HANCOCK PROSPECTING PTY LTD

Alpha Coal Project Supplementary Environmental Impact Statement

AG Railway Corridor – Weed Management Plan

CLIENTS | PEOPLE | PERFORMANCE

Hancock Prospecting Pty Ltd

Report for Alpha Coal Project (Rail)

Weed Management Plan

March 2011

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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1. Introduction

Hancock Prospecting Pty Ltd (HPPL) is proposing to construct a standard gauge, 495 km long railway line for the purposes of transporting processed coal from the Alpha coal mine site to the proposed Port of Abbot Point near Bowen (refer to Figure 1). The proposed railway line (herein referred to as the Project) is a vital piece of infrastructure that will enable export of 60 Mtpa of quality thermal coal to overseas markets.

On 21 October 2008, the Coordinator-General declared the Project a 'significant Project for which an Environmental Impact Statement (EIS) is required' under section 26(1) (a) of the *State Development and Public Works Organisation Act 1971* (SDPWOA). In 2009, the Project was also declared by the Commonwealth Government as a controlled action pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A bilateral agreement was subsequently reached between the relevant Queensland and Commonwealth government departments and required that one EIS be prepared for the Project, addressing the requirements of both the SDPWOA and the EPBC Act.

In September 2009, GHD was commissioned by HPPL to undertake an Environmental Impact Statement (EIS) for the Project. Desktop and field surveys were undertaken to document the existing flora and fauna habitat values along the alignment, to assess the risks to flora and fauna, to identify any significant ecological constraints to development and recommend mitigation measures.

1.1 Study Area

The Project is located between the Alpha coal mine, 50 km north of the Alpha township and the Abbot Point coal export terminal, 22 km north-west of Bowen. The alignment of the Project has been selected on the basis of several factors, primarily environmental, economic and geotechnical grounds. The rail alignment proceeds in a generally north-easterly direction from the Alpha mine, crossing the Belyando River and several of its tributaries in the first 100 km. The railway crosses generally relatively flat lowlands before commencing a gentle climb from near Eaglefield adjacent to the Suttor River, to a point near the existing Newlands mine. This is the highest point on the railway at approximately 300 m above sea level. In the vicinity of the Newlands mine, the railway runs parallel to the QR National's Northern Missing Link railway through a pass in the Leichhardt Range and parallel to the Newlands Railway to a point near the Bowen River for approximately 70 km. The Railway then travels in a north westerly direction down the Bowen River valley through mostly grazing land toward Mount Herbert. West of Mount Herbert, through a pass in the Clarke Range, the railway travels north-easterly crossing the Bogie River and entering Abbot Point on its western boundary. Within the Abbot Point area it runs parallel to the existing Newlands Rail line for approximately six to eight km.

The railway passes approximately 70 km to the north west of Clermont, 55 km to the north west of Moranbah, 20 km to the west of Collinsville, and enters the Port of Abbot Point 22 km northwest of Bowen.

For the purposes of this Weed Management Plan (WMP), the Project area is:

- An easement of approximately 495 km long and 60 m wide;
- A series of laydown areas and construction nodes and local construction access tracks (that will be used during construction only); and
- Local maintenance access tracks (that will be used and maintained through the operational phase).

