

Esso Highlands Limited



Papua New Guinea LNG Project

**Environmental and Social Management Plans  
Appendix 8: Weed, Plant Pathogen and Pest  
Management Plan**

**PGGP-EH-SPENV-000018-010**

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## 1.0 OBJECTIVES

Esso Highlands Limited (Company) has developed this Weed, Plant Pathogen and Pest Management Plan as part of its Environmental and Social Management Plan (ESMP).

The objectives of the Weed, Plant Pathogen and Pest Management Plan are to:

1. Prevent exotic weeds, plant pathogens and pests from entering, spreading or becoming established in the Project areas during construction works
2. Identify and contain, suppress or manage significant weeds, plant pathogens and pests already in the Project area to prevent spread by project activities
3. Implement measures to reduce the risk of spread of dieback in *Nothofagus* forests.

An exotic weed or pest is defined as an invasive (native or introduced) or introduced species that causes an adverse impact on the ecology and/or communities.

The Weed, Plant Pathogen and Pest Management Plan should be read in conjunction with other Company plans:

- Ecological Management Plan
- Water Management Plan
- Erosion and Sediment Control Plan
- Reinstatement Plan.

## 2.0 LEGAL AND OTHER REQUIREMENTS

Legal and other requirements applicable to this plan are identified in Attachment 1.

## 3.0 SURVEYS

Company<sup>1</sup> shall conduct a Weed, Plant Pathogen and Pest Survey of the pipeline right-of-ways (RoW), processing facility sites, wellpads, new roads and access tracks, and other relevant Project areas to identify:

- Construction areas that are high risk for new weed and pest invasion (High risk is defined as an area that intersects a priority ecological area, i.e., Hides Ridge, or anywhere that has potentially uncontrolled access)
- Particular weeds and pests for surveillance, control and management, including compilation of a list detailing priority weeds and pests (i.e., those that have a high potential for significant adverse impacts if an incursion occurs or spread from an existing incursion occurs) and common weeds (i.e., other particular weeds and pests)
- *Nothofagus* forest susceptible to fungal disease and associated dieback that will require special hygiene measures
- Areas of infestations of priority weeds or pests that require management.

Company will also consider those activities that present a high risk of spreading weeds and pests.

Outcomes of Company's Weeds, Plant Pathogen and Pest Survey will include:

- Defined GPS Register of Weeds, Plant Pathogen and Pest High Risk and Priority Areas

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<sup>1</sup> The EPC5A Contractor shall be responsible for undertaking the Weed, Plant Pathogen and Pest Survey for the EPC5A Scope of Work. The scope of the EPC5A Contractor's survey shall include the scope described here for Company and Contractor surveys.

- Definition of further measures/methods to mitigate impacts for input to Contractor's ESMP

Subsequent to and using the information derived from Company's Weed, Plant Pathogen and Pest Survey, Contractor shall undertake a Weed, Plant Pathogen and Pest Survey of the pipeline right of way, new roads/access tracks, and other environmentally undisturbed areas that will be utilized during construction.

The scope of Contractor's Weed, Plant Pathogen and Pest Survey shall include all items listed above for Company's Weed, Plant Pathogen and Pest Survey.

Contractor will utilise a team of qualified personnel that Company has approved to undertake the Weed, Plant Pathogen and Pest Survey and record the results.

Contractor will provide the survey results to Company.

Company may at its discretion provide specialty discipline personnel to join Contractor's survey team. The Weed, Plant Pathogen and Pest survey may be done in conjunction with other engineering surveys.

Clearing will not commence until the Weed, Plant Pathogen and Pest survey has been completed and Company has given approval to proceed.

#### **4.0 MANAGEMENT AND MONITORING**

Table 1 presents a summary of the potential environmental impacts related to weeds, plant pathogens and pests, together with mitigation and management measures to avoid or reduce these impacts.

Contractor shall develop a Weed, Plant Pathogen and Pest Management Plan, which will as a minimum incorporate the measures described in Table 1 but shall not be limited to these measures.

Due to differing scopes of work and work locations, not all management and mitigation measures in the Weed, Plant Pathogen and Pest Management Plan are applicable to all Contractors. Company's Environmental and Social Mitigation Register defines which management and mitigation measures are applicable to each Contract scope of work.

Attachment 2: Weed Management Manual and Planning Guidelines is provided as a guide for Contractor use when developing weed management protocols.

Attachment 3: Pest Management Planning Guidelines is provided as a guide for Contractor use when developing pest management protocols.

In Table 1, any mitigation and management commitments that were contained in the PNG LNG Project Environmental Impact Statement (EIS) are identified by a code commencing with an 'M' in the 'Mitigation Item Reference Number' column. Some mitigation measures have been reworded to provide further clarity or more detailed information regarding required measures. In these instances, the code is displayed in italics, and these reworded measures supersede what is in the EIS.

Other mitigation and management commitments required by Company are identified in Table 1 with a code commencing with an 'A'.

Monitoring required in relation to the Weed, Plant Pathogen and Pest Management Plan is also described in Table 1.

Contractor shall develop site-specific procedures for the monitoring program, to be agreed by Company.

Included in Attachment 4 (Common Weeds) and Attachment 5 (Example Significant Weed Species) are preliminary lists of weed species that have been identified in PNG.

This list can be used by Contractor as part of the required assessment for weed, pest and pathogen management.

Attachment 5 also exhibits several significant weed species present in PNG and is provided to demonstrate the type of material Contractor should generate for work sites.

**Table 1: Management and Monitoring**

Table 1: Management and Monitoring						
Source of Impact	Potential Impact and Relevant Management Plan Objective <sup>†</sup>	Mitigation and Management (Design Feature/Specific Measure)	Mitigation Item Reference Number	Monitoring	Monitoring Frequency	Responsibility
New weeds, plant pathogens or pests imported into the project area from contaminated vehicles, machinery, equipment and/or freight	<ul style="list-style-type: none"> <li>Ecological impacts.</li> <li>Infestation of adjacent agricultural areas.</li> <li>Economic and social impacts.</li> </ul> (Objectives 1, 2, 3)	Establish and enforce a project-wide quarantine program. Focus on sites where equipment and supplies will be imported into PNG or brought into the project area from elsewhere in PNG.	<i>M1, M2, M54</i>	Verification	Ongoing	Company and Contractor
Weeds, plant pathogens and pests spread by project activities from existing infestation/dieback areas.	<ul style="list-style-type: none"> <li>Ecological impacts.</li> <li>Infestation of adjacent agricultural areas.</li> <li>Economic and social impacts.</li> </ul> (Objectives 1, 2, 3)	Contractor Weed, Plant Pathogen and Pest Management Plan will include as a minimum: <ul style="list-style-type: none"> <li>General management plans for general incident management for broad groups of weeds and pests.</li> <li>Specific management plans for high risk specialised weeds and pests.</li> <li>Requirements to wash specific machinery and vehicles and maintain documentation verifying washdown has occurred.</li> <li>Different levels of management control for different sites depending on the threat to ecology and susceptibility to weeds, plant pathogens and pests.</li> <li>A register of unwanted pests. A preliminary list is provided in Attachment 6.</li> <li>Detail on an integrated approach to weed control (e.g., physical removal, slashing, mulching and herbicides) as appropriate.</li> </ul>	<i>M52, M118</i>	Verification	Ongoing	Contractor

