lee of the mountains, however, the day-time temperatures often rise 1 to 2 °C above those on the windward sides or on the smaller islands. Also, the humidity on the lee side tends to be somewhat lower.

Due to the influence of the surrounding ocean, the changes in the temperature from day to day and season to season are relatively small. The average temperatures change only about 2 to 4°C between the coolest months (July and August) and the warmest months (January to February). Around the coast, the average night-time temperatures can be as low as 18 °C and the average day-time temperatures can be as high as 32 °C. In the central parts of the main islands, average night-time temperatures can be as low as 15 °C. Past records, however, show extreme temperatures as low as 8 °C and as high as 39.4 °C have been recorded. South-eastern coastal areas and the high interior often experience persistent cloudy and humid weather.

Rainfall is highly variable and mainly orographic, being influenced by the island topography. The south-east trade winds are often saturated with moisture, causing any high land mass lying in their path to receive much of the precipitation. The mountains of Viti Levu and Vanua Levu create wet climatic zones on their windward sides and dry climatic zones on their leeward sides; hence, the main islands have pronounced dry and wet zones. Little climatic differentiation occurs on the smaller islands.

Fiji experiences a distinct wet season (November to April) and a dry season, controlled largely by the north and south movements of the South Pacific Convergence Zone, the main rainfall producing system for the region. Much of the Fiji’s rain however falls in heavy, brief local showers. Rainfall is often deficient during the remainder of the year, particularly in the "dry zone" on the north-western sides of the main islands. Annual rainfall in the dry zones averages around 2000mm, whereas in the wet zones, it ranges from 3000mm around the coast to 6000mm on the mountainous sites.

Natural Drainage Features

The site is located on a narrow coastal strip and as such is subject to water logging. A series of open drains to conduct excess water away are evident at several locations. There are no permanent natural water courses at the site.

Land Use

The proposed site is an undeveloped site that has been utilised in the past for agricultural and plantation practices. Surrounding land use is industrial with some small areas cropping. A sawmill is located on the southern side of the site and a copra processing factory on the northern boundary. The sawmill is in daily use. The mill operates two shifts and is operational until midnight. The Savusavu BP terminal is located on the other side of the copra mill.
Land on the opposite side of the road has been purchased for use in association with a proposed deep water port facility to be constructed near the proposed site.

**Air Quality**

The site and surrounding area is rural. Notwithstanding the presence of the sawmill and copra processor, which itself utilises a boiler, air quality is considered to be good.

**Noise**

The site is located in an active industrial zone. During operational hours the sawmill is a very noisy operation. The mill operates until late (12 midnight) in two shifts. The copra mill, while less noisy, operates some machinery during the night, when operational. Background noise investigations by Vipac have indicated that background noise levels during non-operational periods are low, approximately 27dBA (Appendix 4).

**Visual Landscape**

The coastal strip in this area offer water and coastal range views in a rugged and spectacular landscape. The road is located inland and above the site and accordingly some views of the water are offered in the immediate vicinity of the site. The site is immediately adjacent to, and fully visible from, the road. A residence located up-slope (and over the road) from the site overlooks the sawmill and the proposed site. This residence is owned by Lumber Processing and is currently rented out.

**Roading, Access and Transportation**

Access to the site is from Transinsular Road near Nabaci Village. Transinsular Road is the main transport route between Labasa and Savusavu.

**Water**

Public Works Department maintain a reticulated water supply to the front gate of the site. The town water supply will be utilised as feed water for the boilers. Consultation with the PWD has indicated that there is sufficient water available to provide boiler make up water to the site and the community. PWD have embarked on a programme of upgrade that will establish improved supply.

**Storm Water**

Stormwater drainage at the site is informal. A single drain has been constructed on the southern boundary of the property.

**Socio-cultural and Community Environment**

**Jerusalemi Village**

Jerusalemi village is located approximately 250 metres from the proposed plant site at Valaga Bay. There are 23 households and the population is around 200. Major income source is farming. Cash crops grown include dalo, tapioca, yagona, and copra. While some work as permanent employees of Lumber Processors, Copra Millers, BP Oil Terminal, quite a number of the younger men prefer to work as casual labourers in the mills and factories around.
The village has about 200 acres of Yavusa land divided amongst the four mataqalis that reside in the village. The village has FEA power supply. Water supply to the village is from a mountain stream. Each household has a stand pipe. Cooking fuel comes from three sources: bush wood, mill wood, and gas.

**Hanshine Enterprises Ltd**

The primary business of the Company is downstream timber processing of logs. It mostly processes native timber, occasionally pine as well. Timber is processed from both plantation and indigenous forest. The logs are procured from Viti Levu. The break down of source use varies from year to year but is reported by Hanshine to be approximately 60% plantation timber and 40% native forest. The Company produces timber profiles such as flooring, quarter and half rounds, weather boards, shiplap, skating, veneering, boards, etc. The Company employs about 25 people.

Total annual processing = 5000m3 of logs

Hanshine report that a very small portion of mill waste is used as firewood by the local community. One to two percent of the wood shavings and saw dust is used for the purpose of landfill and mulching of vanilla vines. The remaining mill waste is generally burnt at the mill site. A small portion of the fire wood is taken free by mill employees. Some firewood is sold to residents of Naqere Settlement at $5 a bundle. The sales average about $200 per month.

Majority of the residents of Naqere Settlement use gas for cooking as most of them are salary earners or run businesses of their own. Firewood is used during weekends and on special social occasions. Depending on personal preference, people also buy firewood from contractors who chainsaw logs and sell firewood in bundles.

Furthermore, Naqere area is developing fast as an industrial hub in Savusavu. Frequent FEA power outage in the area is a great concern for the company. Sudden and frequent power cuts damage motors and machinery at the sawmill. This results in an idle labour cost to the Company, effecting productivity.

**Lumber Processors Ltd**

The parcel of land between Lumber Processors and Copra Millers of Fiji is approximately eleven acres freehold owned by Satish Gulabdas family. This is the proposed site for the biomass plant. The Government of Fiji has shown some interest to acquire the foreshore portion of the land to setup a port of entry for Vanua Levu. Other operators in the vicinity who have acquired land for their own use include BP Oil, Copra Millers of Fiji, and Coco Wood (a subsidiary of CIDA). A number of employees of Lumber Processors live near the proposed site. The names of the employees are: Charlie Powell, Martin, Ram Chander, Ramdeo and Net Ram. These employees live there by courtesy of the Company. The land and the wooden houses belong to the Company.

Lumber Processors throughput is about 10,000 m3 of logs annually. As is generally the case, mill waste is around 50 percent. Lumber Processing have identified a need for an increased electricity supply at the mill.

Firewood is taken free of charge by the neighbouring villagers. The Company sells some firewood to the outsiders, but the amount of sale is quite small. The frequency of take from July to December 2005 is as follows:

<table>
<thead>
<tr>
<th>Month (2005)</th>
<th>Frequency</th>
</tr>
</thead>
</table>
The value of firewood collated from the delivery docket is $130 for six months of 2005.

**Copra Millers of Fiji Ltd**

The Government owns major shares in Copra Millers of Fiji Ltd. Subsidiary shares are held by CIDA. Copra Millers use wood stumps to fire the boiler. The steam generated is used to cook coconut meal. Screw press is used to extract oil from the meal.

Copra Millers process about 8000 tons of copra annually. Every 1000 tons of copra pressed yields 610 tons of oil and 305 tons of coconut meal. 85 tons is wastage in the form of moisture loss. The meal is sold locally as animal feed. A small quantity of meal is exported to Australia. The Manager of the mill has identified that they need more power.

**Coconut Industry Development Authority**

Coconut Industry Development Authority (CIDA), previously known as Coconut Board, is a statutory body which looks after the interest of coconut industry in Fiji. Cocowood Pilot Project is set up by CIDA to process coconut trunks to produce quality grade timber that can be used to make furniture and other high value timber products. The project was opened by Hon. Gyani Nand, Minister for Agriculture, on 18th August, 2006.

The Cocowood Project uses trunks of senile trees which are more than 80 years old. Presently the Project is procuring trunks from Cakaundrove Province in lengths of 2.5m 3.0m, and 3.4 metres. It produces sawdust, chips, pith, and off-cuts as waste material.

**Light Industrial Area-Naqere**

The area between Hanshine Enterprises and the site is perhaps one of the largest residential and industrial areas in Savusavu. Some of the establishments along the road as one drives from Hanshine to Lumber Processors are:

- Housing Colony- developed by Housing Authority, 300-400 households.
- Savusavu Secondary School- co-ed with hostel facilities
- Vishnu Holdings- bus company
- Waiqele Buses- bus company

<table>
<thead>
<tr>
<th>Month</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>7</td>
</tr>
<tr>
<td>August</td>
<td>1</td>
</tr>
<tr>
<td>September</td>
<td>2</td>
</tr>
<tr>
<td>October</td>
<td>nil</td>
</tr>
<tr>
<td>November</td>
<td>1</td>
</tr>
<tr>
<td>December</td>
<td>nil</td>
</tr>
</tbody>
</table>
• Vehicle Repair Garages- three in number
• Heavy Machinery Yard
• Joinery Shops
• Fiji Gas Terminal
• Vanua Petroleum (storage yard)
• Coconut Cream Factory
• PWD yard
• St. Bedes College
• St. Andrews Primary School
• Teachers College- with residential facilities
• A village
• Montfort Boys Town- residential with staff quarters.

Public Utilities

Public Works Department maintain a reticulated water supply to the front gate of the site. Electricity distribution network is available at the site.

Archaeological sites

The site has been substantially modified for plantation and agricultural pursuits. As a consequence any archaeological values that may have been present have been removed.

Saw Milling Operations

Studies have indicated that the viability of transporting mill off cuts for fuel depends on distance from source to the power station. Preliminary resource agreements have been provided to sawmill operations that are considered most likely to be able to provide sufficient resource for the running of the power station on an on-going basis.

Transport from mill to power station is an additional factor that can impact on the economic viability of wood supply. Twenty kilometres is the distance generally considered to be the maximum economical distance for transporting mill waste (Barefoot power, 2005). Operations considered to meet this specification include:

• Lumber Processing;
• Hanshine;
• Palmwood (coconut processing);
• CIDA (coconut processing).
The following table provided by FEA (2005) provides some background to the potential fuel resource available for the Savusavu site.

| Sawmill operators near Savusavu with excess biomass |
|---------------------------------|----------------|----------------|----------------|
| Sawmill company name            | Lumber Processing | Hanshine | CIDA planned |
| Production (m³/day)             | 16              | 8        | 6             |
| Final products                  | 8               | 4        | 2             |
| Total waste (m³/day)            | 16              | 8        | 8             |
| - forestry residues             | 8               | 4        | 4             |
| - off cuts                      | 5               | 2.5      | 2.5           |
| - planing shavings              | 2               | 1        | 1             |
| - sawdust                       | 1               | 0.5      | 0.5           |
| Total mass of waste (t/day)     | 7               | 3.5      | 3.5           |
| Energy potential of off cuts and forestry residues only | 3000 MWh/yr | 1500 MWh/yr | 1500 MWh/yr |
| Power (kW)                      | 500 kW          | 250 kW  | 250 kW        |
| Transformer on site             | 250 kVA         | 300 kVA | 200 kVA?      |
| Sawmill electrical power consumption per year | 300 MWh/yr | 180 MWh/yr | 180 MWh/yr? |
| Future plans                    | Expand by 3 times current capacity | No expansion plans | To be built |

A draft assessment of sawmill waste completed by SOPAC (2006) concludes that the sustainable use of wood waste for fuel on a regular basis will depend on ensuring a regular availability of the resource and keeping the cost of the resource as low as possible.

Hanshine processes mostly native timber, occasionally processing pine as well. Timber is processed from both plantation and indigenous forest. The logs are procured from Viti Levu. The break down of source use varies from year to year but is reported by Hanshine to be approximately 60% plantation timber and 40% native forest. Similarly, Lumber Processing mills native timber obtained from both plantation and indigenous forest from Viti Levu. The break down of source use is reported by Lumber Processing as approximately 25% plantation timber and 75% native forest. The two remaining operations (Palmwood and CIDA) utilise senescent palm trees from plantation operations. Wood residues from these processes are available for use as fuel.

A detailed assessment of timber wastes available has not been completed, however, preliminary assessment indicates that sufficient resource is available from these two operations. World Bank is currently facilitating an assessment of timber wastes available as a fuel resource.

The power plant is expected to utilise approximately 24,000 t/year of woody off cut waste with the consumption of mill waste estimated at 2 t/MWh. Lumber Processing estimate 10,000 t/yr of
mill off cuts can be made available and with current expansions underway expects to produce up to 20,000 t/yr. Palmwood have estimated that their waste production as a minimum of 5,000 t/yr. The Coconut Industries Development Association (CIDA) aims to process approximately 5000 lower trunk stems per year, producing approximately 3,000 t/yr of waste. At present off cuts are burnt on site or utilised by the local community as firewood. The coconut timber mill will utilise approximately 30% of the tree (the bottom third). The remaining residue is available as fuel supply for the proposed biomass co-generation plant.

Sawmills have customarily made some of their waste wood available to the community for fire wood or, at a nominal price, for other unspecified use. Mill operators report that collection of the wood resource by locals is a very low level activity, taking little resource. The majority of waste is burned on-site as waste.
ANALYSIS OF IMPACTS

Construction Phase Impacts

It is during earthworks that most large construction projects have greatest potential to impact on the environment. Construction issues identified below can be managed through the application of conventional environmental controls. In order to ensure that these controls are appropriately applied throughout the project, the site will be subject to auditing by FEA. It is recommended that auditing during initial works (earthworks) that auditing be conducted at least on a fortnightly basis. Once construction of the facility proper commences it is recommended that this frequency be altered to monthly.

Management strategies are described in the Master Environmental Management Plan (Appendix 6).

Ecological

The site is predominantly cleared at the road side, the area to be developed. The remainder of the site comprises predominantly grass, coconut palms and a small area of regrowth on the sea side of the site and along side the drainage ditch. Other than obtaining access for piping of water, development of the site will not include the foreshore. Terrestrial habitat values at the project site and surrounding land have been substantially modified over an extended period by land use practices. It is considered unlikely that the construction of the power station would contribute to a further degradation of terrestrial habitat values at the site.

Potential for impacts on aquatic and marine habitat during construction exists primarily through the accidental discharge of pollutants such as fuel and oil, and transport and deposition of sediment, from the construction site into nearby aquatic and marine habitat.

It is considered that conventional measures for ensuring environmental protection (e.g. fuel storage and handling, erosion and sedimentation control and vegetation management) at a work site will be adequate for the protection of terrestrial and marine habitat values. A key element of this is ensuring that the area of disturbance is minimised. This will aid in reducing the extent and type of environmental management measures required at the site during construction and operations.

The drain on the southern side of the site currently receives silt from informal drainage from the neighbouring sawmill site and the road side. As a consequence, habitat values in this feature are considered to be substantially modified.

Erosion and Sedimentation

Substantial earthworks will be required to raise the low lying areas of the site above present levels. In order to ensure that sediments are not transported off-site and into nearby waterways, and whereby degrading aquatic habitats, it is recommended that sediment containment, such as silt traps and silt fencing, is required. Measures will be required at all locations where there will be bare soil, such as a new access road and filled areas, and at all locations where water and sediment may leave the construction site.

Erosion risk is considered low given the largely flat nature of the area to be developed. It is recommended that erosion control measures are required at the site. It is considered that the scale
of earthworks required for the project can be easily managed through the application of conventional erosion and sedimentation control measures.

**Economic**

Construction and operation of the power station has a low potential to impact on the economic well being of the local community. Once design and operation details have been finalised it is recommended that opportunities for local contractors to be utilised during operation should be discussed with the community.

**Social**

Construction of the power station is considered to have a low potential to impact on the well being of the local community. It is recommended that construction works are limited to daylight hours only. Residents should be kept informed of the project, particularly when noisy operations are scheduled. Further, it is recommended that, once design and operation details have been finalised, opportunities for local contractors to be utilised during operation should be discussed with the community.

**Visual**

The site will be fully visible from the road and nearby residences during the construction period. It is considered that future visual concerns may be partially addressed through the use of screening vegetation. While it may not be possible to screen the site from residences situated upslope from the site, the provision of screening vegetation at the road side will help to soften the visual impact from these locations. It is recommended that screening vegetation be established along the access road and around the southern and eastern boundary of the site.

**Waste**

Waste materials expected to be produced as part of the construction phase will include, but not be limited to the following:

- Minor quantities of vegetation material (scrubby regrowth) will be generated. Much of this vegetation will consist of weed and plantation species.
- Packing materials and general construction waste.
- Oily wastes.
- General refuse.

It is recommended that cleared vegetation be retained for chipping as fuel for the power station or is burned at site.

It is recommended that waste be removed from the site for disposal at a waste disposal facility on at least a weekly basis.

**Water**

Erosion of soils and subsequent transport of sediments from the sawmill and road side to the drain has resulted in siltation and probable degradation of marine, and aquatic habitat values and
water quality the drain may have. Sediments entering the drain from the proposed site have potential to contribute to this potential impact. It is recommended that drainage should be designed such that water flowing from the site into the drain is controlled to prevent erosion and minimise the transport of an additional sediment load into the drain.

Fuels and oils that may be accidentally spilled on-site during works have potential to impact aquatic habitat values and water quality. Where possible no fuels or oils are to be stored at the site during construction. Where it is necessary to store fuels the store will be an appropriately bunded and secure facility that is located away from any watercourse.

Spill recovery equipment is required to be located with the fuel and oil storage. For the purposes of this project a spill of more than 10 litres is to be considered significant. In the event of a spill of 10 or more litres the contractor is to commence clean-up immediately. FEA are to be notified immediately.

**Air**

Construction activities have the potential to generate dust, particularly during the period that the site will be filled and levelled, and while machinery and equipment are operated on unpaved surfaces. In addition to any potential for deposition in the natural environment, where in extreme circumstances it may cause harm to plants and animals, dust may be create nuisance and health issues for nearby and down wind communities. It is recommended that measures for the control of dust of required. Dust can be managed through the application of traditional watering or the application of soil tacifiers.

**Transport**

Machinery and vehicle movement along the main road, and at the site, during construction will be significant. Main vehicle movements during construction revolve around the delivery of materials and machinery to the site, daily construction crew attendance, and materials movement on-site. Signage indicating construction works and the presence of heavy machinery shall be utilised on the road. It is recommended that operation of trucks and machinery is limited to daylight hours. It is recommended that an information and awareness campaign be mounted with community, school children, teachers, and drivers before the start of project.

**Land Use**

No change to land use of the site or surrounding lands will be bought about by construction works at the site. However, the nature of the land use of the site will change from its current form to that of a conventional industrial use. It is considered that this use is consistent with the intent of the industrial zoning.

It is considered that the proposed industrial use will have little impact upon the surrounding land uses.

**Noise**

Notwithstanding that nearby residences are accustomed to significant noise emitted from the nearby industry, the sawmill in particular, construction noise is variable and is likely to be intrusive to nearby residences. It is recommended that works should be limited to daylight hours six days per week. Further it is recommended that the community should be kept informed of activities at the site, particularly when noisy works are expected.
Archaeology

The site has been quarried subject to agricultural and plantation practices and as a consequence any archaeological values that may have been present have been removed. Notwithstanding this, in the event that potential items of archaeological are uncovered work is to cease at that location and FEA informed immediately. The Fiji Museum are to be contacted by FEA.
## Construction Mitigation and Abatement Measures

<table>
<thead>
<tr>
<th>Aspect to be Managed</th>
<th>Mitigation Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compliance: Compliance of construction works with any permit requirements, the Master Environmental Management Plan and good environmental practice.</td>
<td>The project shall be subject to regular auditing by FEA. Audits shall be conducted, at least, on a fortnightly basis during earthworks. Once construction of the facilities commences auditing will be conducted monthly. The MEMP requires that the CEMP nominate and implement a schedule of internal auditing and inspection.</td>
</tr>
<tr>
<td>Ecological: Minimisation of ground disturbance</td>
<td>The area of disturbance is to be minimised.</td>
</tr>
<tr>
<td></td>
<td>Areas to be disturbed by works will be marked out on the ground. There will be no disturbance of soils or vegetation outside this envelope without the written authority of FEA.</td>
</tr>
<tr>
<td>Erosion and Sediment Control: Management of erosion and potential for aquatic habitats to be impacted by sediment transport and deposition.</td>
<td>Sediment containment, such as silt traps and silt fencing, is required. Measures will be required at all locations where there will be bare soil and at all locations where water and sediment may leave the construction site. Drainage should be designed such that water flowing from the site into the drain is controlled to prevent erosion and minimise the transport of an additional sediment load into the drain. Principles for earthworks management include:</td>
</tr>
<tr>
<td></td>
<td>• Reuse of soils on-site.</td>
</tr>
<tr>
<td></td>
<td>• Minimisation of stockpiling.</td>
</tr>
<tr>
<td></td>
<td>• Minimisation of soils and vegetation disturbance.</td>
</tr>
<tr>
<td></td>
<td>• Minimisation of the disturbance envelope.</td>
</tr>
<tr>
<td></td>
<td>• Revegetation of exposed soils, including any stockpiles, as soon as the area is available.</td>
</tr>
<tr>
<td></td>
<td>• Works not conducted during the wet season.</td>
</tr>
</tbody>
</table>
| Economic: Maximise opportunity for employment in the local community. | No stock piling of soils within 10m of a water course.

- All stock piles shall have erosion and sedimentation control techniques applied (such as seeding of stockpiles (if they are going to be in place for a while) and use of silt fencing.

| Social: Minimise potential for complaint resulting from noisy operations. | Once design and operation details have been finalised opportunities for local contractors to be utilised during operation should be discussed with the community.

- Limit construction activities to daylight hours.
- Residents to be kept informed of activities at the construction site, particularly if noisy operations are required.

| Visual: Reduce visual impacts | Planting of screening vegetation.

| Waste: Manage site waste generation | Cleared vegetation should be retained for chipping as fuel for the power station or is burned at site.

- General waste removed from the site for disposal at a waste disposal facility on at least a weekly basis.

| Water: Minimise potential for impacts on water quality and aquatic habitat | Drainage installed such that water flowing from the site into the drain is controlled to prevent erosion and minimise the transport of an additional sediment load into the drain.

- Fuel and oil spill recovery equipment is to be maintained at the fuel store.

- Where possible no fuels or oils are to be stored at the site during construction. Where it is necessary to store fuels the store will be an appropriately bunded and secure facility that is located away from any watercourse.

- It is recommended that fuels and oils should only be stored onsite in appropriately bunded and secured area.

- Spill recovery equipment is required to be located with the fuel and oil storage. For the purposes of this project a spill of more than 10 litres is to be considered significant. In the event of a spill of 10 or more litres the contractor is to commence...
<table>
<thead>
<tr>
<th>Category</th>
<th>Action and Mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air (dust): Minimise nuisance.</td>
<td>Application of dust control either by conventional means (e.g., watering) or the application of soil tacifiers.</td>
</tr>
</tbody>
</table>
| Transport (heavy vehicle and machinery movements): Minimise noise impacts, reduction of opportunity for dust generation. | Signage indicating construction works and the presence of heavy machinery shall be utilised on the road.  
Construction activity limited to daylight hours.  
Implement an information and awareness campaign with community, school children, teachers, and drivers before the start of project. |
| Noise: Minimise noise impacts.                    | Construction activity limited to daylight hours.                                       
The community should be kept informed of activities at the site, particularly when noisy works are expected. |
| Archaeology: Incidental finds.                    | Work to cease at that location and FEA informed immediately. The Fiji Museum is to be contacted by FEA. |
Operation Phase Impacts

Activity at the site will be continuous in daylight hours during commissioning. Once operational it is proposed that the station will operate as a base load supply. The environmental issues particularly relevant to the operation of the site are predominantly associated with noise and emissions to water. It is recommended that the project is subject to auditing on at least an annual basis.

Management strategies are described in the Master Environmental Management Plan (Appendix 6).

Ecological

The power station cooling system will utilise sea water drawn from Valaga Bay. No additives are used in the cooling water so there is little potential for chemical pollutants to be discharged to the bay via the cooling water discharge under normal operating conditions. Water circulated through the cooling system will leave the boilers approximately 12°C warmer than it went in. In order to avoid thermal pollution impacting on the local marine environment the power station has been designed to ensure water will only be discharged to the bay once it has been cooled to acceptable limits. Design expectations are that the water discharge temperature will be in the range of 3-6°C. This is well within the expected tolerance of the receiving environment.

The specific biological elements of Valaga bay, in front of the proposed development are not well understood. There are no reef systems known to be in close proximity to the proposed discharge site, however, it is recommended that further study to characterise the marine environment in front of the site is required.

No specific guidelines for marine water quality are in place in Fiji. It is recommended that Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000) are applied. This standard provides a process for determining appropriate water quality targets. It is recommended that a baseline study is required both to facilitate setting of water quality targets and simply to obtain a better understanding of the receiving environment. This will enable appropriate water quality monitoring parameters to be determined for the cooling water discharge.

Water quality targets include temperature, suspended solids, pH, and conductivity within an approved mixing zone at the cooling water discharge. It is recommended that these parameters are monitored at all times by automatic logger to ensure that discharge temperatures remain within allowable limits.

Although not part of this study, one of the issues associated with the development of Nawi Island Resort that has caused some concern for Hunter Pearls was the mobilisation of sediments. While the power station is some distance away and unlikely to impact on water quality at the pearl farm it is recommended that the cooling water outfall be designed such that mobilisation of bottom sediments is minimised.

Habitat values of the drain along the southern boundary has potential to be impacted by the transport of sediment and chemicals that may enter the drain from the site. It is recommended that only fuels and oils required for the operation of the facility should be stored onsite. Where this is required it is recommended that storage should be in appropriately bunded and secured area. Requirements for bunding are provided below.
Erosion and Sedimentation

In order to ensure that sediments are not transported off-site and into nearby waterways it is recommended that permanent sediment containment, such as silt traps and silt fencing, is required.

Economic

Construction and operation of the power station has a low potential to impact on the economic well being of the local community. Once design and operation details have been finalised it is recommended that opportunities for local contractors to be utilised during operation should be discussed with the community.

Social

The following is a summary of issues and concerns identified by the social impact assessment and community consultation consultant. A complete copy of the report, including assessment of community wood use from sawmills, is provided in Appendix 3.

The issues discussed in this chapter have been collated from community consultations and discussions with key informants and saw mill managers. (For record of discussion see appendix). The issues cover a wide range of subjects; some are specific to a particular location while others are common concerns applicable to stakeholders across the board. The main stakeholders who have contributed to the subject matter of this chapter include managers at Hanshine Enterprises and Lumber Processors, families at Lumber Processors, Advisory Councillors, and residents of Jerusalemi village.

Firewood Availability

According to the villagers the Firewood supply could slowly dry up once the saw millers have a resource agreement with FEA. This will affect the villagers adversely. In addition to cooking, the villagers also use wood to smoke and dry copra. The villagers are not sure that the promise to keep aside firewood for the use of the villages would be followed through. “Is there a mechanism to insure that it will be so?” they queried.

Sawmills have customarily made some of their waste wood available to the community for firewood or, at a nominal price, for other unspecified use. The use of off-cut wood by the power station places an economic value on a previously unwanted resource. There is potential for people who currently obtain fire wood from the sawmills to have reduced access to firewood. It is recommended that sawmills contracted to supply off cuts be required or encouraged to maintain adequate wood resources at the mill and to make it available as fire wood. Similarly the sawmills should be encouraged to continue the practice of selling off cuts to the community as required.

Smoke- air pollution and health hazard

The families living close to Lumber Processors and residents of Jerusalemi village expressed concern that the operation consumed a lot of wood, was environmentally damaging, and a potential health hazard through the emission of soot and smoke.

