

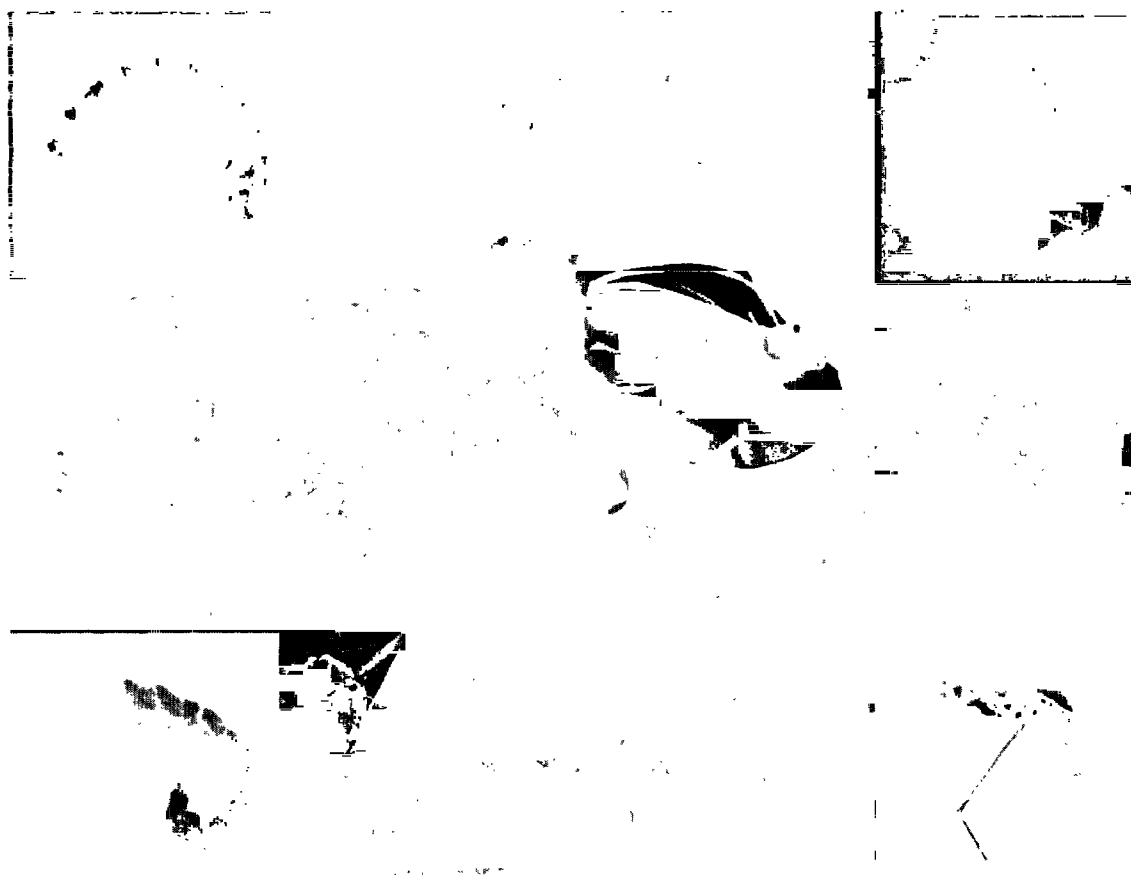
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**SMALLHOLDER AGRICULTURE
DEVELOPMENT PROJECT (SADP)**



ENVIRONMENTAL MANAGEMENT PLAN



Douglas Environmental Services

January 2007

**SMALLHOLDER AGRICULTURE
DEVELOPMENT PROJECT (SADP)**

Environmental Management Plan

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ACRONYMS

CBO	Community-Based Organisations
DEC	Department of Environment and Conservation
E.A	Environmental Assessment
ECMMP	Environmental Control Measures and Monitoring Programs
EMP	Environmental Management Plan
ESAP	Environmental and Social Awareness Program
ESMF	Environmental and Social Management Framework
GIS	Geographic Information System
IPMP	Integrated Pest Management Plan
LLG	Local-Level Government
NGO	Non-Governmental Organisation
PNGFA	Papua New Guinea Forest Authority
PNG	Papua New Guinea
PNGOPRA	Papua New Guinea Oil Palm Research Association Inc.
QABB	Queen Alexandra's Birdwing Butterfly
SADP	Smallholder Agriculture Development Project
WMA	Wildlife Management Areas

1. INTRODUCTION

The Smallholder Agriculture Development Project (SADP) is a rural community development project designed to encourage further and sustainable economic growth and enhance community participation and local governance in the rural areas of the four oil palm growing provinces in Papua New Guinea.

The SADP aims to stimulate economic growth for the rural communities in these provinces by actively encouraging the growth of oil palm production as the main income generating activity for smallholders in the project areas. Smallholders currently account for 47% of the total land planted under oil palm in PNG and maintenance of sustainable production by this sub-sector is important for the national industry, for individual household welfare and for the local economies and village commerce in smallholder oil palm areas.

The SADP will actively encourage the growth in smallholder oil palm production with tangible improvements in physical infrastructure and access to oil palm production opportunities for the many smallholders not yet involved in this sub-sector. In this regard, the SADP is responding to expressed community needs for:

1. an increase in the number of smallholders participating in oil palm production in oil palm areas;
2. rehabilitation and maintenance of access and fruit collection roads;

The SADP also aims to improve service delivery for rural communities by supporting participatory local governance. The project would establish and test mechanisms, working within existing local government structures and procedures, to create an enabling model for more effective and accountable service delivery.

In terms of environmental risk, and the focus of this Environmental Management Plan, it is the measures taken to actively encourage the growth in smallholder oil palm production that pose risks of environmental impacts. These will require environmental mitigation and management strategies to be developed and implemented. The revised SADP Terms of Reference indicate that the project intends to:

1. Establish up to 9,000 hectares of new oil palm blocks, each of 2ha size, on land available within the areas covered by existing oil palm infrastructure. The phrase "existing oil palm infrastructure" refers to the existing access and fruit collection roads established and / or maintained by the Oil Palm Industry Corporation or the oil palm mill operators. Along these roads there are many locations where new oil palm blocks could be established on ground between other blocks, which gives rise to the reference term "in-filling" by which this increase in oil palm production area will be achieved.

2. Upgrading and restoring up to 600 km of access roads to existing smallholder oil palm blocks, and maintaining all existing and upgraded roads used for oil palm collection and the establishment of sustainable financing mechanisms for road maintenance.

This Environmental Management Plan is designed to ensure that the SADP complies fully with the requirements of the environmental and conservation legislation in Papua New Guinea, and the environmental safeguards criteria for funding under the World Bank requirements.

The EMP identifies the environmental issues and impacts that might arise during the implementation of the SADP and develops appropriate and effective mitigation strategies for these. Clearly it is more cost-effective to take steps to avoid these impacts where possible during the design of the project, but where they cannot be avoided, this EMP sets out mitigation measures that must be followed and develops monitoring strategies and procedures to assess the effectiveness of the mitigation measures and indicate where more rigorous application of these is required.

The EMP is based on the findings of the SADP Environmental Assessment Report which describes in more detail the nature of the project activities, a detailed description and assessment of the environments in which the project will operate, and the environmental impacts that might arise in the course of project implementation.

2. PURPOSE and USE of the ENVIRONMENTAL MANAGEMENT PLAN

This EMP should be read in conjunction with the SADP Environmental Assessment Report which describes in detail the environments in which the project will operate and the range of activities that will be conducted during the implementation of the project and which have the potential to give rise to environmental issues or adverse environmental impacts.

The purpose of this EMP is to document environmental impact avoidance and mitigation measures and monitoring procedures that will allow the project proponents to:

1. Avoid potential impacts arising by incorporating environmental impact appraisal procedures and impact avoidance strategies in the project design and the project activities' implementation programs;
2. Where the risk of potential impacts cannot be avoided, implement effective mitigation measures that will minimise and reduce to an acceptable level any residual impacts that might arise;
3. Conduct an environmental monitoring program for all potential impacts that will provide adequate data to evaluate the effectiveness of the impact avoidance strategies and mitigation measures and will clearly and promptly indicate any loss of efficacy or failure of these and allow corrective action(s) to be taken;
4. Identify any protection or preservation activities or sites that may be required to protect sensitive environments such as wetlands, critical natural habitats and forest areas, or cultural, historical, archaeological or sacred sites. Develop an impact avoidance strategy and measures to be taken that will ensure that these sites are not affected by any project-related operations or activities.

This EMP also includes a classification system which ranks sites according to their environmental sensitivity and conservation value. This provides a checklist of criteria on the suitability / acceptability of a proposed area for a new oil palm block development.

This EMP is designed to be used both as a reference document for the SADP designers and project managers and as a training / instruction manual for those OPIC and SADP personnel responsible for:

1. the identification and surveying of new block sites,
2. the inspection and monitoring of operations and activities at new block sites;
3. the surveying of road re-alignments; and.
4. the inspection and monitoring of operations and activities at all road reconstruction / upgrading sites;
5. the inspection and monitoring of operations and plant at all gravel extraction sites, gravel sorting and screening sites and other working sites such as equipment storage / repair sites, stockpiles, spoil-heaps and waste pits.

Section 4 of this EMP, Potential Environmental Impacts and Their Mitigation, provides detailed reference to the impacts identified in the Environmental Assessment and detailed descriptions of the avoidance and / or mitigation strategies that will be adopted to avoid or reduce these to an acceptable level.

Section 5 of this EMP, Environmental Control Measures and Monitoring Programs, provides concise instructions on how to conduct the avoidance strategies and implement the mitigation measures previously described, and the monitoring requirements with concise instructions on the conduct of each monitoring program and the evaluation of the monitoring results.

Section 6 identifies and describes the resources and capacity development (including training) that will be required to implement this EMP effectively, and that will meet Department of Environment and Conservation and World Bank requirements. In addition to identifying the resources and training required to implement this EMP, this section also includes:

- job descriptions and criteria that can be used for the preparation of a duty statement and selection criteria for the appointment of Environmental Staff for the SADP;
- an environmental awareness program (workshop) aimed at SADP oil palm stakeholders which aims to encourage the development, by the stakeholders themselves, of practical, innovative and cost-effective measures to mitigate environmental impacts.

3. CRITICAL VALUES to be PROTECTED and PRECAUTIONS

The provinces in which this project will be carried out contain a number of critical natural habitats and critical forest areas, most notably the habitats of the Queen Alexandra's Birdwing Butterfly (QABB) in Oro Province and many important Wildlife Management Areas (WMA's) and Reserves in West New Britain.

Any extension of the existing oil palm areas into new and undeveloped areas could threaten these critical natural habitats and forest areas. For this reason, this project will not extend the existing oil palm development into new and undeveloped areas, but will be restricted to "infilling" and road reconstruction within existing developed areas.

Along the roads throughout the existing developed areas there are many locations where new oil palm blocks could be established on ground between other blocks, which gives rise to the reference term "in-filling" (filling the gaps along the road where oil palm has not yet been planted) by which this expansion of oil palm production area is usually known.

As these proposed new "in-filling" block sites are adjacent to roads, their ease of access has meant that they have been the preferred locations for gardens or other use. This has inevitably resulted in these areas being characteristically highly modified with little original vegetation or habitat remaining. Consequently, in terms of natural conservation value they rank low, and the clearance of the vegetation from these areas has little impact on the conservation value of the area as a whole, providing environmental mitigation measures are properly implemented to protect the environment and maintain buffer zones as vital wildlife corridors and plant refuges. Care will need to be taken to see that these infill blocks conversion to Oil Palm does not move these other uses into sensitive areas

This E.M.P. proposes a set of site selection criteria and site evaluation processes by which any new area or individual block can be assessed to determine whether it is environmentally sensitive or a critical natural habitat that must remain undisturbed and will therefore not be developed for oil palm. Project policy clearly states that no forest areas will be disturbed or damaged by the implementation of this project, and the authors understand that this policy will be rigorously enforced by the project management.

However, throughout the project areas there are remnant patches of forest which must be protected against any disturbance as they provide vital wildlife and plant dissemination refuges and corridors. Although some of these remnant forest areas are no more than one or two hectares in size, and may be adjacent to existing oil palm blocks or roads, nevertheless they may be important refuges and must remain undisturbed. Where a new block is to be established, or where an existing block is to be replanted, a 10 metre wide buffer zone of natural vegetation must be left undisturbed along the boundary between the block and the forest area.

Patches of wetland and remnant swamp areas also occur throughout the project areas and also provide important refuges and corridors. These areas must remain undisturbed by any development and they are particularly susceptible to disturbance by changes in water level which may be caused by the construction or renovation of drainage channels in adjacent oil palm blocks or roads. Patches of wetland and remnant swamp areas are also highly susceptible to the effects of sedimentation caused by sediment laden drainage waters. The project management and OPIC field officers must ensure that all new construction or renovation of block or roadside drainage channels do not discharge into or cause drainage of any wetland or swamp areas. This may at times require a re-alignment of the road by a few metres, in which case this must be done.

The process of site evaluation and selection will be applied to all applications for development at all sites where oil palm does not already exist. Approval for development will only be granted where a field assessment clearly documents that there is no threat to critical habitats or remnant forest areas. This process is described in Section 4.6.1 and detailed procedures are set out in Section 5.5, ECMMP # 1, of this E.M.P.

4. POTENTIAL ENVIRONMENTAL IMPACTS AND THEIR MITIGATION

This section summarises the environmental issues and significant adverse environmental impacts that will need to be eliminated, offset or reduced to acceptable levels during the implementation and operation of the Smallholder Agriculture Development Project.

4.1 Potential Environmental Impacts on Subsistence Resources

The vast majority of people within the project areas are still almost wholly dependent on their subsistence resources for all their water and food requirements (Gaudi et al 2001) and protection of these resources is the paramount objective of the environmental control measures set out in this Environmental Management Plan. These subsistence resources include water supplies and gardens. These resources must be identified through discussion with the local landowners and traditional users of the resource so that effective protection measures can be taken from the outset of work.

4.1.1 Water supplies

4.1.1.1 Potential Impacts from Block Clearance

Water supplies can be affected by a wide range of contaminants from a variety of sources during land clearance and road re-construction. During land clearance for planting oil palm, plant debris and exposed soil can be carried by wind or surface drainage into nearby creeks, obstructing flows and causing increased sedimentation which can affect the quality of the water and lead to nutrient enrichment and the formation of stagnant pools, affecting the quality of the water for downstream users. Mitigation measures must be employed to reduce soil erosion and the transport of plant debris and soils into nearby creeks.

4.1.1.2 Potential Impacts from Road Re-construction

Likewise, several of the activities involved in the re-construction of roads, including the winning of gravel and the installation of culverts and other waterway drainage, can pose a significant risk of sedimentation and contamination of waterways downstream of the road construction site. The installation of culverts may require that the creek is partially dammed or diverted to allow work to be completed, and this may result in a temporary reduction or cessation of flow for some of the users downstream. This must be discussed with the landowners before construction commences.

In particular, the landowner(s) across whose land any temporary diversion or damming may be constructed must be consulted on the route of any diversion and the effects of any diversion or damming on the local surface waters, in particular any effects on the garden drainage systems in the area. It must be remembered that no dam or diversion can be constructed without the agreement of the relevant landowner(s), and this may involve reaching agreement on compensation for the temporary use of the land for this purpose. When the construction has finished,

the diversion or dam must be restored according to the reasonable wishes of the landowner(s) concerned. Effective mitigation measures must be employed to minimise the pollution of downstream waters with sediments or wastes from all road construction activities.

Where disruption to natural water supplies has occurred as a result of construction work or it is unavoidable, it will be necessary to arrange access to an alternative potable water supply for those affected. This will almost certainly involve reaching agreement with other landowners who have access to an unaffected supply (such as riparian landowners upstream), and may require payment of compensation to these landowners for allowing access to the clean supply.

4.1.2 Protection of gardens and garden drainage systems

Gardens are a vital subsistence resource which provides many families with their only source of cash income. Gardens in production will usually be tended everyday by the landowner and it is important this daily access is not disrupted by road construction operations. Landowners with gardens along the road alignment must be consulted ahead of construction operations in order to avoid obstructing garden access or, if this cannot be avoided, identify alternative access for the period of disruption.

4.1.2.1 Protection of Gardens Drainage during Road Reconstruction

Effective garden drainage is important in maintaining garden productivity and avoiding water-logging or inundation of the garden soils. Road construction has the potential to disrupt the efficient drainage of neighbouring gardens by spilling storm-waters and contaminated site drainage waters directly onto adjoining garden plots or indirectly by discharging these in an area where they can enter a garden drainage system. This could result in flooding of the garden and / or contamination of the garden soil with drainage sediments and mud, both of which (but particularly the smothering by sediments from temporary site drainage) can cause substantial damage to garden productivity and land value. Likewise the temporary site drainage and / or the permanent road drains may result in the obstruction or diversion of garden drains in a manner that may cause their drainage waters to back up in the garden.

The temporary site drainage system and the permanent road drains must be planned and constructed in a manner that avoids these impacts. Clearly it will be necessary to consult with the garden owners before and during the construction in order to plan and take effective measures to avoid any discharge into garden areas or disruption to garden drainage either from the temporary site drainage system or the permanent road drains.

Dust can also have a damaging impact on garden crops, particularly those close to being harvested. It will be necessary for the Contractor to discuss the issue of potential crop damage from dust with garden owners along the road alignment,

and agree on any compensation rates that will be paid in the event of such damage occurring.

Prior agreement to compensation rates, for a wide range of damage and goods, is a key to retaining landowner support for the project and maintaining a collaborative / constructive approach to negotiations and problem-solving.

4.2 Access to and compensation for gravel

Negotiations with gravel pit owners over access to and use of the gravel must include reaching agreement on what gravel pit / site rehabilitation / restoration measures will be carried out post-extraction. The agreed pit /site restoration plan must leave a stable and environmentally appropriate land-form that restores / maintains surface drainage patterns and water tables in the area, and one which restores any habitat values previously present.