Table 1: Management and Monitoring

Source of Impact	Potential Impact and Relevant Management Plan Objective <sup>†</sup>	Mitigation and Management (Design Feature/Specific Measure)	Mitigation Item Reference Number	Monitoring	Monitoring Frequency	Responsibility
		(Weed and pest management guidelines are listed in Attachments 2 and 3 respectively; and lists of common weeds, significant weeds and unwanted pests are provided in Attachments 4, 5 and 6 respectively).				
		<p>Establish vehicle wash-down facilities considering the following:</p> <ul style="list-style-type: none"> <li>• Contain the material washed from machinery/equipment for appropriate disposal.</li> <li>• Contain and treat as necessary washdown water. Where washdown water runoff has occurred, areas will be monitored and controlled to avoid weed establishment and spread.</li> <li>• Undertake inspection and clean-down of weeds based on the Australian Pipeline Industry Association guidelines (APIA, 2009).</li> <li>• Wash-down certificates are kept in vehicle &amp; equipment at all times indicating the date and location of wash-down.</li> </ul>	M117	Verification	Ongoing	Contractor
		Control priority weeds and pests in construction areas.	A61	See Surveys	Ongoing	Contractor
		Limit work vehicles and machinery to designated access and work site areas.	M10	Verification	Ongoing	Company and Contractor
		Prohibit the washing of equipment, vehicles or machinery near or within watercourses.	M150	Verification	Ongoing	Company and Contractor
		Use herbicides approved by Company only for the eradication of a serious invasive weed where this is considered to be the most effective form of control.	M80	Verification	Ongoing	Contractor

Table 1: Management and Monitoring						
Source of Impact	Potential Impact and Relevant Management Plan Objective <sup>†</sup>	Mitigation and Management (Design Feature/Specific Measure)	Mitigation Item Reference Number	Monitoring	Monitoring Frequency	Responsibility
		Prohibit the establishment of gardens with introduced plant species and the introduction of exotic plants or animals by project workers and contractors.	M53	Verification	Ongoing	Company and Contractor
		Prohibit transportation of live animals, plants or seeds to the Hides Ridge area.	M50	Verification	Ongoing	Company and Contractor
		Develop and use portable washdown facilities and procedures for <i>Nothofagus</i> areas.	A62	Verification	Ongoing	Contractor
		Map and identify any outbreaks of dieback and report to Company.	A63	Notification	Ongoing	Contractor
Discharge of contaminated ballast water in the Gulf of Papua	Introduction of marine alien and invasive species into offshore waters (ballast water) (Objectives 1, 2)	Comply with International Maritime Organization requirements and industry good practice with respect to ballast water discharge.	M222	Verification	Ongoing	Contractor

<sup>†</sup> See Section 1.



## 5.0 ROLES AND RESPONSIBILITIES

Contractor shall ensure sufficient resources are allocated on an ongoing basis to achieve effective implementation of the Weed, Plant Pathogen and Pest Management Plan.

Contractor's Weed, Plant Pathogen and Pest Management Plan shall describe the resources allocated to and responsible for the execution of each task and requirement contained therein, and shall describe how roles and responsibilities are communicated to relevant personnel.

## 6.0 TRAINING, AWARENESS AND COMPETENCY

Contractor shall ensure that all personnel responsible for the execution of the tasks and requirements contained within the Weed, Plant Pathogen and Pest Management Plan are competent on the basis of education, training and experience.

Contractor's Weed, Plant Pathogen and Pest Management Plan shall describe the training and awareness requirements necessary for its effective implementation.

Contractor's training activity associated with the Weed, Plant Pathogen and Pest Management Plan shall be appropriately documented by means of a training needs assessment, training matrix/plan and records of training undertaken.

## 7.0 PERFORMANCE INDICATORS

Table 2 outlines indicators for measuring and verifying performance in relation to the Weed, Plant Pathogen and Pest Management Plan.

**Table 2: Performance Indicators**

ID #	Performance Indicator	Measurement	Internal Assessment Frequency	Relevant Management Plan Objective†
1	Control new significant weeds, plant pathogens or pests from establishing or spreading from the works area.	Visual inspections during construction to check no establishment or spread of weeds, plant pathogens or pests in the Project area.	Quarterly	1, 2, 3
2	Control spread of dieback in <i>Nothofagus</i> forest within the works area.	Visual inspections to check: <ul style="list-style-type: none"> <li>No development of new dieback areas.</li> <li>No spread of dieback from any pre-existing dieback areas.</li> </ul>	Quarterly	3
Performance Indicators to be further developed and agreed between Contractor and Company				

†See Section 1.

## 8.0 REPORTING AND NOTIFICATION

Contractor shall report to Company the results of Contractor's Weed, Plant Pathogen and Pest Survey and integrate the results, including additional mitigation and management measures as agreed with Company, into the Weed, Plant Pathogen and Pest Management Plan.

Contractor shall notify Company immediately new outbreaks of significant weed and/or pest species or plant pathogens are identified.

Contractor's monthly report to Company shall include:

- Results of the Pre-construction Surveys prescribed in Section 3.0
- Number and results of verification inspections prescribed in Table 1 and measures for control of weeds or pests as a result of the inspections
- Results of dieback visual inspections
- Summary report of Vehicle and Equipment Washdown and Inspection certificates
- Performance Indicators as applicable in the reporting period.

## **Attachment 1: Legal and Other Requirements**

## LEGAL AND OTHER REQUIREMENTS

Contractor shall comply with applicable Papua New Guinea Laws and Regulations, applicable International Finance Institution (IFI) requirements and International Treaties and Conventions (where applicable).

### Papua New Guinea Laws and Regulations

The Environment Act 2000 contains numerous provisions that promote environmental protection, regulate environmental impacts associated with development activities, and safeguard the life supporting capacity of air, water land and ecosystems. None are directly related to pests and weeds *per se*.

The Environmental Contaminants (Pesticides) Regulation 1988 governs the importation, sale, manufacture, distribution and use of pesticides.

### International Financial Institution Requirements

The following International Finance Corporation (IFC) Performance Standards apply to weeds and pest management:

- IFC Performance Standard 6: *Biodiversity Conservation and Sustainable Natural Resources Management* is relevant due to the over-riding objectives of protecting and conserving biodiversity, and promoting sustainable management and use of natural resources. The Performance Standard specifies the need for post-operation restoration of habitats and the adoption of measures to prevent accidental or unintended introductions of alien species. More specifically,


“Intentional or accidental introduction of alien, or non-native, species of flora and fauna into areas where they are not normally found can be a significant threat to biodiversity, since some alien species can become invasive, spreading rapidly and out-competing native species.”


“The client will not intentionally introduce any new alien species (not currently established in the country or region of the project) unless this is carried out in accordance with the existing regulatory framework for such introduction, if such framework is present, or is subject to a risk assessment (as part of the client’s Social and Environmental Assessment) to determine the potential for invasive behavior. The client will not deliberately introduce any alien species with a high risk of invasive behavior or any known invasive species, and will exercise diligence to prevent accidental or unintended introductions.”

- IFC Performance Standard 3 and Guidance Note 3 deal with *Pollution Prevention and Abatement* and include the following provisions in relation to pesticides:
  - The client will formulate and implement an integrated pest management (IPM) and/or integrated vector management (IVM) approach for pest management activities. The client’s IPM and IVM program will entail coordinated use of pest and environmental information along with available pest control methods, including cultural practices, biological, genetic and, as a last resort, chemical means to prevent unacceptable levels of pest damage.
  - When pest management activities include the use of pesticides, the client will select pesticides that are low in human toxicity, known to be effective against the target species, and have minimal effects on non-target species and the environment. When the client selects pesticides, the selection will be based on whether the pesticides are packaged in safe containers, are clearly labeled for safe and proper use, and have been manufactured by an entity currently licensed by relevant regulatory agencies.