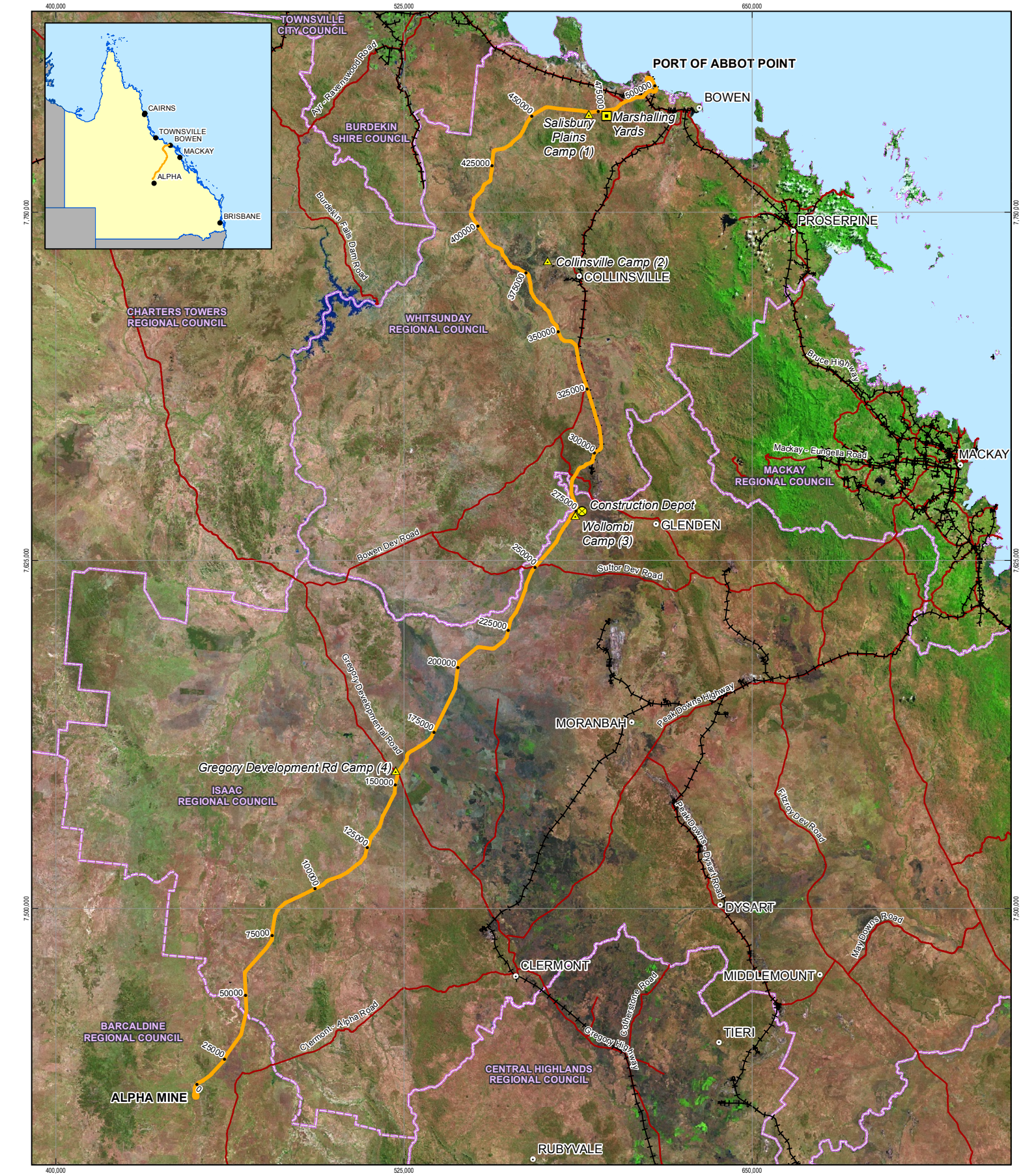
The study area refers to land 30 m either side of the alignment, for the length of the proposed rail alignment. The alignment is the proposed route of the rail line.

1.2 Purpose of Weed Management Plan

This WMP details weed management measures applicable to weed species that may be found in, or have the potential to be spread to the Project area (inclusive of the broader study area). It is prepared to direct the management of weeds in the Project area that are identified under QLD legislation and in applicable local government plans or local laws. It is intended to work in accordance with the pest management principles and desired outcomes of any applicable national, state, regional and local weed management strategies and plans.

The WMP applies to the construction and operational life of the Project to assist with preventing the introduction of weeds to the site and identifies:

- Performance objectives;
- Management actions;
- Performance indicators;
- Monitoring requirements; and
- Reporting requirements and responsibilities.



LEGEND

- Town
- Camp
- Marshalling Yards
- Construction Depot
- Proposed Alignment
- State Road
- Existing Railway
- Local Government Area

Source: See Copyright Details below and for full disclosure please refer to the SEIS ***Volume 2, Appendix B***

1:1,250,000 (at A3)

0 5 10 20 30 40 50

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

N W E S

HANCOCK PROSPECTING PTY LTD

Alpha Coal Project
Supplementary Environmental Impact Statement

PROJECT AREA

Job Number	41-23742
Revision	C
Date	02-03-2011

Figure: 1

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1.3 Legislative framework

Invasive weeds are one of the most serious threats to Australia's natural environment and primary production industries. As such they are regulated under a number of different pieces of Commonwealth and State legislation as well as local laws within Local Government Area (LGA) boundaries.

In addition to legislation, there are a number of recognised lists and accompanying non-statutory plans and strategies for the management of weeds of national interest. For example, Weeds of National Significance (WONS) is a framework endorsed by the Federal, State and Territory governments which identifies 20 weed species and management practices for their prevention of spread and control. Applicable weed management plans at a federal, state and local level are depicted in a flow chart at Figure 2.