4.3 Potential Environmental Impacts on Soils

The potential environmental impacts on the soils of the project area are:

- loss of soil from exposed surfaces through erosion by water and wind, and the subsequent sedimentation of downstream waters;
- the contamination of soils by wastes and other materials (including excessive amounts of fine silts resulting from erosion).

Loss of surface soils (particularly the nutrient- and organic-rich topsoil) depletes the nutrient resources which can result in a loss of plant diversity which may in turn result in a loss, or migration out, of fauna from the area.

4.3.1 Erosion

4.3.1.1 Erosion during Block Clearance

Erosion from exposed soil surfaces during block clearance must be minimised by mulching with the cleared vegetation and prompt re-planting of fast-growing ground cover species.

4.3.1.2 Erosion during Road Reconstruction

Erosion from exposed soil surfaces during road re-construction or upgrading must be minimised by restricting the area of exposed surface during construction, the road construction program should be planned so that no more than 100m of road is cleared, levelled, gravelled, graded and compacted at any one time

To minimise the time that these surfaces remain bare, each stage in the construction program should follow closely behind the previous stage so that the duration of exposure along the road section is also kept to a practical minimum. Each 100m section of road must be completed, including final compaction and

side drain construction before commencing vegetation clearance along the next 100m section.

Some erosion will still occur, particularly during periods of intense rainfall and temporary on-site drainage structures should be constructed to minimise on-site ponding and scouring of bare surfaces, and to capture any site runoff that may otherwise cause sedimentation impacts in downstream watercourses or on adjoining land (see following section). All on-site drainage discharge points must be constructed with sediment traps to minimise sediment loads in the discharge.

4.3.1.3 Areas Particularly Susceptible to Erosion

Any areas particularly susceptible to erosion, such as stockpiles and spoil-heaps, should be contained within perimeter silt fences and located well away from any drainage channels, inundated areas or waterways.

Where roads are being re-constructed or upgraded in hilly country, additional erosion control measures and devices may need to be implemented / installed in these areas on the sloping surfaces, depending on gradients and soil properties. On sloping soil surfaces, "rilling" may be a significant erosive process, particularly on slopes above 40° such as batter slope along road cuttings or embankments. In these circumstances, more stringent erosion control measures will need to be applied, such as the installation of cross drains, particularly along the toe of the slope, and restricting the slope gradient to no steeper than the surrounding slopes which have been stable for at least the last few years.

Active re-vegetation of batter slopes and sloping road-sides is crucial to the rapid and effective stabilisation of the slopes, and this should be carried out as soon as possible after the batter slope is cut in order to minimise the period of exposure.

4.3.1.4 Gravel Extraction Sites

Gravel extraction sites are particularly prone to erosion as the extraction operations inevitably exposes the working area to erosion from wind and water, and measures must be taken to minimise this, particularly where the eroded material could enter a watercourse. Gravels for this project will be extracted from dry pits and from riverside gravel banks.

In order to minimise the exposure of the surface sediments to erosion from wind or water, a systematic Gravel Excavation Plan must be developed by the Contractor for each gravel site that minimises the area of cleared vegetation and the period of surface exposure. Excavation should be planned and conducted in stages so that each stage area can be stabilised, including contouring of cuts and grading of cut slopes to a stable "resting angle", before moving on to the next area (stage) in the excavation sequence. Re-vegetation of the area should promptly follow stabilisation. Vegetation clearance for access to the excavation site should be minimised and the access route should avoid watercourses and swampy areas to minimise the risk of sedimentation in these areas.

A site restoration program must be developed for each gravel extraction site, in collaboration with the landowner(s) and with their full support and agreement. The restoration program must leave a stable and environmentally appropriate land-form that restores / maintains surface drainage patterns and water tables in the area, and one which restores any habitat values previously present.

Where gravel is extracted from dry pits, the excavation pit should be protected from the ingress of storm-waters by a stormwater diversion channel and bund that prevents surface waters from entering the pit or excavation area.

Vegetation in dry pits should only be removed from the in-pit areas that are soon to be excavated. All other areas, including pit batter slopes and the pit perimeter, should not be cleared of vegetation, unless it poses a risk to batter slope or pit stability.

Gravel sorting and screening should be carried out at the gravel extraction site where effective and site-specific control measures can be implemented to minimise dust and mobilisation of sediments by wind and water.

Generally the soils in both provinces are rich volcanic loams, not liable to generate dust, but some quarry sites may present an increased risk of dust movement as these areas are chosen for the presence of sand and gravel rather than soil.

4.3.1.5 Gravel Sorting and Screening

Gravel screening and sorting generates volumes of dust (fine sands and silts) that are susceptible to mobilisation by wind in dry weather or rain-splash and entrainment in surface runoff during periods of rain. Dust can smother vegetation and cause disruption to soil micro-habitats. Gravel dust falling onto the soil surface is likely to be entrained by surface runoff during rain periods, where they are carried by overland flow into surface watercourses leading to sedimentation impacts on the aquatic habitats and biota downstream.

Wind mobilisation of dust can be minimised by locating the gravel screening and sorting operation in a sheltered area of the site, by covering stockpiles with tarpaulin or other screening / protective material, and by spraying with fine mists of water that are sufficient to bind the dust but minimise surface flows of water, which could cause erosion and lead to sedimentation of nearby watercourses.

Gravel screening and sorting rigs should be covered with adequate eaves to prevent rain entering even under storm conditions.

4.3.1.6 Stockpiles and Spoil-heaps

Gravel stockpiles should be located well away from any surface where or areas that may flood under high rainfall conditions, in order to minimise the risk of erosion from both wind, rain and surface water flows.

Some erosion and mobilisation of exposed soils and other surface sediments may occur during gravel excavation and sorting operations. A site containment trench and outer bund will be constructed around the gravel excavation site, and around the gravel sorting operation and gravel stockpiles if required by the Environmental Officer.

The containment trench will intercept any sediment laden runoff or surface flows from these areas. The discharge from this containment trench will be channelled to a settlement trench or pond of sufficient dimensions to allow settlement of sediments before final discharge via a flow dispersion structure (e.g. a stone pile bed) into a well-vegetated area, well away from any creeks or streams, which will act as a final sediment trap and soak-away for the discharge.

The outer bund beyond the site containment trench will divert any surface water from outside the area away from the containment trench, and so minimise the volume of sediment contaminated water that requires treatment / settlement before it can be safely discharged. These sediment control measures are explained more fully later in the Section 4.4.2.1 on Surface Waters.

4.3.2 Contamination of soils

Soils can be contaminated by:

1. inert material such as silts and mud, cement dust or concrete fines and slurries which change the material composition and textural properties of the soil;
2. biodegradable materials which can be toxic at high concentrations but are broken down over time by soil bacteria to yield nutrients and other soil materials; and,
3. non-biodegradable toxic contaminants which are not broken down by most common soil bacteria and so will continue to poison soil communities for a long time.

4.3.2.1 Contamination by inert materials

Fine particles of inert material such as silts, dust and mud can block soil pores restricting soil ventilation and the natural drainage of soil waters. This can lead to water-logging of the soils and the development of anaerobic conditions, disrupting the release and re-cycling of nutrients resulting in a loss of soil condition and fertility. This can lead to a decline in plant diversity and flow-on effects on the fauna as the reduced plant diversity affects their habitat niches.

Road construction sites and operations such as gravel sorting can generate considerable amounts of fine particles which must be contained on site as far as practicable using dust control and silt / sediment containment measures such as fine mist sprays and tarpaulins, and silt and sediment traps at all site discharge points.

Some inert materials such as cement dust or concrete fines and slurries can have more damaging effects as they are more strongly bound to the soil particles by physico-chemical reaction and raise the pH value of the soil to more alkaline conditions. These represent more profound and permanent changes to the soil conditions and recovery can take many years. Where operations involve the use of cement or concrete, such as the installation of culverts or spoon drains / vehicle fords, particular measures must be taken to avoid disposal of cement or concrete slurries onto roadsides, garden areas or into areas from which they could enter a waterway or waterbody.

4.3.1.2 Contamination by biodegradable / organic materials

The main environmental concern regarding the contamination of soils by biodegradable materials is the potential for these to enter surface waters and groundwater, where they may also generate oxygen deficits which may, in turn, lead to anaerobic conditions and the poisoning of the water, rendering it unsuitable for domestic purposes and causing significant loss of aquatic biota (see following section on Surface Waters). Training instruction on the correct disposal of vegetation debris and wastes, and the rigorous establishment of streamside buffer zones around all oil palm blocks will provide assurance that the risks of organically rich oil palm debris and wastes entering surface waters or groundwaters is minimised.

Another organically rich biodegradable material that has to be considered in the context of this program is human faecal waste (excrement). Strict measures must be imposed on the siting of latrines to ensure that faecal contaminated materials cannot enter surface waters or groundwaters, and that faecal contaminated soil is buried at least 500mm below ground surface to prevent accidental exposure, and is effectively isolated from entering surface waters or well-waters by a distance of at least 50 metres. The potential public health risk is severe as the faecal coliforms, such as *E. coli*, and faecal streptococci, can survive a considerable length of time in soils and water and a minimum distance of 50 metres from the faecal contamination to the nearest exposed water (surface water site or well) is required to reduce the public health risk to an acceptable level. A site which has been used as a latrine should not be cultivated for subsistence or cash crops.

4.3.1.3 Contamination by toxic materials

Toxic contaminants are particularly pernicious and can affect a wide area, spreading through the food chain and through surface waters and groundwater from the initial soil contamination site. Severe soil contamination, particularly by toxic materials, can have a devastating affect on the affected area's flora and fauna, that may reduce the floral diversity to just a handful of particularly hardy / tolerant species that are totally unable to support the range of faunal species that previously inhabited the area.

Soils contaminated by toxic materials cannot be used for cultivation as their produce would pose a significant threat to public health, nor can local surface waters and groundwater be used for domestic purposes for the same reason. As most of the inhabitants within the project area depend upon the cultivation of gardens and the use of natural waters for their domestic supplies, toxic contamination of soils must be avoided.

Contamination of soils by toxic materials can arise directly through the careless disposal of wastes and spilling of toxic materials such as pesticides (in the context of oil palm operations these will include herbicides and insecticides), fuels, lubricants, solvents and cleansing agents.

All wastes will be sorted into categories and disposed according to the guidelines and measures set out in Section 4.5 Waste Storage, Handling and Disposal. These measures will ensure that any potential contamination of soils is avoided or minimised to a level that restricts the contamination to the immediate area of waste emplacement and does not pose a threat of contamination to surface waters or groundwater. All on-site waste disposal will be carried out in consultation with, and subject to the agreement of, the landowner(s) and other local people. Where agreement cannot be reached, or where the environmental risk is deemed to be unacceptable (as for toxics such as discarded pesticides, lubricants, solvents and degreasers, and their discarded containers), alternative disposal methods will be identified and applied.

All hazardous / toxic materials will be stored in specifically designed and prepared sites, located well away (> 100m) from any surface waters or areas suffering periodic inundation. The lockable storage area will be completely enclosed within a containment bund and roofed with extended eaves to shed rainwater outside the bund. All hazardous / toxic materials not contained in metal will be kept on wooden pallets slightly raised above the floor of the site. The storage area will be checked everyday by the site supervisor who will check on the integrity of each container and its contents. After use, empty containers (which will still contain some residue) will be kept in this storage area until they are disposed in the manner prescribed in Section 4.5.

Two common causes of toxic soil contamination that are relevant to this program are:

- excessive application of herbicides or pesticides during the preparation and operation of oil palm blocks. All applications of pesticides will be carried out strictly according to PNG OPRA guidelines, and to ensure this occurs, the sale and use of herbicides and pesticides will be strictly limited to block owners / operators who have been trained in their use by OPIC personnel following PNG OPRA guidelines. OPIC and PNGOPRA personnel will also carry out periodic inspection and supervision of their use by these trained personnel to ensure that PNG OPRA guidelines and standards are fully complied with in all aspects of their use from on-site storage to final disposal / end use.
- oil, and other hydrocarbon, spills and leaks from vehicle and machinery repairs. Where there is no alternative to conducting these repairs at the

breakdown site, special care must be taken to prevent any spill or leak of fuel, oil or other lubricants or solvents onto the ground surface. A leak-proof catch tray should be placed under the work area, and all waste oils, other fluids and oil-contaminated equipment and rags must be collected into leak-proof metal waste containers and taken to storage in the lockable storage area until they are disposed of in the appropriate manner, as set out in Section 4.5. After completing the repair, the area must be thoroughly checked and all remaining materials, wastes, and any contaminated soils, must be removed from the area for re-use or disposal

4.4 Surface Waters

4.4.1 Impacts on Surface Flow Regimes

The construction of roads can have significant effects on the natural drainage patterns of an area, particularly where the drainage pattern is a mosaic of small meandering streams that characterise many alluvial plains, including the Popondetta Plains. If adequate cross drainage is not provided, natural drainage paths are obstructed by the road and its foundations, causing surface runoff to back up along the upstream channel, leading to flooding, surface ponding and water-logging of the soils on the upstream side.

As the stream backs up, water levels rise and spill over the road, which will expose the road to erosion by surface wash, particularly if traffic continues to use the road when it is partially inundated. Under these conditions, potholes quickly form as the floodwater finds weaknesses in the road surface and penetrate beneath the compaction layer, causing wash-out and surface collapse. Not only does this severely damage the road and increase maintenance costs considerably, but also erodes considerable quantities of sediment from the road which can cause significant sedimentation of the downstream channel and its habitats and users (see below).

Poorly designed or incorrectly installed culverts can adversely affect the natural flow characteristics (such as velocity and turbulence) of a stream channel and can result in substantial build-up of sediments on the upstream side which obstruct the culvert. This causes a restriction in flow, leading to water backing up and flooding on the upstream side, allowing water to spill over the road (see above). To avoid this, the culvert floor will be carefully aligned to the level and gradient of the original channel. This should ensure that scouring or aggradation as a result of the culvert is avoided, or minimised as far as possible.

Minor stream diversions may need to be constructed during the installation of many of these culverts to avoid unnecessarily contaminating downstream channels with sediment and other construction debris and wastes, such as cement fines. As the installation of even a large culvert should not take more than a few days, the effect of this temporary diversion on surface water drainage is expected to be negligible. However it may result in some temporary

sedimentation downstream, particularly during the first few hours after the diversion is opened, as the freshly cut diversion channel walls will inevitably yield some sediment into the water flow.

4.4.2 Impacts on Surface Water Quality

Clearance of new blocks, preparation of soils prior to planting, the application of pesticides such as herbicides and fungicides, the application of fertilisers and the reconstruction / upgrading of roads can all have potentially significant impacts on the surface water quality. Three main types of impacts on surface water quality can be distinguished:

- sedimentation;
- eutrophication;
- toxic contamination.

Other potential impacts relate to the contamination of surface waters with construction materials, construction wastes, equipment repair / maintenance wastes, and camp / personnel wastes.

Potential water quality impacts in the oil palm areas are monitored by PNGOPRA using freshwater invertebrates. This approach provides a cost effective means of assessing these impacts by directly monitoring the populations of the potentially affected species. This work is supported by the SADP and this freshwater invertebrate monitoring program will be used by the project as necessary where visual observations indicate a potential impact may be occurring. The use of this program is explained more fully in Section 5 under the ECMMPs relating to water quality (see ECMMP 6 and ECMMP 7).

4.4.2.1 Sedimentation

4.4.2.1.1 Clearance and Block Planting

High concentrations of in-stream sediments result from the erosion of exposed soil surfaces during clearance and block planting operations. Wind erosion can carry soil particles into adjoining streams. Rainfall, especially the short periods of intense rainfall that characterise the coastal areas of Oro Province and West New Britain can mobilise large amount of sediment from exposed soil surfaces which will inevitably find their way into the nearby creeks and streams unless effective measures are taken to minimise the area of exposure and contain and trap the sediment before it can reach the waterways.

Measures to minimise surface erosion have been summarised in Section 4.3.1. Even so, some mobilisation of surface sediments by wind and rain will inevitably occur during clearance and block planting operations. Where perimeter or lateral drains are constructed in the block area, these should be reticulated to a settlement trench or sump constructed with flow breakers and of sufficient dimensions (several cubic metres) to reduce flow velocities to less than 1 cm per second through the trench or sump.

As the discharge will still be highly turbid even after such settlement, the discharge must not be allowed to directly enter any creek, natural drainage ditch or other watercourse. The discharge from the trench or sump should be into an area of undisturbed densely vegetated ground cover that will dissipate the flow over a wide an area as possible that will allow percolation of the flow and minimise the risk of overland flows developing and the potential for “rilling” and gulley formation.

Where the block is close to a permanent creek or stream, or coastal shoreline, lake or swamp, a buffer zone of undisturbed natural vegetation must be established and maintained along the waterside. The width of the buffer zone is prescribed by OPIC guidelines derived from the PNG Forest Authority Code of Practice according to the type of water-body or width of the stream (see below).

STREAM / WATER-BODY CATEGORY	BUFFER ZONE
Permanent stream with bed width > 5m	Undisturbed 50 m Buffer Zone
Permanent stream with bed width 1 – 5 m	Undisturbed 10 m Buffer Zone
Permanent stream of any bed width that is used by the community	Undisturbed 50 m Buffer Zone
Coastal shoreline, lake or swamp	Undisturbed 100 m Buffer Zone

OPIC Buffer Zone Specifications

These buffer zones are to ensure that the soils along the waterside remain undisturbed and stable to minimise the risk of erosion of these soils and consequent sedimentation of the stream or water-body. In these situations, the settlement trench or sump should be located on a side of the block well away from the watercourse or water-body, and the discharge directed into an area of undisturbed dense ground cover vegetation. The discharge must not be located in a position where it could directly enter the stream or water-body, nor indirectly through overland surface flows.