- The client will design its pesticide application regime to minimize damage to natural enemies and prevent the development of resistance in pests. In addition, pesticides will be handled, stored, applied, and disposed of in accordance with the Food and Agriculture Organization's International Code of Conduct on the Distribution and Use of Pesticides or other good international industry practice.
- The client will not use products that fall in World Health Organization Recommended Classification of Pesticides by Hazard Classes Ia (extremely hazardous) and Ib (highly hazardous); or Class II (moderately hazardous), if the project host country lacks restrictions on distribution and use of these chemicals, or if they are likely to be accessible to personnel without proper training, equipment, and facilities to handle, store, apply, and dispose of these products properly.


## **Attachment 2: Weed Management Manual and Planning Guidelines**


 <p><b>PNG LNG</b></p>	<h2>Weed Management Manual Guidelines</h2>
<b>Component</b>	<b>Elements and performance criteria</b>
<b>Prepare for work</b>	<p><b>1. Observe safe work practices</b></p> <p>1.1 Protective clothing</p>
<b>Follow safety rules</b>	<p><b>1. Follow workplace requirements and instructions concerning chemicals</b></p> <p>1.1 Safety procedures involved with chemical handling are recognised and followed as required</p> <p><b>2. Recognise risks associated with chemicals</b></p> <p>2.1 Chemical labels and symbols are recognised and hazards identified</p> <p>2.2 Instructions for use of personal protective equipment and application equipment are identified and observed</p> <p><b>3. Follow chemical handling and storage rules</b></p> <p>3.1 Chemical handling and storage instructions on labels are followed</p>
<b>Undertake site assessment</b>	<p><b>1. Collect and collate base information</b></p> <p>1.1 Base plan is prepared of the site</p> <p><b>2. Prepare for site visit</b></p> <p>2.1 OHS hazards associated with undertaking a site visit are assessed for potential risks and controls implemented accordingly</p> <p>2.2 Location ownership and site boundaries are verified</p> <p>2.3 Where required, formal approval is sought to visit site</p> <p><b>3. Undertake site inspection</b></p> <p>3.1 Site inspection is undertaken</p> <p>3.2 Existing on-site and adjacent features that may impact upon the project objectives are identified and recorded</p> <p><b>4. Document information</b></p> <p>4.1 Site survey information is documented in accordance with enterprise procedures</p>
<b>Identify weed species</b>	<p><b>1. Weed identification</b></p> <p>1.1 Range of significant and other weeds are identified according to the weed plan objectives</p> <p>1.2 Resources and equipment for use in weed identification activity are located and identified.</p> <p>1.3 Available processes for plant recognition are identified, selected and prepared for use</p> <p>1.4 Brief descriptions of plant habits, characteristics and significant features are recorded/obtained</p>
<b>Treat weeds</b>	<p><b>1. Prepare to treat weeds</b></p> <p>1.1 Details of weed occurrence are recorded</p> <p>1.2 Treatment methods are selected (Physical or Chemical)</p> <p>1.3 OHS hazards are identified and risks assessed</p>

 <p><b>PNG LNG</b></p>	<h2 style="margin: 0;">Weed Management Manual Guidelines</h2>
<p><b>Component</b></p>	<p><b>Elements and performance criteria</b></p>
	<p><b>2. Treat Weeds</b></p> <p>2.1 Suitable personal protective equipment is selected, used and maintained</p> <p>2.2 Treatments are prepared according to manufacturers guidelines</p> <p>2.3 Treatments are applied in such a way that non-target damage is reduced</p> <p><b>3. Carry out post treatment operations</b></p> <p>3.1 Records are maintained according to project guidelines</p>
<p><b>Control weeds</b></p>	<p><b>1. Assess weed infestation</b></p> <p>1.1 Scope and size of the infestation is assessed</p> <p>1.2 Professional advice is obtained as required according to project guidelines</p> <p><b>2. Treat Weeds (as above)</b></p> <p><b>3. Monitor control methods</b></p> <p>3.1 Control methods are monitored to identify side effects to other plants and if possible, animals</p> <p>3.2 Adjustments to control methods are implemented where necessary to meet effective control and or eradication objectives</p>

These guidelines have been adapted from: NHT 2004. Introductory Weed Management Manual. Department of Environment and Heritage, Australia.





 <b>PNG LNG</b>	<h2 style="text-align: center;">Weed Management Planning Guidelines</h2>
<b>Component</b>	<b>Element</b>
<b>Setting objectives</b>	Analyse weed map/reconnaissance survey information from the site to determine weed priorities, and develop objectives and actions to address them.
<b>Determining weed priorities</b>	<p>Determining which weeds are a priority for control should be based on the potential significance of the impact of each weed present on a site and the feasibility of its control.</p> <p>Whether a weed represents a high or a low threat depends on:</p> <ul style="list-style-type: none"> <li>• Its ability to establish across a site (is there bare soil or open vegetation).</li> <li>• Its competitiveness once established.</li> <li>• The likelihood of long distance dispersal.</li> <li>• Its potential to impact native vegetation.</li> <li>• Changes the weed can cause to ecology.</li> <li>• Potential infestation of adjacent agricultural areas.</li> <li>• Potential to cause human health problems (e.g., <i>Parthenium hysterophorus</i>)</li> </ul>
<b>Management approaches</b>	<p>The approach to weed management will partly depend on whether the objective is eradication, control or containment.</p> <p>Eradication may not always be realistic. For eradication the following features need to apply:</p> <ul style="list-style-type: none"> <li>• The weed occupies a discrete area and will not reinvade from adjoining areas.</li> <li>• All of the infested area is known for a particular site.</li> <li>• The weed is physically obvious and easy to find at low densities.</li> <li>• The control method used kills all plants before reproductive maturity (seed set).</li> <li>• The weed seed does not remain dormant in the soil, or the infestation is detected before seeds are released.</li> <li>• If the plant has produced seeds they have not dispersed.</li> <li>• The available resources must enable initial treatment, regular surveys and control for the lifespan of the soil seedbank.</li> <li>• Weeds that are in the early stages of invasion may be able to be eradicated. Ongoing monitoring will be required to avoid new occurrences.</li> </ul>
<b>Integrated weed management</b>	<p>In many cases the most cost effective and realistic way to control weeds is to combine different control methods. Each method chosen needs to target the weed species when it is most vulnerable. Knowledge of the life cycle of each species is essential to determine the timing of different treatments.</p>
<b>Monitoring performance and making changes</b>	<p>Monitoring provides an understanding of how well control measures are working, the rate of spread of weeds and new occurrences. Where monitoring has identified poor performance or new occurrences actions can be taken to rectify.</p> <p>Monitoring involves mapping the site at regular intervals, taking photos at selected photo points and checking site information to determine if the data has an impact on weed management requirements.</p> <p>Monitoring should focus on:</p> <ul style="list-style-type: none"> <li>• Changes in the extent of weed populations (area contracted or expanded).</li> <li>• Changes in the density of weed cover.</li> <li>• Occurrences of other weed species.</li> <li>• Unexpected changes in weed control activity, e.g., off-target damage, invasion by other species.</li> </ul>