A discussion of air quality is provided below. Some smoke is unavoidable however if the boilers are carefully managed smoke is unlikely to be a major feature of the power station. Electrostatic precipitation will be used in-stack to remove nearly all particulates from the stack emissions.
Noise

Noise, like smoke, was a concern expressed by a number of stakeholders. Ram Chandar and Charlie Powell living close to Lumber Processors felt that the biomass plant may compound the noise already coming from the sawmill operation. Noise from the plant could affect nearby residents. A discussion of noise is provided below. Noise from the power station can be managed through a combination of design and operational controls.

Bad Odour

Bad Odour was mentioned only once during the consultative process. When moist wood is staked for drying, it can emit unpleasant odour due to microbial activity. Or when wood is burnt under different conditions, foul smelling gases can be produced. Nearby residents would have difficulty putting up with unpleasant odour.

A discussion of air quality is provided below. Some smoke is unavoidable however if the boilers are carefully managed smoke is unlikely to be a major feature of the power station. Electrostatic precipitation will be used in-stack to remove nearly all particulates from the stack emissions. Odour generally occurs from fermentation of wood chips which can be appropriately managed through operational controls.

Waste Water Discharge

Chemicals in waste water if put back into waters at Valaga Bay would affect marine life. The village depends upon marine life for their supply of protein foods.

A discussion of water quality is provided elsewhere in this EIA. Water utilised for cooling the power station will be untreated and will be returned to Valaga Bay in the same condition as it was taken. Water drawn from the town supply, used for steam production, will be purified on site. The waste stream from this process will be trickled back into the water discharge from the site contains no introduced chemicals or materials and will not be harmful to water quality or marine organisms. Detailed design of the power station will include water quality monitoring requirements.

Traffic Hazard

Traffic hazard arises from the fact that trucks transporting bio-fuel to the stations would increase in number and frequency. This job may be resourced out to contractors who may not exercise due vigilance in the matter of pedestrian safety, especially children going to schools.

The area will see increased traffic due to other industrial, commercial, and residential developments as well. Very close to the proposed plant site, a tax free zone has been established with basic infrastructure already in place. Port of entry for Vanua Levu is already in the pipeline. A housing estate with 32 lots is underway some distance away from the tax free zone. There are a number of primary, secondary and tertiary educational institutions in the area. The Light Industrial Zone between Hanshine Enterprises and Valaga Bay has already taken off for industrial and commercial developments. These have been described under ‘existing social environment’ of the social impact assessment in Appendix 3.

Increased heavy vehicle traffic will be experienced on the southern side of the site as trucks move from Hanshine Mill and Palmwood to the site. It is anticipated that this operational truck movement will be approximately 4 trucks per hour. This section of road is already busy and in terms of vehicle movements it is considered unlikely that this additional movement will be...
noticeable. It is considered unlikely that trucking contractors would be less vigilant under these conditions. Potentially the trucking contractors will be local and could be more vigilant because of it. Notwithstanding this, it is recommended that an information and awareness campaign can be mounted with community, school children, teachers, and drivers before the start of project.

**Fall Outs from Trucks**

Trucks would be transporting sawdust, chips, and slabs from sawmill to the proposed plants on regular basis. This service may be resourced out to contractors. There is every possibility that contractors will use vehicle which are not properly equipped. There would be biomass fall outs along the road from sawmills to FEA yard. The residents quoted the instance of cane fall outs from trucks transporting cane to mills.

Trucks transporting materials to the site will be required to have their loads secured to minimise the likelihood that fall outs will occur.

**Fijian Traditional Protocol**

This issue was especially brought up at the Jerusalemi village meeting. Fijians, especially in rural areas, are mindful of Fijian protocol and they are not willing to talk about new development like this unless the matter has been first taken up with their chief in a traditional manner. They suggested that FEA should make a traditional approach to Tui Wailevu, inform him about the project, and seek his blessings. The village comes under Tikina Wailevu and traditional protocol requires that a high chief of the area is informed first about the proposal. The present title holder is Ratu Kenijiiji Maiwaleli from Wailevu village.

FEA have arranged to consult with Tui Wailevu and Tui Nasavusavu. The arrangements for that consultation have not yet been finalised. FEA will inform Ministry of Environment of the outcomes of that consultation.

**Frequent Power Outage**

Savusavu is now entering the phase of rapid industrial, commercial, and tourist industry developments. It appears that the demand for power is far outstripping the supply. As a result, according to some stakeholders, especially saw millers, they face sudden and frequent power outage which is detrimental to the health of machinery and arrests expansion and developments in allied areas. Labour is kept idle for periods of time which adds to financial burden of the company. Therefore a development of this nature is welcome provided it eases power supply problems and takes care of negative impacts that may eventuate.

**Visual**

The site will be fully visible from the road and nearby residences. It is considered that visual concerns may be partially addressed for the future through the use of screening vegetation. While it may not be possible to screen the site from residences situated up-slope form the site, the provision of screening vegetation at the road side will help to soften the visual impact from the these locations. It is recommended that screening vegetation be established along the access road and around the southern and eastern boundary of the site.
Waste

Once operational the power station will generate small quantities of general and oily waste. It is recommended that formal waste containment be provided at the power station to facilitate weekly rubbish removal. Where possible, oily waste should be recycled.

Wood contains 0.5-2.0% incombustible minerals. This material remains as fly ash after combustion. The ash contains a range of nutrients such as potassium, magnesium and phosphorus and in some cases may also contain low levels of heavy metals such as cadmium. Fly ash can be utilised by a variety of industrial processes including concrete manufacture, road base and fertiliser. It is recommended that commercial opportunities for re-use of fly ash are investigated by FEA. If the re-use of fly ash of fertiliser is pursued an analysis will be required to determine its chemical properties prior to use as forest return. This will enable an appropriate application rate to be determined for the receiving environment.

Water Quality

It is recommended that parameters determined for monitoring marine water quality are monitored at all times within the mixing zone by automatic logger to ensure that discharge temperatures remain within allowable limits. Actions to be taken in the event of each or all of the parameters should be developed once the targets are understood. This may include plant shutdown.

Sediments entering the drain from the proposed site have potential to contribute to a degradation of water quality within the drain, and eventually Valaga Bay. It is recommended that drainage should be designed such that water flowing from the site into the drain is controlled to prevent erosion and minimise the transport of an additional sediment load into the drain and eventually Valaga Bay.

Fuels and oils that may be accidentally spilled on-site during works have potential to impact aquatic habitat values and water quality. Where possible no fuels or oils are to be stored at the site. Where it is necessary to store fuels the store will be an appropriately bunded and secure facility that is located away from any watercourse.

Spill recovery equipment is required to be located with the fuel and oil storage. For the purposes of this project a spill of more than 10 litres is to be considered significant. In the event of a spill of 10 or more litres the contractor is to commence clean-up immediately. FEA are to be notified immediately.

It is recommended that any waste water streams from the power station, particularly the cooling water, are subject to monitoring for the presence of oil and grease.

Water for Production

Water for use in the boilers will be obtained from the town water supply. Consultation with PWD has indicated that the reticulated supply is adequate to supply the power station needs and maintain town supply. There are no additives to the water. It is recommended that further consideration of the capacity of the town supply be given during the detailed design process.

Cooling water will be drawn from Valaga Bay.
Air

The following summarises the findings of William Wood & Associates. A complete copy of this report can be found in Appendix 5. At the present time there are no available emissions data for the specific wood-fired facilities under consideration. In a recent publication that considers stack emissions, air quality and health, typical stack emission concentrations for a 10MWe wood-fired electricity generating plant are shown in Table 2.
Table 2: Typical stack emission concentrations for a 10MWe wood-fired electricity generating plant.

<table>
<thead>
<tr>
<th>Generation Technology</th>
<th>Plant Size</th>
<th>SO₂</th>
<th>NOₓ</th>
<th>Particulates</th>
<th>VOC’s</th>
<th>CO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combustion</td>
<td>10MWe</td>
<td>50</td>
<td>300</td>
<td>100</td>
<td>50</td>
<td>200</td>
</tr>
<tr>
<td>Gasification</td>
<td>10MWe</td>
<td>30</td>
<td>100</td>
<td>&lt;50</td>
<td>20</td>
<td>400</td>
</tr>
<tr>
<td>Pyrolysis</td>
<td>10MWe</td>
<td>20</td>
<td>200</td>
<td>&lt;50</td>
<td>NA</td>
<td>150</td>
</tr>
</tbody>
</table>

Milligrams per cubic metre of exhaust gas

Source: Combustion emissions based on operating plant data. Pyrolysis and gasification emissions based on estimates for plant under development.

The plant proposed for Savusavu will have a total capacity of 3MWe but is expected to have an efficiency equivalent or better than that for plant from which the above data were derived.

**Relevant Standards**

Fiji does not currently have guidelines for air quality. The FEA has agreed to adopt the air quality standards set out in The World Bank Group Pollution Prevention and Abatement Handbook 1998 Toward Cleaner Production as the relevant standards to apply to emissions from these power plants.

For the purposes of this exercise the standards shown in Table 3 are indicative target standards. It is recognised, however, that the technology to be utilised in controlling stack emissions can only be finalised through a more detailed design process. A major consideration in determining the appropriate technology is minimising operations and maintenance requirements for the stack emission controls. Other technology may not be able to achieve the lower end of these emission thresholds but will still achieve the desired ambient air quality requirements (see below).

Table 3: Proposed stack emissions (emission targets provided by SKM Fiji).

<table>
<thead>
<tr>
<th>Stack gas Parameter</th>
<th>Units</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOₓ</td>
<td>ppm/NM³</td>
<td>300</td>
</tr>
<tr>
<td>NOₓ</td>
<td>ppm/NM³</td>
<td>300</td>
</tr>
<tr>
<td>Particulates</td>
<td>mg/NM³</td>
<td>50-250</td>
</tr>
</tbody>
</table>

The Environmental Management Act 2005 places emphasis on the qualities of human life, on the need for the adoption of sustainable practices and or the use of natural resources at a rate which ensures the ability of future generations to use and benefit from these resources. These objectives can only be achieved through the adoption of “Best Practice” environmental management and the embracing of modern technology where renewable resources are to be used in the proposed power generation facilities.

The present Australian National Environmental Protection Measure (NEPM) sets Standards and Goals for pollutants other than PM2.5 in ambient air are shown in Table 4.
Table 4: Australian National Environmental Protection Measure (NEPM) standards and goals for pollutants other than PM2.5 in ambient air.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Averaging Period</th>
<th>Maximum Concentration</th>
<th>Goal within 10 years Maximum allowable exceedences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Monoxide</td>
<td>8 hours</td>
<td>9.0 ppm</td>
<td>1 day a year</td>
</tr>
<tr>
<td>Nitrogen Dioxide</td>
<td>1 hour</td>
<td>0.12 ppm</td>
<td>1 day a year</td>
</tr>
<tr>
<td></td>
<td>1 year</td>
<td>0.03 ppm</td>
<td>none</td>
</tr>
<tr>
<td>Sulphur Dioxide</td>
<td>1 hour</td>
<td>0.20 ppm</td>
<td>1 day a year</td>
</tr>
<tr>
<td></td>
<td>1 day</td>
<td>0.08 ppm</td>
<td>1 day a year</td>
</tr>
<tr>
<td></td>
<td>1 year</td>
<td>0.02 ppm</td>
<td>none</td>
</tr>
<tr>
<td>Particles as PM$_{10}$</td>
<td>1 day</td>
<td>50 µg/m$^3$</td>
<td>5 days a year</td>
</tr>
</tbody>
</table>

The NEPM criteria will be adopted as the relevant targets to be achieved for ambient air quality.

NEPM targets may be achieved by adopting appropriate pollution controls on facility stacks and or managing total emissions from this and all other sources to the air shed in which the facility is located.

While a definitive assessment is not possible in the absence of detailed baseline data it is still possible to make a reasonable assessment of the likely air quality situation based upon experiences elsewhere, the information available as to prevailing winds and temperatures and the surrounding topography.

Analysis of the limited information available at this time suggests that the installation of a biomass-fired power plant at Savusavu will not compromise local or regional air quality. Indeed it might in practice improve ambient air quality if reliance on the diesel powered plants is reduced. However, in the absence of more definitive meteorological or air quality data it is not possible to categorically state that air quality might not be deleteriously be affected under some conditions in the absence present ambient air quality data, local meteorological data or appropriate air quality modelling.

It is concluded that biomass power plants reduce many key air emissions when compared to conventional generation technologies in particular diesel. Stack emissions from biomass power plants can be managed through the application of conventional technologies, and active management of fuel supply and the firing process.

Based on the assessment prepared by Wood & Associates it is recommended that:

- To ensure that there is good dispersion from the plant it is recommended that the stack is raised above the ridge of any building to ensure emissions are not trapped in localized
effects associated with the ridge-line above the plant. A design stack height of 15m has been used for the feasibility study. It is considered that this height is sufficient to ensure mixing.

- Achievement of the Australian ambient air quality criteria (Table 4) will require a full modelling assessment of all emissions from the planned new power plant. In the event that the planned extended capacity of the new plant is envisaged, the inclusion of these emissions would also be required.

- A monitoring plan that clearly identifies monitoring parameters should be developed for implementation prior to the commencement of works. The monitoring plan should include a responsibility framework to ensure that such mitigations measures that may be indicated may be applied within an agreed timeframe.

- Exhaust stacks will be provided with sampling ports according to the relevant Australian Standard. Iso-kinetic sampling of stack gasses should be undertaken following the completion of commissioning and then at 12 month intervals or as required by the Fiji Ministry of Environment.

- Fixed ambient air sampling station between the plant and nearby residences. Sampling at these locations should be undertaken before and after installation of any new power plant. This will assist in determining present ambient air conditions and will allow an assessment of improvements or otherwise following the commissioning of the new plant. Ambient air sampling should be undertaken annually or at a frequency as required by the Fiji Ministry of Environment.

**Odour**

There is a potential for odours to be emitted from the various feed-stocks and waste components reporting to or issuing from the plant. Odours are generally associated with fermenting wood chips and may be from Hydrogen sulphide, ammonia, mercaptins and carbon oxy-sulphide. They may be emitted from storage areas, gas leaks, waste-water condensate and fly ash.

To ensure that sources of odour cannot be established, detailed planning of storage areas and waste water facilities will be undertaken while consideration will be given to appropriate emission controls on stacks or other points of emission.

**NOx and health effects of NO2**

NO2 is a pulmonary irritant affecting primarily the upper respiratory system. Individuals with asthma, respiratory disorders, and lung disease are more sensitive to the effects of NO2. Continued or frequent exposure to high NO2 levels can cause pulmonary oedema, though the effect on the lungs may occur several hours after exposure. At typical ambient concentrations, NO2 has not been proven to be related to lung disease.

NOx emissions from a wood-fired plant will be very much lower than the emissions from a corresponding diesel power plant depending upon the technology in use.

NOx emissions from diesel generating plant may be 6 times higher than a steam cycle plant.
**SO₂ and health effects of SO₂**

SO₂ is a pulmonary irritant and contributes to respiratory illness, alterations to pulmonary defences and aggravation of cardiovascular disease. It can also damage vegetation and non living materials and is an important precursor to acid rain.

Biomass, especially clean wood, has very low levels of embodied sulphur. Emissions of sulphur as SOx to the atmosphere will represent a small proportion of emissions from an equivalent diesel powered power plant. The majority of the sulphur component will remain with the ash residue from the combustion process.

SO₂ emissions from diesel generating plant may be 10-15 times higher than a biomass based generation plant.

**Particulates**

The primary concern regarding the health effects of particulates (particles less than 10 µm = PM₁₀) is due to it being small enough to be inhaled and lodge deep in the lungs. Small carbon particles may carry other pollutants which may affect the sensitive lung tissues and/or be absorbed into the blood. Respirable particles have been associated with a wide range of respiratory symptoms and exposure to such particles has been linked to increased deaths from heart and lung disease.

Particle loads from wood-fired steam cycle generation plants are up to two times that for the corresponding diesel plant however the particle size tends to be larger than those emitted from diesel units. The proportion of particles less than 10 µm are higher in diesel emissions than from a steam based wood-fired plant. Notwithstanding this, with complete combustion very little particulate matter will be emitted from any wood-fired facility. Emissions of particles of PM₁₀ and PM₂.₅ size increase rapidly when combustion is incomplete. Incomplete combustion is usually a function of low temperature combustion or a lack of oxygen. Stack emissions from the power station will be treated by electrostatic particulate removers (ESP) to ensure that particulate emissions are appropriately managed. ESP technologies are highly efficient particulate removal devices with design efficiencies in excess of 99.5%.

Operation of machinery and vehicles on unpaved surfaces has potential to raise dust. Dust can be managed through the application of traditional watering or the application of soil tacifiers. It is recommended that measures for the control of dust of required.

**Greenhouse**

The combustion of any organic material will produce greenhouse gasses such as Carbon Dioxide and Methane. In this context it is appropriate to look at wood-firing from the perspective of life cycle analysis. In the process of combustion carbon and carbon products will be released to the atmosphere or land as a gas, as fly ash or as boiler residues. This carbon will then enter the natural Carbon Cycle and may then be adsorbed during the process of photosynthesis and laid down as new wood or other vegetative biomass, or may be sequestered in soils or laid down in offshore marine sediments.

Unlike non-renewable fossil fuels there will be no net emissions of greenhouse gasses from burning biomass that are not returned to the natural cycle within the relatively short term (Barefoot Power 2005).
An analysis of wood-fired boiler emissions from the USA provides stack test data for emissions of various pollutants including Hazardous Air Pollutants.

Emissions of greenhouse gases and particulates are presented as:

<table>
<thead>
<tr>
<th>Stack gas Parameter</th>
<th>Units</th>
<th>Lower</th>
<th>Upper</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen</td>
<td>%</td>
<td>10</td>
<td>14</td>
<td>12.5</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>%</td>
<td>3.5</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>ppm</td>
<td>800</td>
<td>2000</td>
<td>1400</td>
</tr>
<tr>
<td>Particulates</td>
<td>Kg/hr</td>
<td>1</td>
<td>7.1</td>
<td>2.95</td>
</tr>
</tbody>
</table>

Data are for boilers ranged between ~3MW to ~18 MW.

**Transport**

Once constructed there will be regular heavy vehicle movement to and from both the sawmills and the power station for wood deliveries. It has been estimated that up to 35 truck loads of wood waste will be transported to the site every day, or 4.3 per hour. It is recommended that wood deliveries be limited to daylight hours only. A community awareness campaign has been recommended previously.

**Land Use**

It is considered that while the project is consistent with the current industrial zoning, it is recommended, that local residents be kept informed of activities at the construction site. The provision of this information will be particularly important during noisy construction operations.

It is considered that during the longer term it may be appropriate for the zoning of the site to be changed to Special Use Power Station. This will serve to better protect the ongoing land use and operations of the site for this purpose. It is recommended that this rezoning process should be commenced as soon as possible.

**Noise**

The following summarises the findings of Vipac Noise Engineers. A complete copy of this reporting is located in Appendix 4.

The sawmill operates until late (12 midnight) in two shifts and during operational hours is a very noisy operation. Notwithstanding that nearby residences are accustomed to significant noise emitted from the nearby industry it is likely that noise emitted from the site during construction and operation would be intrusive to nearby residences. While some of this noise may be mitigated through design noise generated from the power station is likely to include low frequency rumble which is penetrating and will probably be noticeable. Background monitoring undertaken at the site has indicated a moderately low level of background noise during quiet periods (principally night time). It is likely that noise generated at the new facility will be noticeable to nearby residences.
Vipac have identified that sound levels at 40dB + 5 dB during the day and 35 dB + 5dB for the night to be acceptable levels at the sensitive locations.

To achieve these operating noise limits it is likely that engineering noise control will be required for the main items of equipment at each power station site. Vipac consider that preliminary equipment requirements indicate that this could include some or all of the following equipment:-

- Mobile equipment (front end loader)
- Chipper
- Hogger
- Screen(s)
- Conveyor drives
- Burner combustion air blower(s)
- Boiler I.D. Fan(s)
- Cooling tower fans
- Steam turbine / generator units

Engineering noise controls may include some or all of the following:-

- Selection of quiet equipment where possible
- Provision of appropriate inlet and discharge silencers for fans and blowers
- Enclosure of chipper, hogger and screens
- Provision of an acoustically lined inlet tunnel for the chipper infeed
- Provision of an acoustically lined discharge conveyor from the chipper enclosure
- Acoustic lagging or cladding of fans and blowers
- Close fitting acoustic enclosures for the turbine / generator sets
- Acoustic lagging of steam valves and steam lines
- Boiler steam vent silencers and boiler water blow down silencers
- Steam line drain silencers
- Orientation of main buildings on site to optimize acoustic barrier performance of the buildings
- Location of vehicle access points to minimize traffic noise on local villages
- Control of backing alarm noise levels, sirens and other alarms on site
• Management noise controls to prevent the use of mobile equipment, chipping or hogging systems at night

It is recommended that appropriate noise performance requirements should be specified to the equipment or plant suppliers and manufacturers’ noise controls incorporated into the plant design where possible.

Sinclair Knight Merz in their feasibility assessment of the project consider that the noise generated from the new Biomass plant will not be in excess to the original arrangement and have made comment on the following design controls:

• The boilers are projected to have ESP/Baghouse filters which can be fitted with noise attenuators.

• The Stack will be of sufficient height with external insulation and cladding. If required Silencers can be incorporated in the stack.

• If required noise attenuating baffle walls can be positioned to the same height as the boilers to minimise noise levels directed to the village.

• The steam turbines can be fitted in local enclosures positioned in the power station building

• The cooling tower can be fitted with efficient fans to lower noise emissions to within the acceptable levels.

In addition to design considerations, to reduce noise emissions, it is considered that operational constraints are required. To minimise the likelihood of generating excessive noise during quiet (night) periods it is recommended that delivery of wood waste, handling of materials and chipping should only be conducted during daylight hours. This will require that sufficient fuel is available in the boiler bunkers to ensure additional handling is not required.

It is recommended that the sound levels identified by Vipac, 40dB + 5 dB during the day and 35 dB + 5dB for the night, are acceptable levels at the sensitive locations.

**Forest and Milling Operations**

A detailed assessment of timber wastes available at Savusavu has not been completed however, preliminary assessment indicates that sufficient resource is available. World Bank is currently facilitating an assessment of timber wastes available as a fuel resource for the Savusavu plant.

The power plant is expected to utilise approximately 24,000t/year of woody off cut waste with the consumption of mill waste estimated at 2t/MWh. Lumber Processing estimate 10,000 t/yr of mill off cuts can be made available and with current expansions underway expects to produce up to 20,000t/yr. Palmwood have estimated that their waste production as a minimum of 5,000 t/yr. The Coconut Industries Development Association (CIDA) aims to process approximately 5000 lower trunk stems per year, producing approximately 3,000 t/yr of waste.

At present, forest and milling operations are actively monitored and regulated by Ministry of Fisheries and Forests (MoFF). Activities in both sectors are reported in annual reporting prepared by MoFF.
In order to gain access to American and European timber markets forest industries in Fiji are undergoing a process of certification. An independently certified standard of practice for the forest industries in Fiji will provide a high level of certainty that resources and products are managed within a sustainable framework that is acceptable in the international market. It is anticipated that by the time this project has been built all timber milling operations will be certified or in the process of certification.

Even without active regulation or the certification framework, the prospect that forest operations may alter or saw mills might increase production of final products to satisfy the demand for waste material is considered uneconomical and therefore highly unlikely. It is considered that the biomass project will not promote an expansion of forest or milling operation to meet a demand for waste wood at the power station.

Timber for milling is provided from licenced logging operations with approved harvest plans. The logging operations are regulated by MoFF. Similarly sawmill operations are monitored by MoFF. Mills found to be processing timbers not obtained from authorised sources stand to lose their operating licence. Fuel for the power station will be purchased only from those operations that have signed resource agreement. It is considered unlikely that the proposed power station will provide opportunity for an increase, or substantive alteration, to forest practices in forests local to the sawmills or power station.

Notwithstanding this, it is recommended that World Bank undertake an annual due diligence assessment of saw mill operations to ensure that activities remain within expectations. This assessment would be appropriately conducted in partnership with MoFF. Ministry of Fisheries and Forests are currently hard pressed to keep up with current regulation demands and it is recommended that World Bank make some resources available to facilitate the due diligence exercise.

While the power station will be dependant on sawmills, the reverse is not the case. Milling of timbers obtained through the managed forest operations will continue and will continue to grow to meet export demand, irrespective of this proposal.

Wood waste at sawmills is currently heaped and burned. Utilising this waste resource for power generation provides additional an income stream to some logging operations and, in removing a local source of uncontrolled wood smoke emission, has potential to reduce the emission of unmanaged wood smoke emissions in the vicinity of the sawmills.

As previously described, sawmills have customarily made waste wood freely available to the community for fire wood or, at a nominal price, for other unspecified use. While it is considered that the number of people utilising waste wood from the mills for either purpose is very low, the use of off-cut wood by the power station places an economic value on a previously unwanted resource. There is potential for people who currently obtained wood from sawmills to have reduced access. It is recommended that sawmills contracted to supply off cuts be required or encouraged to maintain a continuing supply of wood resources at the mill to be made available for community use. Preliminary consultation with the mills has indicated that mill management recognise their role within the community and have expressed support for maintaining a community resource.
## Operations Mitigation and Abatement Measures

<table>
<thead>
<tr>
<th>Aspect to be Managed</th>
<th>Mitigation Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compliance: Compliance of construction works with any permit requirements, the Master Environmental Management Plan and good environmental practice.</td>
<td>The project shall be subject to auditing by FEA. Audits shall be conducted, at least, on an annual basis.</td>
</tr>
</tbody>
</table>
| Ecological: Minimisation impact of operations. | Design to ensure water will only be discharged to the bay once it has been cooled to acceptable limits. That limit has not been determined as part of this study as it requires a more detailed understanding of the receiving environment and the proposed inputs.  
Baseline study is required both to facilitate setting of water quality targets and obtain a better understanding of the receiving environment.  
Application of Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000) to determine appropriate water quality targets.  
Water quality targets include temperature, suspended solids, pH, and conductivity within an approved mixing zone at the cooling water discharge. It is recommended that these parameters are monitored at all times by automatic logger to ensure that discharge temperatures remain within allowable limits.  
Design cooling water discharge outfall such that mobilisation of bottom sediments is minimised.  
Where feasible, water quality parameters are monitored at all times by automatic logger to ensure that discharge temperatures remain within allowable limits.  
Where practicable only fuels and oils required for the operation of the facility should be stored onsite. Where this is required it is recommended that storage should be in appropriately bunded and secured area (see below). |
| Erosion and Sedimentation control: | Sediment containment, such as silt traps and silt fencing, is required. Measures will be required at all locations where there |
**Fiji Electricity Authority**  
*Environmental Impact Assessment for the Savusavu Biomass Power Plant*

<table>
<thead>
<tr>
<th><strong>Minimise environmental harm from transport of sediments and pollutants offsite.</strong></th>
<th>will be bare soil and at all locations where water and sediment may leave the construction site. Drainage should be designed such that water flowing from the site into the drain is controlled to prevent erosion and minimise the transport of an additional sediment load into the drain.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Economic: Maximise opportunity for employment in the local community.</strong></td>
<td>Once design and operation details have been finalised opportunities for local contractors to be utilised during operation should be discussed with the community.</td>
</tr>
</tbody>
</table>
| **Social: Maintain availability of firewood for cooking and minimise potential for complaint resulting from noisy operations.** | Materials delivery and handling limited to daylight hours only.  
Once operation details have been finalised, opportunities for local contractors to be utilised during operation should be discussed with the community. |
| **Visual: Reduce visual impacts** | Planting of screening vegetation. |
| **Waste: Manage site waste generation** | General waste removed from the site for disposal at a waste disposal facility on at least a weekly basis.  
Commercial opportunities for re-use of fly ash are investigated by FEA. If the re-use of fly ash of fertiliser is pursued an analysis will be required to determine its chemical properties prior to use as forest return. This will enable an appropriate application rate to be determined for the receiving environment. |
| **Water: Minimise potential for impacts on marine water quality and aquatic habitat** | Parameters determined for monitoring marine water quality to be monitored at all times within the mixing zone by automatic logger to ensure that discharge temperatures remain within allowable limits. Actions to be taken in the event of each or all of the parameters should be developed once the targets are understood. This may include plant shutdown.  
Management measures for controlling erosion and sedimentation are required. Drainage should be designed such that water flowing from the site into the drain is controlled to prevent erosion and minimise the transport of an additional sediment load into the drain and eventually Valaga Bay.  
Further consideration of the capacity of the town supply during the detailed design process.  
Fuel and oil spill recovery equipment is to be maintained at the fuel store.  
Where possible no fuels or oils are to be stored at the site during construction. Where it is necessary to store fuels the store
<table>
<thead>
<tr>
<th>Environment</th>
<th>Description</th>
</tr>
</thead>
</table>
| Air: Minimise opportunity for air quality degradation to impact on health and well being. | To ensure that there is good dispersion from the plant it is recommended that the stack is raised above the ridge of any building to ensure emissions are not trapped in localized effects.  
  