4.4.2.1.2 Road Re-construction / Upgrading

Road re-construction and upgrading can be a significant source of waterway sedimentation. Aerial fallout from wind-blown dusts and fine particles can cause some degree of sedimentation in waterways (particularly increases in turbidity from the suspension of fine sediments), following pathways described above for fertilisers, and dust control measures should be adopted at all road construction sites. However, the major source of waterway sedimentation from road construction sites is through sediment laden storm-waters entering streamside catchments or discharging directly into the stream.

Effective stormwater management systems for construction sites must have two components:

- an offsite stormwater management system that effectively minimises / prevents off-site storm waters from entering the construction site where they might be contaminated with sediment, wastes or toxic materials. This will minimise the amount of contaminated water that will need to be treated before it can be safely discharged;

- an on-site stormwater management system that effectively captures all the on-site drainage waters (both during storm conditions and throughout normal weather) that may be contaminated with sediment, wastes or toxic materials and reticulates these to appropriate treatment systems and devices to remove these contaminants before discharge;

4.4.2.1.3 Off-site Stormwater Management Systems

To minimise the amount of surface water on site and thus the amount of contaminated site runoff that is generated, stormwater control structures such as temporary bunds and catch (interceptor) drains should be constructed around the site perimeter to divert storm-waters around the site.

Depending on the size of the construction area, it may be necessary to construct several discharge points in order to avoid large discharge flows during intense rainfall. These should be avoided as they have the potential to scour the drain channel, increasing the amount of sediment in the flow and discharge. The gradients around the site, may also dictate the necessity to install additional discharge points, particularly at low spots along the alignment. Where a drainage channel flows down a gradient, the channel should be stepped with rock or paving slabs, or small gabion baskets, to disrupt the flow and minimise scouring of the drainage channel.

The discharge(s) from this stormwater catch drain should be positioned to discharge into a stable, well-vegetated area via a flow disrupter and dispersion system that will disperse the flow across a wider area and allow the drainage water to soak into the ground rather than form a discrete flow path that may scour. Where gradients allow, a suitable flow disrupter and dispersion system can be constructed with a pile of rocks contained within a stack of discarded vehicle tyres firmly embedded into a stable ground surface. The discharge falls onto the top of the rock pile, breaking the force of the flow, and the water spills out around the side the tyre stack. Where gradients do not permit this, the discharge channel can be constructed with several turnouts that terminate in rock piles in order to disperse the flow.

However, these drain discharges must not be positioned in locations where the discharge could affect gardens. For this reason the location of these off-site stormwater drain discharges should be decided in consultation with the landowner(s), who will have grounds for compensation if the drains causing flooding or water-logging of their garden(s).

The diversion bund and catch drain must be removed and the ground profile returned to its original form when all work at the site is completed, plant and material removed, and the site is closed.

4.4.2.1.4 On-site Stormwater Management Systems

Although all the road re-construction sites will generate sediments and construction debris, the amount generated by road surface levelling, gravelling

and compaction will be minor and except where the site is close to a stream or river, should not pose a significant risk to downstream waters. However, at other sites the amount of sediment and construction debris generated may be substantial, and these sites must be constructed with an on-site stormwater management system consisting of site containment trenches that will intercept all site drainage and prevent its escape beyond the site perimeter. These sites include:

1. on undulating, sloping or hilly sites where road construction involves the construction of road batters or embankments;
2. all vehicle and plant equipment storage and repair areas;
3. all stockpiles and spoil-heaps; and,
4. all camp sites.

4.4.2.1.5 Roads crossing or adjacent to watercourses.

Where the road runs alongside or close to a stream or other water-body, a site containment trench will need to be constructed along the river side of the construction site to capture any loose sediments and site detritus or wastes that could otherwise be carried into the stream during rain events. To avoid unnecessary disturbance of the ground, this containment trench should be constructed along the planned alignment of the road side drain, and will in effect become the road side drain when construction work is complete.

However, discharge from this drain should not be allowed to enter the stream directly. The drain discharge points should be located so that they discharge into stable, well-vegetated areas through a flow dispersion system as far from the stream as practicable. The objective here is to ensure that the drainage waters spread out through the vegetation mat which traps sediment and other material before they reach the stream. Obviously the vegetated area must not be a garden area, and the selection of appropriate discharge sites must be made in consultation with the landowner(s) to ensure that this is so.

4.4.2.1.6 Culvert construction

The particular concerns regarding culvert construction and installation relate to minimising the amount of eroded (and construction) material that enters the watercourse or drainage channel that the culvert serves. Often the culvert is being installed to serve a temporary or very small stream which can be easily dammed whilst a pre-formed culvert and its associated minor earthworks are installed. But with anything other than very minor flows, the most effective means of minimising downstream sedimentation is to construct a temporary diversion channel around the construction site, so that the culvert can be constructed or installed in a dry bed, which minimises the risk of downstream sedimentation, and allows for easier and more reliable emplacement of firm foundations and mounting / construction of the culvert and headwalls. It also allows for easier and firmer placement of any in-stream erosion protection devices such as gabion baskets, without the risk of downstream sedimentation.

However, such an approach must be discussed with the landowners first, and an appropriate diversion alignment agreed with them before construction commences.

4.4.2.1.7 Earthworks, equipment storage and repair areas, and stockpiles

Where circumstances or the nature of the operations pose a significant risk of contamination of surface waters, such as construction of road batters or embankments, vehicle and plant equipment storage and repair areas, stockpiles and spoil-heaps and camp sites, the site must be bounded by site containment trenches.

These site containment trenches will be located and constructed to intercept all runoff and stormwater from within the site and channel them to a properly constructed settlement pond or sump, which depending on the size of the pond and the nature of the soils in which it is constructed, may require the side walls to be protected by Reno mattresses or similar. The size of the pond will depend upon the area of the site, and must be of sufficient size to provide a settlement residence time of between 10 hours and 24 hours. The inflow to the settlement pond should be screened (~ 5mm) to intercept larger detrital materials and floating debris. This should be checked at least once a day and cleared of any detritus. These screen wastes should be disposed as set out in Section 4.5.

The settlement pond discharge (outflow) should be located at the far end of the settlement pond to maximise the flow path length and thus the minimum residence time that the pond is able to achieve. Where the site contains standing plant such as gravel sorting rigs or cement batching plants, the pond should also be equipped with a simple boom barrier that extends across the pond a short distance beyond the inflow (a partially submerged piece of timber securely held in place is usually effective) to retain any hydrocarbon residues on the water surface. This should also be checked every day and any traces of oil or other hydrocarbons should be skimmed off manually and placed in the designated waste oil receptacle.

The pond should discharge into a stable, well-vegetated area via a flow disrupter and dispersion system that will disperse the flow across a wider area and allow the drainage water to soak into the ground rather than form a discrete flow path that may scour, as described above.

Spilling of construction site drainage waters onto gardens must be avoided as not only can this cause flooding of the garden, but also these site drainage waters may contain hydrocarbon or other residues which will contaminate the garden soils and plants, rendering them unfit for consumption.

Where excavated material is to be temporarily stored in spoil-heaps, these must be located at least 100m from the nearest stream or surface water and be contained within a silt fence, containment trench and stormwater diversion bund.

Where roads are constructed in "cuttings" or other situations with up-slope batters such as along hillsides, the road-side drains must be large enough to take the increased surface runoff that may be generated by these larger areas of sloping surface.

4.4.2.1.8 Removal of cleared vegetation and any excavated material

Care must be exercised in disposing of cleared vegetation and excavated material to ensure that they are disposed in areas well away from streams and rivers. Where the amounts are small they can be left as mulch by the roadside, larger volumes will need to be disposed of in consultation with the landowner(s).

4.4.2.1.9 Gravel Extraction Sites

The excavation of gravel must be conducted in a systematic manner according to a prepared site-specific Gravel Extraction Plan (see Section 4.3.1.4). The excavation should proceed in stages in order to minimise unnecessary disturbance of the site and allow for stabilisation of the excavated areas as each stage is completed.

Downstream sedimentation from the extraction of river gravels can be particularly severe if appropriate precautions are not taken from the outset of operations.

These precautions include restricting the access route chosen to one that is located furthest from the river channel, avoiding any tributary streams or channel braids and as far as possible follows the line of the highest ground down to the gravel bed.

All operations must be restricted to areas that can be reached without any risk of machinery entering the river water. This applies not only to the tracks and wheels of vehicles, but also the excavator bucket or grab. No gravel should be removed from within the water channel, nor from within 5 metres of the water's edge, in order to minimise the physical disturbance of gravels in direct contact with the river water.

Where extraction is from a "dry" pit, the excavation should be protected from stormwater inflows by a stormwater diversion channel and bund, with an appropriately located discharge that directs storm-waters well away from the pit and into areas of densely vegetated ground cover.

If screening and sorting of the gravel is to be carried out, this must be conducted at a site some distance, at least 100m from the river, and any other watercourse, and according to the precautions set out in Section 4.3.1.5. In particular, the site must be completely enclosed within a site trench and stormwater diversion bund, which is channelled to a settlement pond of adequate size and discharging via a flow dispersion system into a stable well-vegetated area. All stockpiles of gravel must also be located at least 100m from

the river, and any other watercourse, and fully enclosed with a silt fence, containment trench and stormwater diversion bund.

When all gravel operations at the site have ceased, the area should be inspected by the site supervisor to ensure that all machinery and wastes have been removed and the site is left in a stable and clean condition.

4.4.2.2 Eutrophication

Eutrophication, the nutrient enrichment of natural waters, is not uncommon downstream of intense agriculture operations, particularly where these involve the application of synthetic fertilisers which are characteristically soluble in water and thus readily enter overland flows and the surface water table. In the volcanic soils of both providences, if the fertilizer move through the soil profile, considerable portions of the fertilizer will be retained before entering the more free draining gravel layers, when less retention will occur.

The excessive use of fertilisers (in excess of the prescribed dosages and rates of application), and the application of fertilisers during rainfall, will increase the amounts of fertilisers entering the surface water table and any overland flow or surface runoff that may occur. Fertilisers must be applied only in accordance with the instructions and guidelines given by OPIC for each type of fertiliser used. The block owners should also be instructed by OPIC to exercise care to ensure that fertilisers are not applied during periods of rain, and preferably shortly after periods of rain when all surface waters have drained into the soil. OPIC should also ensure that the fertilizer which is delivered in sacks, is not left in the open, but rather placed in shelter after delivery until used.

Inevitably some fertilisers will move through the surface water table beyond the area of the oil palm block and could enter adjoining creeks and streams if the block extends to the stream edge. However, this can be avoided or at least minimised by establishing a buffer zone along all permanent creeks and streams that border oil palm blocks (see previous chart for buffer zone sizes).

The application of fertilisers during periods of high wind can result in the fertilisers being carried beyond their intended target, depending on the method(s) of application. In these circumstances, the fertilisers can affect the surrounding vegetation, with some plant species suffering adverse effects and over time this may affect the natural plant communities and soils around the block. In time this may affect the range of habitat niches and sustainability of the surrounding natural communities. Wind can also carry fertilisers into waterways through aerial fallout, directly into the creek or stream and indirectly onto adjacent soils and vegetation from where rainfall and surface runoff will carry the fertilisers into the stream.

4.4.2.3 Toxic Contamination

4.4.2.3.1 Pesticide Use (herbicides and insecticides)

The risks of toxic contamination of surface waters arises from the inappropriate or careless storage, use or disposal of pesticides (herbicides and insecticides) and vehicle and equipment fuels, lubricants, solvents and cleansing agents.

PNGOPRA and OPIC have rigorous procedures and guidelines to ensure that the storage, use and disposal of pesticides is conducted in an environmentally safe and secure manner. Pesticides will only be sold to, and used by, oil palm block owners and operators who have been trained in these procedures and guidelines by OPIC personnel and who are regularly inspected and supervised by OPIC to ensure that they continue to apply the procedures rigorously.

These procedures include:

- purchase and use of herbicides and pesticides is limited to specific block owners and operators who have satisfactorily completed OPIC training on the storage, use and disposal of the specific herbicide or pesticide;
- limits on the amounts of herbicides and pesticides that are sold to individual block owners / operators;
- limits on the amounts of herbicides and pesticides that are stored on-site;
- storage of all herbicides and pesticides in the prescribed containers within secure (lockable) areas that are protected from rain and flooding;
- detailed instructions on the method of application, the technique(s) that can be employed, and the precautions that must be taken to ensure operator safety, public health safety and environmental containment and safety;
- detailed instructions on emergency response procedures in the event of a spill or other accidental loss of the material;
- detailed instructions on the disposal of unused material and containers (to be returned to the purchase site);
- detailed instructions on the washing of sprays and other application devices to ensure operator safety, public health safety and environmental containment and safety;
- detailed instructions on the disposal of wash-waters and any contaminated materials such as work gloves, cleaning rags or brushes and contaminated soil or vegetation.

No herbicides or insecticides will be used within the 5 metres or 10 metres of any watercourse (depending on the width of the watercourse) and no materials that are likely to be contaminated with either herbicide or insecticide will be placed in a location where they might enter a watercourse.

OPIC personnel will regularly inspect all blocks where herbicides or insecticides are being used to ensure that all procedures are complied with and that continuing use of the material does not pose any significant risk to the environment, operator safety or the health of the occupiers of the block or the public.

4.4.2.3.2 Road Re-construction

Road re-construction operations can also pose risks of toxic contamination of surface waters where the operational site is alongside or close to a watercourse or water-body. The risk of toxic contamination of site drainage waters and storm-waters comes from a variety of road construction materials and wastes such as hydrocarbons (fuel and lubricants), solvents and degreasers, concrete additives, paints and steel coating treatments, and cleaning agents.

All toxic materials will be stored and used in specially designated areas specifically designed and constructed to avoid any contamination being released into the environment, and with appropriate safety and environmental management precautions.

All hydrocarbons (fuels, oils, other lubricants, solvents and degreasers) and other toxic materials such as paints, treatment chemicals and cleaners will be stored in appropriate (ex-supplier) sealed metal containers which will be kept on raised pallets inside a secure, lockable, covered and bunded hazardous materials lock-up, located at least 100m from the nearest river or stream.

The site will be properly equipped with the correct fire retardant and fire fighting equipment to cope with hydrocarbon fires, and will have the appropriate Material Safety Data Sheets prominently displayed and at least one site manager / supervisor, who is familiar with same, on-site at all times. All the site workers will be given training in how to use the fire fighting equipment, and how to decontaminate and treat any personnel affected by these toxic substances. The site will also house the necessary personal safety equipment (protective gloves, goggles, face masks, protective overalls, protective boots) to use when handling some of these materials, such as the solvents, treatment chemicals and chemical cleaners.

All use of these substances (re-fuelling, maintenance and repair of machinery and vehicles, concrete additives and steel coatings) will be carried out at designated sites which are located at least 100m from the nearest stream or other surface water and are fully enclosed by a site containment trench and stormwater diversion bund, to minimise the risk of entry into surface runoff which could be carried outside the site containment boundary.

All toxic waste will also be collected and stored in appropriate sealed metal containers that will be kept on raised pallets inside this secure hazardous materials lock-up. Regular collection of these containers for appropriate disposal or other end-use off-site will be supervised by the site manager or supervisor.

The collection, storage and disposal of wastes is discussed further in the following section.

4.5 Wastes Storage, Handling and Disposal

4.5.1 New Blocks

The clearance of new blocks will generate large amounts of plant waste which will be composted as mulch over the exposed soil surface to protect the top soil from erosion and promote the recycling of nutrients. The larger woody material will be retained as fuel wood or burnt, although wood stems over 20 cms diameter are likely to be retained by the block owner as "diwai" (timber for house and win-haus construction). It is unlikely that the clearance of new blocks will generate any other wastes.

4.5.2 Road Construction

Road construction sites should not generate much waste, apart from cleared vegetation which will be left as a mulch on the roadside, or where the amount is too great, its disposal must be discussed and agreed with the landowner(s).

4.5.2.1 Litter, Biodegradable and Inert Wastes

The Contractor will be responsible for ensuring that the site is kept free of litter, packaging and spent containers, and other rubbish. These, and any unwanted building or other non-toxic construction wastes, must be regularly collected and disposed of in a local waste pit that has been negotiated with a landowner. The waste pit must be located at least 50m from the nearest watercourse and be sufficiently deep to allow the waste to be covered with a minimum 500mm of compacted, crowned (slightly raised to promote shedding of water) soil when its use is no longer required. The site should be clearly marked and identified, and re-vegetated according to the landowner's requirements.

4.5.2.2 Toxic and hazardous Wastes

No toxic or hazardous wastes or residues, nor contaminated containers, shall be disposed of in these local waste pits. These wastes must be collected separately and disposed of with the plant and equipment wastes from storage and repair sites.

These wastes will be segregated into waste bins for metal wastes (discarded / broken vehicle parts), oily wastes (spent lubricant containers, used absorbent materials, discarded oil filters, oily rags, etc.), and general rubbish.

These waste bins will be covered and kept in the hazardous materials lock-up (see Section 4.4.2.3.2). All used oil will be collected and stored in 40 litre drums inside the lock-up. Discarded tyres will also be retained on site for later disposal or recycling.

All toxic or hazardous wastes will be transported by the Contractor to an authorised waste repository site such as the Municipal Tip, which is approved for the final disposal of that waste by the Local Level Government or Town Council. Final

disposal at that site will be under the supervision and control of the LLG or Town Council's site operator and must comply with all the terms and conditions imposed on the disposal of that waste at that site.