 <p><b>PNG LNG</b></p>	<h2>Weed Management Planning Guidelines</h2>
Component	Element
	<ul style="list-style-type: none"> <li>• Undesirable changes in the condition and extent of native vegetation that may be attributed to weed invasion.</li> <li>• Changes in any weed status that may impact on site rehabilitation work.</li> </ul>
<p><b>Recording</b></p>	<p>Records should be kept of information gathered during monitoring. Weed maps should be updated, site information sheets updated and photo point photographs updated. Reviewing this information will enable informed weed management decisions to be taken to review the weed management plan where required.</p>

These guidelines have been adapted from: NHT 2004. Introductory Weed Management Manual. Department of Environment and Heritage, Australia

### **Attachment 3: Pest Management Planning Guidelines**

 <b>PNG LNG</b>	<h2 style="text-align: center;">Pest Management Planning Guidelines</h2>
<b>Component</b>	<b>Element</b>
<b>Setting objectives</b>	Analyse predisturbance surveillance information and conduct risk assessment on list of unwanted organisms to determine pest management priorities, and develop objectives and actions to address them.
<b>Risk analysis</b>	Determining which pests are a priority for control should be based on a risk analysis approach.  Whether a pest represents a high or a low threat depends on: <ul style="list-style-type: none"> <li>• The probability of entry to the project area.</li> <li>• The probability of establishment.</li> <li>• The probability of spread after establishment.</li> <li>• The potential for significant adverse impacts.</li> </ul>
<b>Recognise the characteristics of threats</b>	High level pest threats are posed by: <ul style="list-style-type: none"> <li>• Highly motile organisms</li> <li>• Delays in detecting a risk organism</li> <li>• Limited or poor phytosanitary/quarantine controls</li> <li>• Importing large quantities of low grade goods</li> <li>• Disposal of waste material from aircraft galleys</li> <li>• The movement and introduction of potted amenity plants which frequently harbour pests</li> <li>• Seven orders of insects commonly encountered include:               <ul style="list-style-type: none"> <li>— Coleoptera</li> <li>— Psocoptera</li> <li>— Thysanoptera</li> <li>— Hymenoptera</li> <li>— Lepidoptera</li> <li>— Hemiptera</li> <li>— Diptera</li> </ul> </li> </ul>
<b>Management approaches</b>	The approach to pest management will partly depend on whether the objective is eradication, control or containment.  Management approaches need to incorporate the following: <p><b>Public Awareness:</b></p> <ul style="list-style-type: none"> <li>• Tailored approaches to meet specific audiences</li> <li>• Education to acknowledge that human mediated incursions pose the greatest risk</li> </ul> <p><b>Pest Risk Analysis:</b></p> <ul style="list-style-type: none"> <li>• Consider biological attributes of the organism               <ul style="list-style-type: none"> <li>— Host range</li> <li>— Dispersal method</li> <li>— Persistence of host</li> <li>— Reproductive method</li> <li>— Type of damage organism can cause</li> <li>— Capacity of organism to carry other pests and diseases</li> </ul> </li> <li>• Possible entry pathways</li> <li>• Level of protection required</li> </ul>

 <b>PNG LNG</b>	<h2 style="text-align: center;">Pest Management Planning Guidelines</h2>
<b>Component</b>	<b>Element</b>
<b>Quarantine, Inspection and Decontamination</b>	<p>PNG's quarantine/biosecurity standards allowed the deliberate and accidental incursion of several serious weeds and pests (Price 2006). Cargo, vehicles and machinery imported into the project area will need to pass weed and pest inspection procedures and be subjected to decontamination where required.</p> <p>Inspection will be required to meet international standards by accredited personnel.</p> <p>Fumigation and washdown facilities will be required.</p> <p>A range of treatments will need to be considered depending on the threat.</p>
<b>Emergency Response</b>	<p>Emergency response requires good planning so that the response reflects the threat posed by the incursion. To reduce delays and to increase the projects ability to prevent further spread clearly outline the line of communication as follows:</p> <ul style="list-style-type: none"> <li>• Identify who needs to know</li> <li>• Identify who speaks to whom to obtain a quick and informed response</li> <li>• Identify who does what including external specialist expertise</li> <li>• Identify what resources are required (human, financial and equipment)</li> </ul>
<b>Surveillance and monitoring of pests</b>	<p>Surveillance needs to be targeted to identify incursions or spread of species identified as high risk by the risk analysis procedure. Surveillance needs to be structured and involve sophisticated and community approaches.</p> <p>Community approaches involve regular meetings with village communities who are likely to be aware of any new species or unusual changes in their local environment. This can be an effective approach.</p> <p>Sophisticated surveillance requires high-level diagnostic skills, particularly for insect pests. Entomology consultants would need to be engaged for training of local staff and for regular (e.g., annual) searches of high risk sites, and when an emergency response is triggered.</p>
<b>Recording</b>	<p>Records should be kept of information gathered during monitoring/surveillance. Reviewing this information will enable informed pest management decisions to be taken and updates to the Weed, Plant Pathogen and Pest Management Plan made where required.</p>

#### **Attachment 4: Common Weeds**

### Common weeds primarily identified along the existing oil export ROW between Kopi and Moro

Family	Species	Common Name	Form	Habitat	Invasive	Comments
Acanthaceae	<i>Asystasia</i> sp.		Herb	Roadsides and cultivated areas	-	
Asteraceae	<i>Ageratum conyzoides</i>		Ephemeral herb	Disturbed areas, e.g. roads	No	Widespread weed in the tropics Does not compete significantly with native species Considered a soil conditioner - not competitive with soil binding/conditioning qualities. Does not persist in shaded areas.
Meliaceae	<i>Azadirachta indica</i> **	Indian lilac	Tree	Wet forest	Yes	Fruits dispersed by birds and bats. May sucker from roots.
Asteraceae	<i>Bidens pilosa</i>	Cobblers peg	Herb to 1.8 m	Roadsides and cultivated areas	Yes	A prolific ephemeral herb. Can form a dense ground cover inhibiting regeneration of other species. Seeds readily attach to clothing and animal fur.
Poaceae	<i>Brachiaria</i> sp.		Grass	Roadsides and cultivated areas	-	
Caesalpinaceae	<i>Cassia alata</i>	Ringworm Shrub/Candle bush	Shrub to 2 m	Forest edges, sago swamp edges, roadsides and wasteland.	Yes	Becomes troublesome in some areas (eg; pasture). Can form dense stands inhibiting regeneration. An infestation may seriously deplete area available. Leaves are well known remedy for ringworm.
Thelypteridaceae	<i>Christella arida</i>		Fern	Roadsides and cultivated areas	-	Native species, useful initial coloniser of sidecast.
Asteraceae	<b><i>Chromolaena odorata</i> **</b>	Siam weed	Large bushy herb	Forest edges and clearings		Forms dense stands which prevent the establishment of other species. Wind dispersed seed. Also dispersed by vehicles and clothes. Can propagate vegetatively from stem and root fragments.
Capparaceae	<i>Cleome viscosa</i> *	Spider flower/tickweed	Annual herb	Disturbed areas and roadsides	Yes	Sticky seeds.
Verbenaceae	<i>Clerodendrum chinensis</i> **		Shrub to 2 m	Roadsides	Yes	Thrives in fertile areas. Can form dense thickets excluding other species. Spread by root suckers, mainly.
Fabaceae	<i>Clitoria ternata</i>	Butterfly pea	Perennial Vine	Roadsides and open land.	Yes	Scandent sub-shrub. Forms bushy vegetation in open situations climbing into other lower vegetation. Forms dense ground cover inhibiting establishment of other species.
Commelinaceae	<i>Commelina diffusa</i>	Spreading dayflower	Succulent Creeping herb	Moist to wet pastures, roadside ditch.	Yes	Prostrate (spreading) growth habit. Forms carpet in wet areas displacing grasses and other native plants.
Asteraceae	<i>Conyza canadensis</i>		Herb to 1 m	Roadsides	Yes	Only an ephemeral. Similar qualities to <i>Crassocephalum crepidioides</i>