  Design to consider to appropriate emission controls on stacks or other points of emission.  
  
  A monitoring plan that clearly identifies monitoring parameters is required. The monitoring plan should include a responsibility framework to ensure that such mitigations measures that may be indicated may be applied within an agreed timeframe.  
  
  Ambient air sampling should be undertaken annually or at a frequency as required by the Fiji Ministry of Environment.  
  
  It is desirable to establish a fixed ambient air sampling station between the plant and nearby residences. Sampling at these locations should be undertaken before and after installation of any new power plant.  
  
  Plant exhaust stacks will be provided with sampling ports according to the relevant Australian Standard. Iso-kinetic sampling of stack gasses should be undertaken following the completion of commissioning and then at 12 month intervals or as required by the Fiji Ministry of Environment.  
  
  Application of conventional dust control (i.e. Watering) or the application of soil tacifiers.  
  
  
  Stack sampling and modelling be undertaken following commissioning to confirm the status of stack emissions and air quality impacts is recommended. |
<table>
<thead>
<tr>
<th>Transport: Transport (heavy vehicle and machinery movements): Minimise noise impacts, reduction of opportunity for dust generation.</th>
<th>It is recommended that wood deliveries be limited to daylight hours only. Implement an information and awareness campaign with community, school children, teachers, and drivers before the start of project.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Use (zoning): Ensure the site is appropriately zoned.</td>
<td>Re-zoning of the site to an appropriate use, such as Special Use Power Station, is required.</td>
</tr>
<tr>
<td>Noise: Minimise noise impacts.</td>
<td>Appropriate noise performance requirements to be specified to the equipment or plant suppliers and manufacturers’ noise controls incorporated into the plant design where possible. Materials delivery and handling limited to daylight hours. Ensure sufficient fuel is available in the boiler bunkers to prevent the need for overnight handling of materials. Design and specification of plant to minimise noise emissions. Acceptable sound levels of 40dB + 5 dB during the day and 35 dB + 5dB apply at the sensitive locations.</td>
</tr>
<tr>
<td>Milling Operations</td>
<td>World Bank undertake an annual due diligence assessment of saw mill operations to ensure that activities remain within expectations. This assessment would be appropriately conducted in partnership with MoFF. World Bank to make resources available to facilitate the due diligence exercise.</td>
</tr>
</tbody>
</table>
ALTERNATIVE DEVELOPMENT OPTIONS

A report prepared by SPREP (2005) identifies a wide range of renewable energy resources in Fiji including biomass, bio-gas, solar, wind, hydro, oceanic, geothermal, bio-diesel and ethanol. This detailed report provides background and identifies issues encountered or expected, in developing some of the options covered. A range of alternate energy generation options have been further investigated in detail by FEA. Several options are canvassed in reporting prepared by Barefoot Power Pty Ltd (2005) for both Fiji generally and Savusavu. FEA approached Barefoot Power to undertake a review of the renewable source of electricity generation options available at Savusavu, with a particular focus on biomass. This report identifies a range of biomass options available to FEA and has identified the use of sawmill waste, and other waste, as being sustainable and practicable. Copies of the Barefoot Power Pty Ltd investigations can be provided on request.

The use of diesel for power generation is a significant cost impost and contributes to increasing consumption of hydrocarbons, a global issue. As Fiji continues down the path of economic development it is likely that hydrocarbon use will increase. The imperative to develop alternative electricity generation options in Fiji is predominantly associated with controlling the cost of energy production, improving generation reliability and reducing reliance on hydrocarbons. Failure to develop and implement alternate energy production options will perpetuate an on-going reliance on diesel fired power generation in Fiji, result in significant cost imposts and increase production of greenhouse gases.

At the Savusavu site this imperative to develop alternative generation is reinforced as the existing power supply at Savusavu is insufficient to meet expected demand and is becoming increasingly expensive. Without the installation of additional power this situation can be expected to deteriorate. Installation of additional generation at the Savusavu site is also expected to lower the occurrence of power outages by reducing pressure on the generation and distribution network. In consideration of the options available for implementation at Savusavu it is considered that the option being pursued is practical, achievable and sustainable.
PUBLIC CONSULTATION

Community consultation was undertaken by Dev & Associates and is recorded in full at Appendix 3.

A Stakeholders Consultation meeting was held at the Holiday Inn (Suva) on September 6, 2006. A list of invitees, attendees and questions is provided in Appendix 3.
ASSESSMENT OF INSTITUTIONAL CAPACITY

An assessment of the capacity of FEA and the Ministry of Environment to monitor and manage the construction and operation of the power station was carried out by Hydro Tasmania Consulting to include:

- consideration of the requirements of the Environment Management Act 2005,
- consideration of FEA requirements;
- consideration of World Bank requirements;
- interviews with key MoE and FEA personnel;
- assessment of the structures in place in both organisations to may assist in managing the project; and
- resources available to both organisations to monitor and manage the construction and operation of the power station.

**Fiji Electricity Authority**

FEA management systems are focused on generation and maintenance of electricity and are not designed to address environmental considerations. In recognition of this, FEA have commenced developing an Environmental Management System (EMS). When implemented, the EMS will facilitate consideration of environment in all aspects of FEA operations, including this project. Work towards the EMS has only recently commenced. It is considered unlikely that the EMS would be completed and implemented in time for the commencement of this project.

FEA currently employ an Environmental Engineer who has primary responsibility for ensuring environmental matters are appropriately addressed throughout FEA. This position is responsible for all existing environmentally relevant activities and will be added to by the commencement of this project, and the renewable programme generally. The position has sole responsibility for a number of significant activities and projects, including setting up the EMS.

Development of an EMS and management of the design and construction process for projects of this nature, especially when considered in the context of the whole renewable programme currently being progressed by FEA, requires specialised and detailed consideration. In the context of this project, and the remainder of the renewable energy programme, it is considered that additional environmental resource is required. Making an additional resource available to the Environmental Engineer is highly recommended and would provide greater surety of environmental performance and outcome for this and other tasks. Doing this would allow the Environmental Engineer to manage the detailed design and construction of this, and other projects currently under development by FEA, or to continue with the development of the EMS.

Based on this assessment it is recommended that FEA give consideration to an additional environmental management resource, at least for the period this project.

**Ministry of Environment**

Development proposals are submitted to an approving authority (a Ministry, department, statutory authority, local authority or person authorised under a written law to approve the proposal) to enable
an assessment of whether or not the proposal is likely to cause significant environmental or resource management impacts.

Administration of the *Environment Management Act 2005*, including the regulation of industry, is undertaken by the Ministry of Environment. At present Fiji has a single environmental regulator. Interview with the regulator has identified that the ability of MoE to adequately regulate this project is significantly limited. Additionally, the regulating officer has identified a requirement for additional experience and skills, in particular in auditing and environmental management systems.

It is recommended that additional MoE regulation capacity is required to ensure adequate regulation of this and other projects. The provision of additional training in auditing and environmental management systems is highly recommended.

**Ministry of Fisheries and Forests**

Regulation and monitoring of logging and sawmill operations is carried out by the Ministry of Fisheries and Forests. Interview with Ministry of Fisheries and Forests (MoFF) staff has indicated that capacity to effectively carry out this function is limited by resources, both people and vehicles.

This project will be powered by sawmill off cuts from nearby licenced sawmills. There will be no activity in forests or plantations directly associated with the power station. While the power station will be dependant on sawmills, the reverse is not the case. Milling of timbers obtained through the managed forest operations will continue and will continue to grow to meet export demand, irrespective of this proposal. While it is considered unlikely that sawmills will increase production of final products to satisfy the demand for waste material, it is recommended that additional MoFF regulation capacity is desirable to ensure adequate regulation.

It is recommended that a due diligence assessment of saw mill operations should be conducted on an annual basis. Based on comments received during Stakeholder Consultation conducted for this project it was considered by attendees (Appendix 8) that this assessment would be conducted by a stakeholder panel including Savusavu Town Council, Ministry of Environment and Ministry of Fisheries and Forests, provided World Bank were to make resources available to them for that purpose. This approach has been utilised by these entities during recent projects in Fiji and they have found it to be beneficial. It is recommended that World Bank give consideration to facilitating an annual due diligence assessment of saw mill operations that may include these stakeholders.
ENVIRONMENTAL MANAGEMENT PLAN

A Master Environmental Management Plan has been prepared for this project and is provided in Appendix 6.

The Master Environmental Management Plan (MEMP) provides minimum requirements for the development of a Construction Environmental Management Plan (CEMP) for the management of environmental matters associated with construction works for the Savusavu Biomass Plant. In requiring the contractor to prepare the CEMP it is expected that there would be a greater level of ownership of the management measures. It is also considered that the contractor is best placed to identify practices that can be practicably undertaken to meet the requirements of the MEMP. In doing so the CEMP will address all commitments and approval conditions.

SUMMARY AND CONCLUSION

Power consumption in Fiji is rapidly increasing, placing greater pressure on the diesel fired generation capacity. The use of diesel for power generation is a significant cost impost, increasing more than 200% since 2001, and contributes to increasing consumption of hydrocarbons and emission of greenhouse gases. As Fiji continues down the path of economic development it is likely that hydrocarbon use will increase.

Power generation at Savusavu is provided by four small diesel units. The existing power supply at Savusavu is insufficient to meet expected demand and is becoming increasingly expensive. Without the installation of additional power this situation can be expected to deteriorate. Installation of additional generation at the Savusavu site is also expected to lower the occurrence of power outages by reducing pressure on the generation and distribution network.

Installation of generation at the Savusavu site will support the electricity network reducing the likelihood of, and opportunity for, power failure.

By using sawmill waste the proposal will:

- contribute to, and enhance, current and future renewable energy programme development by Fiji Electricity Authority;
- utilise an otherwise unused waste;
- provide economic benefit to sawmills and trucking contractors;
- reduce the need for burning of waste at sawmills thus reducing fugitive emissions;
- contribute to a reduced reliance on diesel whereby contributing to international efforts to reduce hydrocarbon consumption;
- contribute to a reduction in greenhouse gas production in Fiji;
- potentially contribute to an improvement in local area air quality;
- provide economic benefit to Fiji by reducing reliability on diesel.

This site has been selected as being appropriately co-located with other noise generating industry, in a zoned industrial area and on land that has been subject to past activity. The site also meets the basic requirements for development and, importantly, is available for purchase.
It considered that the site proposed for the project is appropriate. Based on this assessment it is considered that the project aspects of greatest environmental concern are noise and thermal pollution. Strategies to address all impacts have been recommended based on the preliminary design. Recommendations from this EIA are presented in table form in Appendix 2.

This assessment concludes that the proposal to establish a wood fired power station is sustainable project that will provide benefit at a National and local level, and is in accordance with Fiji’s obligations under the conventions and protocols to which it is currently a signatory. The environmental impacts identified in this assessment are manageable through the application of conventional controls, both technological and procedural.
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Environment Management Act 2005

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SOPAC 2006. Sawmill Waste Assessment – Fiji Island. First Draft for Discussion. PIEPSAP.

UNESCAP. Existing Institutions and Measures for Integrating Environmental Concerns into development planning and decision making for Suva City.


www.unescap.org/drpad/publication/integra/volume2/fiji/2fj03a.htm

www.unescap.org/drpad/publication/integra/volume2/fiji/2fj03b.htm
Appendix 1 Terms of Reference

Introduction

Project Background Information

The Government of Fiji (GoF) and Fiji Electricity Authority (FEA) have asked the World Bank to partly finance its Renewable Power Development Project (RPDP).

The RPDP’s components are:

- Component A: Wailoa Power Station.
- Component B: Deuba Biomass power plant
- Component C: Biomass Power Plants in Vanua Levu (This Project). The FEA proposes to construct a 3 MW biomass power plant at Savusavu.

Project Approvals Process: The Government framework

The environmental impact assessment process

The Ministry of Environment (MoE) through the Environmental Management Act 2005 utilises a screening process to assess whether a project requires an EIA. The EIA process must meet the requirements specified under the Environmental Management Act 2005, in particular, Part 4 Environmental Impact Assessment.

Other Government of Fiji statutory approvals process

Upon submission of the Terms of Reference (TOR), the MoE reviews it against project information provided to assess its accuracy and completeness of all the likely environmental impacts that would be associated with the project and that need to be included in the EIA process. The MoE may consult the Department of Energy on specific areas for expert energy advice.

The World Bank Requirements

The activities to be funded under Component C of the RPDP trigger the following World Bank’s safeguards policies:

- OP 4.01 Environmental Assessment

The RPDP is therefore required to be compliant with the provisions of these policies. However to ascertain by the Bank than no other policies such as Natural Habitats and or Forestry Safeguards Policies are triggered, the EIA needs to address a number of specific concerns related to other policies.

Requirement for EIA:

The Environment Management Act 2005 of Fiji and the World Bank’s own Operational Policy, OP4.01 on Environmental Assessment requires environmental impact assessments of projects proposed for funding to help ensure that the projects are environmentally sound and sustainable, and thus to improve the decision making process.
The FEA is seeking the services of a consulting firm to undertake an Environmental Impact Assessment (EIA) of component C of the RPDP, which is the Savusavu Biomass Plant. These Terms of Reference are issued to guide the work of the consulting firm who will be undertaking the EIA for this sub project. Component C, the Savusavu Biomass Plant, will for the purposes of this TOR from this point forward be referred to as the “project”.

The final EIA report will be reviewed and cleared by both the Ministry of Environment and the World Bank, and will be disclosed locally in Fiji and also at the World Banks Infoshop. According to the World Bank’s Disclosure Policy, the date of disclosure of the EIA reports must be prior to the commencement of World Bank appraisal of the project.

The latest World Bank disclosure date set for the EIA reports is September 24th, 2006.

The EIA is to be carried out in parallel and close collaboration with the feasibility study for the Savusavu Biomass plant, i.e. the project, thereby ensuring that the feasibility design is integrated into the EIA process so as to inform the feasibility design in a timely and effective manner. This is a pre-requisite for the EIA process.

Detailed Description of Savusavu Biomass Plant (The Project).

Introduction

The FEA propose to construct a 3MW biomass power plant in Vanua Levu, adjacent to the Savusavu Copra Mill and the Lumber Processing sawmill. Fuel supply to a new biomass plant will be copra mill residues and sawmill residues.

The EIA should provide a detailed description of the scheme and include power generating capacity, operating scenarios and maintenance routines. A description of the general layout and size of the project should be provided. Detailed information about the ancillary works and the connection to the main electrical grid should be included. The technology used for the biomass power plants will be thermal generation by a steam-boiler setup. The steam boiler setup involves combustion of the biomass which heats water to steam to drive the steam turbine for electricity generation. This process needs water for feeding the boiler and for the cooling water in the condenser.

The EIA should provide a detailed description of the scheme and include power generating capacity, operating scenarios and maintenance routines. Detailed information about the ancillary works and the connection to the main electrical grid should be included.

The fuel supply from Lumber Processing will be approximately 10,000 t/yr and with current expansions underway, approximately 20,000 t/yr of residues could be expected. These wastes include off cuts, shavings and sawdust. The Coconut Industries Development Association (CIDA) is currently assessing the viability of a sawmill in Savusavu, which might process 5000 lower trunk stems per year, producing approximately 4m3/day of wood waste.

Location and Study Area

The proposed new biomass power station will be located adjacent to the Savusavu Copra Mill and the Lumber Processing sawmill. Maps should be provided showing the location of the subject area in relation to the biomass power plant and associated infrastructure. The location of the proposed biomass power station is shown in the diagram below.
A biomass power station located near the road just north of the Lumber Processing mill or further inland between the sawmill and oil mill is considered the optimum location for the power station. Both sites provide access to the waste, though across a port access road which is not part of the Lumber Processing site. This will also allow construction of timber kilns on site, and allow the sale of heat to the mill as well as electricity.

A map should be provided showing the locations of the existing infrastructure and distance between the power station site and the villages. Any areas of environmental significance should be identified. The diagram below shows the options for location of the biomass power plant.
Description of Potential Generation Technology Options

Generation Options

Generation from biomass will be undertaken using full combustion of the fuel to heat water to steam that drives a steam turbines.

Boiler turbine system

The boiler-turbine system involves combustion of the biomass with excess air, producing flue gases, which then produce steam in the heat exchange section of the boiler. The superheated steam leaving the boiler then enters the steam turbine throttle, where it powers the turbine and connected generator to make electricity. After the steam expands through the turbine, it exits the back end of the turbine, where it is cooled and condensed back to water in the surface condenser. This condensate is then returned to the boiler through high-pressure feed pumps for reuse. A schematic of the boiler-turbine system is shown below.
Water Treatment

Water treatment is a complex and necessary process for steam cycles. Water used in steam cycles must be treated to prevent damage occurring to the boiler and turbine sections. Makeup water volumes for this project will be around 4-20 L/s, which will potentially be obtained from local town water supply available at the Savusavu Power Station.

Air Emissions

Biomass power plants reduce many key air emissions such as carbon dioxide, when compared to conventional generation technologies.

NOx, SOx, CO and Greenhouse Gases

Whether combusting directly in steam-boiler system or using gasification, biomass resources do generate air emissions such as nitrogen oxides (NO and NO₂, collectively known as NOx), sulphur oxides (SOx) and carbon monoxide (CO). However, the composition of exhaust gases depends upon the primary feedstock and specific equipment used.

Biomass plants also release carbon dioxide (CO₂), the primary greenhouse gas. However, the cycle of growing, processing and burning biomass recycles CO₂. If this cycle is sustained, there is little or no net gain in atmospheric CO₂.

Particulates

Another air quality concern associated with biomass plants is particulates.

Fly Ash

The combustion of biomass resources normally results in the generation of ash that is high in alkaline materials like potassium, sodium, calcium, and magnesium. The conventional method of
ash disposal (e.g. land filling, ash spreading) can affect not only the land usage but also the environment because of the corrosive nature of the ash constituents.

**Odour**

Biomass combustion will result in emissions from the stack which may present odour problems to nearby residents.

**Wastewater Discharge**

It is assumed that wastewater will be released through stormwater drainage on the site.

**Detailed Tasks to be undertaken by the Consultant**

**Task 1: EIA to be undertaken concurrently with the feasibility study.**

This EIA is to be undertaken concurrently, simultaneously and interactively with the Feasibility Study for this project, to ensure that the EIA and feasibility study inform each other.

**Task 2: Review of relevant information**

The consultant is to identify and review relevant Government of Fiji (GoF) environmental, land, water and other relevant laws, regulations, policies and strategies, and the country’s administrative framework at both the national and sub national levels that will govern the preparation of the EIA and the implementation of the project.

The consultant is to review the World Banks Safeguards Policies, especially the following operational polices:

- OP 4.01 Environmental Assessment

OP 4.01 requires that an EIA be prepared for this project. The consultant(s) should undertake the required analysis to determine what degree the proposed project activities will trigger any of the aforementioned World Bank Operational Policies, with the view to enhance compliance, quality at entry, and project sustainability.

Where there are gaps between the GoF requirements and these Bank policies, the consultant is to make recommendations as to how to close these gaps in the context of the proposed project as appropriate.

The consultant is to review the relevant International and Regional Conventions and Protocols to which Fiji is a signatory, to determine which ones may apply to this project, and what measures are needed to comply with them.

The consultant is to review all relevant FEA reports and studies and other relevant documentation.

**Task 3: Collection of Baseline Data relevant to the Project Impact Zones**

The relevant project impact zones are the project site and boundaries, including feed source sites and power generation sites.

The Consultant will undertake a comprehensive gathering, collection and review of the required biophysical/environmental and social baseline data from existing credible sources that will
influence the relevant impact zones. Where the required data is missing, inadequate or unreliable, the consultant will make recommendations for the necessary surveys and/or collection in the bio-physical and/or social environment to obtain this data.

Field visits to Fiji to conduct interviews, meetings with relevant stakeholders and custodians of such data relevant to the required project sites and impact zones are required.

The EIA shall present the available baseline data pertaining to (i) the physical environment (i.e., topography, geology climate and meteorology, surface and ground water hydrology, land use, etc); (ii) biological environment (i.e., where relevant flora and fauna and habitat values, rare and endangered species within or adjacent to project intervention sites, including wetlands, and other sensitive habitats); and (iii) Socioeconomic and cultural environment, where appropriate.

Where applicable, data is to be presented on detailed maps, drawings and/or satellite imagery illustrating key features of the data, e.g. indigenous forest cover, plantation cover, land use, etc.

**Task 4: Analysis of both Positive and Adverse Impacts**

The consultant will undertake an analysis of the intensity, scale, and scope of the projects direct, induced and cumulative environmental, social, regulatory and institutional impacts, on the relevant impact zones, against the existing baselines, during all stages of project implementation, i.e. planning, construction and operations. The key environmental issues that should be addressed include:

- To determine impacts on air quality by analysing NO\textsubscript{x}, SO\textsubscript{x} emissions from the plant from the combustion process per generation technology used.
- To determine impacts associated with green house gas emissions, particulates, fly ash and foul odour smells associated with fuel types/generation technology.
- To determine impacts associated with point and non-point source contamination of land, soil and water, from waste water disposal, feed transportation, storage, and handling, and the same with regards lubricant use, etc.
- To determine how these impacts may potentially affect local communities.
- To determine the likelihood that the sawmill might increase its production of final products to satisfy the demand for waste material. In other words would the project have an impact on the management and/or development of the plantation from which the Sawmill will obtain its raw material.
- To determine the potential that close-by natural forests, from which a number of sawmills in the vicinity of the proposed power plant location obtain their wood, would change their management practices or development their forest operations as a result of the project.
- To make an assessment regarding the potential that any of these sawmills (other than FHC) would expand their operations so they can supply more waste to FEA’s power plant.
To determine how the biomass waste is currently used, how and by whom and if there is a danger that the project would have a negative impact on any livelihood.

**Task 5: Analysis of Alternatives**

The consultant is to provide an evaluation of reasonable alternatives to fulfil the ultimate development objective of the project. Assess the extent to which these alternatives may be more appropriate from an environmental, socioeconomic and cultural standpoint than the proposed project alternatives. Include the counterfactual scenario – not implementing the project – in order to underline the environmental and social conditions without it. Discuss alternative routes and sites, alternative plan, method of construction, operation, fuels and their sources, generation technologies, etc to be used at the local level.

For air quality and other impacts associated with NO\textsubscript{x}, SO\textsubscript{x}, greenhouse gases, particulates, fly ash and odours, the consultant is to delineate how the alternatives compare in terms of their potential impacts for each generation/combustion technology; capital and operating costs, suitability under local conditions, including skill requirements, public and political acceptability, level of technology, as well as their institutional, training and monitoring exigencies. Identify which impacts would be irreversible and which ones could be mitigated.

This work would be interactive with and inform the on-going feasibility study so that FEA can make the optimum choice and decision with regards which generation/combustion technology best meets its objectives.

**Task 6: Development of Impact Management Measures**

The consultant is to develop a package of tangible management measures for each type and category of impact. This will include the impact zone and each project stage of planning, construction, operation and maintenance as the case may be. Management Measures are to prevent, reverse, minimize, or otherwise reduce adverse impacts to acceptable levels. Management measures are to be consistent with all local laws of Fiji, international laws to which Fiji is obligated and World Bank’s triggered safeguards, OP4.01.

**Task 7: Participatory Public Consultations**

Consultant to undertake participatory public consultation with project affected peoples. Using appropriate methodologies, local communities and other local stakeholders that will, *interalia*, disseminate information on the project and how the project environmental and social positive and adverse impacts may affect them. The public consultations are to be held during the EIA process, in a timely and culturally appropriate manner according to Fiji’s legal requirements, and World Banks disclosure requirements. The consultations should be properly recorded to indicate when, where, and who the stakeholders consulted were, and the views they expressed. The consultant should also record how the views expressed during the consultation process were taken into account in their work, determine what measures if any need to be taken for monitoring and evaluation of project affected people during implementation.

The consultant should also present and discuss with local communities their current use of waste from the saw mill and to seek their views and in the case of potential negative impacts recommend how these may be mitigated.

**Task 8: Assessment of Institutional Capacity**
Consultant to undertake assessment and review of the environmental management capacity of the following institutions/bodies:

- FEA – as the owner and operator of the project.
- Ministry of Environment as custodians of the Environment Management Act, 2005 and as the agency that is responsibly for management of the environment, including oversight monitoring.

The purpose of this assessment is to determine the capacities of these institutions to implement and manage the proposed mitigation and monitoring measures, and to make recommendations as appropriate, including potential capacity building and training needs and their costs to bridge these gaps to ensure satisfactory execution of their respective responsibilities.

**Task 9: Environmental Management Plan – Mitigation and Monitoring**

Prepare an Environmental Management Plan (EMP) for the implementation of the project during construction and operations. The EMP should outline: (i) the potential environmental and social impacts resulting from the project activities; (ii) the corresponding proposed mitigation measures; (iii) institutional responsibilities for implementation of the mitigation measures; (iv) monitoring plan with monitoring indicators; (v) institutional responsibilities for monitoring the implementation of the mitigation measures; (vi) cost estimates for these activities; and (vii) time horizons for implementation of the EMP.

The EMP will become the vehicle through which the management measures identified in the EIA will be implemented in the project. The EMP is to be divided into the three main stages of planning, construction and operations and maintenance, for each project impact zone.

**Task 10: Report Writing**

The structure of the final EIA report is to be agreed between the consultant and FEA, but it must contain an executive summary containing a summary of each chapter of the report, separate chapters containing the presentations of the Tasks 1-9 above, and a separate chapter or annex containing the EMP.