The legislation applicable to the management of weeds within the study area is detailed in Section 1.3.1 to Section 1.3.2 below. For the purposes of this Plan, weeds include:

- Plants declared under the *Land Protection (Pest and Stock Route Management) Act 2002* (Qld);
- Plants declared under the relevant local governments local laws or plans; and
- Plants identified in National plans and strategies.

1.3.1 *Land Protection (Pest and Stock Route Management) Act 2002* (QLD)

All planning and prevention of pests is regulated under the *Land Protection (Pest and Stock Route Management) Act 2002* (hereafter referred to as the LP Act). The purpose of the Act is to provide for:

- Pest management on land; and
- Stock route network management.

The LP Act targets pest plant or animals that have, or could have, serious economic, environmental or social impacts for control.

Declaration of plants under the LP Act imposes a legal responsibility on all land owners to eradicate, control or reduce the occurrence of pests depending on their classification. Large landowning state agencies and local governments are also required to develop and implement pest management plans. Declared plants are classified under three different classes, class 1, 2 or 3, depending on their current or potential establishment in the state and the potential severity of their impact (refer Table 1).

Under the LP Act a landowner must take all reasonable steps to keep private land free of class 1 and class 2 pests. GHD has a duty of care under the LP Act so that activities of its staff, and contractors carrying out on-ground surveys and works associated with the Project are undertaken in a way that avoids the spread of pest plants.

Table 1 Declared Plants under the LP Act

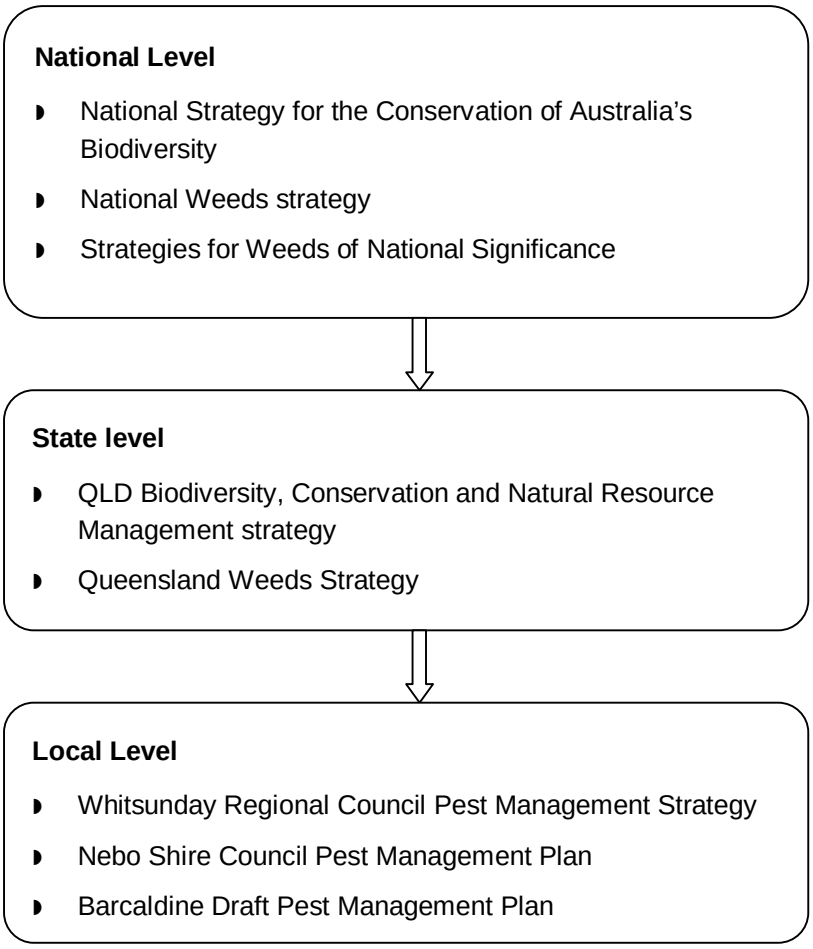
	Class 1 are not commonly present or established; and have the potential to cause an adverse economic, environmental or social impact on the environment
	Class 2 are established in the State; and are causing, or have the potential to cause, an adverse economic, environmental or social impact in the environment
	Class 3 are primarily environmental weeds where the plants are established in the State and have, or could have, and adverse economic, environmental or social impact.

1.3.2 Local laws

The Project area incorporates three local government regional council boundaries; These are the Whitsunday, Isaac and Barcaldine Regional Councils. Under Section 25 of the LP Act a local government must develop a pest management plan for its area. In addition to their requirements under this Act the regional councils have also developed a variety of local laws to deal with the management of weed species that not declared by state legislation but are a local problem.