Family	Species	Common Name	Form	Habitat	Invasive	Comments
						ie production of masses of seed/seedlings that are fast growing and highly competitive with woody seedlings established during rehabilitation.
Asteraceae	<i>Crassocephalum crepidioides</i>	Thick head	Herb to 1.5 m	All sites	Yes	Short lived ephemeral, ubiquitous plant. Noted at all sites and compromises ecological integrity. Produces masses of wind dispersed seeds able to be dispersed over large distances. Large numbers of seedlings are produced, these grow rapidly and compete with newly established seedlings. Observed as seedlings within intact forest along surveyed route below Nogoli Camp. Prefers limestone soils. Control not possible.
Fabaceae	<i>Crotalaria</i> sp.		Perennial herb to 1.5 m.	Roadsides	Yes	Roadside weed. Observed shrubby vegetation growing along section of road from Kaiam ferry to Kaiam village (Gulf).
Cyperaceae	<i>Cyperus</i> sp.		Perennial herb (Sedge)	Roadsides	-	
Cyperaceae	<i>Cyperus rotundus</i>		Perennial herb (Sedge)	Grasslands, sandy or gravelly river banks and cultivated areas		A weedy sedge. Propogates by tubers and rhizomes and occasionally seed. Slow to spread but persistent once established.
Poaceae	<i>Digitaria nuda</i>	Naked crabgrass	Grass	Roadsides and cultivated area	-	
Pontederiaceae	<i>Eichhornia crassipes</i> **	Water hyacinth	Aquatic herb	Freshwater lakes marshes, ponds, ditches and slow moving streams	Yes	A floating weed that can choke waterbodies. Spread by stolons and solitary plants drifting in the current, wind or by boats. Produces long lived seed.
Poaceae	<i>Eleusine indica</i>	Crows-foot Grass	Annual or short lived perennial	Roadsides and cultivated areas	Yes	Common grass in disturbed environments. Out competes newly established seedlings. Difficult to eradicate once established.
Asteraceae	<i>Emilia sonchifolia</i>	Purple sowthistle	Perennial herb	Roadsides and cultivated areas and wasteland.	Yes	Soft-stemmed perennial herb. Seeds dispersed by wind. Common in Kutubu area.
Poaceae	<i>Eragrostis</i> sp.		Grass	Roadsides and poorly drained areas	-	
Poaceae	<i>Eriochloa</i> sp		Grass	Roadsides and cultivated area	-	Low growing grass. Not able to persist in shade. Provides soil stability until overgrown by woody vegetation.
Poaceae	<i>Eriochloa polystachya</i>		Perennial grass	Swamps, drains and ditches, river banks	-	Seed and vegetative fragments dispersed by water.
Lamiaceae	<i>Hyptis capitata</i>		Herb to 1.5 m	Roadsides and	Yes	Woody plant.



Family	Species	Common Name	Form	Habitat	Invasive	Comments
				cultivated area		Can persist in quite low light. Produces large quantities of seed. Difficult to control. Preferred habitat is generally road verges where it forms dense.
Poaceae	<i>Eleusine indica</i>	Wire grass	Grass	Roadsides, cultivated areas and disturbed sites	Yes	Quick growing, long lived and prefers wetter sites. Prolific seed producer.
Euphorbiaceae	<i>Euphorbia geniculata</i>	Milk weed	Annual herb	Roadsides and cultivated area.	Yes	Seed produced early and profusely and if buried remains dormant for a long time, germinating when exposed to the surface by cultivation.
Euphorbiaceae	<i>Euphorbia hirta</i>	Asthma weed	Annual herb		-	Prefers well lit regularly burned areas. Spread by seed and rhizomes. Rhizomes allow rapid recovery after fire.
Poaceae	<i>Imperata cylindrica</i>		Perennial grass	Disturbed areas. Can invade forest after fire	Yes	
Fabaceae	<i>Indigofera sp</i>		Herb to 1.5 m		Yes	Once established, long-lived seeds are incorporated into the soil seed bank, difficult to eradicate. Persists in semi-shaded environments.
Convolvulaceae	<i>Ipomoea hederifolia</i>		Annual vine	Roadsides	Yes	
Convolvulaceae	<i>Ipomoea plebeia</i>		Annual vine	Roadsides and cultivated area	Yes	Common along roadside and in gardens.
Hydrocharitaceae	<i>Hydrilla verticillata</i>		Aquatic herb	Warm freshwater ponds and slow moving streams	Yes	A submerged branching perennial herb. Reproduces both sexually and asexually. Most commonly pieces break free and float to new locations.
Minimiaceae	<i>Kibara cf. fugax</i>					
Verbenaceae	<i>Lantana camara</i>	Lantana	Shrub (Woody)	Weed of pastures and wastelands.	Yes	A serious weed. Forms compact clumps of scrambling dense stands. Cultivated as garden plant in Moro by locals. A noxious plant.
Poaceae	<i>Leptochloa sp.</i>			Roadsides and cultivated area	-	
Fabaceae	<i>Leucena leucacephala</i>		Tree/Shrub to 3 m	Roadsides and garden areas		Common roadside weed. Cultivated in Moro area to provide shade for coffee. Once established, difficult to control because of longevity of seed and suckering ability.
Onagraceae	<b><i>Ludwigia hyssopifolia</i></b>	Pond primrose	Annual herb to 2-3m	Ditches and wet areas	Yes	Favours low altitude wet environments, e.g. Gulf Province ROW sectors. Should be immediately eradicated if detected in Lake Kutubu area (ideal environment for the species).