The reporting deadlines are as follows:

- Draft Annotated Table of Content and discussion of major issues (August 30)
- Draft Report of EIA, and EMP by September 15, 2006

The FEA and Ministry of Environment will facilitate the work of the consultants by providing them with copies of relevant reports and studies, laws, regulations, policy documents etc.
### Appendix 2 Consolidated Table of Recommended Actions

<table>
<thead>
<tr>
<th><strong>Project Phase</strong></th>
<th><strong>Recommendation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design</strong></td>
<td>Power station designed to ensure water will be cooled to acceptable limits before discharge.</td>
</tr>
<tr>
<td></td>
<td>Design to minimise area to be disturbed by works.</td>
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<td></td>
<td>An assessment to characterise the marine environment in Valaga Bay in front of the site is required.</td>
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<td></td>
<td>Further consideration of the capacity of the town supply during the detailed design process.</td>
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<td></td>
<td>Design to include automatic monitoring of discharge streams for determined water quality parameters.</td>
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<td></td>
<td>Design cooling water discharge outfall such that mobilisation of bottom sediments is minimised.</td>
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<tr>
<td></td>
<td>Permanent erosion and sedimentation controls will be incorporated into the plant design.</td>
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<tr>
<td></td>
<td>Design to include an appropriately bunded and secure fuel and oil storage facility that is located away from any watercourse.</td>
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<tr>
<td></td>
<td>Design to ensure no chemical treatment of water.</td>
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<td></td>
<td>Other than obtaining access for piping of water the design will ensure development of the site does not include the foreshore.</td>
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<tr>
<td></td>
<td>Design and specification of plant to minimise noise emissions. Appropriate noise performance requirements in accordance with the Vipac report should be specified to the equipment or plant suppliers and manufacturers’ noise controls incorporated into the plant design, where possible.</td>
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<tr>
<td></td>
<td>Construction activities should be limited to daylight hours only. This should be considered in the project management plan.</td>
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<tr>
<td></td>
<td>Design to ensure sufficient fuel is available in the boiler bunkers to prevent the need for overnight handling of materials.</td>
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<td></td>
<td>Re-zoning of the site to an appropriate use, such as Special Use Power Station, is required.</td>
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<td></td>
<td>To ensure that there is good dispersion from the plant it is recommended that the stack is raised above the ridge of any building to ensure emissions are not trapped in localized effects.</td>
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</table>

Exhaust stacks will be provided with sampling ports according to the relevant Australian Standard. Iso-kinetic sampling of stack gasses should be undertaken following the completion of commissioning and then at 12 month intervals or as required by the Fiji Ministry of Environment.

Fixed ambient air sampling station between the plant and nearby residences. Sampling at these locations should be undertaken before and after installation of any new power plant. Ambient air sampling should be undertaken annually or at a frequency as required by the Fiji Ministry of Environment.

<table>
<thead>
<tr>
<th>Construction</th>
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</thead>
<tbody>
<tr>
<td>Master Environmental Management Plan implemented in full.</td>
</tr>
<tr>
<td>Construction Environmental Management Plan implemented in full.</td>
</tr>
<tr>
<td>Site auditing by FEA.</td>
</tr>
<tr>
<td>Areas to be disturbed by works will be minimised and marked out on the ground. There will be no disturbance of soils or vegetation outside this envelope without the written authority of FEA.</td>
</tr>
<tr>
<td>Sediment containment, such as silt traps and silt fencing, is required. Measures will be required at all locations where there will be bare soil and at all locations where water and sediment may leave the construction site. Drainage should be designed such that water flowing from the site into the drain is controlled to prevent erosion and minimise the transport of an additional sediment load into the drain.</td>
</tr>
</tbody>
</table>

Principles for earthworks management include:

- Reuse of soils on-site.
- Minimisation of stockpiling.
- Minimisation of soils and vegetation disturbance.
- Minimisation of the disturbance envelope.
- Revegetation of exposed soils, including any stockpiles, as soon as the area is available.
- Works not conducted during the wet season.
- No stock piling of soils within 10m of a water course.

All stock piles shall have erosion and sedimentation control techniques applied (such as seeding of stockpiles (if they are going to be in place for a while) and use of silt fencing.)
<table>
<thead>
<tr>
<th>Operation</th>
<th>Opportunity for local contractors to be utilised during operation should be discussed with the community.</th>
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<tbody>
<tr>
<td></td>
<td>Limit construction activities to daylight hours.</td>
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<tr>
<td></td>
<td>Residents to be kept informed of activities at the construction site, particularly if noisy operations are required.</td>
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<td></td>
<td>Planting of screening vegetation.</td>
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<td></td>
<td>Cleared vegetation should be retained for chipping as fuel for the power station or is burned at site.</td>
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<td></td>
<td>General waste removed from the site for disposal at a waste disposal facility on at least a weekly basis.</td>
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<td></td>
<td>Drainage installed such that water flowing from the site into the drain is controlled to prevent erosion and minimise the transport of an additional sediment load into the drain.</td>
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<td></td>
<td>Spill recovery equipment is required to be located with the fuel and oil storage. For the purposes of this project a spill of more than 10 litres is to be considered significant. In the event of a spill of 10 or more litres the contractor is to commence clean-up immediately. FEA are to be notified immediately.</td>
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<td></td>
<td>Where possible no fuels or oils are to be stored at the site during construction. Where it is necessary to store fuels the store will be an appropriately bunded and secure facility that is located away from any watercourse.</td>
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<tr>
<td></td>
<td>Fuels and oils should only be stored onsite in appropriately bunded and secured area.</td>
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<td></td>
<td>Application of dust control either by conventional means (e.g. watering) or the application of soil tacifiers.</td>
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<td>Implement an information and awareness campaign with community, school children, teachers, and drivers before the start of project.</td>
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<td></td>
<td>Signage indicating construction works and the presence of heavy machinery shall be utilised on the road.</td>
</tr>
<tr>
<td></td>
<td>Construction activity limited to daylight hours.</td>
</tr>
<tr>
<td></td>
<td>In the event that an item of potential archaeological significance is uncovered, work is to cease at that location and FEA informed immediately. The Fiji Museum is to be contacted by FEA.</td>
</tr>
<tr>
<td></td>
<td>Application of Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000) to determine appropriate water quality targets.</td>
</tr>
<tr>
<td></td>
<td>Baseline study is required both to facilitate setting of water quality targets and obtain a better understanding of the receiving environment.</td>
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</tbody>
</table>
Water quality targets should include temperature, suspended solids, pH, and conductivity within an approved mixing zone at the cooling water discharge. It is recommended that these parameters are monitored at all times by automatic logger to ensure that discharge temperatures remain within allowable limits.

Parameters determined for monitoring marine water quality to be monitored at all times within the mixing zone by automatic logger to ensure that discharge temperatures remain within allowable limits. Actions to be taken in the event of each or all of the parameters being exceeded may include plant shutdown.

Where feasible, water quality parameters are monitored at all times by automatic logger to ensure that discharge temperatures remain within allowable limits.

Limit materials deliveries and handling activities to daylight hours.

Acceptable sound levels of 40dB + 5 dB during the day and 35 dB + 5dB apply at the sensitive locations.

Planting of screening vegetation along the access road and around the southern and eastern boundary of the site is required.

General waste removed from the site for disposal at a waste disposal facility on at least a weekly basis.

Oily waste should be recycled where possible.

Commercial opportunities for re-use of fly ash are investigated by FEA. If the re-use of fly ash of fertiliser is pursued an analysis will be required to determine its chemical properties prior to use as forest return.

Parameters determined for water quality to be monitored at all times by automatic logger to ensure that discharge temperatures remain within allowable limits. Actions to be taken in the event of each or all of the parameters should be developed once the targets are understood. This may include plant shutdown.

Management measures for controlling erosion and sedimentation are required.

Fuel and oil spill recovery equipment is to be maintained at the fuel store.

Where possible no fuels or oils are to be stored at the site during construction. Where it is necessary to store fuels the store will be an appropriately bunded and secure facility that is located away from any watercourse.

Spill recovery equipment is required to be located with the fuel and oil storage. For the purposes of this project a spill of more than 10 litres is to be considered significant. In the event of a spill of 10 or more litres the contractor is to commence clean-up immediately. FEA are to be notified immediately.

Monitoring of waste water streams from the power station, particularly the cooling water, for oil and grease.
A monitoring plan that clearly identifies monitoring parameters is required. The monitoring plan should include a responsibility framework to ensure that such mitigations measures that may be indicated may be applied within an agreed timeframe.

Stack sampling and modelling be undertaken following commissioning to confirm the status of stack emissions and air quality impacts is recommended. This would require the installation of a local meteorology station.

Fixed ambient air sampling station between the plant and nearby residences. Sampling at these locations should be undertaken before and after installation of any new power plant.

A full modelling assessment of all emissions from the planned new power plant. In the event that the planned extended capacity of the new plant is envisaged, the inclusion of these emissions would also be required.

Ambient air sampling should be undertaken annually or at a frequency as required by the Fiji Ministry of Environment.

Application of conventional dust control (i.e. Watering) or the application of soil tacifiers.

Implement an information and awareness campaign with community, school children, teachers, and drivers before the start of project.

Materials delivery and handling limited to daylight hours.

Ensure sufficient fuel is available in the boiler bunkers to prevent the need for overnight handling of materials.

General waste removed from the site for disposal at a waste disposal facility on at least a weekly basis.

Erosion and sedimentation control measures are required in all areas where soil is disturbed or potential for transport of erosion products into waterways exists.

World Bank undertake an annual due diligence assessment of saw mill operations to ensure that activities remain within expectations. This assessment would be appropriately conducted in partnership with MoFF and identified stakeholders.

World Bank to make resources available to facilitate the due diligence exercise.

<table>
<thead>
<tr>
<th>Process Management</th>
<th>FEA to give consideration to providing additional environmental management resource to the Environmental Engineer.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>It is recommended that additional MoE regulation capacity is required to ensure adequate regulation of this and other projects. The provision of additional training in auditing and environmental management systems is highly recommended.</td>
</tr>
</tbody>
</table>
Appendix 3 Community Consultation
Deuba and Savusavu Biomass Plant Environmental Impact Assessment
Stakeholder Consultation - Minutes of Meeting

Location: Holiday Inn (Suva) Board Room
Date: 6 September 2006
Time: 1400 – 1600

Invited
Ministry of Environment
Ministry of Fisheries and Forests
Land and Water Resource Management Division
Department of Town and Country Planning
Department of Energy
Savusavu Town Council
Navua Rural Local Authority
World Bank

Attended
Ministry of Environment – P. Nair
Land and Water Resource Management Division – K. Cho
Department of Town and Country Planning – M. Ubitah
Department of Energy – J. Fereti, I. Saula
Navua Rural Local Authority – P. Saniyasi
World Bank – P. Sullivan
Fiji Electricity Authority – S. Bishwa
Hydro Tasmania Consulting – A. Langley

Apologies
Savusavu Town Council
Minutes

Meeting opened 1520.

Introduction to technology, location, investigation process and summary of identified major issues and community concerns of both Deuba and Savusavu sites, including:

- Noise
- Cooling water
- Air quality
- Transport/road safety

All issues identified can be managed through the application of conventional controls.

Questions Received

One of the options for discharging cooling water is near the flood barrage. The barrage has limited capacity as it is, is there any potential that this may compromise the capacity of the barrage.

- *It is understood that this option has been entirely discarded with the preferred option of using the drainage ditch. This being the case there will be no impact on the barrage at all but will be confirmed with the engineers.*

  **NOTE:** A. Langley responded by e-mail on September 7 to Mr. K. Cho and Ms. P. Nair to confirm that this option was no longer being considered.

A permit is required to extract water from the creek.

- *FEA will be applying for the permit in due course.*

It seems that there are probably many renewable energy options for Fiji, why biomass?

- *There are a number of reasons for going this way. A number of studies have been completed and have identified a large range of options. The biomass option has been pursued as something that is practical, achievable, virtually off the shelf, is affordable and can be maintained in the future.*

Is the resource sustainable, is there enough?

- *It is my understanding that the resource has not been quantified at this stage, however, there is a study underway to do this. The preliminary considerations of the engineers and people experienced in these matters is that there is sufficient*
resource and not withstanding any hold-ups in the process there should be no difficulty in resource.

Are plantations a potential source of fuel for the power stations?

- Not for this project. There are many reasons for not going down this pathway, not the least of which is managing the harvest and use of any fuel obtained from these sources would be very difficult if not impossible. Another consideration is that this would place another layer of approval complexity to be looked at (through a need to develop Sustainable Harvest Plans and undertake some very complex investigations), although it is something that may be developed at a later date.

Another component of this is that the forest industries are trying to gain access to the U.S. and E.U. markets. This requires them to have in place systems to ensure that logging and associated practices are sustainable and well managed. This certification system is in development at the moment. Once in place there can be a high degree of certainty that the resource is being appropriately managed at the production end, one less thing for the power station to worry about.

Would the biomass project serve as initiative for people owning native timber to convert to plantation for biomass?

Is it an option to use non-commercial trees?

- Wood for the power stations will be obtained only from licenced milling operations that sign a resource agreement with the project. Timber milled comes from licenced and regulated logging operations. The logistics of managing the harvest and use of any fuel obtained from other sources would be very difficult if not impossible. It is also apparent that the economics of growing timber for fuel are not in any way attractive.

One aspect of sustainable logging is to leave some biomass in place, whether standing or as trash on the ground. This is a very important element of the environmental management of logging operations.

Is there a possibility of trees being taken from the hills around the place, ie. encourage deforestation?

- There are many environmental reasons for not allowing this to occur including preventing erosion of the hill slopes. Preventing this from occurring is just one of the reasons that the fuel wood will only be taken from milling operations that obtain their wood from licenced logging operations.

Which types of timber will be used?

- The mills that have been approached to supply fuel mill both hardwood and softwood. The expectation is that it will be predominantly hardwood waste but the
boilers are capable burning either and of course at Savusavu some of the fuel used will be coconut palm waste.

Navua Rural Local Authority and Town and Country Planning are likely to be involved in monitoring of these operations but the capacity to take on this work is low as resources are already stretched. Is there a mechanism for addressing this?

- This has been recognised in the EIA (although only briefly) and World Bank have recognised it as well during a recent meeting. A recommendation for World Bank to undertake due diligence inspections and to facilitate resourcing of these inspections has been made in the EIA, and in fact. The project EMP sets out auditing and inspection requirements for both the construction and operation of the project.

Will the power stations be very visible?

- The Deuba power station is set back from the road and at present is difficult to see unless you know where to look. It will be more slightly more visible during construction and once operational due to the road and a taller stack. A recommendation for screening vegetation has been made in the EIA.

At Savusavu it will be more difficult as the site is right next to the road and is overlooked by at least one residence. Screening vegetation and sensitive design will go part way to softening this impact but it will be difficult to make it invisible.

Will odour be a problem?

- Most odour from this kind of operation comes from poor storage of wood chips. In this case the chips will not be stored long enough to ferment. There will be occasional odour from the stack as the quality of the fuel varies but it is not expected that this will be a feature.

Given that Savusavu will be discharging water to the bay it may be a good idea to consult with the owner of the fishing grounds.

- FEA will look at identifying the relevant people to talk to over the coming week. Thankyou.

Ministry of Environment would like three hard copies and three electronic copies of the documentation.

- They will be delivered to MoE and the other display locations on Monday afternoon.

Meeting closed 1545.
Executive Summary

Introduction

Dev Associates were commissioned by Hydro Tasmania Consulting to carry out social impact assessment of the FEA proposal to set up two biomass plants to generate electricity. The Deuba proposal involves refurbishing the existing Deuba Power Station whereas Savusavu plant is a fresh initiative.

Social Environment-Deuba

The access road to Deuba Power Station is about a kilometre long from Suva- Nadi Highway. It passes through Waidradra Solomoni Settlement. There are 60 families living in this settlement. The homesteads are built on either side of the access road. At the distal end of the access is the Vietnam Indo Fijian Settlement. About 57 families reside in this settlement. The nearest resident to the power station is Rev. Josateki Koroi and family. The Waivunu Sawmill, the main supplier of waste wood, is several kilometres away towards Sigatoka.

Social Environment- Savusavu

At Valaga Bay the nearby human habitation consists of Jerusalemi Village and employees of Lumber Processors. Twenty three Fijian families live in this village with traditional ties to Tui Wailevu. A tax free zone and a housing subdivision consisting of 31 lots are being developed close to the proposed site. The other commercial and industrial establishments in the Valaga Bay area include B P Oil, Copra Millers of Fiji, Cocowood Pilot Project, and Lumber Processors. Hanshine Enterprises, the main supplier of waste wood, is several kilometres away from the proposed site towards Savusavu town.

Methodology

A triangulation of approaches was used in profiling the environment and assessing the actual and potential short term impact and long term effect of the proposed projects. The approaches included community consultation, key informant interview, focus group discussions, and rapid rural appraisal of key issues using field survey techniques. The instruments of survey included a questionnaire designed for the purpose. The duration of field work lasted for about two weeks, one at each site. All meetings and visits were arranged in advance at the convenience of the people. Traditional protocol was followed in consulting Fijian villages. Meetings lasted well into nights as community members are available in the evenings.

The stakeholders who provided information and aided in impact assessment include Waidradra Solomoni Settlement, Vietnam Indo Fijian Settlement, staff at Waivunu Mill, managers at Hanshine Enterprises and Lumber Processors, families at Lumber Processors, Advisory Councillors, and residents of Jerusalemi village.

Findings
The main findings in terms of issues, concerns, and impacts are summarized below.

1. **Road Access:** Access to and from the Deuba site is currently through the settlement. Use of this access for construction and operation of the site would create a hazard and impact on the community.

2. **Firewood Availability:** The main issue with the Indo Fijian community at Vietnam Settlement is availability of firewood. Nearly every household in the settlement has wood stove and uses mill firewood for cooking. The only other village that expressed concern about the availability of firewood is Jerusalemi in Savusavu. According to the villagers the Firewood supply could slowly dry up once the saw millers have a resource agreement with FEA.

3. **Smoke, Noise, and Bad Odour:** Smoke is a major concern since wood will burn 24 hours a day and seven days a week. It could pose environmental and health problems. At Savusavu noise from the biomass plant may compound the noise already coming from the sawmill operation. Stacked or burning wood may produce foul odour affecting nearby residents.

4. **Domestic Water Supply:** The residents of Waidradra and Vietnam settlements are concerned that domestic water supply may be disrupted if the plants consume a great deal of water. This will create hardships as they have no other source of potable water.

5. **Waste Water Discharge:** Chemicals in waste water if put back into waters at Valaga Bay would affect marine life. At Deuba the concern is how storm water and waste water would be linked to the drainage system. The area already suffers from water logging conditions and any ill conceived drainage system will worsen the situation.

6. **Traffic Hazard:** Traffic hazard is an important consideration at Deuba and Valaga Bay as well. It arises from the fact that trucks transporting bio-fuel to the stations would increase in number, frequency and duration. The job most likely would be resourced out to contractors who may not exercise due vigilance in the matter of pedestrian safety, especially children going to schools.

7. **Fall Outs from Trucks:** Trucks would be transporting sawdust, chips, and slabs from sawmill to the proposed plants on regular basis. There is every possibility that contractors will use vehicle which are not properly equipped. There would be biomass fall outs along the road from sawmills to FEA yard.

8. **Appropriate Alternate Technology:** This issue arises from the notion that the biomass technology is noisy, smoky, and dirty. It is not suitable near residential areas. The suggestion is that wind or solar power would be more appropriate technology for a place like Deuba.

9. **Fijian Traditional Protocol:** This issue was brought up at the Jerusalemi village meeting. Fijians, especially in rural areas, are mindful of Fijian protocol and they are
not willing to talk about new development unless the matter has been first taken up with their chief in a traditional manner.

Recommendations: managing issues and concerns

Road Access

It is recommended the FEA consider acquiring alternate access at Deuba.

Firewood Availability

The impact of the project on this amenity will not be significant. However applying the precautionary principle on environmental management it is recommended that any resource purchase agreement with FEA should clearly specify that certain portion of the firewood should be set aside for community use. A mechanism should be put in place to monitor that mills don’t default on this provision of the agreement.

Smoke, Noise, Odour, and Waste Water Discharge

The community notion of these issues is shaped by impressions of old technology. Nevertheless they are important, especially in view of the potential for biomass technology. The issues are recommended for serious consideration by engineering and design team.

Domestic Water Supply

From the feedback received it appears that the plants would not put any significant strain on domestic water supply. After initial intake of water the plants will run on smaller make-up volume. Since water is a basic necessity, it is suggested that PWD, FEA and Consulting Engineers review to double check the water situation after the plant design is finalized.

Traffic Hazard

A road or civil engineer should review the present condition of the road and recommend appropriate improvements and treatments. Suggested mitigating measures include sealing road sections through villages, provision of footpaths, speed limits, speed breakers, and road signage. If necessary, an information and awareness campaign can be mounted with community, school children, teachers, and drivers before the start of project.

Fall Outs from Trucks

Preventive measures to put in place include a containerized mode of transportation for saw dust and wood chips. Containers can be placed at sawmills and once full they can be transported to the plant site. Slabs could be transported in bales that are well strapped or secured with wire.

Appropriate Alternate Technology
This is an issue that would be addressed as part of the overall Environment Impact Assessment. Suffice it to say that each form of technology has its necessary conditions to be technically viable.

**Fijian Traditional Protocol**

Jerusalemi village comes under Tikina Wailevu and traditional protocol requires that a high chief of an area is informed first about the proposal. The present title holder is Ratu Kenijioji Maivaleli. He is a member of the Fiji Senate and can be contacted in Suva. It is suggested that a delegation from FEA approach him traditionally and inform him about the proposal.
Contents

1.0 The Project Proposal

2.0 The Existing Social Environment- Deuba

3.0 The Existing Social Environment- Savusavu

4.0 Summary of Issues and Concerns

5.0 Assessment of Firewood Situation

6.0 Managing Issues and Concerns

7.0 Appendices
The Project Proposal

Introduction

The FEA project proposal consists of two projects; one, to convert the existing diesel generator at Deuba to one that will run on biomass, two, to set up a new biomass plant at Valaga Bay, Savusavu. Both the plants will use wood waste from sawmills operating in the surrounding areas. Biomass technology uses thermal generation to produce electricity; either by way of steam boiler setup or gasification. The steam boiler setup involves combustion of the biomass to produce steam to drive turbine for generating electricity. The other option is gasification where combustion of biomass under specific conditions of temperature and pressure produces hydrocarbon gases. These gases then drive a gas turbine. It appears steam-boiler option is now the preferred option for FEA proposal.

The Deuba Biomass Plant

The FEA already has a diesel power station at Deuba which it intends to refurbish to one that will run on biomass. At peak performance it is expected to generate 3.5 MW of power. The refurbishment will include replacement of current diesel generators with biomass generation equipment. Fuel supply to the new biomass plant at Deuba will be provided by Waivunu Sawmill and other sawmills in the vicinity such as Mana Forest, now known as Sustainable Mahogany Industries. Waivunu mill is operated by Pride Mahogany, formerly known as the Fiji Hardwood Corporation. Mill offcuts, shorts, and slabs from sawmills will be used in the biomass plant. In addition to the offcuts and slabs, popularly called as firewood, wood shavings and sawdust, and small branches that are left at the felling site in the forest can also be transported to the Deuba power station and used as fuel. To ensure sustainability of the project, a harvesting plan has been approved by the Forestry Stewardship Council.

Location and Study Area

The proposed biomass power station will be located at the Fiji Electricity Authority’s existing power station in Deuba (Deuba Power Station). Access is via the main Suva – Nadi Highway, through Waidradra Road which passes through Waidradra Solomoni Settlement and skirts around the Vietnam Waidradra Indo Fijian Settlement.

Savusavu Biomass Plant

The Savusavu Biomass Power Plant is a fresh initiative by the FEA. At peak performance this proposed plant is expected to produce 2 MW of power. The plant will use waste wood from nearby mills to fire steam boilers for electricity generation. The two sawmills that are likely to provide the bulk of the waste wood are Lumber Processors of Fiji Ltd and Hanshine Enterprises. The former sawmill is located adjacent to the proposed site for the Biomass plant while the latter is a few kilometers away. The Coconut Industries Development Authority (CIDA) is currently assessing the viability of a sawmill in
Savusavu, which might process 5000 lower truck coconut stems per year, producing about 4m3/day of wood waste.

**Location and Study Area**

Several locations in Valaga Bay area have been assessed for the proposed biomass plant. It appears the preferred option is the vacant parcel of land between the Lumber Processors of Fiji Ltd and the Copra Millers of Fiji Ltd. This 11-acre freehold land belongs to Satish Gulabdas family who own the Lumber Processors sawmill. The foreshore portion of the land is being negotiated by the Government to setup port of entry facility for Vanua Levu under its Look North Policy. Satish Gulabdas is willing to make available the anti foreshore portion of the land for the proposed project. The technology that would be used at Savusavu plant will be similar to the one described for Deuba plant.

**The Existing Social Environment- Deuba**

**Overview of Deuba Location**

The access road to Deuba Power Station from Suva-Nadi Highway is about a kilometre long. The section of the road that passes through the Waidradra Solomoni Settlement is 0.5 kilometre. At the distal end from the highway the road meets a T-junction; the left fork leads to the existing power station and the right fork passes through the Vietnam Waidradra Indo Fijian Settlement. This fork of the road is 0.4 kilometre long. The fork leading to the power station has houses on either side of the road. The nearest neighbour to the power station is Rev. Josetaki Koroi who owns a farm. His family lives in a big farm house close to the road leading to the station. The Waivunu Sawmill is several kilometers away from the station. Travelling on the highway towards Sigatoka, one passes the sign board to Waivunu Sawmill on the right little after Galoa village.

**The Waidradra Solomoni Settlement (WSS)**

The WSS may look like a Fijian village at first glance but it is not so. The residents are descendents of Solomon Islanders who have intermarried with indigenous Fijian women. Since the paternal side of ancestry is linked to the Solomon Islanders some of the residents are not registered in Vola ni Kawa Bula (VKB). This is a matter of great concern for them. In administrative terms they are treated like the Indo Fijians. For example the admin position of Father Demesi is ‘Advisory Councillor’ and the grouping of houses is called a settlement, popularly known as Waidradra Settlement.

The freehold land on which the WSS is built belonged to Maharaj Family of Navua who operate a bus service. The Anglican Church bought 18 acres of this freehold land in 1988 to settle landless families who belong to Anglican Church denomination and are descendents of Solomon Islanders. It appears there are no individual title holders in this settlement and the 18-acre plot has not been sub divided into individual lots. The houses are built more on individual convenience than on any planned sub division.
The settlement has no traditional chief or link to any formal chiefly title. The formal contact to the settlement is through Turaga ni Koro. The present incumbent is Mr. Pita Matai. Father Demesi is an Anglican priest who also serves as an Advisory Councillor.

One of the major problems faced by the residents is lack of land for planting. Before they used to plant on vacant land with the tacit consent of the owners but with fast commercial developments taking place in Deuba, the ‘vaka vanua’ arrangement is being terminated.

According to Father Demesi there are 60 families living in this settlement. The population of the settlement is 300 people.

Residents derive income from various sources. These include work at Art Village in Pacific Harbour, sawmills, hotels and restaurants, villas, and employment in Suva. The settlement has two teachers, three policemen, and one Government Dispensary Assistant. Selling sago palm by way side is a ‘traditional’ business. The sago palm is collected from forested land that does not belong to the residents of this settlement. According to Father Demesi it is a ‘traditional’ privilege that is intact so far.

The settlement has FEA power supply and PWD water supply. The main source of cooking fuel is firewood collected from the bush. The well-to-do families supplement firewood with gas and kerosene to some extent.

**Vietnam Waidradra Indo Fijian Settlement**

The residents of this settlement are predominantly Indo Fijians. The Settlement has 41 residential lots but 57 families live here. The total population is 266 persons. Residents derive income from various sources which include fishing, selling fruits and vegetables, selling sago palm by the highway, paid employment at Pacific Harbour and Suva. A number of women work as housemaids in villas at Pacific Harbour.

The Settlement has FEA power and PWD water supply. For cooking residents use combinations of gas, kerosene and firewood. Electricity is also used to some extent but mainly to operate kitchen electrical appliances such as rice cooker, blender, and mixer. Before, firewood was freely available from the nearby Pacific Timber Sawmill which is opposite to the power station. The Mill is now closed. But life goes on and people have found other sources of firewood. These include Yarawa Sawmill owned by Noor Ahmed, Fenning, (now known as Waivunu Sawmill), Sustainable Mahogany Industries, and Southern Forest.