4.5.2.3 Waste Management Plans

All road construction contractors will be required to prepare a Waste Management Plan before commencement of operations. This Plan will address all the wastes that might be generated during the road construction program, and provide details of the procedures and measures that the Contractor will adopt to avoid or minimise any potential environmental impacts. The Plan should emphasise the fundamental principle of good waste management, namely that wastes are most effectively dealt with at their source by:

- reducing the amount of waste generated through more efficient processes and work methods;
- reusing "waste" / discarded materials such as containers (but not those that have contained toxic, flammable or other hazardous materials), and many of the inert building wastes (which can often be used elsewhere on the site); and,
- recycling waste materials such as worn vehicle tyres (as containment for flow disrupter / dispersion devices, planters and a variety of village uses), kitchen scraps (as compost, although care must be taken to avoid attracting vermin), and waste oil (which is popular treatment for house and fence posts in the villages).

4.6 Flora and Fauna

The principle impacts on natural flora and fauna result from the disturbance to, and loss of, habitat as a result of vegetation clearance during oil palm block preparation and from the clearance of roadside vegetation during road reconstruction and upgrading works.

4.6.1 Identification of Environmentally Sensitive Sites, Critical Habitats and Protected Areas

The provinces within which the Smallholder Agriculture Development Project areas are located contain a variety of sensitive environments and critical habitats (with high to very high conservation value), and a number of protected areas and areas proposed for protection. These provinces contain extensive forested areas as well as small to medium sized patches of remnant forest which often serve as vital habitat refuges and wildlife corridors allowing movement of wildlife and dissemination of plants through areas which would otherwise be inaccessible to them. For many species this movement is crucial in maintaining their geographic range and the number and diversity of local populations.

OPIC has given assurances that no forested areas will be cleared in this program. It is understood that all the new blocks that are designated to be cleared are located in areas where the vegetation has already been highly modified through subsistence gardening activities, and where there is no forest or remnant forest patches that would be threatened or encroached into by this clearance and the establishment of the blocks and their buffer zones. Likewise, all road reconstruction will be carried out along existing road corridors where the roadside vegetation and immediate hinterland is already modified.

The provinces in which the Smallholder Agriculture Development Project will operate contain several gazetted Wildlife Management Areas (WMAs), Parks and other reserve areas, as well as many areas which have been identified as having particular conservation importance or value and have been proposed for protection or are awaiting gazettal. All new blocks, and any re-alignment of road corridors and the siting of gravel extraction operations and any other project-related activities must avoid these areas and should not encroach within 100 metres of any gazetted WMAs, Parks or Reserves.

However, the project provinces also contain other areas of particular conservation value or environmental sensitivity which, although not gazetted or even proposed for gazettal, should not be encroached upon. In order to expedite decisions on any expansion of oil palm, a system of land categorisation according to the area's environmental sensitivity, conservation value and importance has been developed.

Any expansion of oil palm into new areas in which there is a likelihood that they might contain moderate to high habitat sensitivity or conservation value should be restricted until a Site Sensitivity Survey to assess the site's environmental

sensitivity and conservation value has been carried out by the project Environmental Officer.

One can distinguish several categories of land according to their environmental sensitivity, conservation status, value and importance. Throughout most, if not all, of the project locations (new blocks and road reconstruction sites), the land has already been significantly modified through previous gardening or other intensive subsistence use. With little if any of the original vegetation remaining, these lands are characteristically modified with typical secondary re-growth vegetation or are currently in use as gardens or fallow ground.

In areas where they occur, this type of vegetation and the habitats associated with it are widespread and modification, or even clearance, of this secondary regrowth vegetation from new block sites and from any road re-alignments is most unlikely to significantly reduce the extent or availability of this type of vegetation and habitat. Given its highly modified nature and the extent of its widespread coverage, this land is categorised as having a Site Sensitivity Nil under the Site Sensitivity system.

Within the project provinces there will inevitably be areas in which the vegetation appears to have been little modified and for which little is known of its environmental sensitivity or conservation value. As these are areas where the vegetation does not appear to have been significantly modified, they are clearly not in the Site Sensitivity Nil category, and so are assigned to the Site Sensitivity 1 category. All areas assigned to this category have unknown conservation status or value, but by the nature of their vegetation, could contain areas and sites of high or very high conservation value, or areas of particular environmental sensitivity.

Any project sites or locations occurring within a Site Sensitivity 1 land area must be surveyed in detail to determine whether they contain or could threaten any sensitive environments, critical habitats or conservation values. An inspection survey report evaluating the conservation value or importance of the area will be submitted to OPIC, the in each case.

In contrast, land with a clear and demonstrated conservation value that has been recognised as such by its gazettal as a protected area (Parks, Reserves and Wildlife Management Areas) are assigned to Site Sensitivity 2 category. These are all lands for which no program activity, operation or site must encroach within 100 metres of the boundary.

Several areas in the program provinces have been widely recognised as containing particular conservation values or importance. In many instances these have been proposed for gazettal and are currently awaiting endorsement and / or completion of the detailed application to the relevant government agency. Lands in this category will also be assigned to the Site Sensitivity 2 category.

If road reconstruction requires the re-alignment of the road corridor in an area categorised as having a Site Sensitivity Status of 1 or 2 (see above), the re-alignment must be subject to, and dependent on, a detailed site survey along the entirety of the new alignment by the Environmental Officer.

The detailed site survey of any new road alignments must extend back at least 250 metres either side of the new alignment and 500 metres upstream and downstream of any stream or watercourse crossings. This is to allow adequate accommodation of the oil palm blocks, which can extend up to 200 metres back from the road and allowing for an additional 50 metres "buffer" between the block boundary and any sensitive or critical habitat, local reserve or protected area. The survey must include consultation and input from all the landowners with land affected or adjacent to the new alignment.

A summary of the proposed Site Sensitivity land area classification system for use in the identification of development sites in the Smallholder Agriculture Development Project is set out below:

Classification of Area	Description of Vegetation in Area	Development Indication
Site Sensitivity Nil	Significantly modified vegetation, characteristically gardens and fallow	Can be developed for oil palm and roads
Site Sensitivity 1	Conservation status / value unknown, expert survey required before any development can be considered	Cannot be developed until expert survey done, and the area / site is re-assigned to Site sensitivity - Nil
Site Sensitivity 2	Conservation status known, high or very high conservation value, but area is not formally protected. Conservation value recognised, area is gazetted as reserve, WMA etc.	Cannot be developed Cannot be developed, cannot encroach within 100 metres of boundary.

Classification of Area by Conservation Value or Importance

4.6.2 Potential Impacts from Block Clearance

Although the clearing of the vegetation within new oil palm blocks destroys most of the habitat niches within the block area, these areas with a Site Sensitivity of Nil are characterised by secondary re-growth, gardens and fallow areas, and are typically widespread and abundant in distribution. From this perspective, the clearance of one or two hectare blocks for oil palm production should not have a significant impact on the distribution or availability of this type of habitat. Undisturbed buffer zones should be established along all permanent streams and watercourses to provide wildlife corridors and plant refuges along this important ecological transition zone between the aquatic habitats of the watercourse and the terrestrial habitats. These streamside buffer zones with their undisturbed natural vegetation extending down to the water's edge can also provide a more effective and robust stabilisation of the stream banks than the more exposed ground beneath an oil palm canopy where the density of vegetation is limited by lower light levels. This more robust stabilisation of the stream banks will provide greater protection against erosion and reduce the levels of silt runoff and downstream sedimentation, improving the water quality downstream and reducing the levels of sediment-related impacts on downstream aquatic communities and other downstream users.

Some of the habitat niches lost during the clearance may be restored when some of the former plant species regenerate from the compost mulch that is left covering the soil surface when clearance is completed. The introduction of fast growing ground cover species further restores some of these habitat niches and introduces others. However, once the seedling oil palms have reached a height and canopy spread that gives an effectively closed canopy (after a few years), many of these herbaceous plant populations will decline and habitat diversity and value will reflect this decline.

4.6.3 Potential Impacts from Road Reconstruction

4.6.3.1 Impacts on Vegetation

Impacts on vegetation will be restricted to the temporary clearance of roadside vegetation along road corridors and where associated site works such as gravel pit operations, cement batching, stockpiling or spoil-heaps, and equipment housing and repair sites are established. There will also be some minor disturbance to riparian vegetation where the road corridor crosses a stream or river. This disturbance to riparian vegetation may extend for a few metres either side of the road corridor in cases where culvert construction requires the temporary diversion of stream channels.

This clearance of roadside and riparian vegetation will only be temporary as experience shows that these areas are quickly recolonised by vegetation, initially by pioneer species but followed by succession species within a few weeks of clearance. Within a few months the original plant assemblage is close to full recovery, albeit the larger shrubs, bushes and small trees will take longer to establish.

This re-colonisation process should be promoted (and the bare soil protected) by mulching the cleared areas with the vegetation that has been cut back. Not only will this protect the soil and recycle the nutrients, but importantly many of the original plant species will rapidly grow back from suckers, cuttings and seeds in the plant mulch. By supporting the restoration of the original complete plant assemblage, this will promote the rapid recovery of the former habitat value and help to minimise the disturbance to the local flora and fauna.

The importance of using plants from the site to prepare the mulch requires that the cleared vegetation is diligently retained on site and reapplied as a mulch as soon as possible after works have ceased. For this reason cleared vegetation must not be burnt, nor removed from the site for other disposal. The clearance of the vegetation, preparation of the mulch on-site and the application of the mulch as soon as possible after works have ceased is the responsibility of the contractor and regular inspections by OPIC personnel will be carried out to ensure that this is routinely carried out in accordance with the above.

Associated site works such as gravel pit operations, cement batching, stockpiling or spoil-heaps, and equipment housing and repair sites will involve the clearance of some vegetation, but as these areas are garden fallow or degraded plantation which are both common and widespread throughout the project area, the risk to plant diversity and habitat values is considered low.

Disturbance to the riparian vegetation during culvert construction is unlikely to be significant in terms of riparian habitat disturbance or loss, as the disturbed area is small and the habitat widespread. Prompt re-vegetation, necessary to minimise erosion, is expected to restore a stable stream or river bank which is likely to be colonised by these species shortly after.

4.6.3.2 Impacts on Fauna

Potential impacts on fauna will include:

- Temporary loss of roadside habitat as a result of vegetation clearance;
- Temporary disturbance of aquatic habitats as a result of disturbance of stream flow patterns and downstream sedimentation;
- Temporary physical disturbance of terrestrial fauna as a result of noise and dust levels.

Impacts on terrestrial fauna are expected to be minor and temporary as the areas affected are already disturbed and the species remaining have adapted to this disturbance over preceding years. Most of these track and roadside areas are currently under garden fallow or "trackside" vegetation. Although these areas offer suitable habitat for several species of bird such as wagtails, fantails and finches and a number of butterflies and other insects, this type of habitat is common and widespread throughout the project area

Impacts on aquatic fauna and flora are also expected to be minor and temporary as any disruption to stream flow patterns during culvert installation will be quickly restored and the potential impacts of downstream sedimentation will be controlled by the rigorous application of sedimentation control measures at all road reconstruction sites adjacent to or crossing watercourses.

At the present time, the proposed road reconstruction program does not pose a significant threat to the habitats in these areas, providing all parties comply with the OPIC Guidelines of 1998, which prohibit the cutting of forest areas for planting with oil palm, and that any road realignments in areas with a Site Sensitivity Status of 1 or 2 are subject to an expert survey of conservation status and value along the proposed new alignment.

4.6.4 Environmental Enhancement of Habitat Values

The establishment of buffer zones, the replanting of roadside verges and the restoration of gravel extraction sites and other working areas offers the opportunity to enhance local habitat values by selective planting of particular high conservation value species such as food plants and open canopy trees which provide a wider range of habitat niches than herbaceous shrubs and bushes.

For example, in Oro Province, the caterpillar of the Queen Alexandra's Birdwing Butterfly (QABB) feeds exclusively on a food-plant vine, *Pararistolochia dielsiana*. Some of these vine seedlings could be planted at re-vegetated sites as a means of extending the potential range of the QABB. However, these vines will only thrive in partial shade, so including them in a re-vegetation program would only be worthwhile at shady sites with adjacent tree cover.

If such a QABB habitat enhancement program were to be pursued, it should be carried out in accordance with the findings of the Oro Conservation Project regarding the habitat preferences of the QABB. Adult QABB are nectar feeders, feeding on the flowers of *Instia bijuga*, *Albizia falcata* and *Kleinhovia* spp, as well as the bushes *Hibiscus*, *Bougainvillea*, *Ixora* and the lilac *Ipomea* (Mercer 1999). The caterpillars feed exclusively on *Pararistolochia dielsiana* vine. A habitat enhancement planting program should address both these QABB stages by planting the trees and bushes as well as the food-plant vine.

The work by Mercer indicated that relatively high densities of *Pararistolochia dielsiana* were preferred (< 100 vines / ha), so a minimum 10 vines per 100m roadside should be planted, preferably in the most shady roadside locations along each 100m section, and set back from the road along the tree line. *Bougainvillea*, *Ixora*, *Hibiscus* and the lilac *Ipomea* could be planted along the roadside.

The inclusion of open canopy forest tree species in re-vegetation programs, particularly in the disturbed areas such as "dry" gravel pits and other working areas would enhance the habitat values of the area by providing a greater

diversity of species than currently exists. However this must be carried out in consultation and agreement with the landowner(s) concerned.

4.7 Air Quality

Potential impacts on air quality will be limited to:

1. Dust emissions from the wind erosion of exposed soil surfaces during vegetation clearance operations associated with the preparation of new oil palm blocks, road re-construction and earthworks operations (road cuttings and embankments);
2. Possible dust emissions from gravel sorting and screening operations and from stockpiles and spoil-heaps; and truck movements during earthworks.

4.7.1 Dust Emissions

Dust emissions from the wind erosion of exposed soil surfaces during vegetation clearance operations on new oil palm blocks will be minimised by applying mulches (from the cleared vegetation) and the rapid planting of protective ground-covering plants before the planting of the oil palm seedlings.

Dust control measures may be employed at all road reconstruction sites by the road constructing contractors as directed by the Environmental Officer. These will include site dust suppression by water spray and the application of the erosion control measures described in Section 4.3.1.2. Similar dust control measures will be employed at all gravel extraction sites. Gravel sorting and screening plant will be installed with dust suppression screens and curtains to minimise the aerial mobilisation of dusts and fines. All stockpiles and spoil-heaps will be sited in sheltered locations or covered to minimise the aerial mobilisation of dusts.

4.7.2 Pesticides and Fertilisers

No insect idea sprays or fertiliser sprays are used in OPIC smallholder operations. Herbicide (glyphosate – only) is used under the direction and control of PNGOPRA in each case (see Integrated Pest Management Plan for details (ECMMP #3).

4.7.3 Vehicle Exhaust Emissions

Vehicle exhaust emissions during road construction will be of a temporary nature in any one location and will not reach concentrations which pose a risk of significant adverse impacts over this short period of time. Once the roads are operational, the frequency of harvest truck movements will not be sufficient for their exhaust emissions to cause adverse effects on air quality.

4.8 Noise

Noise impacts will arise from the road reconstruction machinery and from the gravel extraction, sorting and screening. In both cases these operations will be limited to normal working hours (7.30 a.m. to 5.00 p.m.) and so will not cause disturbance during the evening or night-time. Smallholders and local people will be informed prior to the commencement of any works. Noise management will take the form of maintaining road construction and gravel extraction, sorting and screening equipment in good order.

4.8.1 Noise from Road Reconstruction

In the case of road reconstruction, noise impacts will be temporary in nature in any one location as the road construction advances and will not be of an intensity which causes significant adverse impacts over this short period of time. Furthermore, given the landowners desire for the construction of the roads and the short-term nature of the impacts, it is considered unlikely that noise impacts will result in any stated public nuisance.

4.8.2 Noise from Gravel Sorting and Screening

Although gravel extraction itself generates no more noise than other vehicle movements, the sorting and screening operations can generate higher noise levels. As these sorting and screening operations may be operating at any one site for several months, this may cause some minor disturbance to nearby families. For this reason, all gravel sorting and screening plant must be located a minimum 100 metres from the nearest inhabited dwellings.

4.9 Cultural & Archaeological Sites

The establishment of new oil palm block sites and the re-alignment or widening of roads during reconstruction and upgrade has the potential to impact on sites of cultural, historical or archaeological importance. This impact can be direct, where the site is disturbed or damaged, or indirect, where access to or use of the site is adversely affected, disrupted or rendered inaccessible or unusable.

The survey and inspection of all proposed new oil palm block sites must include an investigation to identify and evaluate whether there are any cultural, historical or archaeological sites of importance within the block area itself or within a 100 metre perimeter of the block. The investigation should consist of enquiries amongst local landowners, particularly the local elders and clan chiefs, and assessments of any records (such as church records and Lands' Department records) to identify any possible sites of significance or note. If any possible sites of note are found, these should be referred back to the landowners, local elders, clan chiefs and to the District and Provincial Lands Officers for their comment, evaluation and decision on the endorsement of the proposed block application.

Where archaeological / historical objects or sites are uncovered during the course of new block clearance or road reconstruction, work will cease and the PNG National Museum and Art Gallery will be contacted for advice. Local and Provincial agencies such as churches, schools, and any historical societies or authorities (local experts) should also be contacted for advice and assistance.

4.10 Public Disruption and Safety

The risk of public disruption and to safety is unlikely to arise from any new block establishments or replanting operations, but the reconstruction of the roads does pose a risk. However, it is considered unlikely that there will be any concerns raised by oil palm growers or other landowners during the road reconstruction as they all stand to benefit from the improved access to markets and government services that these upgraded roads will provide.

The process of consulting with all affected landowners and getting them to sign an agreement prior to construction should further help to ensure that there are few land disputes or landowner complaints once construction starts.

Care will be taken in the site planning and throughout road reconstruction work to minimise disruption to the local communities from noise and dust, and maintain access to gardens, foot-tracks and the upstream riverbanks.

OPIC field officers in collaboration with the contractor will conduct public safety awareness programs at village meetings and in the local community school(s) to ensure that all are fully informed of issues of public safety and public health.