Family	Species	Common Name	Form	Habitat	Invasive	Comments
Malvaceae	<i>Malvastrum coromandelianum</i>	False mallow	Annual herb to 1 m	Roadsides and wastelands.	Yes	Tough shrub. Has fruit segment which has bristles that can facilitate its spread by sticking to clothing. Observed along roads in Kutubu area.
Poaceae	<i>Melinis minutiflora</i>	Molasses Grass	Grass to 40 cm	Disturbed areas	Yes	Very flammable grass. Well adapted to wet upland areas on volcanic soil. Difficult to eradicate. Forms a dense mat smothering other species. Wind dispersed seed and spreads by runners.
Poaceae	<i>Melinis repens</i> *	Natal grass	Grass	Drier sites along roadsides and disturbed areas	Yes	Naturalised in disturbed dry areas.
Convolvulaceae	<b><i>Merremia peltata</i></b>		Subwoody vine	Disturbed forest	Yes	Can dominate disturbed forest areas in the lowlands. Can smother trees and regenerating vegetation.
Asteraceae	<i>Mikania micrantha</i> **		Vine	Disturbed forest, stream banks, roadsides and cultivated land	Yes	A smothering vine. Grows best where humidity, fertility and organic matter are high. Seed spread by wind, in clothing, animal fur. Will establish from broken stem fragments.
Fabaceae	<i>Mimosa diplotricha (invisa)</i> **	Giant sensitive plant	Shrub	Roadsides	Yes	Can form a dense ground cover restricting regeneration in rehabilitation areas. Seed pods float and can spread by water. Can also attach to clothing mud and fur. Fire hazard when dry.
Fabaceae	<i>Mimosa pudica</i>	Sensitive plant	Herb (prostrate creeper)	Roadsides and river banks	Yes	Can form a dense ground cover restricting regeneration in rehabilitation areas. Seed pods float and can spread by water. Can also attach to clothing mud and fur.
Asteraceae	<b><i>Parthenium hysterophorus</i> **</b>	Parthenium	Herb (annual)	Roadsides, pastures and cultivated areas	Yes	Seed dispersed by wind and water. LNG plant site is a potential habitat.
Passifloraceae	<i>Passiflora foetida</i> *	Wild passionfruit	Vine	Disturbed areas, particularly spoil and roadsides	Yes	Can form a dense ground cover delaying establishment of other species. Seed dispersed by birds and mammals.
Passifloraceae	<i>Passiflora ligularis</i>	Sweet passionfruit	Vine	Disturbed sites and cultivated areas.	Yes	Vigorous vine that can form dense ground cover inhibiting establishment of other species. Cultivated in certain parts of Highlands for its edible fruits. Planted by locals in the Kutubu area for its edible fruits. Potential pest in future.
Poaceae	<i>Paspalum conjugatum</i>		Stoloniferous perennial grass to 1 m	Wet habitats, particularly low along roads and cultivated areas, particularly on acid low nutrient soils	Yes	Low growing grass. More common on volcanic than limestone soils. Whilst exotic, should not be viewed with alarm due to its creeping habit and ability to bind loose soil surfaces.

Family	Species	Common Name	Form	Habitat	Invasive	Comments
						Persists in lower light environments.
Poaceae	<i>Pennisetum purpureum</i>	Elephant grass	Grass to 3 m	Roadsides and disturbed ground	Yes	Tall and aggressive grass up to 6 m height. Favours riparian habitats. When dry will promote fire. Will block succession when established.
Euphorbiaceae	<i>Phyllanthus amarus (niruri)</i>		Herb	Roadsides and cultivated area	-Yes	Spread by seed.
Urticaceae	<i>Pilea microphylla</i>	Military fern	Fern to 30 cm	Nurseries, gardens and paths	Yes	Highly favoured by constant moisture. Common nursery weed. Unhygienic nursery practice facilitates spread. Can reproduce sexually and asexually. Almost impossible to eradicate once established. Accidental introduction will compromise habitats of filmy ferns and other low growing plants of riparian areas.
Piperaceae	<b><i>Piper aduncum</i></b>	Bamboo piper	Small tree/shrub to 7 m	Disturbed forest and cultivated areas	Yes	Potential to out compete regeneration along the RoW and arrest natural succession. Spread by seed and suckers.
Araceae	<i>Pistia stratiotes</i>	Water lettuce	Aquatic plant	Freshwater lakes, ponds and in open still or very slowly moving fresh water.		A free floating plant capable of forming dense mats on the surface of lakes, ponds, rivers and other bodies of water. Can become a serious pest blocking slow-moving water ways. Spread from broken-off pieces or whole plants being moved on boats or fishing equipment from an infested to a clean water body. Recorded in Lake Kutubu – a potential pest in the future.
Myrtaceae	<i>Psidium guava</i>	Guava	Shrub to 5 m	Planted in gardens	Yes	Commonly planted for edible fruit. Tolerates semi-shade. Can form dense mono-specific stands. Seeds dispersed by birds. Also has suckering ability. Once established is difficult to eradicate. Given popularity as fruit tree, control is not possible. Plant likely to become a pest in future.
Fabaceae	<i>Pueraria phaseoloides</i>	Tropical kudzu	Climbing perennial shrub	Roadsides and cultivated area	No	Spread by seed.
Poaceae	<i>Rottboelia cochinchinensis **</i>		Grass	Roadsides	Yes	Tall annual grass supported by prop roots. Spread by seed.
Rosaceae	<i>Rubus rosifolius</i>	Native raspberry	Shrub/tree (1.5 m)	Roadsides and in wastelands.	Yes	Small prickly shrub. Forms dense thickets. Fruits dispersed by animals. Nuisance in pastures and natural areas where it displaces desirable plants. Interferes with passage and use of land. Observed along roads in Kutubu area.

Family	Species	Common Name	Form	Habitat	Invasive	Comments
Salviniaceae	<i>Salvinia molesta</i> **	Giant salvinia	Aquatic fern	Still water or slow moving rivers	Yes	Floating fern which forms dense mats. A serious weed. Reproduces vegetatively. Spread by wind and water and boats and animals.
Acanthaceae	<i>Sanchezia parviflora</i>		Shrub (3m)	Significant weed of wet areas and gardens	Yes	Spread from cuttings and material dumped after pruning. Any accidental dumping, especially adjacent to a watercourse will result in loss of stream dwelling vegetation. Shade loving.
Malvaceae	<i>Sida acuta</i>		Herb to 1 m	Roadside		Shrubby herb.
Malvaceae	<i>Sida rhombifolia</i>	Sida	Herb to 1 m	Common in nurseries, roadsides and abandoned gardens	Yes	Difficult to eradicate, Very competitive Seed spread by attaching to clothing and mud on vehicles.
Asteraceae	<i>Sigesbeckia orientalis</i>	Indian weed	Annual herb to 1 m	Cultivated area.	Yes	Wind dispersed seeds. Seed very sticky and can spread by sticking to clothing or soil on machinery. Has tendency to move into cleared areas and reproduces vigorously.
Poaceae	<i>Sorghum halepense</i> **		Perennial grass to 1.5 m	Roadsides and cultivated land	Yes	Spread by seed and rhizomes.
Bignoniaceae	<i>Spathodea campanulata</i> **	Tulip tree	Tree to 25 m	Abandoned cultivated land and forests	Yes	Spread by wind dispersed seed, suckers and cuttings.
Rubiaceae	<i>Spermacocce repens</i> **		Herb	Roadsides and cultivated area	-	Seeds spread by sticking to clothing and livestock, and transported via mud on vehicles.
Thelypteridaceae	<i>Sphaerostephanos unitus</i>		Fern	Disturbed forest and cultivated areas	Yes	Spread rapidly by long creeping rhizomes.
Verbenaceae	<i>Stachytarpheta jamaicensis</i>	Snake weed	Spreading annual or perennial herb	Open disturbed and dryer habitats	Yes	Highly favoured by disturbance and extremely difficult to control. More common below 800m – does not thrive at higher altitudes. Will significantly compete with plants established during any rehabilitation initiative.
Verbenaceae	<i>Stachytarpheta cayennensis (urticifolia)</i> **	Cayenne snakeweed	Herb	Roadsides	Yes	Coarse tough herb. Prefers fertile soils. Seeds dispersed by vehicles, rain water, and garden refuse. Shade tolerant and can invade forests.
Asteraceae	<i>Synedrella nodiflora</i>	Nodeweed/pig grass	Herb to 1 m	Frequently disturbed areas, waste places, roadside and cultivated areas.	Yes	Wind dispersed seeds. Seeds are quick to regenerate. Eradication is sometimes difficult – has fibrous woody root stock. Common weed of cultivation.
Asteraceae	<i>Tithonia diversifolia</i>	Sunflower/tree	Shrub to 3 m	Roadsides and	Yes	Highly competitive in disturbed areas.