Isaac Regional Council does not currently have a weed or pest management plan for its area, therefore, the Nebo Shire Council Pest Management Plan (Nebo is a local council recently amalgamated into the Isaac Regional Council area) is taken as the applicable management plan for this LGA. Barcaldine's pest management plan is also in draft form, awaiting approval from the State.

Figure 2 Applicable Weed Management Plans



2. Weed Management Plan

2.1 Existing Environment

Ecological surveys undertaken for the EIS identified 33 introduced species present in the Project area, of which eight species are 'declared plants' under the LP Act. These species are listed in Table 2. A quick reference guide to declared plants identified in the area surveyed and species that weren't identified but are considered as having potential to occur is provided at Appendix A. Fact sheets detailing the appropriate management methods for each of the declared species identified are provided at Appendix B.

Table 2 Declared plants recorded in the study area

Species	Common Name	Distribution
Class 2 weeds		
Harrisia sp.	harrisia cactus	Sclerophyll woodland throughout the study area. Not common in any location.
Parkinsonia aculeata	parkinsonia	Port area. Not common.
Parthenium hysterophorus	parthenium	Beside roads throughout the study area wherever black clays were found.
Opuntia stricta	prickly pear	Scattered throughout the study area.
Cryptostegia grandiflora	rubber vine	Beds and banks of creeks and rivers and on alluvial plains and flats. Can occur in dense stands, creating an almost impenetrable barrier.
Opuntia tomentosa	velvety tree pear	Scattered throughout the study area.
Ziziphus mauritania	chinee apple	Present as isolated individual trees in the Port area.
Class 3 weeds		
Lantana camara	lantana	In the northern half of the study area only. Not common.

Landowners must take reasonable steps to control class two pest plants on their land under the LP Act. However, landowners are only required to control class three pest plants on their land if they adjoin an environmentally significant area (e.g. a National Park or other area defined by Council).

2.2 Potential Impacts

This WMP is relevant to the construction and operation phases of the Project. The construction and operation activities involving the transport of materials to the site and increased traffic to/from the site has the potential to introduce new species to the area and spread currently occurring species to other areas in the region. Similarly, any rehabilitation activity has the potential to provide a vector through which weed species can be introduced.

2.2.1 Construction Phase

The EIS for the Project details the potential impacts associated with various stages of the Project. Detailed descriptions of impacts and proposed mitigation measures can be found in the EIS in the Nature Conservation chapter, but has been summarised here for the construction and operational phases of the Project.

Construction phase activities where weed management is required includes but is not limited to:

- Vegetation clearing of the construction footprint, work areas, construction camps and associated access roads
- Construction of the railway line including:
  - soil stockpiling
  - transportation of fill and materials to and from site
  - construction vehicle movements.

2.2.2 Operational Phase

The operational phase of the Project encompasses the day-to-day activities involved with running of the railway line after construction. Activities associated with the operation and maintenance of the Project where weed management is required includes:

- Maintenance of railway line and associated rail corridor
- Vehicular movements within the rail corridor
- Rehabilitation and revegetation activities.

The Project area will be susceptible to infestation if not managed appropriately given it will provide new habitat particularly during the rehabilitation of exposed soils. The potential introduction of weed species should be controlled to protect properties within the Project area from any introductions and to avoid any follow on impacts to nearby areas to which species could be introduced.

Potential impacts during the construction and operation phases include:

- Introduction and spread of weed species
- Soil disturbance, facilitating the establishment of weeds in disturbed areas
- Transport of weed seeds from one area of the site to another, facilitating spread of weeds
- Displacement of native vegetation by weeds if inadequate control is implemented.

Consequently, spread of weed species can impact upon flora and fauna communities by:

- Degradation of habitat values
- Competition for resources
- Reducing habitat availability
- Introduction of diseases or nuisance to the community.

These impacts are described in detail in the EIS (Appendix F: Terrestrial Ecology).

2.3 Performance Objectives

The performance objectives for this WMP are:

- To limit the negative impacts on flora and fauna in the local area by weed species that may be associated with the Project area during construction and operation activities
- To prevent the introduction and spread of declared plants and environmental weeds
- Control current weed species infestations on the site
- Prevent displacement of native vegetation
- Prevent the spread of weeds within the site or off-site.

2.4 Responsibilities

All Project and construction staff are required to abide by the *Environmental Protection Act 1994* (EP Act) and comply with all procedures outlined in this WMP. Project staff must not carry out any activity that is likely to cause, or causes, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm.