In particular, the need to restrict access to any dangerous sites such as gravel extraction pits and stormwater sumps, and to equipment and hazardous materials that characterise such construction sites must be explained and discussed in detail. These health and safety awareness programs must also cover the downstream effects of the construction works on water quality and the risk to public health from entering these waters during the construction period. This may require identifying alternative water supplies for any river-water users that may be affected by the decline in downstream water quality as a result of the construction works.

Stagnant water in depressions that result from road reconstruction works may provide habitats for the breeding of mosquitoes and other disease vectors. Such areas will be kept to a minimum as part of general site management procedures.

The accommodation of workers in villages during the construction phase could potentially lead to the spread of HIV/AIDS if adequate measures are not taken. Construction supervisors will ensure that workers and villagers are made aware of the potential hazards and that condoms are made available to workers.

4.11 Occupational Health and Safety

During reconstruction of the roads, a potentially hazardous environment will be presented to workers and the local community. These potential impacts will be managed by providing safe and hygienic construction sites and through the provision of appropriate training (ie induction) on safe work practices to all workers. The induction will include awareness-raising in relation to HIV / AIDS (see above). Appropriate warnings and safeguards will also be installed to ensure that no accidents occur.

5. ENVIRONMENTAL CONTROL MEASURES and MONITORING PROGRAMS

Project Environmental Control Measures and Monitoring Programs (ECMMPs) provide concise instructions on how to conduct the avoidance strategies and implement the mitigation measures previously described, and the monitoring requirements with concise instructions on the conduct of each monitoring program and the evaluation of the monitoring results. The ECMMPs, detailed in this section of the EMP, comprise objectives, methods of control, monitoring requirements and responsibilities.

5.1 Environmental Personnel

The project will require two (2) dedicated environmental personnel. Each oil palm province will need to have an **Environmental Officer** attached to the OPIC office in the province that will carry out the environmental management and monitoring of project activities in the province.

The **Environmental Officer** based in each province will be responsible for:

1. Preparing and implementing an Annual Environmental Management and Monitoring Plan that will provide a realistic scheduling and cost estimates of all provincial environmental monitoring visits, reporting requirements and other environmental activities that may be undertaken during the coming year;
2. Monitoring the effective implementation of the ECMMPs for the identification and clearance of new blocks by OPIC Land Officers and by Block Owners;
3. Monitoring the effective implementation of all the road reconstruction ECMMPs by each road contractor at each site;
4. Conducting regular environmental monitoring programs at sites assigned Site Sensitivity Status 1 or 2, and at any other sites at which there is a risk of off-site impacts to sensitive environments or conservation values in order to evaluate the effectiveness of the ECMMPs and identify any improvements or adjustments required
5. Evaluate and comment on the Weekly Environmental Report Forms submitted by each road contractor;
6. Prepare the monthly Environmental Monitoring Report specifically commenting on:
 - a. Compliance with the ECMMPs for the identification and clearance of new blocks;
 - b. Each road contractor's compliance with the road reconstruction ECMMPs at each site;
 - c. The parameters monitored and the findings obtained from the regular environmental monitoring programs conducted at each site assigned Site Sensitivity Status 1 or 2, and at any other sites at which there is a risk of off-site impacts to sensitive environments or conservation values by the Environmental Officer;

- d. The evaluation of the Weekly Environmental Report Forms submitted by each road contractor;
 - e. Any other environmental issues or concerns that have arisen during that month.
7. Submit the monthly Environmental Monitoring Report to the OPIC Regional Manager and the SADP Manager.

The Project will conduct a twice yearly environmental audit of project operations using the services of an independent consultant in association with two officers from the department of DEC.

The **Environmental Consultant** will be responsible for:

1. Managing and monitoring the effective application of the Environmental Control Measures and Monitoring Programs set out in this E.M.P. by carrying out twice yearly monitoring visits to each province to:
 - a. Advise and assess the performance of the provincial Environmental Officers in their monitoring of the ECMMPs;
 - b. Provide regular "on-the-ground" technical assistance and support at field sites to the Environmental Officers in their monitoring to ensure that the ECMMPs are applied effectively and that the monitoring programs are capable of identifying any unforeseen impacts and any additional mitigation measures required;
 - c. Provide comment and advice to the Environmental Officers and the SADP Manager on the road contractors' Weekly Environmental Report Forms and the Environmental Officer's monthly Environmental Monitoring Report, specifically commenting and advising on appropriate courses of action for any non-compliance or unforeseen impacts or issues which may have arisen;
2. Provide technical advice on all aspects of the environment, including specific Environment and Conservation issues and concerns, to the Project Management Team and to the OPIC management at regional and national level;
3. Prepare and submit an Environmental Report to the OPIC Regional Manager and the SADP Manager after each visit covering:
 - a. The findings of the Environmental Consultant's provincial monitoring visits and the actions taken to address these, specifically commenting on any follow-up actions from the findings of earlier visits and any unforeseen impacts or issues that have arisen, and how these are being addressed;
 - b. A summary and appraisal of the Environmental Monitoring Reports from each provincial Environmental Officer, specifically commenting on any issues raised and how these are being addressed;
 - c. Review and commentary on any environmental or conservation issues that have arisen during the past six months and how these are being addressed;

- d. Review and commentary on any ongoing environmental or conservation issues that have arisen earlier and how these are being addressed;
 - e. The environmental performance of the project, noting where non-compliance with this E.M.P. has occurred, the causes of such non-compliance, the mitigation measures and monitoring procedures taken to address the non-compliance, and the effectiveness of the actions taken.
- 4. Carry out inspections of disputed areas proposed by Landowners for Oil Palm development.
 - 5. Provide Environment & Conservation training as needed to Environmental Officers and other identified officers.

5.2 New Blocks

All applications to develop new oil palm blocks will be reviewed by the relevant OPIC Lands Officer. This review should include a consideration of each block's adjacent areas (up to 100 metres beyond the block boundaries) to determine whether development of the block poses a risk to any environmentally sensitive areas or areas which may contain critical habitats or conservation values. The review should also assess any risk to sensitive areas from gardening or other activities displaced from the proposed Oil Palm block.

The principle objectives of this review are:

- 1. To classify the proposed block area and the surrounding areas within 100 metres of the proposed block's boundary according to its Site Sensitivity Status as described in Section 4.6.1.;
- 2. To determine the proximity of any remnant forest areas, wetlands or swamps in the vicinity and assess whether the development of the block poses a threat to these and how these threats can be mitigated;
- 3. To identify any environmental risks or constraints relating to the soils, nearby streams and other water-bodies, adjacent natural vegetation and land uses.

Where the survey clearly indicates that the proposed block is classified as Site Sensitivity Nil, that is significantly modified vegetation, and where it indicates there is no threat to remnant forest areas, wetlands or swamps, or any environmental risks or constraints that cannot be easily mitigated, the application to develop the block for oil palm can be granted.

Where the review determines that the Site Sensitivity Status of the proposed block or the surrounding 100 metres cannot be reliably determined, or where the development of the proposed block poses a threat to a remnant forest area, wetland or swamp, the block should be assigned to Site Sensitivity Status 1 and the application to develop the block should be declined, in the first instance. Under these circumstances the block owner may request for an expert survey which will be carried out by an inspection which will be carried out by the Environment Officer.

If this inspections cannot clearly identify a conservation value that would be affected by the development, or a substantive threat to a remnant forest area, wetland or swamp, the block area should be reclassified Sensitive Site Status Nil, and the application to develop can be granted. If this inspection identifies a conservation value or substantive environmental threat, this must be recorded and documented by the Environmental Officer and the area must be reclassified as Sensitive Site Status 2 and cannot be developed for oil palm.

Sensitive Site Status 2 areas also include areas where the conservation value is statutorily recognised and the area has been gazetted as having conservation or protection value. Examples of Sensitive Site 2 areas include Wildlife Management Areas, Parks and other gazetted reserves. These areas cannot be developed.

Once the survey has been conducted and the experts are agreed that the area is designated Sensitive Site Status Nil, the application can proceed.

The Environmental Officer will provide training and advice to new block owners and operators on the clearance plan, in particular:

- the importance of clearing the block area in stages to minimise the area of exposed soil at any one time in order to reduce the risk of erosion;
- the layout and scheduling of these stages, in particular where to start and how big each stage should be;
- the need for and layout of the block drainage channels, and how these should be constructed to minimise the risk of channel walls collapsing;
- the location and construction of all drain discharge points into areas of dense ground covering vegetation that will trap sediment in the discharge waters and minimise the risk of any downstream sedimentation;
- the immediate back-covering of exposed soil with a mulch of soft vegetation to reduce exposure and potential erosion;
- the prompt planting of ground-anchoring protective vegetation to stabilise the soil surface;
- how to deal with larger woody vegetation that cannot be mulched or composted.

5.3 Road Reconstruction

The Road Reconstruction ECMMPs will be included in the **Scope of Works for the Road Contractors** engaged in the road reconstruction component of the SADP and all road contractors will be responsible for ensuring that these ECMMPs are strictly complied with by all site personnel at all sites.

Instances of non-compliance will be handled in the first instance by the Environmental Officer who will issue a verbal instruction to comply at the time of the site visit and will follow this up with a written instruction to comply. Continued non-compliance will result in a verbal and written warning to the contractor that

these ECMMPs are contractual conditions and the Terms of Contract he or she has signed and that continued non-compliance could lead to a Breach of Contract action being taken.

All road contractors will complete a weekly Environmental Report Form and submit this to the OPIC Environmental Officer.

The **Environmental Officer** will brief all road contractor(s) on their environmental responsibilities prior to commencement of construction, pointing out that these are Terms of Contract that must be complied with. The Environmental Officer will regularly monitor through site visits, the road contractors' implementation of these ECMMPs and provide a monthly report to the **OPIC Project Manager** outlining each of the road contractors' compliance with these and any key issues that have arisen and the actions taken to mitigate these.

5.4 Environmental Control Measures and Monitoring Programs

The ECMMPs presented in the following pages set out the control measures (means of mitigation) and the monitoring programs that should be adopted for each of the environmental issues identified in this E.M.P.

They provide a concise set of instructions which can be used as the basis for training and induction of OPIC personnel, new block owners, block owners replanting and for road reconstruction contractors. Each ECMMP is a "stand-alone" set of instructions for a particular project component or environmental issue.

ECMMP # 1

IDENTIFICATION and SURVEY of NEW BLOCK AREAS, ROAD RE-ALIGNMENTS and WORKING SITES

Objective

To ensure that no critical habitats or forest areas are disturbed or damaged by the establishment of new oil palm blocks, road realignments or working sites.

Methods

Conduct a review of the Sensitive Site Status of the proposed block:

1. All applications to develop new oil palm blocks must be located within an existing oil palm growing area;
2. A Sensitive Site Status review must be completed by the OPIC Field Officer i on all sites for which an application to develop a new oil palm block has been submitted;
3. Each review area must cover the block area itself and extend into the surrounding areas for at least 100 metres beyond the block boundaries;
4. Where this review determines that the block area and the surrounding 100 metres is of Site Sensitivity Status Nil, approval to develop can be granted.
5. Where this review determines that the block or its surrounding vegetation is of Site Sensitivity 1 and may contain sensitive environments, critical habitats or other conservation values, approval to develop should not be granted.
6. Where approval is not granted the block owner may appeal, in which case an inspection should be carried out to determine whether the block should be assigned a Site Sensitivity Status Nil, in which case it can be developed for oil palm, or whether the block should be assigned a Site Sensitivity Status of 2, in which case it cannot be developed.
7. This expert survey must be carried out by the Environmental Officer.
8. The area will be assessed by the Environmental Officer for its conservation value and potential conservation importance. He/she will evaluate the range and quality of habitats present within the survey area, including any watercourse or water-body that may be present within or adjacent to the survey area. He/she also, record the types and frequency of species observed.
9. Based on His/her findings, the Environmental Officer will classify the proposed block area into one of the three Site Sensitivity Status categories.
10. He/she will also determine the proximity of any remnant forest areas, wetlands or swamps in the vicinity and assess whether the development of the block poses a threat to these and how these threats can be mitigated;
11. He/she will also identify any environmental risks or constraints relating to the soils, nearby streams and other water-bodies, adjacent natural vegetation and land uses;
12. In cases where he/she decides that the proposed block is categorised as site Sensitivity Status Nil and that there is no threat to remnant forest areas, wetlands or swamps or any environmental risks or constraints that cannot be easily mitigated, the application to develop the block for oil palm can be granted.

Site Sensitivity Status Nil	Significantly modified vegetation, characteristically gardens and fallow	Can be developed for oil palm and roads
Site Sensitivity Status 1	Conservation status / value unknown, more detailed expert survey required before any development can be considered	Cannot be developed unless a more detailed expert survey re-assigns the block to Site Sensitivity Status - NIL
Site Sensitivity Status 2	Conservation status known, high or very high conservation value, but area is not formally protected. Conservation value recognised, area is gazetted as reserve, WMA etc.	Cannot be developed Cannot be developed cannot encroach within 100 metres of boundary.

13. In cases where he/she decides the development of the proposed should be assigned to Site Sensitivity Status 2, and the application to develop the block should be declined. Under these circumstances the block owner may request for a second inspection to be carried out by the Environmental Consultant during the 6 monthly audits.
14. If this second inspection cannot clearly identify a conservation value that would be affected by the development, or a substantive threat to a remnant forest area, wetland or swamp, the block area should be reclassified Site Sensitivity status Nil and the application to develop can be granted;
15. If this second inspection clearly identifies a conservation value or substantive threat, this must be recorded and documented by the Environmental Consultant and the area must be reclassified as Site Sensitivity Status 2, and the application to develop must be declined.
16. Once the second inspection has been conducted and the Environmental Consultant has agreed that the area is designated Site Sensitivity Status Nil, the application can proceed and development of the block area can commence (if all other application criteria have been met).

Conduct a Site Sensitivity status review of new road alignment or new off-road working site (excluding established and recently operated gravel extraction sites):

- Where a road realignment of more than five (5) meters displacement is required or indicated, a Site Sensitivity Status survey of the new alignment extending to 10 meters either side of the new alignment and extending the full length of the new alignment must be carried out by the Environmental Officer.
- Where a new off-road working site is required, a Site Sensitivity Status survey of the new site and extending into the surrounding areas for at least 100 metres beyond the proposed site boundaries must be carried out by the Environmental Officer.
- In particular, these two surveys must ensure that points 12 and 13 above are assessed in depth as disturbance and the risk of remote impacts from roads

and off-road working sites will be much greater than from the development of an oil palm block.

Monitoring

In the case of a first inspection, the Environmental Officer will prepare a Survey Report which will summarise the findings of the inspection and the basis of the decision reached. This Inspection Report will include:

1. Location (with grid references) and identification of the proposed block, name and contact details of the block owner, and of the block operator if different to the owner;
2. Detailed map of the survey area (block and 100 meter surroundings) and the adjacent areas;
3. Date and time of the survey and weather conditions at the time of the survey and during the previous 48 hours;
4. Descriptions of the habitat(s) and vegetation found, highlighting and describing in detail any critical habitat(s), including any patches of remnant forest;
5. Full listing of the species found and the numbers (frequency) of each species, highlighting any species of particular conservation value or importance;
6. The proximity of, and any threat to, remnant forest areas, wetlands or swamps;
7. Any environmental risks or constraints relating to soils, nearby streams and other water-bodies, adjacent natural vegetation and adjacent land uses which the survey identified;
8. Effective mitigation measures and monitoring requirements to ensure that these risks or constraints can be completely avoided or managed at a level which will avoid any significant adverse environmental impact(s);
9. The practical feasibility and costs involved of these mitigation measures and monitoring requirements;

Copies of this Survey Report will be kept on file at the OPIC Regional Office and provided to:

- Block Owner;
- Project Office;
- Provincial Administration;

In the case of a second inspection, the Environmental Consultant will prepare the Survey Report in collaboration with the Environmental Officer, the OPIC Regional Manager, the SADP Manager, the representative from the national Department of Environment and Conservation. This Report will follow the same format as a "first" Survey Report (see above) and will summarise the findings of the survey and the basis of the decision reached.

Copies of this second Survey Report will be kept on file at the OPIC Regional Office and provided to:

- Block Owner;
- Project Office;
- Department of Environment and Conservation;

Corrective Action

Where a substantive complaint is received regarding the conduct, quality or findings of the survey, this will be reviewed by the OPIC Regional Manager in collaboration with the Project Management Team. If this review finds there is a substantive cause for complaint, the OPIC Regional Manager with the agreement of the Project Management Team, may enter into negotiations with the complainant to reach a mutually acceptable resolution, or may decide to call in an independent expert to review the complaint before entering into negotiations with the complainant.

Responsible Party

The Environmental Officer, in collaboration with the OPIC Lands Officer, will be responsible for organising the first inspection. The Inspection Report will be prepared by the Environmental Officer.

In the case of a second survey, the Environmental Officer, in collaboration with the OPIC Lands Officer, will be responsible for organising the inspection under the direction of OPIC. The second Survey Report will be prepared by the Environmental Consultant in collaboration with the inspection team.

ECMMP # 2

NEW BLOCK CLEARANCE MANAGEMENT and MONITORING

Objective

To avoid or minimise the risk of off-site environmental impacts from the clearance of vegetation and the preparation of ground on new blocks.

Methods

OPIC field officers and the Environmental Officer will conduct a one-day field training exercise for all new block owners that will cover the following aspects:

1. The new block area will be cleared in stages to minimise the area of exposed soil at any one time and reduce the risk of soil erosion;
2. Each new block owner will prepare a "staged" block clearance plan that will set out the layout and scheduling of each stage taking into account the ground conditions and the nature of the vegetation to be cleared in different parts of the block. This block plan will provide for a 10 meter buffer zone of undisturbed natural vegetation to be retained around the block boundaries;
3. Where a block is close to a permanent creek or stream, or coastal shoreline, lake or swamp, a buffer zone of undisturbed natural vegetation will be retained along the waterside. The width of the buffer zone is prescribed by OPIC: (based on PNG Forest Authority Code of Practise).