Family	Species	Common Name	Form	Habitat	Invasive	Comments
		marigold		disturbed areas		Difficult to eradicate. Can spread rapidly. Wind dispersed seeds. Any spread of this plant into the construction area would be major blow to rehabilitation efforts. This issue may need discussion with local villagers, given that spread is likely linked to horticultural practice.
Asteraceae	<i>Tridax procumbens</i>		Perennial herb	Cultivated areas and wastelands.	Yes	A decumbent weed of gardens. Wind dispersed seeds.
Malvaceae	<i>Urena lobata</i>		Herb to 1 m	Roadsides and disturbed areas	Yes	Woody weed. Can also form very dense mono-specific stands qualities. Most common in degraded areas where it persists for many decades providing light is not limited. Difficult to control because of its woody qualities. Seeds have barbs which attach to clothes.
Asteraceae	<i>Vernonia cinerea</i>		Annual herb to 1.5 m	Roadsides and cultivated area	No	Wind dispersed seeds. Less competitive than <i>Crassocephalum crepidioides</i> . Detracts from ecological integrity but not considered to require control.
Asteraceae	<i>Wedelia biflora</i>	Wedelia	Shrub to 2 m	Forest margins, streamsides and pastures.	Yes	Forms dense tangled thickets supported by other vegetation. Can invade degraded areas as a pioneer species. Common throughout Kutubu area.

- The list has been compiled from rehabilitation surveys and does not represent a complete list of weeds likely to be encountered
- Weeds in **red "bold"** are considered highly or potentially highly invasive and a priority for control. Other species may fall into this category that are not highlighted in the table.
- Weeds marked \*\* have not been identified along the right of way but may be present in the project area or are potentially likely to invade.
- Some native/naturalised species, particularly grasses (e.g. *Imperata cylindrica*) may cause weed problems particularly in areas requiring rehabilitation.

## **Attachment 5: Example Significant Weed Species**

## Siam weed- *Chromolaena odorata*



### What does it look like?

**Habit:** Big bushy herb or subshrub with long rambling (but not twining) branches; stems terete, pubescent  
**Branches**

**Leaves:** opposite, flaccid-membranous, velvety-pubescent, deltoid-ovate, acute, 3-nerved, very coarsely toothed, each margin with 1-5 teeth, or entire in youngest leaves; base obtuse or subtruncate but shortly decurrent; petiole slender, 1-1.5 cm long; blade mostly 5-12 cm long, 3-6 cm wide

**Inflorescence (capitula)** in sub-corymbose axillary and terminal clusters; peduncles 1-3 cm long, bracteate; bracts slender, 10-12 mm long; involucre of about 4-5 series of bracts, pale with green nerves, acute, the lowest ones about 2 mm long, upper ones 8-9 mm long, all acute, distally ciliate, flat, appressed except the extreme divergent tip;

**Flowers:** florets all alike (disc-florets), pale purple to dull off-white, the styles extending about 4 mm beyond the apex of the involucre, spreading radiately; receptacle very narrow; florets about 20-30 or a few more, 10-12 mm long; ovarian portion 4 mm long; corolla slender trumpet form; pappus of dull white hairs 5 mm long

**Fruit/seeds (achenes):** glabrous or nearly so.

### Where is it found?

Grows in many soil types but prefers well-drained soils. It does not tolerate shade and thrives well in open areas. Forms dense stands which prevent establishment of other species, both due to competition and allelopathic effects. Requires disturbance to become established.

### What are its effects?

Can form dense thickets in disturbed areas and may prevent recruitment of native plant species, delaying succession. When dry, is a flashy fuel which promotes wildland fires.

**Dispersal:** Wind-dispersed seeds. Seeds also cling to hair, clothing and shoes. The tiny seeds can occur as a contaminant in imported seed or on vehicles and machinery. Vehicle traffic can spread the seed along roads. Can propagate vegetatively from stem and root fragments.

### How do you control it?

**Physical:** Manual slashing and use of bush-cutter or tractor-drawn implements are commonly used methods of control. Slashing causes regeneration unless followed by other control methods. Manual weeding is labour

intensive. The use of tractor drawn equipment is limited to areas that are accessible.

**Chemical:** Chemical control using herbicides applied at the seedling stage or on regrowth has given encouraging results. Triclopyr has proven to be the most effective. However, problems in herbicide use include the high cost of the chemicals and their application, ecological concerns and, non-compatibility in many environmental situations. Removing seed and flower heads and spraying with 2,4-D Amine plus Picloram (Tordon in Australia) kills top growth and the root system.

**Cultural:** Mulching will effectively suppresses *C. odorata*. This method is labour intensive and requires sufficient mulching materials.

## *Ludwigia hyssopifolia*



### **What does it look like?**

**Habit:** Annual herb to 1 (rarely 2-3) m tall.

### **Branches**

**Leaves** lanceolate, up to 9 cm long and 3 cm wide, acuminate, cuneate basally, lateral nerves 11-17 pairs; petiole up to 1.8 cm long.

**Inflorescence** minutely puberulent

**Flowers:** **Sepals** 4, 2-4 mm long, lanceolate; **petals** 4, yellow, 2-3 mm long, elliptic; stamens 8, slightly unequal, 0.5-2 mm long (excl. anthers)

**Fruit** capsular, finely puberulent, 1.5-3 cm long, about 1 mm thick, sessile.

**Seeds** of 2 kinds, those of lower section of capsule 0.7-0.85 mm long, those in upper section 0.35-0.5 mm long.

### **Where is it found?**

A plant of wet places; swamps and stream edges, roadside ditches; often a weed of pastures. Mostly from sea level to 700 m. Has spread along the existing oil pipeline right of way in Gulf Province.

### **What are its effects?**

Invasive in wetter areas.

**Dispersal:** Seeds in the capsule are provided with "floats", and therefore they may be water-dispersed.

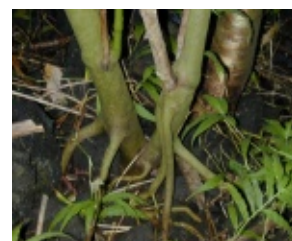
### **How do you control it?**

**Physical:** Taller plants may require mechanical removal.

**Chemical:** Two applications of 0.45 kg of 2,4-D in 91 L of water at 4-week intervals. Spot spray later.



## Bamboo Piper- *Piper aduncum*



### What does it look like?

**Habit:** Big bushy herb or subshrub with long rambling (but not twining) branches; stems terete, pubescent

**Branches**  
**Leaves:** opposite, flaccid-membranous, velvety-pubescent, deltoid-ovate, acute, 3-nerved, very coarsely toothed, each margin with 1-5 teeth, or entire in youngest leaves; base obtuse or subtruncate but shortly decurrent; petiole slender, 1-1.5 cm long; blade mostly 5-12 cm long, 3-6 cm wide

**Inflorescence (capitula)** in sub-corymbose axillary and terminal clusters; peduncles 1-3 cm long, bracteate; bracts slender, 10-12 mm long; involucre of about 4-5 series of bracts, pale with green nerves, acute, the lowest ones about 2 mm long, upper ones 8-9 mm long, all acute, distally ciliate, flat, appressed except the extreme divergent tip;

**Flowers:** florets all alike (disc-florets), pale purple to dull off-white, the styles extending about 4 mm beyond the apex of the involucre, spreading radiately; receptacle very narrow; florets about 20-30 or a few more, 10-12 mm long; ovarian portion 4 mm long; corolla slender trumpet form; pappus of dull white hairs 5 mm long

**Fruit/seeds (achenes):** glabrous or nearly so.

### Where is it found?

Grows in many soil types but prefers well-drained soils. It does not tolerate shade and thrives well in open areas. Forms dense stands which prevent establishment of other species, both due to competition and allelopathic effects. Requires disturbance to become established.