Some people hire vans to cart firewood from the mills, while others place orders with firewood contractors who periodically frequent the Settlement. One load of firewood, close to 3 tons, costs between 40 to 50 dollars and lasts for about five to six months.

Considered from the highway, the Settlement is at the distal end of the Waidradra access road. From the T junction, mentioned earlier, the Settlement extends 0.4 kilometres one way and 0.3 kilometres the other way. The settlement stands on freehold land purchased from Maharaj family. It was bought by a Land Purchase Cooperative and later subdivided
into forty one residential lots. Examination of individual title reveals the following details:

Plan of Proposed subdivision of Lot 1 DP 6185

Waidradra Province of Serua

Island of Viti Levu

CT 3412

Lot 1 DP 5347 Lot 2 DP 6185

Road access is clearly shown on the certificate of title. The right fork access is 9.0 metre wide. The left fork access, which leads to the power station, is 20.12 metre wide. The 20-metre access is shown to continue with the Waidradra access road.

**Rev. Koroi and Family**

Rev Koroi is perhaps the nearest resident to the existing Deuba power plant. He owns a piece of freehold land that extends from the highway to the access road leading to the power station. He is now engaged in commercial farming selling root crops, vegetables and fruits to establishments in Suva. According to Rev Koroi, 2 acres of his land next to the highway has been rezoned as commercial. He intends to build retirement homes for the sick and elderly.

Rev Koroi prefaced his concerns about the proposed switch to bio-fuel with a segment of history going back to 1940s. He hails from Vanuabalavu and went to Levuka for primary education. In those days Levuka had a power station operated by a kaivalagi (white man). Dogo (wood from mangrove) was used to fire the boilers at the power station. Gradually all the coastal dogo disappeared from Ovalau. Punts used to be dispatched to Rewa, Verata, and other places to fetch firewood. The operation had a drastic effect on the environment. The building tops and windows in Levuka were dusted with black soot. But nobody could object or raise a finger for it was the days of British Raj.

Rev. Koroi’s conclusion of Levuka operation was: the operation consumed a lot of wood, was environmentally damaging, and a health hazard through the emission of soot and smoke.

**Waivunu Sawmill**

Waivunu Sawmill is owned by Pride Mahogany, previously known as Fiji Hardwood Corporation. At present about 80 percent of all mahogany logs produced are sawn at this mill. By the end of the year 2007, the management hopes to process all mahogany logs at this mill. At the present level of operation, the mill is producing about 12,500 tons of mill waste per year. When a log is processed all parts of the log that is not accounted for in timber production figures is termed mill waste. Typically mill waste consists of several products. These are:
• Docking/trimming waste
• Waste slabs
• Off cuts – off gauge timber, generally < 25mm in thickness
• Shorts- cuts to remove defective part of timber, generally < 900mm in length.
• Saw dust
• Shavings

When a log is sawn about 50 percent of wood is mill waste. In common parlance docking waste and waste slabs are together referred to as firewood. Off cuts and shorts are generally sold to people who use it for building sheds, animal pens, pellets, and boxes for packing and transporting tomatoes and other produce. Saw dust and shavings are generally used as landfill, bedding material for animal pens and mulch to retain soil moisture.

The Sawmill has problems disposing mill waste. Disposal by continuous burning has been the means of getting rid of firewood in the past. The Company has now begun to sell firewood though some portion of the firewood is still given free of cost to employees, villagers, and regular contractors.

The Price List of Firewood (Memo dated 3 August 2006) is as follows:

<table>
<thead>
<tr>
<th>Load</th>
<th>Price (VIP) F$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Sack (bag)</td>
<td>2.00</td>
</tr>
<tr>
<td>2 tons Docking shorts</td>
<td>6.00</td>
</tr>
<tr>
<td>6 tons- docking shorts</td>
<td>10.00</td>
</tr>
<tr>
<td>6 tons- waste slabs</td>
<td>15.00</td>
</tr>
<tr>
<td>10- wheeler docking shorts</td>
<td>15.00</td>
</tr>
<tr>
<td>10- wheeler waste slabs</td>
<td>20.00</td>
</tr>
<tr>
<td>Firewood- long term customers</td>
<td>15.00 – 50.00</td>
</tr>
<tr>
<td>Firewood bundle (wire binded)</td>
<td>8.00</td>
</tr>
</tbody>
</table>

There are three villages that generally take advantage of this FOC firewood.

Wainiyabia – 7 km away
Galoa - 3 km away

Nakorovou- 5 km away

Discussions with Sales Clerk (from Wainiyabia village), Office Manager, and Operations Manager indicate that the villages take up a very small portion of the firewood for special occasions such as wedding, death, church ceremony, family get together, public holidays and lovo on weekends and public holidays. They estimate the consumption of firewood at about one ton per village per month.

The pay and pick customers include farmers from Valley Road, timber merchants from Navua and Nausori, companies operating boilers, and occasional empty trucks returning from Suva.

The firewood cash sales for June-July 2006 is $750.

The Operations Manager believes that FEA proposal will not affect the privileges enjoyed by the communities, at least for some time to come. In addition to mill waste the FEA wood requirement could be met from two other sources. They are:

Increased production as Management implements the policy of centralizing all processing at Waivunu, and by retrieving wood waste from the forest. The CEO Pride Mahogany feels that 50 percent of the wood is left behind in the forest at the felling sites.

The Manager Operations is positive some portion of the firewood can be set aside for the Neighbouring communities. This gesture makes good social and economic sense as many workers at the mill and office are from the nearby villages. As the Manager Operations put it: Pride Mahogany is a public corporation with a big heart.

The Existing Social Environment- Savusavu

Hanshine Enterprises Ltd

The primary business of the Company is downstream timber processing starting with logs. It mostly processes native timber, occasionally processing pine as well. The logs are procured from Vanua Levu. The Company produces timber profiles such as flooring, quarter and half rounds, weather boards, shiplap, skating, veneering, boards, etc. The Company employs about 25 people.

Total annual processing = 5000m3 of logs

According to the Office Manager and Managing Director, a very small portion of mill waste is used as firewood by the local community. One to two percent of the wood shavings and saw dust is used for the purpose of landfill and mulching of vanilla vines. The remaining mill waste is generally burnt at the mill site.
A small portion of the fire wood is taken free by mill employees. Some firewood is sold to residents of Naqere Settlement at $5 a bundle. The sales average about $200 per month.

Majority of the residents of Naqere Settlement use gas for cooking as most of them are salary earners or run businesses of their own. Firewood is used during weekends and on special social occasions. Depending on personal preference, people also buy firewood from contractors who chainsaw logs and sell firewood in bundles.

The Company feels the proposal by FEA would not affect the local community in terms of firewood availability. The Company is willing to set aside some portion of the firewood for community use. It is willing to strike a balance between its social obligations and commercial interest.

Frequent FEA power outage in the area is a great concern for the company. Sudden and frequent power cuts damage motors and machinery at the sawmill. Idle labour is a cost to the Company and productivity takes a battering. Furthermore, Naqere area is developing fast as an industrial hub in Savusavu. Power shortage arrests developments and diversification of industries in allied areas.

The Company therefore welcomes the move by FEA to supplement existing power by biomass power plants.

**Lumber Processors Ltd**

The parcel of land between Lumber Processors and Copra Millers of Fiji is about eleven acres freehold owned by Satish Gulabdas family. This is the proposed site for the biomass plant. The Government of Fiji has shown some interest to acquire the foreshore portion of the land to setup a port of entry for Vanua Levu. The portion of the land adjacent to the road is the preferred option three for the FEA biomass plant. Satish is willing to make that portion of land available to FEA on mutually agreed terms and conditions.

Others operators in the vicinity who have acquired land for their own use include B P Oil, Copra Millers of Fiji, and Coco Wood (a subsidiary of CIDA). A number of employees of Lumber Processors live near the option 3 proposed site. The names of the employees are: Charlie Powell, Martin, Ram Chander, Ramdeo and Net Ram.

These employees live there by courtesy of the Company. The land and the wooden houses belong to the Company.

Lumber Processors throughput is about 10,000 m3 of logs annually. As is generally the case, mill waste is around 50 percent.

Firewood is taken free of charge by the neighbouring villagers. While the consultant was there some children were picking firewood from a waste heap.
The Company sells some firewood to the outsiders. But the amount of sale is quite small. The frequency of take from July to December 2005 is as follows:

<table>
<thead>
<tr>
<th>Month (2005)</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>7</td>
</tr>
<tr>
<td>August</td>
<td>1</td>
</tr>
<tr>
<td>September</td>
<td>2</td>
</tr>
<tr>
<td>October</td>
<td>nil</td>
</tr>
<tr>
<td>November</td>
<td>1</td>
</tr>
<tr>
<td>December</td>
<td>nil</td>
</tr>
</tbody>
</table>

The value of firewood collated from the delivery docket is $130 for six months of 2005.

(Satish Gulabdas, who normally operates from New Zealand, happened to be in office at the time of this interview).

**Copra Millers of Fiji Ltd**

The Government owns major shares in Copra Millers of Fiji Ltd. Subsidiary shares are held by CIDA. Copra Millers use wood stumps to fire the boiler. The steam generated is used to cook coconut meal. Screw press is used to extract oil from the meal.

Copra Millers process about 8000 tons of copra annually. Every 1000 tons of copra pressed yields 610 tons of oil and 305 tons of coconut meal. 85 tons is wastage in the form of moisture loss. The meal is sold locally as animal feed. A small quantity of meal is exported to Australia. The Manager did not have any real concern except to say they need more power.

**Jerusalemi Village**

Jerusalemi is the nearest village to the proposed plant site at Valaga Bay. There are 23 households and the population is around 200. Major income source is farming. Cash crops grown include dalo, tapioca, yagona, and copra. While some work as permanent employees of Lumber Processors, Copra Millers, B P Oil Terminal, quite a number of the younger men prefer to work as casual labourers in the mills and factories around.

The village has about 200 acres of Yavusa land divided amongst the four mataqalis that reside in the village. The village has FEA power supply. Water supply to the village is from a mountain stream. Each household has a stand pipe. Cooking fuel comes from three sources: bush wood, mill wood, and gas. The concerns of the villagers have been recorded under community consultation.
Coconut Industry Development Authority

Coconut Industry Development Authority (CIDA- not to be confused with Canadian International Development Authority), previously known as Coconut Board, is a statutory body which looks after the interest of coconut industry in Fiji. Cocowood Pilot Project is set up by CIDA to process coconut trunks to produce quality grade timber that can be used to make furniture and other high value timber products. The project was opened by Hon. Gyani Nand, Minister for Agriculture, on 18th August, 2006.

The Cocowood Project uses trunks of senile trees which are more than 80 years old. Presently the Project is procuring trunks from Cakaundrove Province in lengths of 2.5m 3.0m, and 3.4 metres. It produces sawdust, chips, pith, and off-cuts as waste material.

It would be socially desirable if the FEA proposal can buy the waste from Cocowood. The benefits will trickle down to numerous large and small coconut farmers on Vanua Levu. But all will depend on the market outlets for the round and square beams that the project produces. It appears all is not well with Pacific Green – the main buyer of cocowood.

Light Industrial Area-Naqere

The area between Hanshine Enterprises and the proposed FEA plant is bristling with developmental activities. It is perhaps one of the largest residential and industrial areas in Savusavu. Some of the establishments along the road as one drives from Hanshine to Lumber Processors are as follows:

- Housing Colony- developed by Housing Authority, 300-400 households.
- Savusavu Secondary School- co-ed with hostel facilities
- Vishnu Holdings- bus company
- Waiqele Buses- bus company
- Vehicle Repair Garages- three in numbers
- Heavy Machinery Yard
- Joinery Shops
- Fiji Gas Terminal
- Vanua Petroleum (storage yard)
- Coconut Cream Factory
• PWD yard
• St. Bedes College
• St. Andrews Primary School
• Teachers College- with residential facilities
• A village
• Montfort Boys Town- residential with staff quarters.

An appreciation of this environment is necessary if mill waste were to be transported from the Hanshine Sawmill to the proposed plant site at Valaga Bay.

Summary of Issues and Concerns

The issues discussed in this chapter have been collated from community consultations and discussions with key informants and saw mill managers. (For record of discussion see appendix). The issues cover a wide range of subjects; some are specific to a particular location while others are common concerns applicable to stakeholders across the board. The main stakeholders who have contributed to the subject matter of this chapter include Waidradra Solomoni Settlement, Vietnam Waidradra Indo Fijian Settlement, staff at Waivunu Mill, managers at Hanshine Enterprises and Lumber Processors, families at Lumber Processors, Advisory Councillors, and residents of Jerusalemi village.

Firewood Availability

The main issue with the Indo Fijian community at Vietnam Waidradra Settlement is availability of fire wood for cooking purposes. Nearly every household in the settlement has wood stove and uses mill firewood for cooking. They neither have the time nor access to bush firewood for obvious reasons. They don’t own forested land and in most homes men and are employed. Only elderly women and those who have young children to look after stay at home. Their concern for firewood was so pressing that the consultant had to carry out a rapid rural assessment of firewood use in the community.

The only other village that expressed concern about the availability of firewood is Jerusalemi in Savusavu. According to the villagers the Firewood supply could slowly dry up once the saw millers have a resource agreement with FEA. This will affect the villagers adversely. In addition to cooking, the villagers also use wood to smoke and dry copra. The villagers are not sure that the promise to keep aside firewood for the use of the villages would be followed through. “Is there a mechanism to insure that it will be so?” they queried.

For Waidradra Solomoni Settlement firewood is not an issue. They collect wood from the nearby bush for cooking. Most households cook on open firewood stoves.

Smoke- air pollution and health hazard
Smoke from the chimney is a major concern since wood will burn 24 hours a day and seven days a week. Father Demesi of Waidradra Settlement recounted his Australian experience. Quite some time ago when he visited Wonthaggi town in Victoria, he found the sky line overcast with smoke emitted from a biomass plant used to generate electricity. This form of pollution is not acceptable to the villagers as it can prove a health hazard in the long run. They also cited the parallel case of cement factory in Lami.

Rev. Koroi prefaced his concerns about the proposed switch to bio-fuel with a segment of history going back to 1940s. He hails from Vanuabalavu and went to Levuka for primary education. In those days Levuka had a power station operated by a kaivalagi (white man). Dogo (wood from mangrove) was used to fire the boilers at the power station. Gradually all the coastal dogo disappeared from Ovalau. Punts were dispatched to Rewa, Verata, and other places to fetch firewood. The operation had a drastic effect on the environment. The building tops and windows in Levuka were dusted with black soot. But nobody could object or raise a finger for it was the days of British Raj.

Rev. Koroi’s conclusion of Levuka operation was: the operation consumed a lot of wood, was environmentally damaging, and a health hazard through the emission of soot and smoke.

The families living close to Lumber Processors and residents of Jerusalemi village expressed similar concern about smoke.

**Noise**

Noise, like smoke, was a concern expressed by a number of stakeholders. Ram Chandar and Charlie Powell living close to Lumber Processors felt that the biomass plant may compound the noise already coming from the sawmill operation. Jerusalemi villagers and Rev. Josetaki Koroi were also concerned about the noise levels.

Rev Koroi is perhaps the nearest resident to the existing Deuba power plant. He owns a piece of freehold land that extends from the highway to the access road leading to the power station. He is now engaged in commercial farming selling root crops, vegetables and fruits to establishments in Suva. According to Rev Koroi, two acres of his land next to the highway has been rezoned as commercial. He intends to build retirement homes for the convalescing and elderly.

Noise from the plant could affect nearby residents and the elderly who will be eventually living at the retirement homes.

**Bad Odour**

Bad Odour was mentioned only once during the consultative process. When moist wood is staked for drying, it can emit unpleasant odour due to microbial activity. Or when wood is burnt under different conditions, foul smelling gases can be produced. Nearby residents would have difficulty putting up with unpleasant odour.

**Domestic Water Supply**
This concern was raised by the residents of Waidradra and Vietnam Settlements. They are worried that their domestic water supply may be affected if the biomass plants consume a great deal of water in the long run. Already there are times when PWD is not able to supply water for various reasons. This project proposal may aggravate the water problem.

**Waste Water Discharge**

This issue is applicable to biomass plants at Deuba and Valaga Bay. Chemicals in waste water if put back into waters at Valaga Bay would affect marine life. The village depends upon marine life for their supply of protein foods. At Deuba the concern is how the storm water and waste water, if any, would be linked to the drainage system. The residents say the area already suffers from water logging conditions and any ill conceived drainage system will worsen the situation.

**Traffic Hazard**

This concern was repeatedly brought up during community consultation. It applies with equal force to proposed plants at Deuba and Savusavu. Traffic hazard arises from the fact that trucks transporting bio-fuel to the stations would increase in number and frequency. This job may be resourced out to contractors who may not exercise due vigilance in the matter of pedestrian safety, especially children going to schools.

The access road in Deuba is narrow, in poor condition, and passes through Waidradra and Vietnam settlements. The houses are quite close to the road. Children walk to and from schools along this road every morning and afternoon during week days. Many workers commute between home and work using this road. Quite a number of them can be seen walking to the highway to catch buses or taxis.

Traffic hazard is an important consideration at Valaga Bay site as well. The area will see increased traffic due to other industrial, commercial, and residential developments as well. Very close to the proposed plant site, a tax free zone has been established with basic infrastructure already in place. Port of entry for Vanua Levu is already in the pipe line. A housing estate with 32 lots is underway some distance away from the tax free zone. There are a number of primary, secondary and tertiary educational institutions in the area. The Light Industrial Zone between Hanshine Enterprises and Valaga Bay has already taken off for industrial and commercial developments. These have been described under ‘existing social environment.’

**Fall Outs from Trucks**

Trucks would be transporting sawdust, chips, and slabs from sawmill to the proposed plants on regular basis. This service may be resourced out to contractors. There is every possibility that contractors will use vehicle which are not properly equipped. There would be biomass fall outs along the road from sawmills to FEA yard. The residents quoted the instance of cane fall outs from trucks transporting cane to mills in the Western Division.

**Appropriate Alternate Technology**
This issue arises from the notion that the biomass technology is noisy, smoky, and dirty-so to say. It is not suitable for residential areas where there is proposal to build homes for the convalescing and elderly. The suggestion is that wind or solar power would be more appropriate technology for a place like Deuba.

Fijian Traditional Protocol

This issue was especially brought up at the Jerusalemi village meeting. Fijians, especially in rural areas, are mindful of Fijian protocol and they are not willing to talk about new development like this unless the matter has been first taken up with their chief in a traditional manner. They suggested that FEA should make a traditional approach to Tui Wailevu, inform him about the project, and seek his blessings. The village comes under Tikina Wailevu and traditional protocol requires that a high chief of the area is informed first about the proposal. The present title holder is Ratu Kenijioji Maivaleli from Wailevu village.

Frequent Power Outage

Savusavu is now entering the phase of rapid industrial, commercial, and tourist industry developments. It appears that the demand for power is far outstripping the supply. As a result, according to some stakeholders, especially saw millers, they face sudden and frequent power outage which is detrimental to the health of machinery and arrests expansion and developments in allied areas. Labour is kept idle for periods of time which adds to financial burden of the company. Therefore a development of this nature is welcome provided it eases power supply problems and takes care of negative impacts that may eventuate.

Assessment of Firewood Situation

At Waivunu Sawmill

This assessment of the extent and nature of firewood use is based on discussions with Manager Operations and office staff at Waivunu Sawmill. Additional information is collated from sales figures kept by delivery clerk.

The dispatch of firewood derived from Timber Docket Delivery for the months of June and July 2006 are as follows.

Waivunu Sawmill Firewood Dispatch

<table>
<thead>
<tr>
<th>FOC Firewood Dispatch</th>
<th>Firewood Sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date (June 2006)</td>
<td>Firewood (Tons)</td>
</tr>
<tr>
<td>2</td>
<td>3.0</td>
</tr>
<tr>
<td>5</td>
<td>0.5</td>
</tr>
</tbody>
</table>
There are three villages that generally take advantage of free firewood amenity.

Wainiyabia – 7 km away

Galoa - 3 km away

Nakorovou - 5 km away

Discussions with Sales Clerk (from Wainiyabia village), Office Manager, and Operations Manager indicate that the villages take a very small portion of the firewood for use on special occasions such as wedding, death, church ceremony, family get together, public holidays and lovo on weekends and public holidays. They estimate the consumption of firewood at one ton per village per month.

The pay and pick customers include farmers from Valley Road, timber merchants from Navua and Nausori, companies that operate boilers, and occasional empty trucks returning from Suva.

The firewood cash sale for June-July 2006 is $750.

The Operations Manager believes that FEA proposal will not affect the privileges enjoyed by the communities. In addition to mill waste the FEA wood requirement to fire
boilers could be met from two other sources. They are increased production as Management implements the policy of centralizing all processing at Waivunu, and retrieving wood waste left behind at felling sites. The CEO Pride Mahogany feels that 50 percent of the wood is left behind in the forest at the felling sites.

The operations manager is positive that certain portion of the firewood can be set aside for community use. This approach makes good social and economic sense as many workers at the mill and office are from the nearby villages. In the words of Manager Operations: Pride Mahogany is a public corporation with a big heart.

Firewood Use at Vietnam Indo Fijian Settlement

It appeared that majority of the families at Vietnam Settlement used firewood for cooking. To assess the nature and extent of firewood use, the consultant carried out a rapid rural assessment of the situation. Ten households were surveyed with the help of a questionnaire especially designed for the occasion (copy appended). Respondents were interviewed face-to-face. The nature and amount of firewood in storage was physically verified. Systematic random sampling was used to pick households for the survey.

The results of the survey are summarized below:

<table>
<thead>
<tr>
<th>Household Cooking Fuel Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vietnam Indo Fijian Settlement</td>
</tr>
<tr>
<td>Dated: 16 August 2006</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>House/hold</th>
<th>Head</th>
<th>Sex</th>
<th>Age</th>
<th>Interviewee</th>
<th>Relation to Head</th>
<th>Family Size</th>
<th>Income Source</th>
<th>Water-Piped</th>
<th>Electricity</th>
</tr>
</thead>
<tbody>
<tr>
<td>h/h 1</td>
<td>Ganesh Mahesh Rakesh Vinay Devend Jainesh Naresh Ramesh Dewan Rupendra</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>h/h 2</td>
<td>m m m m m m m m m</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h/h 3</td>
<td>32 46 43 46 33 39 48 40 52 47</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h/h 4</td>
<td>Sadhana Mahesh Rachana Pushpa Devend Jainesh Naresh Ramesh Dewan Rupendra</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h/h 5</td>
<td>wife head daughter wife head head head head Head</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>h/h 6</td>
<td>7 4 6 5 5 3 6 2 7 4</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h/h 7</td>
<td>bus driver labourer Carpenter Carpenter Carpenter Gardener cook Casual painter Joiner</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>h/h 8</td>
<td>Y Y Y Y Y Y Y Y Y Y</td>
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<tr>
<td>h/h 9</td>
<td>Y Y Y Y Y Y Y Y Y Y</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h/h 10</td>
<td>Y Y Y Y Y Y Y Y Y Y</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Relevant Extracts from the Survey

Average Family Size  = 4.9 persons/family

Main Income Source  = driver, labour, carpenter, gardener, cook, painter, joiner.

Cooking Fuel

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td>9 of 10 (90%)</td>
</tr>
<tr>
<td>Kerosene</td>
<td>7 of 10</td>
</tr>
<tr>
<td>Gas</td>
<td>7 of 10</td>
</tr>
<tr>
<td>Electricity</td>
<td>5 of 10</td>
</tr>
</tbody>
</table>
No. using all 4 sources = 1 (10%)
   3 sources = 5 (50 %)
   2 sources = 4 (40 %)
   1 source = 0

Location of Stove
   Inside House = 8
   Veranda = 0
   Outside = 1
   No stove = 1

Average Wood Expenditure = $8/month

**Sustainable Mahogany Industries**

Attempts to set up appointment with either the manager or office accountant were not successful. Christopher Donlon, Principal of the Company, was quite busy and felt that FEA had already collected some data from his office. However, when contacted over telephone this is what he had to say:

The Company does sell some firewood to the local community but the uptake is minimal. All sales amount to about one ton of firewood per week. (Detail figures the Company was unable to release).

**At Hanshine Enterprises Savusavu**

According to the Office Manager and Managing Director a very small portion of mill waste is used as firewood by the local community. One to two percent of the wood shavings and saw dust is used for the purpose of landfill and mulching of vanilla vines. The remaining is generally burnt at the mill site.

A small portion of the fire wood is taken free by mill employees. Some firewood is sold to the local community of Naqere Settlement at $5 a bundle. The sales average about $200 per month. About 80% of the residents of Naqere Settlement use gas for cooking as most of them are salary earners or run businesses of their own. Firewood is used during weekends and on special social occasions. Depending on personal preference, people also buy firewood from contractors who chainsaw logs and sell firewood in bundles.

The Company feels the proposal by FEA would not affect the local community in terms of firewood availability. The Company is willing to set aside some portion of the firewood for community use. It is willing to strike a balance between its social obligations and commercial interest.
At Lumber Processors Ltd Savusavu

Firewood is taken free of charge by the neighbouring villagers. While the consultant was there some children were picking firewood from a waste heap.

The Company sells some firewood to customers who call at the mill. But the amount of sale is quite small. The frequency of take from July to December 2005 is shown below:

<table>
<thead>
<tr>
<th>Month (2005)</th>
<th>Frequency</th>
</tr>
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<tbody>
<tr>
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<td>7</td>
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<tr>
<td>September</td>
<td>2</td>
</tr>
<tr>
<td>October</td>
<td>nil</td>
</tr>
<tr>
<td>November</td>
<td>1</td>
</tr>
<tr>
<td>December</td>
<td>nil</td>
</tr>
</tbody>
</table>

The value of firewood as collated from the delivery docket is as follows:

<table>
<thead>
<tr>
<th>Date</th>
<th>$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 July</td>
<td>10</td>
</tr>
<tr>
<td>11 July</td>
<td>5</td>
</tr>
<tr>
<td>11 July</td>
<td>5</td>
</tr>
<tr>
<td>12 July</td>
<td>20</td>
</tr>
<tr>
<td>23 July</td>
<td>30</td>
</tr>
<tr>
<td>28 July</td>
<td>10</td>
</tr>
<tr>
<td>28 July</td>
<td>5</td>
</tr>
<tr>
<td>15 August</td>
<td>10</td>
</tr>
<tr>
<td>1 September</td>
<td>20</td>
</tr>
<tr>
<td>8 September</td>
<td>10</td>
</tr>
<tr>
<td>14 November</td>
<td>5</td>
</tr>
</tbody>
</table>

Total for half year: $130
Satish Gulabdas, CEO Lumber Processors, who normally lives in New Zealand happened to be in office at the time of this interview. He does not have any difficulty with the social policy of setting aside some firewood for community use.

**Conclusion**

In conclusion it appears the impact of the proposed project on firewood availability will not be significant. The use of firewood is nominal and on special occasions except in the case of Vietnam Indo Fijian Settlement. About 90 percent of households in this Settlement use firewood on regular basis but the extent of usage is small. Kerosene, gas, and electricity are used to supplement firewood cooking. Residents procure firewood from different sawmills depending upon wood preference. Private contractors also deliver firewood procured from mills that will not be affected by this project. All mill operators interviewed are willing to set aside a portion of the firewood for community use. This is so because it makes good business sense (explained in next section).