STREAM / WATER-BODY CATEGORY	BUFFER ZONE
Permanent stream with bed width > 5m	Undisturbed 50 m Buffer Zone
Permanent stream with bed width 1 – 5 m	Undisturbed 10 m Buffer Zone
Permanent stream of any bed width that is used by the community	Undisturbed 50 m Buffer Zone
Coastal shoreline, lake or swamp	Undisturbed 100 m Buffer Zone

4. Need for and layout of the block drainage channels, and how these should be constructed to minimise the risk of channel walls collapsing or scouring along bends and turn-outs;
5. Location and construction of all drainage channel discharge points into areas of dense ground covering vegetation that will trap sediment in the discharge waters and minimise the risk of any downstream sedimentation;
6. Immediate back-covering of exposed soil with a mulch of soft vegetation to reduce exposure and potential erosion;
7. Prompt planting of ground-anchoring protective vegetation to stabilise the soil surface;
8. How to deal with larger woody vegetation that cannot be mulched or composted (fuel-wood and rough-hewn construction timber).

Monitoring

The Environmental Officer will return to the new block once clearance is complete and the block is ready to be inspected for oil palm planting by the OPIC field officers. The Environmental Officer will inspect the block for:

1. Retention of appropriate buffer zones around the block area;
2. Minimal disturbance / damage to the buffer zones;
3. Adequate drainage channels properly constructed and lined as appropriate;

4. All drainage channel discharge points located at sites where they cannot drain directly into a surface channel or water-course and are directed into areas of dense vegetation;
5. All the soil surface covered with a mulch of soft vegetation and ground-anchoring vegetation planted;
6. Inspection of surrounding areas indicates that there has been no off-site damage or disturbance to vegetation or watercourses.

The Environmental Officer will prepare and file a brief New Block Environmental Inspection Report giving his findings, any follow-up actions required and his recommendation in regard to approving the block for oil palm planting or whether any further actions are required by the block owner before approval for planting is granted.

Corrective Action

Where further actions or remedial measures are required of the block owner before approval for planting is granted, these will be recorded on file in the New Block Environmental Inspection Report and relayed to the block owner, pointing out to him or her that the block will have to pass a second inspection, to be conducted by the Environmental Officer, before approval can be granted.

Responsible Party

The block owner is responsible for the preparation of the new block and compliance with the measures set out above before approval can be granted to provide oil palm seedlings to the block owner for planting.

The Environmental Officer will be responsible for inspecting the block and providing the environmental approval for planting, which will be recorded as a recommendation in the New Block Environmental Inspection Report filed at OPIC Regional Office.

ECMMP # 3

INTEGRATED PEST MANAGEMENT

Objective

To comply with best practice integrated pest management procedures throughout all OPIC operations.

Integrated Pest Management in oil palm in PNG

The diverse array of insect pest taxa attacking oil palm in Papua New Guinea are managed by adherence to the principles of IPM (Integrated Pest Management), using the range of options available, which have maximum effect on the pest and minimum effects on environmental and human health.

The main pests currently likely to cause damage to oil palm in PNG are:

- "Sexava", Orthoptera: Tettigoniidae, (two genera, four species).
- "Stick insects", Phasmida: Phasmatidae, (one genus, two species).
- "Rhinceros beetles and Chafer beetles", Coleoptera: Scarabaeidae, (five genera, at least eight species/sub-species).
- "Bagworms", Lepidoptera: Psychidae, (three or four genera). The specific taxonomy of these insects is still unclear.
- "Rats", (Rodentia, Muridae), (one genus and 3-4 species).

Effective management of invertebrate and vertebrate pests requires strict adherence to the following procedures to ensure that their control follows best practice requirements of ISO14,001 and RSPO.

1. Monitoring and Reporting

Routine and thorough monitoring is essential in the management of pests of oil palm.

Any pest damage sighted by OPIC extension officers (EO) during their visits to growers must be reported immediately to OPIC divisional managers (DM).

All field visits to plantations or nurseries should be considered as being monitoring exercises, and form an important component of these visits.

1.1 Monitoring

- Three transects along harvest path (edge, middle and edge), should be walked while randomly checking palms. This will give a good idea of current levels of pest infestation, which can be recorded as Light, Medium or Severe on the record sheet (Figure 2).
- Damage to the palm fronds is readily seen by looking up into the canopy.
- Damage to younger palms that have been recently planted out is typically caused either to the fronds (leaflets), or to the base of the spear or the roots.
- Samples of any pest species encountered should be collected, and fully labelled (See Figure 1).

1.2 Reporting

A Pest Report Form (available from PNGOPRA - Figure 2) should be completed as accurately and as quickly as possible and returned to PNGOPRA (with pest samples, if collected).

- A map showing the number and location of the block must be attached to the Pest Report Form.

2. **Action taken by PNGOPRA**

- Every reported infestation is visited by staff from PNGOPRA entomology section, or if not, they must be followed up by Extension Staff with guidance from PNGOPRA.
- Following a field visit, PNGOPRA will prepare a "Pest Infestation Recommendations (PestRec)" report (Figure 3). This will provide the recommendations for action to be taken, and should be responded to as soon as possible

3. **Options for Pest Control on Oil Palm** are summarised as follows:

IPM strategies are normally the recommendation made by PNGOPRA. Insecticide treatment of palms is recommended only when the situation has become too serious (i.e. when the levels of damage are considered to have reached an economic threshold, currently accepted at Medium levels of damage - when confirmed by PNGOPRA).

Regular monitoring of the infested area may be recommended by PNGOPRA in certain situations.

IPM recommendations are:

3.1 Biological control

- regular re-distribution of endo-parasitoids (e.g. *Stichotrema*) by PNGOPRA
- distribution of egg parasitoids, (e.g. Hymenoptera, Trichogrammatidae and Encyrtidae), which will have been mass reared by PNGOPRA
- pheromone trapping (e.g. for *O.rhinoceros*, *S.australis*). Traps are placed at 2 traps/ha, at about 2m above ground. PNGOPRA will provide the pheromone.
- use of baculo-virus (e.g. against *O.rhinoceros*) provided by PNGOPRA
- bio-pesticide, *Metarhizium* was tried, but has so far failed to sporulate in the field.
- host-specific fungi used against certain weed species (e.g. *Mikania micrantha*) provided by PNGOPRA.

3.2 Cultural control

- Sanitation (palm pruning, and removal of dead fronds, maintenance of frond rows), clearance of palm circles, and weed reduction.
- Establishment of nectar producing plants to encourage natural enemies.
- Encouragement of cover crop growth (e.g. *Pueraria*, *Calopogonium*).

3.3 Physical control

- Hand picking of pest insects from all the fronds or from younger palms, including those in planting bags.

3.4 Chemical control

Insecticide treatment is used only in serious situations of high pest densities at economic damage levels. Guidance is available from PNGOPRA on best practice methods for the handling and use of insecticides for trunk injection (OPRATIVE Word #3), and for Trunk injection procedures (OPRATIVE Word #9).

Insecticide treatment of infested palms is only undertaken by trained teams targeting specific trees using trunk drilling and insecticide injection, which permits the distribution of the systemic insecticide to the leaflets.

Prophylactic spraying of any oil palms is actively discouraged, and is considered as Non-compliance with respect to the PNG oil palm industry's commitment to RSPO.

4 **Mollusca (snails).**

In PNG the only snail pest is the Giant African Snail (*Achatina fulica*). It is not strictly a pest of oil palm, although it feeds voraciously on the cover crop (e.g. *Pueraria*).

4.1 Monitoring and Reporting

Regular monitoring for this pest is not undertaken; however infestations must be reported to PNGOPRA using the Pest Report Form (Figure 2).

IPM techniques used to control this pest are:

4.2 Biological control

The indigenous flatworm snail predator, *Platydemus manokwari* is regularly found among infestations of young snails.

Children should be encouraged to collect the snails to feed to livestock, especially ducks and pigs.

Snails may be destroyed by simply crushing the shells.

4.3 Chemical control

Baiting using the chemical, methiocarb (a carbamate**) (WHO class 1b), may be used under strict supervision from PNGOPRA in very severe small scale infestations, although such intervention is seldom warranted. Heavy rain will rapidly wash the chemical away.

In small nursery areas, a completely cleared (surrounding) barrier about 1.5m wide, acts effectively to prevent incursion of snails.

NB. ** [carbamates are nerve-transmitter inhibitors and must be handled under strict supervision only].

5 **Vertebrates**

The only vertebrate pests of serious economic importance in PNG are rats/mice (Muridae, *Rattus* spp.).

5.1 Monitoring and Reporting

Extension Officers should undertake visual estimates of damage to the fruits and kernels during the harvesting process. Male flowers may be assessed separately, by simply scoring the damage to spikelets. Pest Report Form (Figure 2) must be completed.

5.2 Control

IPM techniques for rats are limited to Biological Physical and Chemical control techniques.

5.2.1 Biological control

In many countries rats are collected as a food source. This is to be encouraged as long as no form of chemical control was currently being undertaken.

The use of owls (*Tyto alba*) has been recommended on previous occasions, but for various reasons (e.g. killing and accidental poisoning of the birds), it has not gained acceptance in PNG.

Some snakes (e.g. the harmless pythons) are known to feed on rats, and wherever possible should **not** be killed.

Encouragement of other forms of biological control (e.g. the protozoan, *sarco-cystis*) is still experimental.

5.2.2 Cultural control

Rat populations may be reduced, in areas where grass is growing in between palm rows, by rolling the grasses (200litre drums are used commonly in Oro Province on mainland PNG).

5.2.3 Physical control

Encourage children to kill rats in plantations PROVIDED no chemical intervention is taking place.

Trapping is not an option, except for research purposes.

Where infestations are identified, the spreading of EFB should be encouraged to remove sheltering sites for the snails.

5.2.4 Chemical control

Use of rodenticides (rodent poisons).

Chemical control should not be undertaken until damage levels to the developing fruit bunches or male flowers are estimated at above 5%. Before undertaking chemical control advice must be sought from PNGOPRA.

For the effective control of rats, specific bait poisons are used under strict guidance. PNGOPRA will supervise any baiting programme, as the treatment rounds and bait placement are critical and must be carefully monitored.

6 Weeds

There are presently four principal weed taxa that should be **reported** to PNGOPRA if seen:

- *Chromolaena odorata*
- *Sida rhombifolia*
- *Mikania micrantha*
- *Mimosa diplotricha*

Three principal methods of control are used for weeds.

6.1 Biological control

Phytophagous arthropods and fungal pathogens. Intervention using biological agents will be arranged and supervised by PNGOPRA (new projects are starting)..

6.2 Physical control

Growers should be encouraged to remove weed plants from their plantations.

6.3 Chemical control

Herbicide application against weeds must only be undertaken by growers who have been trained in the safe handling and use of herbicides.

Figure 1

Correct labelling of specimens collected.

DO NOT USE BIRO pens for labelling, use PENCIL.

LOCALITY, including Block number:


DATE OF COLLECTION:

COLLECTED BY:

Reference number (to refer to Pest Report Form on **Figure 2**)

Figure 2.

Sexava Report Form



Plantation/Division


Area/Section(s)

Block/Field No(s).


Date reported

Reporting Officer

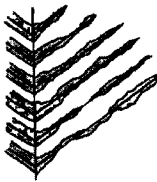
Damage (on average)



Light



Moderate




Severe

Tick box (☑)

Please return this form, fully completed, to OPRA's Snr Entomologist as soon as possible:
 PNGOPRA, Dami Research Station, P.O. Box 97, Kimbe, WNB. Fax 9854040

Sexava Report Form



Plantation/Division


Area/Section(s)

Block/Field No(s).


Date reported

Reporting Officer

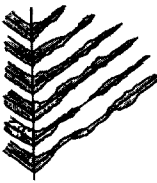
Damage (on average)



Light



Moderate



Severe

Tick box (☑)

Please return this form, fully completed, to OPRA's Snr Entomologist as soon as possible:
 PNGOPRA, Dami Research Station, P.O. Box 97, Kimbe, WNB. Fax 9854040

Figure 3.

To:

.....

.....



Sexava: Outbreak report and recommendation form

Plantation/Division	Date reported
Area/Section	Date visited
Field/Block No.	Visited by
Species present	Date of report

Level of damage	Light	Moderate	Severe
	✓		

Recommendation:

The damage in the area shown on the attached map is light, so chemical control at this time is not recommended. The area will be monitored on a regular basis by Entomology Section and further recommendations made if necessary.	✓
Only immature adults and/or nymphs are present and no eggs were found in the ground. A single trunk injection* is recommended for the areas marked on the attached map. A second round of control is not necessary. Estimated date of egg laying starting: If control is not done by this date a second treatment may be required	
There are mature adults in the area and eggs are being laid. An immediate first trunk injection* is recommended for the areas marked on the attached map. Any delay will mean more eggs in the ground and an increased chance of having further outbreaks. Entomology section will monitor the area and recommend when the second treatment should be done	
The area has been monitored since the report and damage has now reached a point where control is necessary. A first trunk injection* is recommended for the areas marked on the attached map. Entomology section will monitor the area and recommend whether a second treatment should be done	
The area has been monitored since the first trunk injection and a second treatment is not required yet. Entomology will continue to monitor the area and recommend when the second treatment should be done	
The area has been monitored since the first trunk injection and it is now recommended that a second treatment* be done in the areas marked on the attached map	

* Recommended dosage of methamidophos (60% W/V SL) is 10ml per palm, placed into a single 1.5cm diameter hole, 15cm deep and drilled at a 45° angle into the trunk, 1m above ground. The hole must be plugged with a wooden stake.

Parasitoid releases

Egg parasitoids *L. bicolor* will be/have been released into
 *D. leefmansia* the area on:
 Stichtotrema infected sexava will be/have been released in the area on:

Additional comments:

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TREATMENT AUTHORISATION: DEC approves the importation of methamidophos into PNG under the strict conditions that: a) it is for the sole purpose of controlling oil palm pests by trunk injection, b) that the treatment is carried out by supervised and trained treatment teams, and c) that the treatment is in strict accordance with authorised PNG OPRA recommendations. This form, and the attached map of areas to be treated, constitute PNG OPRA's authorised treatment recommendation; any deviation from these recommendations will constitute an offence and will be reported to DEC.

Inspecting Officer: Authorised by:

cc: DoR - Dami, Snr Entomologist - Dami

Tick or fill in relevant box.

ECMMP # 4**ROAD RECONSTRUCTION;
EROSION CONTROL MANAGEMENT and MONITORING****Objective**

To minimise the erosion of soil from sites.

Methods Of Control:

All road contractors will apply the following methods of erosion control. Compliance by the contractor will be regularly checked by the Environmental Officer:

- Minimise as far as practicable the time that surfaces remain bare.
- A staged road reconstruction plan will be followed so that road reconstruction and earthworks are completed in stages (100m stages recommended) so that only a minimal area of ground is open or clear at any one time;
- Progressively re-vegetate and mulch disturbed areas as soon as practicable after completion of work;
- Keep vegetation clearing to a minimum and re-vegetate cleared sites, in consultation with the landowner(s);
- On steep slopes, and where otherwise appropriate, clear vegetation using chainsaws so that tree roots can remain to help stabilise slopes;
- Erosion control structures such as stormwater diversion (catch) drains and bunds will be constructed and maintained to temporarily divert stormwater around construction sites;
- Onsite drainage schemes will be constructed and maintained to minimise ponding and uncontrolled runoff;
- Avoid earthworks during high rainfall periods, if possible;
- Side drains (depth 500mm or greater) will be installed along all roads to prevent roadside "ponding" and surface wash;
- Design drains and culverts to remove all runoff water without scour. On steep slopes culverts may need to be stepped using rock slabs or gravel in gabion baskets;
- Ensure major roads to be used by 12-14 tonne trucks have a base of at least 300mm to reduce the need for future rehabilitation;

Monitoring

Monitoring of compliance with these methods of erosion control by the contractor at each site will be carried out by the Environmental Officer and will occur by way of regular (at least once every two weeks) visual inspections to ensure that appropriate control structures have been installed and are operating effectively.

Corrective Action

Where visual inspection identifies that damage has occurred to areas then these shall be rehabilitated. The contractor will be reminded that these form Conditions of Contract and a failure to comply could lead to a breach of contract action being taken.

Responsible Party

Under the terms of the contract, the contractor will be responsible for implementing and self-monitoring the methods of erosion control detailed above. The Environmental Officer will be responsible for monitoring each contractor's compliance with these at all sites.

Enforcement will be through advice and warning to the contractor, and if the failure to comply continues, through the application of Breach of Contract procedures.

ECMMP # 5**ROAD RECONSTRUCTION;
DUST CONTROL MANAGEMENT and MONITORING****Objective**

To minimize the generation of dust at the sites.

Methods Of Control

All road contractors will apply the following methods of dust control. Compliance by the contractor will be regularly checked by the Environmental Officer:

- All exposed / bare soil surfaces are to be mulched and re-vegetated as soon as practicable after clearing;
- A staged road reconstruction plan will be followed so that road reconstruction and earthworks are completed in stages (100m stages recommended) so that only a minimal area of ground is open or clear at any one time;
- During dry weather water spray will be used to dampen reconstruction working surfaces and gravels, newly-laid road surfaces and newly formed roadsides (including newly mulched and re-vegetated roadsides); if so directed by the Environmental Officer.
- A speed restriction of 40 km per hour will be imposed on all gravel haul trucks;

Monitoring

Monitoring of compliance with these methods of dust control by the contractor and / or gravel pit operator at each site will be carried out by the Environmental Officer. This will comprise regular (at least once every two weeks) visual inspections to ensure that appropriate control structures have been installed and are operating effectively.