### What are its effects?

Can form dense thickets in disturbed areas and may prevent recruitment of native plant species, delaying succession. When dry, is a flashy fuel which promotes wildland fires.

**Dispersal:** Wind-dispersed seeds. Seeds also cling to hair, clothing and shoes. The tiny seeds can occur as a contaminant in imported seed or on vehicles and machinery. Vehicle traffic can spread the seed along roads. Can propagate vegetatively from stem and root fragments.

## **Attachment 6: Unwanted Pest Register**

**Unwanted Pest Register**

Species	Common Name	Organism type	Habitat	Comments
<b>AMPHIBIANS</b>				
<i>Bufo marinus</i>	Cane toad	Amphibian	agricultural areas, lakes, natural forests, riparian zones, ruderal/disturbed, urban areas, water courses, wetlands	Compete with native amphibians for food and breeding habitats. Their toxic secretions are known to cause illness and death in domestic animals that come into contact with them, such as dogs and cats, and wildlife, such as snakes and lizards. Occurs in the Port Moresby area.
<b>BIRDS</b>				
<i>Acridotheres tristis</i>	Indian Mynah	Bird	Urban areas, forest edges	Displace native birds. Kill chicks and destroy eggs. Transports weed seeds.
<b>FISH</b>				
<i>Clarias batrachus</i>	Walking catfish	Fish	Estuarine habitats, lakes, water courses, wetlands	Preys on native tadpoles. Can live out of water for some time and move short distances over land.
<i>Cyprinus carpio</i>	Common carp	Fish	Estuarine habitats, lakes, water courses, wetlands	Reduces water clarity and destroys and uproots the aquatic vegetation used as habitat by a variety of species. A highly invasive species.
<i>Gambusia affinis</i>	Mosquito fish	Fish	Estuarine habitats, lakes, water courses, wetlands	Highly predatory. Eats the eggs of economically desirable fish and preys on and endangers rare indigenous fish and invertebrate species.
<i>Oreochromis mossambicus</i>	Mozambique tilapia	Fish	Estuarine habitats, lakes, marine habitats, water courses, wetlands	A possible threat to native species through competition for food and nest space.
<i>Oncorhynchus mykiss</i>	Rainbow trout	Fish	Lakes, water courses	Highly invasive. Transmits disease, predation and competition with native species.
<i>Poecilia reticulata</i>	Guppy	Fish	Estuarine habitats, lakes, water courses	Potential to cause decline in populations of native fish species.
<i>Salmo trutta</i>	Brown trout	Fish	Estuarine habitats, lakes, marine habitats, water courses	Potential to reduce populations of native fish species.
	Climbing perch/anabass			
<b>INSECTS</b>				
<i>Anoplolepis gracilipes</i>	Crazy ant	Insect	Agricultural areas, coastland, natural forests, planted forests, range/grasslands, riparian zones, ruderal/disturbed, scrub/shrublands, urban areas, water courses. Can invade homes and buildings	Forms multi-queened super colonies that can decimate a range of native species including arthropods, reptiles, birds and mammals on the forest floor and canopy Can impact key-stone species. Can damage the forest canopy by farming and protecting sap sucking scale insects.
<i>Bemisia tabaci</i>	White fly	Insect	Agricultural areas, urban areas	Potential to impact adjacent subsistence agriculture gardens and cause crop failure. Commonly introduced on ornamental plants.
<i>Brontispa longissima</i>	Coconut hispid beetle	Insect	Agricultural areas and planted forests.	Attacks palm leaf fronds, particularly of the coconut palms. Spread by human activities, particularly the lack of quarantine of ornamental palms.

Species	Common Name	Organism type	Habitat	Comments
<i>Oryctes rhinoceros</i>	Coconut black beetle	Insect	Agricultural areas, natural forests	Serious pest of coconut palms. Transported in aircraft holds, pot plants and sawdust.
<i>Solenopsis geminata</i>	Fire ant	Insect	Agricultural areas, coastland, natural forests, planted forests, range/grasslands, riparian zones, ruderal/disturbed, scrub/shrublands, urban areas	Painful sting. More readily invades disturbed habitats such as forest edges. A grave threat to conservation values where it invades native communities. Devastates native ant communities. Reduces populations of native butterfly eggs. Potential to impact plants. A hot climate specialist.
<i>Wasmannia auropunctata</i>	Little red fire ant	Insect	Coastland, planted forests, riparian zones, ruderal/disturbed, scrub/shrublands	Negative impacts on vertebrates and invertebrates causing population decline in small mammals. Stings humans and can cause blindness.
<b>MAMMALS</b>				
<i>Felis catus</i>	Cat	Mammal	Agricultural areas, coastland, natural forests, planted forests, range/grasslands, riparian zones, ruderal/disturbed, scrub/shrublands, urban areas, wetlands	Predator of native mammals and birds and other fauna.
<i>Macaca fascicularis</i>	long-tailed macaque	Mammal	Agricultural areas, natural forests, planted forests, range/grasslands, riparian zones, ruderal/disturbed, scrub/shrublands, urban areas	A colony exists in the Jayapura area. Negatively impact ecology by eating the eggs and chicks of endangered forest birds. They compete with native birds for resources such as native fruits. Disperse exotic plant species. Carry potentially fatal human diseases, including B-virus.
<i>Rattus exulans</i>	Pacific rat	Mammal	Agricultural areas, coastland, natural forests, planted forests, range/grasslands, riparian zones, ruderal/disturbed, scrub/shrublands, urban areas, wetlands	Predates on large flightless invertebrates, small lizards and, burrowing birds eggs and agricultural crops.
<i>Rattus rattus</i>	Black rat/European house rat/Ship rat	Mammal	Agricultural areas, coastland, natural forests, planted forests, range/grasslands, riparian zones, ruderal/disturbed, scrub/shrublands, urban areas	Has directly caused or contributed to the extinction of many species of wildlife including birds, small mammals, reptiles, invertebrates, and plants, especially on islands.
<i>Sus scrofa</i>	Feral pig	Mammal	Agricultural areas, coastland, natural forests, planted forests, range/grasslands, riparian zones, ruderal/disturbed, scrub/shrublands, urban areas, wetlands	Disturb native vegetation by digging. Spread weed seeds. Disrupt plant succession and rehabilitation areas. Destroy habitat for small mammals.
<b>MOLLUSCS</b>				
<i>Achatina fulica</i>	Giant African Snail	Mollusc	Agricultural areas, forests, riparian zones, wetlands	Impacts native snails. Causes herbivory. Can carry disease.
<i>Euglandina rosea</i>	Cannibal snail	Snail	Natural forests, planted forests, ruderal/disturbed, scrub/shrublands, urban areas	Feeds on native snails causing loss of species.
<i>Pomacea canaliculata</i>	Apple snail	Mollusc	Agricultural areas, lakes, water courses, wetlands	Feeds of native water plants and has the potential to cause serious habitat modification of native wetlands.