**Managing Issues and Concerns**

**Firewood Availability**

Firewood as a matter of concern was raised only by Vietnam Settlement and Jerusalemi village. Though, at first glance, it appears to be a major concern but in actual point of fact it is not so. This is evident from the facts presented in the section ‘Assessing Firewood Situation.’ The facts can be summarized as follows:

There are two sources of firewood; one is mill wood and the other bush wood. Both are in use. Mill wood is used on special occasions and as a supplement to other sources of cooking fuel. Its use is quite small compared to the volume of firewood produced by saw mills. People who use firewood have wood preference and procure different species of wood from different mills operating in the area. In addition to saw mills there are private contractors who supply sawn firewood at doorsteps at competitive prices. Since carrier or van hire on individual basis is expansive, people prefer contractors. Only people who live close to mills hand pick and shoulder carry firewood to their homes. While the consultant was at Lumber Processors only five children from Jerusalemi village were hand picking firewood from a heap. No adult men or women were seen around.

All the mill operators consulted are willing to set aside a portion of the firewood for community use. The reasons for their willingness to do so are:

When a log is sawn, about 50 percent of it is mill waste. The cost of this waste is factored in the price of the timber the mill sells. So if the mills can get a price for the waste firewood, it is an added bonus- an icing on the cake. Secondly, disposing waste firewood by burning or just abandoning is a fire and security risk for the company. Thirdly, since many of the mill workers are from neighboring villages, its makes good business sense to set aside a portion of the ‘waste resource’ for the use of the community.

Therefore, as a mitigative and pre-emptive measure, any Resource Purchase Agreement with FEA should clearly specify that certain portion of the firewood should be set aside
for community use. A mechanism should be put in place to monitor that mills don’t default on this provision of the agreement.

**Road Access at Waidradra**

To deal with this issue, FEA has three options. The first is based on the principle of avoidance; to find a new access altogether and avoid the use of the present access that passes through Waidradra Settlement. The plot of land that is next or adjacent to Waidradra Settlement is freehold land that belongs to Rev. Koroi. From discussions and the plans he has for developing his farm, it appears that he may not be willing to part with his land. The only place to explore this option is the land that is close to the Pacific Timber which is now closed. This access would make a straight connection from the highway to the Power Station.

The second option is to confront the situation by pursuing legal option. Is the access a legal easement that is registered on the title deed that can be used for public good? Some initial investigation and discussion with Vietnam settlers on the issue shows a clear access marked on the CT 3412 and Lot 1 DP 5347 and Lot 2 DP 6185. From the T junction (discussed earlier) the fork to the left is a marked access 9 metres wide. The right fork that leads to the power station is marked access 20.12 metres wide. Therefore, access is not a problem with Vietnam settlers. Whether this applies to Waidradra Settlement is a subject of further investigation and confirmation by the FEA’s Land Affairs Department. That is if FEA decides to take up this option.

The third option is conciliatory in nature; to consult the settlers and arrive at some form of agreement. This obviously will involve some form of compensation.

**Smoke, Noise, Bad Odour, and Waste Water Discharge**

These are issues that relate to the routine running of the plants. They need serious consideration since the plants will run 24 hours a day and seven days a week. Suffice it to say that these issues will be addressed by the engineering and design team. The community notion of some of these issues is shaped by impressions of old technology. We do not have examples of biomass plants in Fiji to cite as examples of better and improved modern technology. The potential for this technology is great especially in view of the fact that 50 percent of wood is left behind at the felling site (according to CEO-Pride Mahogany) and about 50 percent is waste wood at mill site. Therefore, the pilot plants should be sound environmentally, robust technologically, and viable economically.

**Traffic Hazard**

This relates to number, speed, and frequency of vehicles that will operate between the plants and sawmills that will supply waste wood. A road or civil engineer should review the present condition of the road and recommend appropriate improvements and treatments. Suggested mitigating measures that could be put in place include sealing sections of the road through villages, provision of footpaths, speed limits, speed calmers, and road signage. If necessary, an information and awareness campaign can be mounted.
with community, school children, teachers, and drivers before the start of project activities.

**Fall Outs from Trucks**

Certain measures can be put in place to avoid saw dust, wood chips, and slabs falling off trucks. A containerized mode of transportation could be adopted for saw dust and wood chips. Containers can be placed at sawmills and once full they can be transported to the plant site. Slabs could be transported in bales that are well strapped or secured with wire. The other option is to slice and chop the slabs into chips at sawmill site.

**Appropriate Alternate Technology**

This is an issue that would be addressed as part of Environment Impact Assessment. Suffice it to say that each form of technology has its necessary conditions to be technically viable. For example we can not have a wind mill in a place where wind velocity and prevalence is not favourable. Therefore it’s a matter for experts to decide the place and form of technology that is suitable.

**Fijian Traditional Protocol**

Jerusalemi village comes under Tikina Wailevu and traditional protocol requires that a high chief of an area is informed first about the proposal. The present title holder is Ratu Kenijioji Maivaleli from Wailevu village. He is a member of the Senate and can be contacted in Suva itself. It is suggested that a delegation from FEA approach him traditionally and inform him about the proposal.

**Appendices**

**Community Consultation- Waidradra Solomoni Settlement**

Date: 15 August 2006

Time: 6 – 8 pm

Venue: Turaga ni Koro veranda

Present:

Turaga ni Koro- Pita Matai

Advisory Councillor- Father Demesi

Village Elder 1- Villiamoe Suluma

Village Elder 2- Jack Maikali

Men- 5
Women 3

Issues and Concerns

1. Smoke from the chimney is a major concern since wood will burn 24 hours a day and seven days a week. Father Demesi recounted his Australian experience. Quite some time ago when he visited Wonthaggi town in Victoria, he found the skyline overcast with smoke emitted from a biomass plant which used to operate to generate electricity. This form of pollution is not acceptable to the villagers as it can prove a health hazard in the long run. They also cited the case of cement factory in Lami.

2. Water Supply. The residents are worried that their water supply may be affected if the biomass plants generating electricity will consume lot of water in the long run.

3. Storm water discharge. How would the storm water or waste water from the plant be discharged? If released on the surface, it can breed mosquitoes and cause water logging conditions.

4. Fall outs from trucks. Trucks would be transporting sawdust, chips, and slabs from sawmill to the proposed plants on regular basis. There is every possibility that contractors will use vehicle which are not properly equipped. There would be biomass fall outs on the road through the village to the FEA yard. They quoted the instance of cane fall outs from trucks transporting cane to mills in the Western Division.

5. Traffic Hazard

6. Present Road Condition. The present road condition passing through the village is pretty bad with pot holes and puddles of water everywhere. Despite several pleas to FEA, nothing has been done.

7. Road Access. The residents claim that the present access used by FEA that runs through Waidradra Settlement is on private land.

8. Transmission Line. The FEA transmission line connecting the present power station to the national grid runs underground along the present road access through the settlement. They are literally walking on high tension wires day in and day out. They want to be compensated for this as well.
Community Consultation- Vietnam Waidradra Indo Fijian Settlement

Date: 15 August 2006

Time: 9 – 11 pm

Place: Ramayan Mandali Meeting Hall

Present:

Vice President Mandali  Dhirendra Chand
President Ramayan Mandali  Shiu Chand

Men  15
Women  4
Youth  7

It being Tuesday, the discussion on the project started after the residents had finished recital of Ramayan.

Issues and Concerns

1. The main issue with the Indo Fijian community is availability of fire wood for cooking purposes. Nearly every household in the settlement has wood stove and uses firewood for cooking purposes. They have no access to bush firewood for two good reasons. One, they do not have access to forested land and two, they do not have the time on hand to collect firewood as both men and women work. Only elderly women and those who have young children to look after stay at home. Their concern for firewood was so pressing that the consultant had to carry out a rapid rural assessment of firewood use in the community.

2. Land Issue and Related Social Problems

Since most of the mahogany plantations stand on native land, the supply of mahogany can be disrupted any time if the indigenous landowners are unhappy about some issues with Pride Mahogany or FEA. They can disrupt the supply of logs anytime. Would this mean that the supply of electricity too would be disrupted?

3. Cost of Electricity

Since a cheaper fuel would be used to generate electricity (compared to diesel oil) can the community expect a reduction in the cost of electricity?

Key Informant Interview- Rev. Josetaki Koroi
Rev Josateki Koroi
Retired President- Methodist Church in Fiji
Date: 16 August 2006
Time: 4 – 5 pm
Place: Koroi Farm House

Rev Koroi is perhaps the nearest resident to the existing Deuba power plant. He owns a piece of freehold land that extends from the highway to the access road leading to the power station. He is now engaged in commercial farming selling root crops, vegetables and fruits to establishments in Suva. According to Rev Koroi, 2 acres of his land next to the highway has been rezoned as commercial. He intends to build retirement homes for the sick and elderly.

Rev Koroi prefaced his concerns about the proposed switch to bio-fuel with a segment of history going back to 1940s. He hails from Vanuabalavu and went to Levuka for primary education. In those days Levuka had a power station operated by a kaivalagi (white man). Dogo (wood from mangrove) was used to fire the boilers at the power station. Gradually all the coastal dogo disappeared from Ovalau. Punts used to be dispatched to Rewa, Verata, and other places to fetch firewood. The operation had a drastic effect on the environment. The building tops and windows in Levuka were dusted with black soot. But nobody could object or raise a finger for it was the days of British Raj.

Rev. Koroi’s conclusion of Levuka operation was: the operation consumed a lot of wood, was environmentally unhealthy, and a health hazard through the emission of soot and smoke.

His Concerns

1. Noise from the plant could affect nearby residents and the elderly who will be eventually living at the retirement homes.

2. Smoke and soot from the chimney could have adverse effect on the environment and predispose people to respiratory disorders.

3. He has questioned whether biomass plant development is appropriate for the area in view of the commercial and tourist related developments in Pacific Harbour. Should not FEA consider more appropriate forms of technology such as wind mills and solar panels?

4. Traffic Hazard- especially heavy trucks negotiating treacherous route. The ground around the present plant site is generally boggy/ muddy in nature.

5. Bad Odour could emanate from the yard where the wood is stored for drying and from the kiln that burns the wood for heat energy.
Telephone Interview- Christopher J Donlon:

Christopher J Donlon
Principal
Sustainable Mahogany Industries
Date: 15 August 2006

The Company does sell some firewood to the local community but the uptake is minimal. All sales amount to about one ton of firewood per week. Detail figures the Company was unable to release. (This is roughly the same amount of firewood sale as reported by Waivunu Mills.)

Key Informant Interview- Taione Lave

Taione Lave
Operations Manager
Waivunu Sawmill
14 Aug 2006
Venue: Waivuni Sawmill Office
Time: 2-5pm

Waivunu Sawmill is owned by Pride Mahogany, previously known as Fiji Hardwood Corporation. At present about 80 percent of all mahogany logs produced are sawn at this mill. By the end of the year 2007, the management hopes to process all mahogany logs at this mill. At the present level of operation, the mill is producing about 12,500 tons of mill waste per year. When a log is processed all parts of the log that is not accounted for in timber production figures is termed mill waste. Typically mill waste consists of several products. These are:

- Docking waste
- Waste slabs
- Off cuts – off gauge timber, generally < 25mm in thickness
- Shorts- cuts to remove defective part of timber, generally < 900mm in length.
- Saw dust
- Shavings
When a log is sawn roughly 50 percent of the timber goes out as mill waste. Of this waste, the largest component (about 80 percent) is firewood. In common parlance docking waste and waste slabs are together referred to as firewood. Off cuts and shorts are generally sold to people who use it for building sheds, animal pens, pellets, and boxes for packing and transporting tomatoes and other produce. Saw dust and shavings are generally used as landfill and at times as bedding material for animal pens.

The Sawmill has problems disposing mill waste. Disposal by day and night burning has been the means of getting rid off firewood in the past. Now the Company has begun selling firewood though some portion of the firewood is still given free of cost to employees, villagers, and regular contractors.

The Price List of Firewood (Memo dated 3 August 2006) is as follows:

<table>
<thead>
<tr>
<th>Load</th>
<th>Price (VIP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Sack (bag)</td>
<td>$2.00</td>
</tr>
<tr>
<td>2 tons Docking shorts</td>
<td>6.00</td>
</tr>
<tr>
<td>6 tons- docking shorts</td>
<td>10.00</td>
</tr>
<tr>
<td>6 tons- waste slabs</td>
<td>15.00</td>
</tr>
<tr>
<td>10- wheeler docking shorts</td>
<td>15.00</td>
</tr>
<tr>
<td>10- wheeler waste slabs</td>
<td>20.00</td>
</tr>
<tr>
<td>Firewood- long term customers</td>
<td>15.00 – 50.00</td>
</tr>
<tr>
<td>Firewood bundle (wire binded)</td>
<td>8.00</td>
</tr>
</tbody>
</table>

There are three villages that generally take advantage of this free facility.

Wainiyabia – 7 km away

Galoa - 3 km away

Nakorovou- 5 km away

Discussions with Sales Clerk (from Wainiyabia village), Office Manager, and Operations Manager indicate that the villages take up a very small portion of the firewood and mostly on special occasions such as wedding, death, church ceremony, family gathering, public holidays and lovo. They estimate the consumption of firewood at about one ton per village per month. On their way home occasional passers-by also pick a few pieces of firewood.
The pay and pick customers include farmers from Valley Road, timber merchants from Navua and Nausori, companies that fire boilers, and occasional empty trucks returning from Suva. The firewood cash sales for June-July 2006 are $750.

**Social Policy**

The Operations Manager believes that FEA proposal will not affect the privileges enjoyed by the communities, at least for some time to come. In addition to mill waste the FEA wood requirement to fire boilers could be met from two other sources. The sources are:

- Increased production as Management implements the policy of centralizing all processing at Waivunu, and by retrieving wood waste from the forest. The CEO Pride Mahogany feels that 50 percent of the wood is left behind in the forest at the felling sites.

The operations manager feels that certain portion of the firewood can be set aside for the neighbouring communities and, if necessary, the privilege could be phased out very gradually. This approach makes good social and economic sense as many workers at the mill and office are from the nearby villages. As the operations manager put it: Pride Mahogany is a public corporation with heart.

**Focus Group Discussion- Hanshine Enterprises**

Nam Bok Cho  
Managing Director, Hanshine Enterprise Ltd

Sarina Singh  
Office & Sales Manager, Hanshine Enterprise Ltd

Date: 22 Aug 2006

Time: 9-10 am

Place: Hanshine Office, Naqere, Savusavu

Primary business of the Company is downstream timber processing starting with logs. It mostly processes native timber, occasionally processing pine as well. The logs are procured from Vanua Levu. The Company produces timber profiles such as flooring, quarter and half rounds, weather boards, shiplap, skating, veneering, boards, etc. The Company employs about 25 people.

Total annual processing = 5000m3 of logs

Mill waste is about 50 percent.
According to the Office Manager and Managing Director a very small portion of mill waste is used as firewood by the local community. One to two percent of the wood shavings and saw dust is used for the purpose of landfill and mulching of vanilla vines. The remaining is generally burnt at the mill site.

A small portion of the fire wood is taken free by mill employees; some firewood is sold to the local community of Naqere Settlement. The firewood is sold at $5 a bundle. The sales average about $200 per month. About 80% of the residents of Naqere Settlement use gas for cooking as most of them are salary earners or run businesses of their own. Firewood is used during weekends and on special social occasions. Depending on personal preference, people also buy firewood from firewood contractors who chainsaw logs and sell firewood in bundles.

Issues:

1. The Company feels the proposal by FEA would not affect the local community in terms of firewood availability. The Company is willing to set aside some portion of the firewood for the use of the community. It is willing to strike a balance between its social obligations and commercial interest.

2. Frequent FEA power outage in the area is a great concern for the company. Sudden and frequent power cuts damage its motors and machinery at the sawmill. Labour idle time is a cost to the Company and productivity takes a nose dive. Furthermore Naqere area is developing fast as an industrial hub in Savusavu. Power shortage arrests developments and diversification of industries in allied areas.

3. The Company therefore welcomes the move by FEA to supplement existing power by biomass power plants.

Focus Group Consultation – Lumber Processors

Satish Gulabdas, Managing Director

Hemant Kumar, Manager

Lumber Processors Ltd, Valaga, Savusavu.

Date: 22 August 2006

Time: 10.-11.00 am

Place: Office, Lumber Processors.

The parcel of land between Lumber Processors Sawmill and the Copra Millers of Fiji Ltd is about eleven acres freehold owned by Satish Gulabdas family. This is the proposed site for the biomass plant. The Government of Fiji has shown some interest to acquire the foreshore portion of the land for setup a port of entry for Vanua Levu. The portion of the
land adjacent to the road is the preferred option three for the FEA biomass plant. Satish is willing to make that portion of land available to FEA on mutually agreed terms and conditions.

Others operators in the vicinity who have acquired land for their own use include B P Oil, Copra Millers of Fiji, and Coco Wood (a subsidiary of CIDA). A number of employees of Lumber Processors live on the other side of the road adjacent to the option 3 proposed site. The names of the employees are Charlie Powell, Martin, Ram Chander, Ramdeo, and Net Ram. These employees live there by courtesy of the Company. The land and the wooden houses belong to the Company.

Lumber Processors process about 10,000 m3 of logs yearly. As is generally the case, mill waste is around 50 percent.

Firewood is taken free of charge by the neighbouring villagers. While the consultant was there some children were picking firewood from a waste heap.

The Company sells some firewood to the outsiders. But the amount of sale is quite small. The frequency of take from July to December 2005 is as follows:

<table>
<thead>
<tr>
<th>Month (2005)</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>7</td>
</tr>
<tr>
<td>August</td>
<td>1</td>
</tr>
<tr>
<td>September</td>
<td>2</td>
</tr>
<tr>
<td>October</td>
<td>nil</td>
</tr>
<tr>
<td>November</td>
<td>1</td>
</tr>
<tr>
<td>December</td>
<td>nil</td>
</tr>
</tbody>
</table>

The dollar value of firewood as collated from the delivery docket is as follows:

<table>
<thead>
<tr>
<th>Date</th>
<th>$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 July</td>
<td>10</td>
</tr>
<tr>
<td>11 July</td>
<td>5</td>
</tr>
<tr>
<td>11 July</td>
<td>5</td>
</tr>
<tr>
<td>12 July</td>
<td>20</td>
</tr>
<tr>
<td>23 July</td>
<td>30</td>
</tr>
</tbody>
</table>
28 July 10
28 July 5
15 August 10
1 September 20
8 September 10
14 November 5
Total for half year $130

Issues

1. Savusavu is now set up for rapid industrial, commercial, residential and tourist development, especially the area around Valaga Bay and Naqere. The demand for power is outstripping the supply by miles. So any development easing the power supply is generally welcome by the enterprises in the area.

2. The quantity of firewood taken by the villagers is quite small. LP can always set aside some firewood for their use without any difficulty.

3. The critical issues that need to be addressed include smoke, noise, and waste water disposal.
Affected and Interested Family Consultation: Ram Chander Family

Ram Chander – 55 years
Employee Lumber Processors
Date: 22 August 2006
Place: Residence of Ram Chander
Time: 11- 12 noon

There are six persons in the family
Mr and Mrs Ram Chander
Son and daughter-in-law
Two grandchildren

Ram Chander works as a caretaker of farms for LP. He earns about $70 per week. His son is a van driver and makes about $200 per week. His family uses firewood free from the LP mill. He burns about one tonne of firewood every three months.

Issues:

1. Ram Chander reckons that the power need for the area will rise steeply. Two developments have just taken off the ground close to the Option 3 site. One is the designation of the Tax Free Zone with basic infrastructure already in place and the other is a Housing Colony with 32 lots out of which 25 plots have already been taken. An acre-plot is being sold for about $30,000. These housing lots are developed for sale on the freehold land owned by Gulabdas family.

2. Smoke for the wood burning could affect the residents. The new residential area is on the higher ground compared to the plant on the proposed site. The chimney would have to be tall and it also depends on the prevailing wind.

3. Noise could be a problem if it produces a heightened effect with the noise coming from the lumber mill and copra millers.

4. Traffic Hazard
Affected and Interested Family Consultation: Charlie Powell

Charlie Powell- 35 years
Employee of Lumber Processors
Date: 22 August 2006
Time: 12 – 1.00 pm
Place: Lumber shed

Charlie is married and lives with his wife. His adopted son is about two and a half years old. He lives in a company house which is about half a kilometre from the Lumber shed. He works as a timber baler at the sawmill and earns $2.47 an hour and works on an average 40 hours a week. He supplements his family income by planting dalo and tapioca and selling them to Satish for export market.

Charlie uses about a ton of firewood every 3 to 4 months. He gets the firewood FOC from the sawmill. Sometimes his wife collects firewood from the bush.

Charlie’s Issues and Concerns

Noise
Smoke
Trucks Passing by frequently.
Stakeholder Consultation: BP Oil

Varea
Terminal Manager
B P Oil, Valaga Bay, Savusavu
Phone contact: 8850838 office
         9991267 mobile
         8850862 home
Date: 22 August 2006
Time: 1 – 2.00 pm
Place: Lunch Shed, B P Oil

Mr Varea has no real concern about the FEA proposed project. Asked about the fire hazard he said: We have two boilers or fires burning closer than the proposed project. One is at the Copra Millers and the other at the Coco Wood. As long as proper procedures are followed he sees no problem.
Village Meeting and Discussion- Jerusalemi Village

Jerusalemi Village

Date: 22 August 2006

Time: 7 – 9 pm

Venue: Village Community Hall

Present:

Village Chief: Ilusio Colaenima
Turaga Ni Koro Elaitia Matalomane (away in Suva)
Turaga Ni Yavusa Bonefasonawa
Village elder Mosese Bobi

Men 9
Women 4
Youth 3

Jerusalemi is the nearest village to the proposed plant site at Valaga Bay. There are 23 households and the population is around 200 people. Major income source is farming. Cash crops grown include dalo, tapioca, yagona, and copra. While some work as permanent employees of the sawmill, Copra Millers, B P Oil Terminal, quite a number of the younger men prefer to work as casual labourers in the mills and factories around.

The village has about 200 acres of Yavusa land divided amongst the four mataqalis that reside in the village. The village has FEA power supply. Water supply to the village is from a mountain stream. Each household has a stand pipe. Cooking fuel comes from three sources: bush wood, mill wood, and gas.

Issues and Concerns

1. FEA should make a traditional approach to Tui Wailevu, inform him about the project, and seek his blessings. The village comes under Tikina Wailevu and traditional protocol requires that a high chief of the area is informed first about the proposal. The present title holder is Ratu Kenijioji Maivaleli from Wailevu village. As a member of the Senate he spends most of his time in Suva.

2. The Firewood supply could slowly dry up once the saw millers have a resource agreement with FEA. This will affect the villagers adversely. In addition to cooking, the villagers also use wood to smoke and dry copra. The villagers are not
sure that the promise to keep aside firewood for the use of the villages would be followed through. Is there a mechanism to insure that it will be so?

3. Smoke

4. Noise from the plant

5. Chemicals in waste water if put back in the Valaga Bay would affect marine life. The villagers depend upon marine life for their supply of protein foods.

6. Traffic Hazard, especially so with the school children. There are a number of primary and secondary schools in the area and the road becomes quite busy in the mornings and afternoons after the school break. The educational institutions in the area include:

   - Muanivatu District School
   - St. Andrews Primary School
   - St. Bedes College
   - Savusavu Secondary School
   - Yaroi District School
   - Khamendra Bhartiya School
Focus Group Discussion- CIDA, Coco Wood, and Palm Wood

Richard Cook
Project Engineer, Cocowood Pilot Project

Vijendra Kumar
Senior Coconut Development Officer, Coconut Industry Development Authority

Date: 23 August 2006
Time: 2 – 4.30 pm
Place: CIDA Office and Pilot Project Site

Coconut Industry Development Authority (CIDA- not to be confused with Canadian International Development Authority), previously known as Coconut Board, is a statutory body which looks after the interest of coconut industry in Fiji. Cocowood Pilot Project is set up by CIDA to process coconut trunks to produce quality grade timber that can be used to make furniture and other high value timber products. The project was opened by Hon. Gyani Nand, Minister for Agriculture, on 18th August, 2006.

The Cocowood Project uses trunks of senile trees which are more than 80 years old. Presently the Project is procuring trunks from Cakaundrove Province in lengths of 2.5m, 3.0m, and 3.4 metres. It produces sawdust, chips, pith, off-cuts as waste material.

Concern

1. It would be socially desirable if the FEA proposal can buy the waste from Cocowood. The benefits will trickle down to numerous large and small coconut farmers on Vanua Levu. But all will depend on the market outlets for the round and square beams that the project produces. It appears all is not well with Pacific Green – the main buyer of cocowood.
Palm wood, which has similar operations as Coco Wood but on a larger scale, has stopped operations. The mill is not running and there are no workers around. It is having problems with Pacific Green who used to buy their processed logs. It appears that Pacific Green has relocated its entire down stream processing to main land China. This is causing some problem with supplier of processed coco logs.

**Concern**

In view of the above marketing hiatus, only time will tell how Cocowood and Palm wood would shape in their ventures.

**Individuals Consulted**

<table>
<thead>
<tr>
<th>Name</th>
<th>Position/organization</th>
<th>Contact Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Christopher Donlon</td>
<td>Principal Sustainable Mahogany Industries</td>
<td>3450501</td>
</tr>
<tr>
<td>Shivangini Bishwa</td>
<td>Environmental Engineer, FEA</td>
<td>3224385  9253333</td>
</tr>
<tr>
<td>Taione Lave</td>
<td>Operations Manager, Waivunu Mills</td>
<td>3451922  9997294</td>
</tr>
<tr>
<td>Edrian Hazelman</td>
<td>CEO, Fiji Hardwood Corporation</td>
<td>3372664  9997507</td>
</tr>
<tr>
<td>Hemant Kumar</td>
<td>Manager, Lumber Processors Ltd</td>
<td>8850836  9265067</td>
</tr>
<tr>
<td>Satish Gulabdas</td>
<td>CEO, Lumber Processors</td>
<td>8850836</td>
</tr>
<tr>
<td>Sarina Singh</td>
<td>Office Manager, Hanshine Enterprise</td>
<td>8850251</td>
</tr>
<tr>
<td>Nam Bok Cho</td>
<td>M D, Hanshine Enterprise</td>
<td>8850251  9923251</td>
</tr>
<tr>
<td>Ratu Peni Volavola</td>
<td>Manager Land Affairs, FEA</td>
<td>3311133  9999269</td>
</tr>
<tr>
<td>Richard Cook</td>
<td>Project Engineer, Cocowood Project</td>
<td>8853244  9217680</td>
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</tbody>
</table>
Vietnam Indo Fijian Settlement

Household Cooking Fuel Survey

Dated 16 August 2006

Head of Household  Sex  Age

Interviewee  Relation to Head

Size of Family

Main Income Source

Water  piped

Electricity  FEA

Cooking Fuel

Kerosene

Gas

Electricity

Wood

Woodstove

Location

Inside house

Veranda

Outside
How often Used?

Daily  
Weekly  
Occasionally  

Type of Wood

- Mill wood
- Bush wood
- Both

Physical verification

Form No/Date

Bibliography


Appendix 4 Noise Assessment Report
Fiji Electricity Authority

Environmental Noise Assessment

Deuba and Savusavu

Biomass Power Stations

August 2006

Report No. 42785-01

Vipac Engineers & Scientists Ltd

PO Box 506

Kings Meadows TAS 7249

27 August 2006
Introduction

Vipac Engineers & Scientists was commissioned by Mr Alex Langley of Hydro Tasmania Consulting to carry out an environmental noise assessment of two sites in Fiji under consideration for locating wood fired power stations. The sites are at Deuba on Viti Levu and Savusavu on Vanua Levu.

The initial proposal is to install 3 off 1mW packaged units at each site based on biomass fired steam boilers and steam turbine driven generators. The potential design capacity for each site is to have 5mW of generation capacity subject to the availability of a sustainable supply of fuel. The fuel supply is to be residue from local saw milling operations and will consist of a mixture of flitch wood, sawdust and copra timber processing waste.