The Environmental Officer will also enquire of roadside householders (focussing on the women of the households) whether they have experienced any nuisance or concerns regarding dust from passing gravel trucks or the road construction works at each site.

Corrective Action

Where inspection indicates that one or more of the above methods have not been complied with by a contractor or gravel pit operator, the contractor or operator will be reminded that these form Conditions of Contract and a failure to comply could lead to a breach of contract action being taken.

Responsible Party

Under the terms of the contract, the contractor will be responsible for implementing and self-monitoring the methods of erosion control detailed above. The Environmental Officer will be responsible for monitoring each contractor's compliance with these at all sites.

Enforcement will be through advice and warning to the contractor, and if the failure to comply continues, through the application of Breach of Contract procedures.

Objective

To minimise the impact of sedimentation on waterways.

Methods Of Control

All road contractors will apply the following methods of sedimentation control. Compliance by the contractor will be regularly checked by the Environmental Officer:

- Complete reconstruction works and earthworks in stages so that only a minimal area of ground is exposed at any one time;
- Avoid earthworks during periods of high rainfall, if possible;
- Minimise the number of discharge points from the site;
- Construct control structures such as sumps and settlement ponds around drainage points to trap sediment;
- Avoid discharging directly into streams or other water-bodies, or into garden areas. Site stormwater discharges should be constructed with flow breakers and should be located well away from streams and directed into areas of well-established dense vegetation that will disperse the flow over a wide an area as possible to maximise rapid percolation and minimise overland flows;
- Provide silt fences or similar around areas susceptible to erosion;
- Protect construction sites from off-site surface runoff using bunds or trenches in order to minimise the amount of on-site stormwater and ponding;
- Locate stockpiles and spoil-heaps away from any drainage channels or waterways, and contain them with silt fences and containment trenches;
- Do not allow machinery to enter a watercourse unless this is unavoidable;
- Avoid vehicle fording of streams. If this cannot be avoided, the vehicles must be thoroughly washed down, well away from the stream before the vehicle enters it;
- Where weirs and diversion channels are constructed around culvert installation and headwall construction works, the walls must be properly graded and compacted to minimise the risk of collapse and entrainment of sediment in the diversion channel;
- All diversion channel bends should be constructed with as large a radius as possible to minimise the risk of undercutting of the bend walls by the diverted water flow;
- Diversion channel gradients should be minimised as far as practicable and where necessary flow breakers, such as rocks or widening of the channel should be installed / constructed to minimise flow velocities;
- Where culvert headwalls are constructed in-situ (for example winged headwalls), a diversion channel must be constructed so that the concreting works are carried out in the dry. All construction debris and spilt concrete

finer must be removed from the dry site before the flow is restored to avoid any risk of downstream contamination of the watercourse by concrete fines or other construction materials.

Monitoring

The Environmental Officer will conduct regular inspections of all sites to assess the contractor's compliance with the sedimentation control measures set out above.

Where road reconstruction crosses a permanent stream or other permanent watercourse, or where it runs adjacent to a permanent stream or watercourse, the Environmental Officer will carry out a baseline visual inspection of the streambed, water quality (noting any turbidity or colouration of the water and water flow at one or more sites upstream and two or more sites downstream of the construction site before construction commences. In particular the visual inspection will assess and record any differences in the streambed morphology and benthic components between the upstream and downstream sites, and any changes (increase or decreases) in the water turbidity and colouration, and water flow between these sites. These inspections will be carried out on at least two occasions, one of which should be during dry weather conditions and one during or immediately following rainfall.

A field record including observations of water conditions (flow assessments, clarity, colour, odour and the presence of any scums), stream bed, in-stream habitats and streamside habitats, and weather will be made at each site on each occasion.

A second series of inspections will be taken when the road reconstruction site is working. This second series will follow the same format (observations, site location, observation point(s) and time of observations) as the baseline observations set.

A third series of post-construction observations will be taken two weeks after all operations have ceased and the contractor has left the site. This will also follow the same format as the earlier occasions.

Variations in the observed conditions between the locations, between the different occasions within each set, and between sets will be assessed and evaluated by the Environmental Officer, who will prepare a brief inspection report based on the field record. Where variations of greater than 50% are observed between locations within one data set, or between the same locations in different data sets, the Environmental Officer will inform the Road Contractor and instruct and assist him to take appropriate measures to mitigate the perceived impact(s).

Where the Environmental Officer is of the opinion that a more rigorous monitoring of upstream and downstream water quality is required to determine the scale of any potential impacts, he (or she) shall request assistance from PNGOPRA's water quality monitoring program to visit the site and make recommendations in regard to additional water quality monitoring using freshwater invertebrates, and if necessary, conduct this monitoring together with the Environmental Officer. Alternatively the Environmental Consultant may, during the Audit inspections carry out appropriate further monitoring.

Where PNGOPRA do conduct a freshwater invertebrate monitoring program, they will prepare an Environmental Impact Evaluation Report which will describe the extent and scale of any impacts, and make recommendations to mitigate these by advising changes / improvements to the ECMMPs. This Environmental Impact Evaluation Report will be presented to the Environmental Officer, the OPIC Regional Manager and the SADP Manager. A copy of the report should also be forwarded to the independent Environmental Consultant for his / her review and comment.

Stream Invertebrate Monitoring Program –

1. Objective:

Freshwater invertebrates are widely used as indicators of the state of streams and rivers around the world. They are easy to sample, they are usually much more abundant than fish and with experience they are relatively easy to identify. With an understanding of the habitat requirements and tolerance of particular invertebrate types, ecologists can determine much about the condition of stream habitats, and how this is being affected by land use.

Activities in oil palm areas, particularly road construction and vegetation change (from native forest to oil palm) will affect stream habitats, and the degree of impact can be measured by stream invertebrate monitoring. To correctly interpret the results of such monitoring, a database needs to be developed to build an understanding of the stream invertebrate faunas associated with different habitat factors.

2. Data collection methodology – Sampling and Analysis of Samples

Stream invertebrate sampling methods suitable for lowland PNG streams (West New Britain and Oro Provinces) were described by Moore (2006). The "kick sampling" method for stony sites and "sweep sampling" method for soft-bottom sites involve the disturbance of the streambed and collection of fine organic matter in a hand-held net. Samples are preserved with ethanol allowing later identification of invertebrates by suitably qualified biologists in the laboratory.

3. Sampling sites and frequency:

3.1 Numbers of sampling sites:

Moore (2006) analysed lowland stream invertebrate samples from 19 sites in West New Britain and 19 sites in the Oro Province, and the high proportion of frequently-occurring taxa suggests that monitoring of similar numbers of representative sites in each region would be appropriate for the development of long term monitoring program.

3.2 Selection of sampling sites:

Most streams in oil palm areas and in nearby native forest areas are low-gradient, slow-flowing and soft-bedded. Given that these are the streams most likely to be affected by oil palm operations, sampling sites should have an approximate 75:25 percent ratio of soft bottom to hard bottom.

Given that Moore (2006) identified road construction and vegetation clearance as the probable major causes of impacts on stream faunas, sampling sites should include upstream-downstream comparisons of at least two examples of current or recent road construction and at least two examples of recent vegetation clearance in each of the two provinces. Ideally each case study should involve at least one upstream sampling site and two downstream sampling sites, and it will be important to ensure that these sites are of similar habitat type.

3.3 Timing of sampling;

The study of Moore (2006) only involved one-off sampling. To build a robust database these sites should be sampled twice per year for at least two years, and that the sampling dates are timed to reflect any differences in stream condition between dry season and wet season.

4. Summary of proposed monitoring programme

The table below summarises site selection and sampling frequency for a proposed baseline monitoring programme for one region (the same sampling regime could be applied to the West New Britain and Oro Provinces). As outlined above, 75% of sites should be soft bottom.

	Road construction case studies	Land clearance case studies	Effects of established oil palm
No. of sites	2 cases, each with one upstream site and 2 downstream sites	2 cases, each with one upstream site and 2 downstream sites	4 cases each with one site in native forest upstream of an oil palm area, and one site downstream at several hundred metres into an oil palm plantation.
Frequency of sampling	2/year (dry and wet)	2/year (dry and wet)	2/year (dry and wet)
No. of samples involved	12 samples per year	12 samples per year	16 samples per year

The Environmental Officer will also hold regular meetings, with the riparian landowners and other users of the water to obtain their comments on water quality issues. Any substantive comments on tainting or contamination of the water must be recorded and should be followed up with an immediate series of field tests and sampling. The report of this monitoring shall be reviewed by the Environmental Officer, the OPIC Regional Manager and the independent Environmental Consultant, who together shall make appropriate recommendations in regard to any further action, compensation or restitution that is warranted.

This review should identify potential risks and causes of any impacts, and recommend effective remediation measures, either to temporarily contain the problem or to provide an effective long term solution. Temporary remediation may

involve the cessation of works at the site and the expert may identify the need to expand the water quality parameter list or make other changes to the water quality testing program.

Corrective Action

Where inspection by the Environmental Officer indicates that one or more of the above methods of sedimentation control have not been complied with by a contractor, the contractor will be reminded that these form Conditions of Contract and a failure to comply could lead to a breach of contract action being taken.

Where local landowners and other water users express their concern regarding water quality, the road reconstruction site will be inspected and additional methods of control implemented. Where the local landowners and other water users provide substantive comments on water tainting or contamination, additional water quality data will be immediately collected and expert opinion sought (see above).

Responsible Party

Under the terms of the contract, the contractor will be responsible for implementing and self-monitoring the methods of sedimentation control detailed above. The Environmental Officer will be responsible for monitoring each contractor's compliance with these at all sites.

Enforcement will be through advice and warning to the contractor, and if the failure to comply continues, through the application of Breach of Contract procedures.

ECMMP # 7**ROAD RECONSTRUCTION;
GRAVEL EXTRACTION MANAGEMENT and MONITORING****Objective**

To minimize the long term impacts of gravel extraction.

Methods of Control

All contractors operating gravel pits will apply the following methods of control. Compliance by the contractor will be regularly checked by the Environmental Officer:

- the contractor shall prepare a Gravel Extraction Plan for each site providing a staged extraction program and specifying the measures to be taken at each site to minimise erosion and sedimentation of watercourses;
- Where possible, extract gravel from dry gravel pits rather than gravel pits in river channels;
- Where river gravel is extracted, machinery or equipment must not be allowed to enter the water channel, and extraction of gravels should be restricted to no closer than a minimum 5m from the water channel;
- River gravel extraction should only be carried out under low flow conditions and never under high flow conditions;
- Ensure containment of sediment-loaded runoff and contaminants at all quarry sites;
- Employ safety measures to avoid any loss of load from trucks;
- Ensure stability of exposed quarry faces or overburden stockpiles;
- Bund refuelling areas and ensure containment of any oil leaks or spillages;
- Specify means employed to protect the channel banks, avoid discontinuities in the river bed, minimise erosion upstream and sediment loading problems downstream of the quarry site.

Monitoring

The Environmental Officer will conduct regular (at least once every two weeks) inspections of all gravel extraction sites to assess the contractor's compliance with the control measures set out above.

The Environmental Officer will also ensure that regular inspection (at least once a month) of water quality upstream and downstream of the gravel extraction site is carried out throughout the period the site is operating and for at least three (3) months after all gravel extraction operations cease.

This water quality inspection program will be based on and follow a similar format to the monitoring program proposed for the monitoring of sedimentation impacts (see previous).

A baseline series of water quality observations will be conducted by the Environmental Officer prior to extraction operations commencing at the site and will comprise of observations carried out at three locations (one upstream, two

downstream) on at least two occasions (one following a period of dry weather and one during or immediately following rainfall). A field record including observations of water conditions (flow assessments, clarity, colour, odour and the presence of any scums), stream bed, in-stream habitats and streamside habitats, and weather will be made at each site on each occasion.

A second series of inspections will be taken when the road reconstruction site is working. This second series will follow the same format (observations, site location, observation point(s) and time of observations) as the baseline observations set.

A third series of post-construction observations will be taken two weeks after all operations have ceased and the contractor has left the site. This will also follow the same format as the earlier occasions.

Variations in the observed conditions between the locations, between the different occasions within each set, and between sets will be assessed and evaluated by the Environmental Officer, who will prepare a brief inspection report based on the field record. Where variations of greater than 50% are observed between locations within one data set, or between the same locations in different data sets, the Environmental Officer will inform the Road Contractor and instruct and assist him to take appropriate measures to mitigate the perceived impact(s).

Where the Environmental Officer is of the opinion that a more rigorous monitoring of upstream and downstream water quality is required to determine the scale of any potential impacts, he (or she) shall request assistance from PNGOPRA's water quality monitoring program to visit the site and make recommendations in regard to additional water quality monitoring using freshwater invertebrates, and if necessary, conduct this monitoring together with the Environmental Officer.

Where PNGOPRA do conduct a freshwater invertebrate monitoring program, they will prepare an Environmental Impact Evaluation Report which will describe the extent and scale of any impacts, and make recommendations to mitigate these by advising changes / improvements to the ECMMPs. This Environmental Impact Evaluation Report will be presented to the Environmental Officer, the OPIC Regional Manager and the SADP Manager. A copy of the report should also be forwarded to the independent Environmental Consultant for his / her review and comment.

The Environmental Officer will also hold regular meetings, at least once every month, with the riparian landowners and other users of the water to obtain their comments on water quality issues. Any substantive comments on tainting or contamination of the water must be recorded and should be followed up with an immediate series of field tests and sampling by the PNGOPRA water quality monitoring program, and the report of this monitoring shall be reviewed by the Environmental Officer, the OPIC Regional Manager, the SADP Manager and the independent Environmental Consultant, who together shall make appropriate recommendations in regard to any further action, compensation or restitution that is warranted.

This review should identify potential risks and causes of any impacts, and recommend effective remediation measures, either to temporarily contain the problem or to provide an effective long term solution. Temporary remediation may

involve the cessation of works at the site and the expert may identify the need to expand the water quality parameter list or make other changes to the water quality testing program.

Corrective Action

Where inspection by the Environmental Officer indicates that one or more of the above methods of control have not been complied with by a contractor operating the gravel pit / extraction site, the contractor will be reminded that these form Conditions of Contract and a failure to comply could lead to a breach of contract action being taken.

Where local landowners and other water users express their concern regarding water quality, the gravel extraction site will be inspected and additional methods of control implemented. Where the local landowners and other water users provide substantive comments on water tainting or contamination, additional water quality data will be immediately collected and expert opinion sought (see above).

Responsible Party

Under the terms of the contract, the contractor operating the gravel pit / extraction site will be responsible for implementing and self-monitoring the mitigation measures and methods of control detailed above. The Environmental Officer will be responsible for monitoring each contractor's compliance with these at all sites.

Enforcement will be through advice and warning to the contractor, and if the failure to comply continues, through the application of Breach of Contract procedures.

ECMMP # 8

ROAD RECONSTRUCTION; VEGETATION MANAGEMENT and MONITORING

Objective

To ensure minimal removal of native and productive vegetation cover.

Methods Of Control

All road contractors will apply the following methods of measures of vegetation management. Compliance by the contractor will be regularly checked by the Environmental Officer:

- Ensure that no vegetation is removed without prior approval of the Environmental Officer;
- Minimise the damage to or removal of isolated mature trees. These may only be cut or removed with the prior approval of the Environmental Officer ; and relevant landowners.
- Obtain advice and approval from the Provincial Wildlife Officer prior to the removal of disturbed forest vegetation along roadsides on the Popondetta Plains that may be considered important for the Queen Alexandra's Birdwing Butterfly. Do not remove vegetation where the QABB foodplant vine *Parastilochia dielsiana* vines (samples will need to be occasionally verified with an appropriate expert) exist along roadsides;
- Obtain advice and approval from the Provincial Wildlife Officer, a local NGO active in the field of conservation (such as The Nature Conservancy in West New Britain) or a recognised expert before removing disturbed forest vegetation along roadsides in other oil palm provinces;
- Avoid the burning of removed vegetation. Where possible, mulch cleared vegetation and use in rehabilitation;
- Re-vegetate, or promote natural re-vegetation, of all cleared areas as soon as possible after completion of earthworks in consultation with the landowner(s). Re-vegetate with appropriate species, including "open-canopy" tree species and native bushes (and the *Pararistolochia dielsiana* vine in Oro Province) to minimise erosion and weed invasion and improve habitat values for certain species (including the QABB in Oro Province);
- Where possible, maintain cleared native and productive vegetation and soils in good condition so that they can be used in the direct rehabilitation associated with completed road sections.

Monitoring

Regular monitoring shall be undertaken by the Environmental Officer by way of weekly (at least) visual inspection to ensure that vegetation management measures are complied with, in particular that all vegetation clearance is minimised and that cleared areas are revegetated as soon as possible after completion of construction.

Corrective Action

Where visual inspection identifies that damage has occurred to areas then these shall be rehabilitated. The contractor will be reminded that these form Conditions of Contract and a failure to comply could lead to a breach of contract action being taken.

Any complaints regarding vegetation removal shall be immediately investigated by the Environmental Officer and where the removal contravenes the measures specified above, the Environmental Officer shall refer the matter to the OPIC Project Manager for his consideration and deliberation on what action will be taken to remedy the situation and ensure it does not re-occur.

Responsible Party

Under the terms of the contract, the contractor will be responsible for implementing and self-monitoring the vegetation management methods detailed above. The Environmental Officer will be responsible for monitoring each contractor's compliance with these at all sites.

Enforcement will be through advice and warning to the contractor, and if the failure to comply continues, through the application of Breach of Contract procedures.

ECMMP # 9**ROAD RECONSTRUCTION;
PUBLIC DISRUPTION AND SAFETY MANAGEMENT and
MONITORING****Objective**

To minimise disruption to communities during construction.