Site description

Deuba

It is proposed to use the existing Fiji Electricity Authority (FEA) power station site at Deuba. This power station currently houses 5 off multi cylinder diesel generator sets (3 of these generators are potentially operational) and 3 off packaged diesel generators. The original generators have not been used for approximately 2 years and the packaged generators are used primarily during periods of peak power demand. A transformer substation is also located on this site.

The original power station buildings are located on essentially flat land at the foot of a hill that has been partially excavated to accommodate the power station. The hill is on the northern and western sides of the site with flat land to the east. A sawmill is located on the southern side of the site between the power station and the Suva Nadi Highway. The Waidradra Settlement is located approximately 200 metres to the east with local gardens between the power station and the village. Figure 1 shows the view to and from the power station and figure 2 shows a locality map for the area.
Figure 1 - Deuba Power Station site and Waidradra Set Village from the power station.

There are no topographical barriers to the propagation of noise from the power station site to the nearby village. The hill on the northern and western side of the site is likely to act as an amphitheatre and will reflect some of the noise emissions from the power station towards the village.
The proposed site for the Savusavu Biomass Power Station is on vacant land approximately 4 kilometers from Savusavu. The site is located between an existing sawmill (Lumber Processors Fiji Ltd) and a copra processing plant (Copra Millers of Fiji Ltd). Both these industries appear to operate during the day time only from Monday to Friday and Saturday morning. On Sunday there was no apparent activity at the copra processing plant, however, there was some activity associated with a timber treatment plant at the sawmill.

The village of Jerusalemi is located approximately 250 metres north west of the proposed site and there is one house on elevated ground overlooking the site at less than 200 metres. There are no topographical barriers between the site and the noise sensitive locations nearby and the land is primarily open grassy land. Figures 3 & 4 show the proposed site and the village of Jerusalemi. A site locality map is shown in figure 5.
Figure 3 – Proposed site for Biomas Power Station.

Figure 4 – Proposed site and village of Jerusalem
Figure 5 – Locality map for proposed Savusavu Biomass Power Station.

**Ambient noise measurements**

As Fiji does not currently have environmental noise regulations all noise measurements have been carried out in general accordance with the requirements of Australian Standard AS1055.1 – 1997 ‘Acoustics – Description and measurement of environmental noise. Part 1 General procedures.’ [1]

The following instrumentation was used:

- Type 1 sound level meter and spectrum analyser - Larson Davis 2900 (S/N 2900 A0343)

- Type 1 sound level meter and environmental noise logger – Larson Davis 870B (S/N 870B1189)

- Acoustic calibrator – Larson Davis CA250 (S/N 2706)

Sound level meters were calibrated prior to use.

To characterise the existing ambient noise level in the vicinity of both sites the environmental noise logger was used to record the following environmental noise parameters for 15-minute intervals over a 24-hour period.
• $L_{A10,15min}$ - Noise level exceeded for 10% of the time.

• $L_{Aeq,15min}$ – Equivalent continuous noise level.

• $L_{A90,15min}$ – Level exceeded for 90% of the time.

• $L_{Amin,15min}$ – Minimum noise level in 15 minute measurement interval.

No noise sources were excluded from these measurements.

Typical 1/3-octave band ambient noise spectra were obtained over a short periods at each site and traffic noise was excluded from these spectral measurements.

For reasons of security, instrumentation was placed within the Deuba Power Station boundary fence and at the rear of the timber mill adjacent to the proposed site at Savusavu.

The minimum ambient noise levels recorded at both sites were considered to be representative of the typical ambient noise levels for each of the nearby villages.

**Deuba**

During measurements at the Deuba site the weather was showery, warm (approx 20° C), gusting wind and 8/8 cloud cover. While the weather conditions were less than ideal, ambient noise levels of 35 to 37 $L_{A90,15min}$ were obtained during the morning of 16 August 2006. Noise levels as low as 31 $L_{Amin,15min}$ were obtained over this same period. This is likely to have been a period with reduced wind speed. With the wind blowing, ambient noise levels were controlled by the rustling of palm fronds. Figure 6 shows the ambient noise history for this site and figure 7 shows a typical 1/3-octave band spectrum for the area.
Figure 6 – Environmental noise history for Deuba Power Station
Figure 7 – Typical ambient noise spectrum for Deuba

**Savusavu**

The measurements at Savusavu were conducted over a 3 day period from 18 to 20 August 2006. The instrumentation was located at the rear of the Lumber Processors Fiji mill for security reasons. Measurements at this location only provided useful data when the sawmill was not operating.

Noise measurements from 0900 to 2400 hrs on 18 August 2006 showed short periods only when the ambient noise level dropped below 40 dBA. The generally high levels were due to local activity in the mill and the noise of rain on the mill roof. Calm periods occurred on 19 August 2006 in the morning (0600 to 0800 hrs) and in the evening (1600 to 1800 hrs). There was only intermittent activity on the site during the morning of Sunday 20 August and the weather was generally calm and fine from 0600 to 1400 hrs.

During the periods of calm and dry weather when there was no work on site ambient noise levels were typically 30 to 32 L_{A90,15min}. Noise levels as low as 27 L_{Amin,15min} were recorded during these periods. Figure 8 shows the ambient noise history for this site while a typical 1/3-octave band spectrum for Jerusalemi village is shown in figure 9.
Figure 8 - Environmental noise history for proposed Savusavu Power Station site.
Figure 9 – Typical ambient noise spectrum for Jerusalemi Village no traffic and no wind.

Assessment of ambient noise

Both sites have local villages nearby and noise sensitive dwellings are currently subjected to negligible transportation noise at night. This results in low ambient noise levels at night for both areas. During calm weather conditions night noise levels as low as 25 to 30 dBA would be expected and noise levels during the day of 35 to 40 dBA could be expected in the villages. These ambient noise levels are also typical of rural areas with negligible traffic in Australia.

Measured ambient noise for both Deuba and Savusavu substantiate these typical levels.

As Fiji currently has no environmental noise regulations reference has been made to several other potentially relevant standards and recommended guidelines as follows:-

- World Health Organization guidelines [2]


• Environment Protection Authority (NSW) ‘Environmental criteria for road traffic noise’ (EPA 99/3). [5]

**WHO Guidelines**

WHO guidelines published in 1999 recommend that to avoid sleep disturbance, ambient noise levels in sleeping areas should not exceed 30 dBA.

The impact of noise on sleep disturbance and awakening response is an area of current research work and the WHO has published more recent work in this field indicating that children are likely to have their sleep disturbed at lower threshold noise levels than adults [6].

**Australian Standards AS 2107:2000**

In areas of negligible transportation this Australian Standard recommends the following design sound levels for sleeping areas in residential buildings:-

- Satisfactory 25 dBA
- Maximum 30 dBA

**Environment Protection Authority (NSW)**

The EPA (NSW) has published environmental criteria for road traffic noise [5]. These guidelines note that sleeping areas in a building are generally the most sensitive to noise impact and that in the absence of other recommendations maximum noise levels in a bedroom should not exceed 35 to 40 $L_{A_{max}}$.

**Australian Standard AS 1055:1997**

This Australian Standard recommends the methods for measurement and assessment of environmental noise; however it does not recommend acceptable noise levels. It assigns this task to the ‘relevant regulatory authority’.

The standard does note that when assessing the noise emissions from an industrial site an adjustment to the measured noise level should be made for the character of the noise. Adjustments are recommended where noise emissions are ‘tonal’ or ‘impulsive’ in nature.

It also suggests that the following statistical noise parameters are useful in assessing noise impact:-

- $L_{A_{10,T}}$ ‘A-weighted sound pressure level exceeded for 10% of the measurement period T’.
• **L\textsubscript{A90,T}** ‘A-weighted sound pressure level exceeded for 90\% of the measurement period T’.

• **L\textsubscript{Aeq,T}** ‘Equivalent continuous A-weighted sound pressure level measured over the time period T’.

The difference between these parameters with and without the noise of interest provides an indication of the potential for causing annoyance or disturbance.

Regulating authorities in Australia tend to use a measurement period of 15 minutes for these parameters and often write operating permits in terms of L\textsubscript{Aeq,15min} (after adjustments for tonality or impulsiveness).

In general the greater the difference between the L\textsubscript{Aeq} with the plant operating and the L\textsubscript{A90} without the plant operating the greater the potential for annoyance at noise sensitive locations in the community. In Australia, regulating authorities are unlikely to approve operating noise levels for a new plant where the L\textsubscript{Aeq} is more than 5 to 10 dBA above the L\textsubscript{A90} for the area without the plant operating.

To avoid the problem of ‘background creep’ regulating authorities must also consider setting overall maximum noise levels for an area. Setting these maximum limits requires the consideration of economic, social, and environmental parameters and these limits may vary depending upon the project and/or location.

**Recommended noise limits for Biomass Power stations**

Based on the above references we recommend the following noise limits for the environmental noise emissions from the proposed Biomass Power Stations. When adjusted for tonality and impulsiveness (as per the requirements of AS1055:1997) environmental noise levels at noise sensitive locations around the plant should not exceed:

• Night operations - 40 L\textsubscript{Aeq,15min}.

• Day operations - 45 L\textsubscript{Aeq,15min}.

**Recommendations for noise control**

To achieve these operating noise limits it is likely that engineering noise control will be required for the main items of equipment at each power station site.

Preliminary equipment requirements indicate that this could include some or all of the following equipment:

• Mobile equipment (front end loader)
• Chipper
• Hogger
• Screen(s)
• Conveyor drives
• Burner combustion air blower(s)
• Boiler I.D. Fan(s)
• Cooling tower fans
• Steam turbine / generator units

Engineering noise controls may include some or all of the following:-

• Selection of quiet equipment where possible
• Provision of appropriate inlet and discharge silencers for fans and blowers
• Enclosure of chipper, hogger and screens
• Provision of an acoustically lined inlet tunnel for the chipper infeed
• Provision of an acoustically lined discharge conveyor from the chipper enclosure
• Acoustic lagging or cladding of fans and blowers
• Close fitting acoustic enclosures for the turbine / generator sets
• Acoustic lagging of steam valves and steam lines
• Boiler steam vent silencers and boiler water blow down silencers
• Steam line drain silencers
• Orientation of main buildings on site to optimize acoustic barrier performance of the buildings
• Location of vehicle access points to minimize traffic noise on local villages
• Control of backing alarm noise levels, sirens and other alarms on site
• Management noise controls to prevent the use of mobile equipment, chipping or hogging systems at night

Appropriate noise performance requirements should be specified to the equipment or plant suppliers and manufacturers’ noise controls incorporated into the plant design where possible.

**Summary & Conclusions**

• Existing ambient noise levels have been measured and assessed for proposed biomass power station sites at Deuba on Viti Levu and Savusavu on Vana Levu. Measurements were carried out for a minimum of 24 hours at each site and typical environmental noise spectra were also recorded.

• A review of appropriate environmental noise regulations / guidelines from ‘Australia’ and the ‘World Health Organization’ has been carried out and environmental noise limits recommended for both sites.

• A summary of potential noise sources associated with the biomass power stations and an outline of potential engineering noise control options has been presented.
References


Appendix 5 Desk Top Air Quality Assessment Report
Fiji Electricity Authority

Environmental Impact Assessment for the Savusavu Biomass Power Plant

Fiji Electrical Authority

Renewable Power Development Project

Savusavu

Biomass Power Generation Plant

Report for

Hydro Tasmania Environmental Services

August 2006
Introduction

The Fiji Electrical Authority (FEA) has called for expressions of interest for the preparation of Environmental Impact Assessments for a number of proposed biomass-fired power plants to either replace existing diesel powered plant or as new stand-alone plants.

Among these proposals is that for a 3 MW power unit plant to be located at a site approximately 7.5 km from Savusavu town centre (Figs 1, 2 & 3) on Vanua Levu.

A briefing document titled “Terms Of Reference For The Preparation Of An Environmental Impact Assessment For Fiji Electrical Authority Renewable Power Development Project (RPDP) Savusavu Biomass Plant” were issued in early August 2006.

This document advises that FEA will approach the World Bank for partial funding for this renewable energy project. The document also advises that the Fiji Ministry of Environment will require an Environmental Impact Assessment (EIS) consistent with the requirements of the Fijian Environmental Management Act 2005. A component of this will be an assessment of the air quality as affected by the operations of the power plant as measured against the World Bank’s Thermal Power: Guidelines For New Plants”. These guidelines cover a wide range of plant capacities and differentiate between plants in degraded air sheds, plants smaller than 500 MWe with moderate air quality and plants greater or equal to 500 MWe in airsheds with moderate air quality and all plants in airsheds with poor air quality. The guidelines while providing advice on acceptable levels of pollutants in each case do not offer advice for small power plants of the 1 – 5 MWe scale in airsheds with moderate of better air quality.

The information available for the Savusavu site suggests an airshed with good air quality located where there is good atmospheric exchange under the influence of the prevailing Trade Wind conditions.

At present, power generation at Savusavu is provided by a number of diesel generators located some distance from the new proposed site. These diesels are currently overloaded. The proposed biomass-fired power plant is intended to support these as the base load generator leaving the diesels for supplementary power. The replacement of diesels as the base load generators is likely to lead to significant reduced loadings to the local airshed.

This document provides a desk top assessment of the implications to ambient air quality from the operations of the proposed power plant.
Fig 1  Fiji Showing Site of the Proposed Power Plant.

(Google Satellite Image). Savusavu
Fig 2  Satellite image of Wailevu Bay showing topography and situation around the proposed Savusavu Power Station Site.
Fig 3   Topographical map of the Savusavu area on Vanua Levu showing the relationship of the proposed development to towns, infrastructure and to the surrounding high ground.

The facility is to be sited close to the existing copra mill, to the west of the highway and within 200m of the sea and less than 0.5 km of ground rising steeply to the East to approximately 50-60 meters. To the North-West and within 2 km is a substantial hill rising to in excess of 300m.

There appear to be individual dwellings within a few hundred meters of the site with small towns and businesses at distances of less than 0.5 km.

Fig 4 Below shows the present site layout and the location of the site.
Renewable Power Supply:

There is now increasing world-wide interest in developing renewable energy power plants to provide extra capacity or, in some cases, to replace existing fossil fuel driven facilities.

Among the technologies that have been established elsewhere in the world are small to medium sized biomass-driven generators. The proposed plant at Deuba will be fuelled by waste wood from local sawmill operations.

Bio-energy is becoming increasingly more competitive. Conventional wood-fired steam cycle systems have efficiencies of the order of 20-25% while combined cycle gasification plants may achieve efficiencies close to 40%. Adopting biomass power for the proposed situations in Fiji will reduce reliance on increasingly expensive imported non-renewable fuels such as diesel while it will also utilize in a sustainable manner the abundant sawmill wastes and other biomass available on the islands. From an environmental standpoint the incorporation of renewable biomass into energy production also reduces overall emissions of greenhouse gasses as much of the carbon consumed in the process is taken up through photosynthesis into new vegetation.

The introduction of the proposed 3 MW unit for Savusavu will give rise to the following outcomes in the area (dti 2000):

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>A fuel requirement of approximately 24,000 tonnes biomass per year</td>
<td></td>
</tr>
<tr>
<td>Approximately 35 two-way fuel delivery movements per day (approximately 4.3 per hour)</td>
<td></td>
</tr>
<tr>
<td>A plant with a visible smoke stack at least 5m above any building ridge height</td>
<td></td>
</tr>
<tr>
<td>Emissions typical of any combustion process but minimised to meet the required standards</td>
<td></td>
</tr>
<tr>
<td>A reduction in national Greenhouse gas emissions</td>
<td></td>
</tr>
<tr>
<td>Production of sufficient electricity to meet the needs of up to 3000 households</td>
<td></td>
</tr>
<tr>
<td>Creation of construction and operational jobs</td>
<td></td>
</tr>
<tr>
<td>Increased demand for local goods and Inputs into the local economy</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Outcomes Associated with the Proposed Biomass Power Plant

Climatology:

An airshed’s capacity for any particular pollutant is a function of the combined emissions from all sources of that pollutant into the receiving environment and the worst case climatic conditions that affect dispersion or retention of such pollutants over an extended time period. Regional topography will also play a significant role in determining the prevailing climatic conditions and thus has the potential to influence localized dispersion and mixing conditions.

A number of recognized atmospheric conditions can bring about poor atmospheric mixing and dispersion of air contaminants. Among these conditions are: atmospheric inversions or stable air conditions which prevent good vertical mixing; sea breeze fumigation events or prolonged calm conditions. Fig 4 shows an oblique image of part of the island of Vanua Levu including the
position of the proposed site, the direction of the prevailing winds and the high ground close to the plant.

The Fijian islands are located at 18.00 S 175.00 E and experience a tropical marine climate with very little seasonal temperature variation (≈ 3 – 4°C variation in maximum temperature between the seasons). Night to day variation in temperature in all seasons is greater than inter-seasonal variation and may be of the order of 6-7°C (data for Suva on the island of Viti Levu). The windward side of Viti Levu is assumed to experience a similar climate to the windward side of Vanua Levu).

The prevailing winds are the south easterly trade winds reinforced by day time localized sea breezes. Winds are generally light to moderate with occasional tropical storms during the wet season. Average wind speeds are 4 – 6 knots during May to October however summer calm periods may occur. The wet season occurs principally between November to April and moisture laden air releases rain as it rises as it rises over the mountain ranges. The Savusavu site is located on the windward side of the island to the SE, or “wet” side of the mountains. Average annual rainfall is 2,338mm with an average monthly fall of 195mm, however very dry conditions may occur with the lowest monthly rainfall being recorded as 0.7mm.

The regular trade winds and the daily sea breeze cycle and heavy rainfall are anticipated to give rise to good dispersive conditions, especially on the windward side of the islands while on the leeward side increased solar insolation in the greater absence of cloud will give rise to better vertical thermal missing conditions.

Fiji may also experience prolonged dry spells of several months when the leeward side of the islands may experience little or no rain at all. Climatic fluctuations have been observed to coincide with El Nino events. Night to day variation in temperature in all seasons on the leeward side the island is of the order of 8-10°C (data for Nadi, leewards side of Viti Levu). The leeward side of Viti Levu is assumed to have a similar climate to the leeward side of Vanua Levu.

The almost equal day-length and night time regime of the tropics is unlikely to favour the development of significant cold katabatic air drainage events likely to lead to the prolonged atmospheric inversions such as those frequently experienced at higher latitudes. In addition the regular trade winds and sea breeze events will also mitigate against such formations. Any inversion that might develop during a calm spell would be of only a very short duration and would be rapidly eroded by sunlight.
Fig 4 Oblique satellite image overlooking Savusavu township looking north towards Valaga Bay. The high ground to the north and west of the proposed powerplant site is evident. The direction of the prevailing SE’erly trade winds is indicated by the broad arrow (Google Earth image). The site is to some extent sheltered from the full extent of these trade winds.

Present infrastructure:

At present power at Savusavu is generated using diesel powered generators. Little information is available with respect to these generators at this time, however they are assumed to have emissions similar to those from Cummings KTA-G3 units of ~0.8 MW capacity. These units are usually installed in groups and may, or may not have NO\textsubscript{x} scrubbing installed. Recent work at Bell Bay in Tasmania for units without NO\textsubscript{x} scrubbing indicated that high ground levels of NO\textsubscript{x} may occur in the near vicinity of a group of such plants producing 6MW under some atmospheric conditions.

Information available on the world wide web indicates that emissions from biomass powered generation sites of an equivalent output capacity will be a significant improvement on emissions from the equivalent diesel powered plant. This is particularly the case where greenhouse gas emissions are concerned (Todd 2001, Jungmeir 1999, CSIRO 2006, Stuckley 2001) especially when the full life-cycle implications of the use of a renewable resource such as waste wood and biomass is considered.
Likely emissions from a biomass-fired electricity generating plant.

In a recent publication that considers stack emissions, air quality and health, typical stack emission concentrations are shown for a 10MWe wood-fired electricity generating plant.

<table>
<thead>
<tr>
<th>Generation Technology</th>
<th>Plant Size</th>
<th>SO₂</th>
<th>NOₓ</th>
<th>Particulates</th>
<th>VOC’s</th>
<th>CO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combustion</td>
<td>10MWe</td>
<td>50</td>
<td>300</td>
<td>100</td>
<td>50</td>
<td>200</td>
</tr>
<tr>
<td>Gasification</td>
<td>10MWe</td>
<td>30</td>
<td>100</td>
<td>&lt;50</td>
<td>20</td>
<td>400</td>
</tr>
<tr>
<td>Pyrolysis</td>
<td>10MWe</td>
<td>20</td>
<td>200</td>
<td>&lt;50</td>
<td>NA</td>
<td>150</td>
</tr>
</tbody>
</table>

Milligrams per cubic metre of exhaust gas

Source: Combustion emissions based on operating plant data. Pyrolysis and gasification emissions based on estimates for plant under development.

(dtI New and Renewable Energy Program 2000):

Table 2 Potential Stack Emissions from a Biomass-Fired Power Plant

The plant proposed for Savusavu will have a total capacity of 3MWe (2 x 1MW modular units) but is expected to have an efficiency equivalent or better than that for plant from which the above data were derived. There will be provision in the design for future expansion up to 5 MWe.

The power option under consideration is for full combustion of the fuel to heat water to steam that then drives a steam turbine;

Relevant Standards

The FEA has agreed to adopt the air quality standards set out in The World Bank Group Pollution Prevention and Abatement Handbook 1998 Toward Cleaner Production as the relevant standards to apply to emissions from these power plants.

These standards require that the plant comply with upper emissions of:

<table>
<thead>
<tr>
<th>Stack gas Parameter</th>
<th>Units</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOₓ</td>
<td>ppm/NM³</td>
<td>300</td>
</tr>
<tr>
<td>NOₓ</td>
<td>ppm/NM³</td>
<td>300</td>
</tr>
<tr>
<td>Particulates</td>
<td>mg/NM³</td>
<td>50-250</td>
</tr>
</tbody>
</table>

Table 3: Emissions targets provided by Hydro Tasmania Environmental Services.

The present Australian National Environmental Protection Measure (NEPM) sets Standards and Goals for pollutants other than PM2.5 in ambient air as:

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Averaging</th>
<th>Maximum</th>
<th>Goal within 10</th>
</tr>
</thead>
</table>

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Page 160
<table>
<thead>
<tr>
<th></th>
<th>Period</th>
<th>Concentration</th>
<th>Maximum allowable exceedences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Monoxide</td>
<td>8 hours</td>
<td>9.0 ppm</td>
<td>1 day a year</td>
</tr>
<tr>
<td>Nitrogen Dioxide</td>
<td>1 hour</td>
<td>0.12 ppm</td>
<td>1 day a year</td>
</tr>
<tr>
<td></td>
<td>1 year</td>
<td>0.03 ppm</td>
<td>none</td>
</tr>
<tr>
<td>Sulphur Dioxide</td>
<td>1 hour</td>
<td>0.20 ppm</td>
<td>1 day a year</td>
</tr>
<tr>
<td></td>
<td>1 day</td>
<td>0.08 ppm</td>
<td>1 day a year</td>
</tr>
<tr>
<td></td>
<td>1 year</td>
<td>0.02 ppm</td>
<td>none</td>
</tr>
<tr>
<td>Particles as PM$_{10}$</td>
<td>1 day</td>
<td>50 µg/m$^3$</td>
<td>5 days a year</td>
</tr>
</tbody>
</table>

Table 4: The Australian National Environmental Protection (Air Quality) Measure criteria will be adopted as the relevant targets to be achieved for ambient air quality.

NEPM targets may be achieved by adopting appropriate pollution controls on facility stacks and or managing total emissions from this and all other sources to the airshed in which the facility is located.

**Likely causes of Pollution**

**NO$_x$ and health effects of NO$_2$**

NO$_2$ is a pulmonary irritant affecting primarily the upper respiratory system. Individuals with asthma, respiratory disorders, and lung disease are more sensitive to the effects of NO$_2$. Continued or frequent exposure to high NO$_2$ levels can cause pulmonary oedema, though the effect on the lungs may occur several hours after exposure. At typical ambient concentrations, NO$_2$ has not been proven to be related to lung disease.

NO$_x$ emissions from a wood-fired plant will be very much lower than the emissions from a corresponding diesel power plant (dti 2000) depending upon the technology in use.

NO$_x$ emissions from diesel generating plant may be 27 times higher than a corresponding dual cycle gasification plant and 6 times higher for a steam cycle plant (Barefoot Power 2005).

**SO$_x$ and health effects of SO$_2$**

SO$_2$ is a pulmonary irritant and contributes to respiratory illness, alterations to pulmonary defences and aggravation of cardiovascular disease. It can also damage vegetation and non living materials and is an important precursor to acid rain.

Biomass, especially clean wood-waste, has very low levels of embodied Sulphur Emissions of Sulphur as SO$_x$ to the atmosphere will represent a small proportion of emissions from an
equivalent diesel powered power plant. The majority of the Sulphur component will remain with the ash residue from the combustion process.

SO\textsubscript{2} emissions from diesel generating plant may be 10-15 times higher than a biomass based generation plant (dti 2000, Barefoot Power 2005).

**Particulates and health effects of PM\textsubscript{10} (particulate matter)**

The primary concern regarding the health effects of PM\textsubscript{10} is due to it being small enough to be inhaled and lodge deep in the lungs, where the small carbon particles may carry other pollutants which may affect the sensitive lung tissues and/or be absorbed into the blood. (Some of these are known or possible carcinogens such as polycyclic aromatic hydrocarbons). Respirable particles have been associated with a wide range of respiratory symptoms and exposure to such particles has been linked to increased deaths from heart and lung disease.

The proportion of particles less than 10 µm are higher than that in emissions from either a gasification of steam based wood-fired plant. Particle loads for diesels are up to 3 times those or gasification but particles from wood-fired steam cycle generation plants are up to two times that for the corresponding diesel plant.

With complete combustion very little particulate matter will be emitted from any wood-fired facility. Emissions of particles of PM\textsubscript{10} and PM\textsubscript{2.5} size increase rapidly when combustion is incomplete. Incomplete combustion is usually a function of low temperature combustion or a lack of oxygen.

**Green House Gasses:** The combustion of any organic material will produce quantities of greenhouse gasses such as Carbon Dioxide, Methane. In this context it is appropriate to look at biomass-firing from the perspective of life cycle analysis. In the process of combustion carbon and carbon products will be released to the atmosphere or land as a gas, as fly ash or as boiler residues. This carbon will then enter the natural Carbon Cycle and may then be adsorbed during the process of photosynthesis and laid down as new wood or other vegetative biomass, or may be sequestered in soils or laid down in offshore marine sediments.

Unlike non-renewable fossil fuels there will be no net emissions of greenhouse gasses from burning biomass that are not returned to the natural cycle within the relatively short term.

An analysis of wood-fired boiler emissions from the USA (Kaminski et al. 2002) provides stack test data for emissions of various pollutants including Hazardous Air Pollutants (HAPs).

Emissions of green house gasses and particulates are presented as:

<table>
<thead>
<tr>
<th>Stack gas Parameter</th>
<th>Units</th>
<th>Lower</th>
<th>Upper</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen</td>
<td>%</td>
<td>10</td>
<td>14</td>
<td>12.5</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>%</td>
<td>3.5</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>ppm</td>
<td>800</td>
<td>2000</td>
<td>1400</td>
</tr>
<tr>
<td>Particulates</td>
<td>Kg/hr</td>
<td>1</td>
<td>7.1</td>
<td>2.95</td>
</tr>
</tbody>
</table>
Table 5: Data are for boilers ranged between ~3MW to ~18 MW (Kaminski et al. 2002)

Volatile Organic Compounds VOC’s: The USEPA considers a source to be a Major Source if an individual HAP exceeds 10 ton (US) per annum, or the total HAP’s emissions are greater than 25 tons per annum (Kaminski et al. 2002).

<table>
<thead>
<tr>
<th>Federal HAP</th>
<th>Actual ton per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetaldehyde</td>
<td>0.05</td>
</tr>
<tr>
<td>Acrolein</td>
<td>0.24</td>
</tr>
<tr>
<td>Benzene</td>
<td>0.25</td>
</tr>
<tr>
<td>Chlorine</td>
<td>0.05</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>0.26</td>
</tr>
<tr>
<td>Hydrogen Chloride</td>
<td>1.14</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.10</td>
</tr>
<tr>
<td>Styrene</td>
<td>0.11</td>
</tr>
<tr>
<td>Toluene</td>
<td>0.06</td>
</tr>
<tr>
<td>Total HAPs</td>
<td>2.06</td>
</tr>
</tbody>
</table>

Table 6: Hazardous Air Pollutants (HAP) Test data for an approximate 10 MW wood-fired boiler operating for a full year.

These data allow the conclusion that small wood-fired boilers are insignificant sources of HAP emissions.

Fly ash: Residual ash form the combustion process will require an environmentally acceptable method for its disposal. Barefoot Power (2005) reports that wood contains 0.5 – 2.0% incombustible material which will present as ash. This ash will contain a range of nutrients together with some heavy metals such as Cadmium. Barefoot Power report that a 2MW power plant, similar to that envisaged for Deuba, that consumes up to 28,000 tonnes of biomass a year may produce ash volumes of up to 560 tonnes/year.

This material will require disposal at rates per Ha that are dependant upon the heavy metal content. The establishment of a suitable disposal protocol will require a pre-analysis of the biomass supply to determine the nutrient/metal/contaminant content. This need will assume a high priority as the design criteria for the plant are finalized.

Odours: There is a potential for odours to be emitted from the various feed-stocks and waste components reporting to or issuing from the plant. Odours may be from Hydrogen sulphide, ammonia, mercaptins and carbon oxy-sulphide. They may be emitted from storage areas, gas leaks, waste-water condensate and fly ash.
To ensure that sources of odour cannot be established, detailed planning of storage areas and waste water facilities will be undertaken while consideration will be given to appropriate emission controls on stacks or other points of emission.

**Best Practice:** At the present time there are no available emissions data for the specific biomass-fired facilities under consideration, nor is there yet a decision as to the precise technology to be employed e.g. biomass-fired boiler for steam, or Combined Cycle gasification and boiler plant.

In addition there are no available data for existing diesel powered generators, however these may be inferred from similar installations elsewhere.

The aim of the Fiji Environmental Management Act and Vanua 2005 clearly places emphasis on the qualities of human life, on the need for the adoption of sustainable practices and or the use of natural resources at a rate which ensures the ability of future generations to use and benefit from these resources. These objectives can only be achieved through the adoption of “Best Practice” environmental management and the embracing of modern technology where renewable resources are to be used in the proposed power generation facilities.

Best Practice will dictate that the plant will be required to achieve, or better, the emissions targets detailed in Table 3. Best Practice will also require that suitable emissions controls are fitted to remove tars, particulates and other gas species.

To ensure that there is good dispersion from the plant there will be a need to raise the stack well above the ridge of any building. Additionally, at Deuba, the situation where the power house is located within a cutting or quarry will require special attention to ensure emissions are not trapped in localized effects associated with the ridge-line above the plant.

Achievement of the Australian ambient air quality criteria (Table 4) will require a full assessment of all emissions where background emissions, those from the planned new power plant and those from the existing power generation facilities to be included. In the event that the planned extended capacity of the new plant is envisaged, the inclusion of these emissions would also be required.

To demonstrate achievement of these targets would require a modelling approach with on-ground validation.

Best Practice would therefore also require that steps be taken to develop a monitoring plan with the identification of monitoring indicators together with a clear responsibility framework to ensure that such mitigations measures that may be indicated may be applied within an agreed timeframe.

**Monitoring:**

**Stack Testing:** Plant exhaust stacks will be provided with EPA sampling ports according to the relevant Australian (or equivalent) Standard.

Iso-kinetic sampling of stack gasses should be undertaken following the completion of commissioning and then at 12 month intervals or as required by the Fiji Environmental Protection Agency.

**Ambient air sampling:** It is desirable to establish a number of fixed ambient air sampling stations between the plant and nearby residences. Ideally sampling at these locations should be undertaken before and after installation of any new power plant. This will assist in determining
present ambient air conditions and will allow an assessment of improvements or otherwise following the commissioning of the new plant.

Ambient air sampling should be undertaken at a frequency as required by the Fiji Environmental Protection Agency.

**Conclusions and Recommendations**

This document provides an assessment of air quality issues likely to be associated with the proposal to install a 2 MWe biomass-fired power station at Savusavu, Vanua Levu.

The installation is proposed for a new power station site and the design will allow for eventual capacity for expansion to 5 MWe.

There is a paucity of both local meteorological or air quality data for the Fijian islands. The climate data that is available relates to broad scale seasonal information as to rainfall, average temperatures and gross seasonal differences. There is however reasonable information available as to site topography, locational information as to the sites and the presence of townships dwellings and other features for the proposed site.

While a definitive assessment is not possible in the absence of detailed baseline data it is still possible to make a reasonable assessment of the likely air quality situation based upon experiences elsewhere, the information available as to prevailing winds and temperatures and the surrounding topography.

Additionally power generation has been provided for some time through the use of diesel powered generating facilities. Information presented within this report identifies that capacity to capacity diesel powered power plants will produce between 6 to 27 times more NO\(_x\) than biomass powered plants, similarly up to 10 to 12 times more SO\(_x\) but, depending upon technology, biomass powered plants may emit up to 2 times more PM\(_{10}\) particulates (boiler driven steam turbines) or 3 times less (gasification combined cycle plants). Despite this, there is no evidence that the present diesel power plants have given rise to localized or regional air quality problems.

While emissions performance will be much improved over that of equivalent diesel plants, it will however be additive where these plants may continue to operate as either peaking or base load power. Emissions controls are planned for the biomass-powered plants (SKM report) and this will do much to improve the particulates emission component.

Analysis of the limited information available at this time suggests that the installation of a biomass-fired power plant at Savusavu will not compromise local or regional air quality. Indeed it might in practice improve ambient air quality if reliance on the diesel powered plants is reduced.

A caveat should however be placed in the absence of more definitive meteorological or air quality data that might otherwise confound such a view. Ultimately it is not possible to categorically state that air quality might not be deleteriously be affected under some conditions in the absence present ambient air quality data, local meteorological data or appropriate air quality modeling.

Stack emissions may however be managed through appropriate emissions controls to ensure that such emissions are unlikely to give rise to pollution events that could compromise current conditions.
To ensure good dispersion it is recommended that a stack of sufficient height be provided to place emissions above any influence of any building or other surrounding structures or features.

It is recommended that steps be taken to install a local meteorology station to obtain data on wind speed, wind direction, temperature, humidity and rainfall. These data would be essential if any future attempt to provide modeling for the site is required, for example to underpin any future expansion of the plant.

It is also recommended that consideration be given to undertake some ambient monitoring of air quality, in particular particulate loadings up-wind and down-wind of the plant and other local industries.

W Wood

August 29th 2006.
References:


Appendix 6 Master Environmental Management Plan

This Master Environmental Management Plan (MEMP) provides minimum requirements for the development of a Construction Environmental Management Plan (CEMP) for the management of environmental matters associated with construction works for the Savusavu Biomass Plant (The Project). In requiring the contractor to prepare the CEMP it is expected that there would be a greater level of ownership of the management measures. It is also expected that the contractor is best placed to identify practices that can be practicably undertaken to meet the requirements of the MEMP. In doing so the CEMP will address all commitments and approval conditions.

The MEMP:

- provides statements on the Fiji Electricity Authority overall environmental management intent.

- will provide the contractor with the skeleton of their own CEMP.

- will be used as an audit tool so as to measure a contractors performance in relation to the environmental requirements of The Project.

The MEMP requires that the CEMP:

- will address, but not be limited to, all items provided in the MEMP.

- documents activities, measurable performance criteria associated with the management and control of all environmental aspects of the project.

- nominate the on-site person/position responsible for environmental management generally and individual elements, including waste and hazardous materials management.

- address all work elements.

- be approved by FEA prior to the commencement of works.

The Contractor is required to demonstrate a clear level of commitment to environmental management. FEA requires that the approved CEMP be fully implemented and maintained throughout the life of the project.

The approved CEMP will be subject to audit by FEA at commencement, mid term and completion (as a minimum). Where non-compliance is determined, and depending on the severity of the non-compliance, it may be a requirement for works to cease until such time that the non-compliance is rectified or resolved. This will be at the contractors cost.

The contractor is required to:

1. Provide a CEMP compliance report at commencement and completion of works. This document (to be provided to the Project Manager) may be in the form of a letter confirming that the approved CEMP has been fully implemented and providing brief discussion of any agreed variation to procedures and activities provided in the approved CEMP.

2. Provide monthly reporting of environmental performance. This document (to be provided to the Project Manager) may be in the form of dot points or a check box form that itemises
activities undertaken during the previous month to implement and maintain the CEMP and will include any incidences or variances that may have occurred.

**Interested Parties**

- Fiji Electricity Authority
- Ministry of Environment
- World Bank

Definitions

Major spill - > 10 litres

**Environmental Management Elements**

**Compliance**

**Principle**

- To ensure that works are carried out in such a way that the potential for environmental impact is minimised.
- To ensure that works are carried out within legislated and stipulated requirements.

**Position Responsible for Element**

The CEMP will designate the position responsible for this element and will ensure the position has sufficient resources and authorities necessary to fulfil the function.

**Commitments**

- The Contractor will develop a Construction Environmental Management Plan (CEMP) that addresses, but not be limited to, the commitments and philosophies provided in this document.
- Works will not commence in the absence of an approved CEMP.
- Works are to be conducted in accordance with the approved CEMP at all times.
- Complaints and incidents are to be reported to FEA when they occur.
- The CEMP will designate individuals or positions responsible for management of waste and hazardous materials.
- The CEMP will address all items discussed in this Master Environmental Management Plan.
- All necessary permits, licences and authorities are to be in place prior to commencement of works.

**Evidence of compliance**

On-going compliance with the CEMP shall be evidenced by:
- Approved CEMP.
- CEMP compliance report.
- Monthly CEMP status reporting.
- Periodic auditing by FEA.

**Non-compliance action**

If, by inspection, self reporting, or incident, works are found not to be in compliance with the approved CEMP, the non-compliance will be rectified or resolved as soon as is practicable. In cases of significant non-compliance it may be a requirement for works to cease. Additional immediate action that is required, in all cases, includes:

- Inform FEA of the nature of the non-compliance and the action to be taken.
- Rectify non-compliance.
- Non-compliance to be logged recording the time and date, nature of non-compliance, who reported to the responsible position, how and when it was rectified and by whom.

**Environmental Considerations for Induction**

**Principle**

- To minimise the opportunity for environmental harm to occur.

**Commitments**

♦ All employees, contractors and site visitors will undergo site specific induction that may include relevant environmental considerations.

♦ A log of induction is to be maintained.

♦ The CEMP will outline the induction process.

**Evidence of compliance**

On-going compliance with the CEMP shall be evidenced by:

- Log of induction and environmental awareness training.
- Periodic audit by FEA.

**Cultural Heritage**

**Principle**

- To ensure that any cultural heritage values that may be associated with the site are protected.

**Commitments**

♦ In the event that artefacts are uncovered during stripping or clearing, work is to cease at that location and the artefacts left *in situ* to allow assessment. The Contractor is to ensure that FEA is advised immediately:
Evidence of compliance

On-going compliance with the CEMP shall be evidenced by:

- Periodic audit by FEA.

Erosion and Sedimentation.

Principle

- To minimise the opportunity for erosion and sedimentation to occur.
- To protect existing aquatic values such that the potential for degradation of water quality of existing water bodies (both temporary and permanent, including groundwater) is minimised.
- To ensure that works are carried out within legislated and stipulated requirements.

Commitments

- An Erosion and Sedimentation Control Plan (ESCP) will be developed for inclusion in the CEMP. The plan is to be approved by a person experienced in the preparation of ESCPs.
- Land disturbance will be confined to the minimum possible area and be confined to construction areas only. The ESCP will nominate the area to be disturbed. Movement outside this area will not be permitted.
- Drainage that originates from a work site will be filtered (by silt traps or silt fencing) and not allowed to discharge directly into a watercourse.
- Measures installed for the control of erosion and drainage will be installed such that unmanaged erosion does not occur.
- Works will not commence in the absence of an authorised ESCP.
- Earthworks will not be conducted during the wet season.
- Soils will be compacted as soon as practicable.
- Fill material should not contain weeds or soil pathogens.
- Measures installed for the control of erosion, pollution and drainage will be subject to a defined regular monitoring and maintenance programme. The ESCP will include a schedule of maintenance for management measures.
During construction, installed drainage systems and sediment control structures will be visually monitored weekly and after severe rainfall events, to ensure they are clear and that run-off is being diverted successfully.

Temporary erosion control measures will be used where required when there is a delay between stages of development.

Permanent erosion control will be installed on access roads and will be maintained for the duration of the construction period.

Stock-piled soils will be protected by stabilisation and/or silt fencing and located away from drainage lines and native vegetation.

Stormwater and overland water flow shall be directed around works areas via installed drainage.

Discharge from installed drains shall be directed and dispersed such that erosion does not occur.

Existing watercourses will be maintained.

Evidence of compliance

On-going compliance with the CEMP shall be evidenced by:

- Authorised ESCP.
- Periodic auditing by FEA.

Water Quality

Principle

- To protect existing aquatic values such that the potential for degradation of water quality of existing water bodies (both temporary and permanent, including groundwater) is minimised.
- To ensure that works are carried out within legislated and stipulated requirements.

Commitments

- Design cooling water discharge outfall such that mobilisation of bottom sediments is minimised.
- Application of Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000) to determine appropriate water quality targets.
- Where feasible, water quality parameters are monitored at all times by automatic logger to ensure that discharge temperatures remain within allowable limits. Actions to be taken in the event of each or all of the parameters should be developed once the targets are understood. This may include plant shutdown.
- Water quality monitoring of waterways (including short-lived drainage lines) within, or in immediate proximity to, the construction area shall be conducted at least weekly when there is water present, irrespective of weather conditions. Drainage lines and erosion and sediment
control measures are to be monitored visually to ensure that control measures are functioning in accord with their intent.

♦ Water quality monitoring results will be forwarded to FEA as soon as they become available.

♦ Permanent erosion and sedimentation controls will be incorporated into the plant design.

♦ Where possible no fuels or oils are to be stored at the site during construction. Where it is necessary to store fuels the store will be an appropriately bunded and secure facility that is located away from any watercourse.

♦ Spill recovery equipment is required to be located with the fuel and oil storage. For the purposes of this project a spill of more than 10 litres is to be considered significant. In the event of a spill of 10 or more litres the contractor is to commence clean-up immediately. FEA are to be notified immediately.

♦ Monitoring of waste water streams from the power station, particularly the cooling water, for oil and grease.

Evidence of compliance

On-going compliance with the CEMP shall be evidenced by:

- Water quality monitoring results.
- Periodic auditing by FEA.

Flora and Fauna

Principle

• To minimise the potential for on-going impacts on existing flora and fauna values (including habitat loss and degradation) such that the potential for the loss of individuals and degradation of habitat is minimised.

• To ensure that works are carried out within legislated and stipulated requirements.

Commitments

♦ An assessment to characterise the marine environment of Valaga Bay, in front of the proposed development, is required.

♦ No clearing or damage of vegetation not within the area required for construction works.

♦ Cleared vegetation will be burned or retained for use as fuel for the power station.

♦ Vehicle access and movement of equipment will be restricted to constructed roads.

Evidence of compliance

On-going compliance with the CEMP shall be evidenced by:

- Periodic auditing by FEA.

Rehabilitation and Revegetation
Principle

• To ensure that natural values present at the site are maintained or enhanced.

Commitments

♦ All soils and vegetation disturbed by works will be stabilised and revegetated.

♦ Soil will be stockpiled for later restoration works.

♦ Road verges will be rehabilitated back to the edge of the pavement.

♦ Rehabilitated areas shall be monitored to determine the effectiveness of rehabilitation and to identify the presence of weeds. Where necessary additional works will be undertaken to rectify identified shortcomings.

♦ Cover crops will be established on roadsides to minimise the opportunity for weeds to spread through the site.

♦ All areas not required for the operation of the site will be rehabilitated progressively and in a timely manner utilising local native species. Revegetation and rehabilitation as single work item at the completion of construction is not acceptable.

Evidence of compliance

On-going compliance with the CEMP shall be evidenced by:

- Revegetation works commenced.

- Periodic audit by FEA.

Waste Management

Principle

• To ensure that works are carried out within legislated and stipulated requirements.

• To ensure that waste is managed in a timely and environmentally responsible manner in order to minimise the potential for adverse impacts on the environment.

Commitments

♦ The CEMP will describe all waste materials, including controlled wastes, expected to be generated during construction and the likely source. Where possible, estimates of the quantity of waste likely to be generated should be made.

♦ Fly ash is to be disposed of by forest return. Analysis of the chemical makeup of the ash is required to determine the appropriate forest application rate.

♦ All waste, including crib room waste, is to be removed from the site on a regular and timely basis.

♦ A log of waste removal showing date, waste type, quantity and destination is to be maintained.
Disposal of all wastes is to be in accordance with relevant statutory requirements and as directed by FEA.

Spillage to bunds (including contaminated rainwater collecting in bunds) will be disposed of as controlled waste using an appropriately licensed waste cartage contractor.

Controlled wastes, such as oily waste, will be removed from site in a timely fashion by an appropriately licensed contractor.

Disposal of all wastes is to be in accordance with relevant statutory requirements and as directed by FEA.

No burning of waste on-site.

No dumping/burying of waste on-site. Wastes will be progressively removed from site and will not be stockpiled unduly.

Evidence of compliance

On-going compliance with the CEMP shall be evidenced by:

- Waste contractors agreement.
- Copy of waste contractors manifest.
- Log of waste removal.
- Periodic auditing by FEA.

Disposal of Contaminated Materials

Principle

- To ensure that works are carried out in such a way that the potential for environmental impact is minimised.
- To ensure that works are carried out within legislated and stipulated requirements.
- To ensure that, where it may occur, contamination is dealt with in a timely and responsible manner.

Commitments

- Contamination that occurs at the site during construction and operation may be removed from site to an approved disposal facility.
- A log of any contaminated materials for disposal is to be maintained showing date of excavation, quantity and destination.
- Any disposal or remediation of contaminated materials is to be in accordance with relevant statutory requirements and as directed.

Evidence of compliance
On-going compliance with the CEMP shall be evidenced by:

- Certificate of disposal from registered facility.
- Log of contaminated materials removal.
- Certificate of analysis. Copy to be held on-site and one copy provided to FEA.
- Periodic auditing by FEA.

**Control of Materials Likely or Known to Cause Environmental Harm**

**Principle**

- To ensure that works are carried out in such a way that the potential for environmental impact from the use and storage of potential pollutants is minimised.
- To ensure that management, storage and handling of hazardous materials is in accordance with stipulated and statutory requirements.

**Commitments**

- An area is to be nominated for storage of potential pollution causing materials. The plan will document techniques and procedures to be used for control of pollution (including provision of bunding capable of 100% storage).
- Hazardous materials will be managed in accordance with applicable dangerous goods requirements and relevant standards. In the absence of a local standard AS 1940:2000 or equivalent will be applied.
- A register of all controlled wastes and hazardous materials (and accompanying Material Safety Data Sheets) held or used on site will be maintained.
- Hazardous materials (e.g., oils, herbicides), not required for daily operation are to be stored offsite. Storage is to be in accordance with statutory requirements.
- All materials (of any quantity) likely or known to cause environmental harm are to be stored in a designated, secure and bunded location that is located away from depressions and drainage lines which carry surface water.
- Facilities utilised for the temporary or permanent storage of hazardous materials are to be designed, constructed and maintained in accordance with statutory requirements. Measures are to be in place prior to the commencement of works.
- Mobile fuel tanks are to be parked at the nominated hazardous materials storage location.
- The refuelling and maintenance of construction equipment will be carried out such that waste materials can be confined, collected and removed off-site efficiently. An area is to be nominated for storage of potential pollution causing materials. The plan will document techniques and procedures to be used for control of pollution (including provision of bunding capable of 100% storage).
Hazardous materials will be managed in accordance with applicable dangerous goods requirements and relevant standards. In the absence of a local standard AS 1940:2000 or equivalent will be applied.

A register of all controlled wastes and hazardous materials (and accompanying Material Safety Data Sheets) held or used on site will be maintained.

Hazardous materials (e.g. oils, herbicides), not required for daily operation are to be stored offsite. Storage is to be in accordance with statutory requirements.

All materials (of any quantity) likely or known to cause environmental harm are to be stored in a designated, secure and bunded location that is located away from depressions and drainage lines which carry surface water.

Facilities utilised for the temporary or permanent storage of hazardous materials are to be designed, constructed and maintained in accordance with statutory requirements. Measures are to be in place prior to the commencement of works.

Mobile fuel tanks are to be parked at the nominated hazardous materials storage location.

The refuelling and maintenance of construction equipment will be carried out such that waste materials can be confined, collected and removed off-site efficiently.

Spill kits are to be provided at all locations where pollution causing materials are held and/or used (including mobile tankers).

Waste oil will be recycled, where appropriate.

Under no circumstances will a vehicle be left unattended while refuelling.

No oils or fuels to be dumped to the ground.

Equipment and machinery will not be refuelled within 20 metres of a watercourse or drain.

Spillage to bunds (including contaminated rainwater collecting in bunds) will be disposed of as controlled waste using an appropriately licensed waste contractor. Uncontaminated rainwater will be released, via an oil separator, to nearby vegetated areas such that erosion does not occur.

Evidence of compliance

On-going compliance with the CEMP shall be evidenced by:

- Waste contractors agreement.
- Register of hazardous materials.
- Periodic audit by FEA.
- Logs of incidents and complaints.

Clean-up of Spilled Oil or Other Environmental Contaminants

Principle
• To ensure that works are carried out in such a way that the potential for environmental impact is minimised.

• To ensure that works are carried out within legislated and stipulated requirements.

• To ensure timely response to spill events.

**Position Responsible for Element**

The CEMP will designate the position responsible for this element and will ensure the position has sufficient resources and authorities necessary to fulfil the function.

**Commitments**

♦ Spill kits are to be provided at all locations where pollution causing materials are held and/or used (including mobile tankers).

♦ Personnel will be trained in spill response and clean-up.

♦ Oil (or other chemical) spillage is to be cleaned up immediately using bio-sorbant or other appropriate and approved, material or methods.

♦ A log of incidents, identifying date, the nature of the incident/complaint and action taken is to be maintained. Photographs are recommended.

♦ Spilled material is to be collected for disposal, by a licensed waste contractor, in an appropriate registered waste container. A log of waste removal showing date, waste type, quantity and destination is to be maintained.

♦ In the event of a major spill (10 litres or more) event FEA are to be informed immediately.

**Evidence of compliance**

On-going compliance with the CEMP shall be evidenced by:

- Log of waste contaminated material removal.

- Log of incidents.

- Completed incident report.

**Emission Control**

**Principle**

• To minimise the impact of noise and dust from construction works on the wider community and local wildlife.

**Commitments**

♦ A monitoring plan that clearly identifies monitoring parameters should be developed for implementation prior to the commencement of works. The monitoring plan should include a responsibility framework to ensure that such mitigations measures that may be indicated may be applied within an agreed timeframe.
Exhaust stacks will be provided with sampling ports according to the relevant Australian Standard. Iso-kinetic sampling of stack gasses should be undertaken following the completion of commissioning and then at 12 month intervals or as required by the Fiji Ministry of Environment.

Fixed ambient air sampling station between the plant and nearby residences. Sampling at these locations should be undertaken before and after installation of any new power plant. This will assist in determining present ambient air conditions and will allow an assessment of improvements or otherwise following the commissioning of the new plant. Ambient air sampling should be undertaken annually or at a frequency as required by the Fiji Ministry of Environment.

Stack sampling and modelling be undertaken following commissioning to confirm the status of stack emissions and air quality impacts.

A local meteorology station is installed to obtain data on wind speed, wind direction, temperature, humidity and rainfall. These data would be essential if any future attempt to provide modelling for the site is required, for example to underpin any future expansion of the plant.

Sound levels not to exceed 40dB + 5 dB during the day and 35 dB + 5dB at sensitive residential locations.

Implementation of noise mitigation recommended by Vipac.

Deliveries of wood will only be received during daylight hours.

Handling and processing of wood for feed stock will only be conducted during daylight hours.

Machinery and vehicles will be maintained in accordance with manufacturer’s specifications.

Machinery and vehicles will be in good repair and be fitted with noise suppressors.

Dust suppression will be carried out in a regular and timely fashion such that dust does not create a nuisance for the workplace or nearby residences.

A log of complaints will be maintained.

Any noise related complaint will be responded to.

The process to be utilised for dealing with complaints shall be described in the CEMP.

**Evidence of compliance**

On-going compliance with the CEMP shall be evidenced by:

- No complaints
- Periodic audit by FEA.

**Completion of Works**
Principle

- To ensure timely reinstatement of the site following construction.
- To ensure that works are carried out within legislated and stipulated requirements.

Commitments

- At the completion of works the site will be reinstated, with all wastes and unused materials removed.
- Materials not required for the operation of the site will be removed in a timely manner.

Evidence of compliance

On-going compliance with the CEMP shall be evidenced by:

- CEMP completion report.
- FEA audit report.

Emergency Procedures

Principle

- To ensure timely and appropriate response to emergency.

Commitments

- An Emergency Procedures Plan (EPP) is to be documented and kept at the work site for reference. This should include measures and procedures, including an Incident Communication Protocol, for environmental incidents such as fire, oil and/or chemical spill, contact lists and Material Safety Data Sheets. In the event of an incident, e.g., spill or loss of oil directly to the environment from its containing vessel, the Contractor is to ensure that FEA is advised as promptly as possible:
  1. Site Supervisor/Manager.
  2. FEA - Project Manager,
     Design Manager,
     Environmental Engineer, Ms Shivangi Bishwa
- Works will not commence in the absence of an approved EPP.
- Personnel will be familiar with all response plan actions.
- Spill response equipment will be available to all construction crews handling chemicals or fuels at the Site.
- A log of incidents will be maintained by the contractor.

Evidence of compliance
On-going compliance with the CEMP shall be evidenced by:

- Approved Emergency Procedures Plan.
- Incident log.
- Periodic audit by FEA.

**Records to be Maintained**

**Principle**

- To ensure that an accurate and auditable record of environmental activities is maintained.

**Commitments**

- A log is to be maintained for:
  - Complaints
  - Incidents
  - Induction and environmental awareness training
  - Waste removal (including waste oil)
  - Disposal of contaminated materials/soils
  - CEMP Non-compliance.
- Incidents and complaints are to be reported to FEA immediately.

**Evidence of compliance**

On-going compliance with the CEMP shall be evidenced by:

- Logs maintained.
- Periodic audit by FEA.

**Stakeholder Communication**

**Principle**

- To ensure FEA is kept informed of all project activities and issues at all times.

**Commitments**

- Signage indicating construction works and the presence of heavy machinery shall be utilised on the highway.
- Implement an information and awareness campaign with community, school children, teachers, and drivers before the start of project.
- A CEMP compliance report is to be completed and provided to FEA within two weeks of commencement of works and within two weeks of completion of works.
Complaints and incidents are to be reported to FEA when they occur.

Logs to be maintained in accordance with Element EMP.

**Evidence of compliance**

On-going compliance with the CEMP shall be evidenced by:

- Logs maintained.