Methods Of Control

All road contractors will apply the following measures to minimize public disruption and ensure public safety. Compliance by the contractor will be regularly checked by the Environmental Officer:

- Inform local authorities and local landowners of project plans, works schedule and location of proposed works;
- Maximise opportunities for local employment associated with construction activities;
- Include women's and other community groups in project activities;
- Ensure that previously identified cultural sites are not disturbed;
- Where objects of archaeological or historical importance are located during construction works, cease construction work and notify the Engineer who will in turn notify the PNG National Museum and Art Gallery;
- Where possible, program work such that high noise levels occur during times of least impact (i.e. during normal working hours avoiding Saturdays and Sundays);
- Minimise noise impacts by maintaining construction equipment in good order;
- Discuss with externally-sourced construction workers the need for considerate and safe behaviour while located in the area;
- Raise awareness amongst landowners / villagers of HIV/AIDS.

Monitoring

Regular monitoring shall be undertaken by the contractor and the Environmental Officer by way of discussions with local residents, with a particular focus on the women, youth and elderly, to ensure that communities are not unduly affected by construction activities and that all local people are aware of the safety risks and the appropriate measures they should take to avoid injury or accident.

Corrective Action

Any complaints from the community will be investigated and action taken, if necessary, to minimise the specified disruption.

Where inspection or substantiated complaints indicate that one or more of the above measures have not been complied with by a contractor or gravel pit operator, the contractor or operator will be reminded that these form Conditions of Contract and that a failure to comply could lead to a breach of contract action being taken.

Responsible Party

Under the terms of the contract, the contractor will be responsible for implementing and self-monitoring the measures to minimise public disruption and ensure public safety detailed above. The Environmental Officer will be responsible for monitoring each contractor's compliance with these at all sites.

Enforcement will be through advice and warning to the contractor, and if the failure to comply continues, through the application of Breach of Contract procedures.

Objective

To provide and maintain a clean and safe working environment.

Methods Of Control

All road contractors will apply the following methods of general site management to maintain a clean and safe working environment. Compliance by the contractor will be regularly checked by the Environmental Officer:

- Provide and maintain adequate warning signs at construction site boundaries;
- Maintain materials used for vehicle maintenance and repair in a clearly marked and secure area;
- Spray water on exposed surfaces, resulting from construction works, during dry periods and stabilise disturbed areas as soon as practicable to prevent dust problems;
- Wet any spoil loads being carried in open trucks in dry weather;
- Operate and maintain plant and equipment in accordance with manufacturer's instructions;
- Provide an impervious and bunded area for oil and fuel transfer and cleaning of equipment and vehicles;
- Minimise waste generated through reduction, reuse, recycling and composting;
- Prior to removal from site, store all waste in suitable areas/receptacles to prevent hazards such as fires, attraction to vermin or dissemination of dust;
- Dispose of all inorganic construction waste at a Council-designated dump site;
- Remove all disabled machinery from the project site;
- Ensure adequate sanitation is provided for construction workers and that it does not contaminate groundwater;
- Minimise depressions and screen areas of standing water to reduce potential for mosquito breeding;
- Ensure occupational health and safety measures and equipment are in place on construction sites and that workers receive appropriate training/induction (including in HIV / AIDS).

Monitoring

Regular monitoring shall be undertaken by the Environmental Officer by way of weekly (at least) visual inspection to ensure that all construction sites fully comply with the measures specified above.

The Environmental Officer will also enquire of local residents, with a particular focus on women, youth and the elderly, whether they have experienced any nuisance or have concerns regarding the construction site and its operations.

Corrective Action

Any complaints from the community will be investigated and action taken, if necessary, to minimise the specified disruption.

Where inspection or substantiated complaints indicate that one or more of the above measures have not been complied with by a contractor or gravel pit operator, the contractor or operator will be reminded that these form Conditions of Contract and that a failure to comply could lead to a breach of contract action being taken.

Responsible Party

Under the terms of the contract, the contractor will be responsible for implementing and self-monitoring the general site management measures detailed above. The Environmental Officer will be responsible for monitoring each contractor's compliance with these at all sites.

Enforcement will be through advice and warning to the contractor, and if the failure to comply continues, through the application of Breach of Contract procedures.

ECMMP # 11**ROAD RECONSTRUCTION;
COMPLETION OF ROAD RECONSTRUCTION or OTHER
SITE WORKS MANAGEMENT and MONITORING****Objective**

To ensure that all completed construction works and site works, including gravel extraction works are left in a safe, stable and environmentally secure condition.

Method

All contractors and gravel site operators will apply the following methods at the completion of all works and site closure. Compliance by the contractor / site operator will be checked by the Environmental Officer before a Practical Completion Certificate and final payments are made:

1. contractor will undertake rehabilitation of any works sites, including gravel pits, storage sites and access routes;
2. contractor will remove all wastes, debris and disabled (non-repairable) machinery to designated approved disposal sites;
3. contractor will grade the site to a stable form;
4. contractor will re-vegetate the site as appropriate and as agreed with the landowner(s) at the earliest opportunity to prevent erosion;
5. progressive rehabilitation will occur along the road corridor as work progresses.

Monitoring

The Environmental Officer will inspect the site when notified by the contractor or site operator of completion of works and site closure. If the contractor has fully complied with all the above measures, and if the site is in a safe, stable and environmentally secure condition, OPIC will issue a Practical Completion Certificate to the contractor and arrange final payments (subject to any retentions that may be held under the contract).

Corrective Action

Where the inspection indicates the contractor has not fully complied with all the above measures, or where the site is not in a safe, stable and environmentally secure condition, the contractor will be advised to comply before a Practical Completion Certificate is issued and before final payments will be processed.

Responsible Party

The Environmental Officer will be responsible for monitoring the completion of works and site closure. The Environmental Officer's approval is required before a Practical Completion Certificate is issued and before final payments are processed.

6. INSTITUTIONAL STRENGTHENING AND CAPACITY BUILDING

6.1 Introduction

This section proposes a framework to strengthen OPIC's capacity to manage, monitor and control through effective mitigation the environmental effects of smallholder oil palm developments in Papua New Guinea. It does not address the management, monitoring or control of the environmental effects of the oil palm milling or associated activities such as the treatment of mill wastes or the transport of fresh fruit bunches and products, as these are the responsibility of the mill operators operating under Department of Environment and Conservation issued Environmental Permits. OPIC's responsibilities are understood to be:

- to promote, support and enhance the smallholders' production of oil palm fruit;
- to maintain and improve the transport infrastructure (roads) that service the smallholder blocks.

To date, OPIC has not had the capacity to routinely manage and monitor the environmental effects of smallholder oil palm development or the construction and maintenance of the road infrastructure. Where environmental issues have arisen in the past, these have been addressed on an ad hoc basis, at times by PNGOPRA and at times by the employment of external consultants.

6.2 Capacity Development and Training

This project offers the opportunity to establish an effective and sustainable environmental management and monitoring capacity within OPIC, with an environmental office and officer at each OPIC Regional Centre.

This capacity will be developed in OPIC by the SADP funding an Environmental Officer and providing an environmental office and equipment at each of the OPIC Regional Centers for the duration of the SADP. At project completion, these officers will become part of the OPIC establishment at each Regional Centre.

Although these Environmental Officers will have an environmental qualification and some limited experience, they will need on-the-job training and personalised skills development programs before they are able to perform all the tasks required to conduct all the activities set out under each ECMMP and to maintain an effective program of environmental management and monitoring plus conservation assessment and management techniques in their province. This initial on-the-job training will be conducted by an Environment and Conservation consultant who will be recruited under the SADP. The consultant will provide a training completion report to the OPIC Regional Manager and the SADP Manager at that time.

In the second year the focus of training and skills development will be the identification and development of additional skills and knowledge specific to that particular province's environmental situation.

Preferably this training will also be conducted by the same consultant who conducted the first year's training. This will not only provide continuity and consistency to the training, but also the familiarity with the local issues that the consultant will develop during the first year will provide a sound basis for developing and delivering in the most effective manner the second year's training. At the end of this second year, the consultant trainer will provide a training completion report to the OPIC Regional Manager and the SADP Manager at that time.

Although primarily focused on the Environmental Officer in each region, the OPIC road engineers recruited should also attend all the training programs in order to gain familiarity and competency with the practical implementation of the ECMMPs required under this EMP. These road engineers will be visiting and inspecting every road construction and road re-alignment site much more frequently than the Environmental Officer and it will be clearly cost effective if they are able to inspect and advise the roads contractors on the proper and effective implementation of these ECMMPs. This is vital if sound environmental practices are to be routinely and consistently implemented at every road construction and road re-alignment site.

6.3 Institutional Strengthening Requirements to Implement the E.M.P.

6.3.1 Environmental Activities

The following activities will need to be implemented under the SADP in all project areas in order to fulfill the requirements of the E.M.P.:

1. Sensitive Sites Status Review of all new block applications;
2. Environmental inspection of new blocks, monitoring of compliance with the relevant ECMMPs (# 1, 2, and 3), reporting of compliance and the management of any follow-up actions such as remediation measures that may be required;
3. Environmental inspection of road reconstruction sites, monitoring of compliance with the Road Reconstruction ECMMPs, reporting of compliance and the management of any follow-up actions that may be required;
4. Environmental inspection of gravel extraction sites and other working areas, monitoring of compliance with the relevant ECMMPs, reporting of compliance and the management of any follow-up actions that may be required;
5. Water quality monitoring (visual observations, augmented as necessary by PNGOPRA water quality monitoring using freshwater invertebrates) of waterways adjacent to new and replanted blocks where fertilizers are

being applied, evaluation and reporting of results and the management of any follow-up actions that may be required;

6. Water quality monitoring (visual observations, augmented as necessary by PNGOPRA water quality monitoring using freshwater invertebrates) of waterways crossed by or adjacent to road reconstruction sites, evaluation and reporting of results and the management of any follow-up actions that may be required;
7. Water quality monitoring (visual observations, augmented as necessary by PNGOPRA water quality monitoring using freshwater invertebrates) of waterways adjacent to gravel extraction sites and other working areas, evaluation and reporting of results and the management of any follow-up actions that may be required;
8. Additional water quality assessments, as needed by the Environmental Consultant during the regular Audit process.
9. Management and monitoring of the environmental effects of the Integrated Pest Management Plan, evaluation and reporting of same and the management of any follow-up actions required;
10. Preparation and delivery of environmental awareness programs to all new block owners and operators, road contractors, gravel pit operators, and other SADP oil palm stakeholders.
11. Preparation and submission of Monthly Environmental Reports to the OPIC Regional Manager and the SADP Management Team;
12. Preparation and submission of the Annual Environmental Reports to the OPIC General Secretary and Board and the World Bank.

6.3.2 Management Capacity

This work load will require a dedicated Environmental Officer to be based at the OPIC Regional Office in each oil palm province. The Environmental Officer will report to the OPIC Regional Manager.

6.3.2.1 Regional Environmental Officers

Each of these Environmental Officers will need to be suitably qualified and experienced with a minimum of:

1. Degree in Environmental Science, Environmental Management or Ecology;
2. Practical experience in the best practice approach to environmental management and monitoring;
3. Practical experience in water quality monitoring including the interpretation and evaluation of water quality data;
4. Demonstrated knowledge of the conservation values and environmental constraints affecting development in the province;
5. Good communication and reporting skills, including a working knowledge of Microsoft Word and preferably Microsoft Excel;

6. Ability to engage dialogue and negotiate with oil palm landowners, contractors and other stakeholders in SADP and OPIC Regional Office;
7. Driver's license.

It is preferable that the Environmental Officer also has practical experience / knowledge in:

1. The oil palm industry in Papua New Guinea, including its stakeholders, organization and production methods;
2. Engaging discussion and participation amongst stakeholders at community consultative meetings;
3. Preparing, organizing and delivering environmental awareness programs at the village and community level;
4. The local NGO community and key conservation / environment authorities / agencies within the province.

6.3.2.2 Regional Environmental Infrastructure & Equipment

In order to carry out the tasks listed in Section 6.2.1, each Environmental Officer will require:

1. Work station at OPIC Regional Office with desktop computer, phone and e-mail connection;
2. 200^{cc} plus Motorcycle;
3. Digital Camera (for visual recording and reporting of environmental impacts); and
4. other equipment as detailed under the SADP documentation.

6.4 Other Management Requirements to Implement the E.M.P.

As OPIC extends its in-house activities into the environmental sector it should actively seek to establish closer and more cooperative working relationships with the appropriate regulatory authorities, particularly at the provincial level, and other local environmental and conservation organizations (NGOs) that are active in the province. Experience shows that close cooperation between industry, government and NGOs in the environment sector can yield considerable benefits in terms of more efficient planning, more cost-effective development and the avoidance of environmental damage and costs.

This project could provide a useful vehicle for fostering and enhancing closer and more cooperative working relationships between these three groups.

6.4.1 Provincial Environmental Regulators

In the case of the provincial regulatory authorities, who act on behalf of the Department of Environment and Conservation at the provincial level, these are often desperately short of capacity, both in terms of funding and access to other resources including training. Indeed, the national Department of Environment and Conservation is also short of funding and access to other resources.

Provincial environmental and conservation personnel should be provided with the opportunity to attend and be involved with capacity development and training offered under this project. Logistical support could easily be provided by the project to ensure that these personnel could attend. Not only would this build capacity in the provincial authority, it would also establish a sound basis for the development of longer term cooperation and collaboration between OPIC and the local environmental regulators, which will benefit not only the industry and government, but also the environment and conservation.

6.5 Capacity Development for SADP Oil Palm Stakeholders

6.5.1 Environmental Awareness Program

The efficacy of the environmental mitigation measures proposed in this program will be enhanced if they are implemented by block owners and road contractors who have an understanding of the environmental issues involved that underlie the identification and development of these measures. To facilitate this understanding the SADP will organize locally-based environmental awareness programs for oil palm stakeholders in each province. These programs will be organized as environmental awareness workshops by the OPIC Regional Office under the direction of the Environmental Officer.

Each workshop will be facilitated by a team led by the Environmental Officer and assisted by other OPIC and PNGOPRA field officers. The provincial representative of the Department of Environment and Conservation will also be invited to attend and join the team of facilitators. Members of local NGOs active in the environment and conservation sectors will also be invited to attend.

The workshop participants will include:

- New block owners, although not a formal requirement for approval of their application, all new block owners will be strongly encouraged to attend;
- Block owners engaged in the SADP replanting program, who will also be strongly encouraged to attend;
- Road contractors and their construction site managers, and all gravel extraction site operators, will be required to attend as part of their contractual obligations;
- Any other block owners or operators who may wish to attend should be encouraged to do so.

Given the number of potential participants in each province, it is highly likely that several such workshops will need to be arranged in each province during the duration of the project. It is strongly recommended that over the duration of the project, all OPIC personnel will have the opportunity to participate in these workshops. Thus by the end of the project all OPIC personnel will have a sound and practical understanding of the environmental issues surrounding oil

palm smallholder production, and the basis for the environmental mitigation measures and monitoring programs that are conducted by OPIC.

These environmental awareness workshops will cover two days (either consecutive or some days apart, depending on the availability of the facilitators and participants).

Workshop activities on the first day will cover:

1. Identification of the environmental components in the local area and in the surrounding region;
2. Preparation of an "environmental inventory" of the local area and surrounding region;
3. Identification of the relationships between environmental components within the local area, and between the local area and the surrounding region;
4. Preparation of an "environmental map" of the local area indicating these relationships;
5. Assessment of the importance and value of these components and relationships to natural life and human well-being;
6. Preparation of an "inventory of environmental values" identifying and defining important subsistence resources, important economic resources, areas of conservation value including critical habitats such as wetlands and forest areas, sensitive or fragile environments such as steep slopes skeletal soils and watersheds, and areas of traditional cultural historical or archaeological value;
7. Identification and assessment of current environmental impacts on these environmental values from existing developments and the risks to these values from possible future developments;
8. Preparation of an "environmental impacts and future risks" inventory of the area;
9. Identification of mitigation measures that can be taken to avoid or reduce these impacts;
10. Identification of measures that can be taken to remedy these impacts and restore / enhance environmental qualities / values that have been affected;
11. Identification of the resources needed and tasks to be carried out to implement these impact mitigation and remedial measures;
12. Identification and design of precautionary measures that could be taken to avoid or reduce the impact of future environmental risks;
13. Identification of the resources needed and tasks to be carried out to implement these precautionary measures;

Workshop activities on the second day will comprise in-field inspections of various sites within the local area that demonstrate:

- existing environmental impacts (the aquatic environments offer good examples of impacts on water quality such as sedimentation and eutrophication);
- critical habitats (such as wetlands, coastal areas and forested land);
- sensitive environments (such as erosive scouring on steep slopes and skeletal soil areas);
- effective mitigation measures that avoid or significantly reduce the impact(s). Where possible these should be coupled with an inspection of areas where effective mitigation has not been carried out so that a clear comparison of the efficacy of the measures can be demonstrated;

Throughout both days the facilitators should draw on the participants' personal experiences in identifying environmental impacts, their causes and developing measures to avoid or mitigate these. A primary aim of this workshop is to encourage and promote innovative solutions to environmental problems that have arisen or might arise in the development and maintenance of smallholder oil palm blocks and in road maintenance operations.

The Environmental Officer will maintain a record of each workshop, noting attendance, the topics covered, the sites visited and what each demonstrated, and most importantly, the issues raised by the participants and any innovative solutions to environmental problems that were reported or developed by the participants. These Workshop Records will be kept on file at the OPIC Regional Office and summarised in the Environmental Officer's monthly reports.

6.5.2 Informal Capacity Building of SADP Stakeholders

The Environmental Officers should use opportunities that might arise, such as meetings with block landowners in the course of monitoring and inspections, to engage those present in discussions on potential environmental impacts that might arise, effective mitigation measures and other environmental issues pertaining to the oil palm industry.

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