2.4.1 Design Manager

Responsibilities of the design manager include:

- Taking environmental considerations, such as weed management, into account during the preliminary, detailed and final design stages
- Reporting on the functionality of the final planning layouts
- Performing the detailed design of the Project and incorporating the requirements of this WMP in the design.

2.4.2 Construction Manager

The construction manager has overall responsibility for the delivery of the construction phase of the Project. Specific responsibilities relevant to this plan include:

- Make sure staff are trained in their obligations under the WMP
- Implementing environmental protection measures as described in the WMP

- Providing copies of the WMP to each sub-contractor with responsibilities under the plan
- Warrant the full and complete implementation of the WMP by sub-contractors
- Auditing sub-contractors implementation of the WMP and adherence to the requirements of the WMP
- Managing corrective actions arising from monitoring activities and external audits
- Reviewing the WMP implementation and effectiveness.

2.4.3 Environmental Officer

The environmental representative is responsible for:

- Overseeing compliance with the relevant federal and state environmental legislation approval requirements under the EPBC Act, VM Act, NC Act and LP Act during the Project in collaboration with the Construction Manager
- Monitoring and reporting on the performance of environmental protection measures in accordance with the requirements of the WMP
- Undertaking monitoring and reporting requirements as outlined in this WMP
- Confirming relevant environmental commitments have been satisfied.

2.4.4 Construction personnel and subcontractors

All construction personnel must be aware of the requirement to exercise environmental due diligence and achieve compliance with this WMP and other relevant policies and procedures.

2.4.5 Operations Manager

The operation manager has overall responsibility for the ongoing operation and maintenance of the Project. Specific responsibilities relevant to this plan include:

- Make sure operations staff are trained in their obligations under the WMP
- Make sure operations activities such as rehabilitation and revegetation practices adhere to the WM.
- Monitoring the implemented environmental protection measures as described in the WMP
- Managing corrective actions arising from monitoring activities and external audits
- Reviewing the WMP implementation and effectiveness during operation.

2.5 Management Actions

To achieve the performance objectives across construction and operational activities, the following management actions will be employed to reduce the risk of the introduction of weed species as well as detect their presence so that corrective action can be implemented.

Table 3 Weed Management Actions

Phase	Management Action	Responsible Person
Construction	Identify potential existing infestation areas using all available resources (mapping, consultation feed back from Landholders and desktop searches) prior to construction to determine any site-specific requirements. This will be ongoing to reflect potential new locations and/or species (declared in the LP Act and/or recognised by landowners as being problematic at specific sites).	Environment Officer
Construction	After carrying out earthworks or if driving through boggy or heavily grassed areas, remove any build-up of soil/plant material from vehicles and equipment prior to leaving the site. Inspect all vehicles/machinery and relevant equipment (including boots, digging implements etc.) for any build-up of soil and plant material that may contain noxious plant material before entering a property or moving between properties prior to establishment of the corridor. Following completion of clearing activities and the establishment of the corridor, inspections of vehicles and personnel and wash down procedures will occur when entering and leaving the cleared corridor.	Construction Manager Environment Officer
Construction	All onsite personnel will follow these weed hygiene procedures: ◗ Prior to access to the site, all construction machinery at risk of transporting pest species of concern (or their vectors, e.g. seeds) for this location must be thoroughly washed down before moving to the site according to accepted industry standards – Queensland checklist for clean-down procedures (DERM, 2000) (Appendix C) ◗ Proof of inspection, such as 'wash down tickets' from state operated facilities is required for all vehicles coming from known areas of weed infestation, before permission is granted to enter uninfected tenure areas. ◗ All forms of wash down which are undertaken on-site, but not in a designated wash down station must be recorded by GPS. This will allow future wash down procedures to be undertaken at the same location and will allow for monitoring and management of weeds at the site. A vehicle wash down register template is provided at Appendix D. ◗ If the vehicle is not considered clean by a Supervisor/ Environment Officer, it shall be rewashed and reinspected before certification.	Construction Manager Environment Officer

Phase	Management Action	Responsible Person
Construction/ Operation	Only approved access tracks and roads are to be used for access to the rail corridor.	Environment Officer
Construction/ Operation	Class 1 and 2 declared pest weed plants and WONS must be removed according to management strategies defined by DEEDI declaration fact sheets where appropriate. Refer to Appendix B for details specific to weed removal for declared plants.	Environment Officer
Construction/ Operation	Adequate and suitable waste disposal options must be provided during construction and operation to ensure that stray waste does not attract fauna to the area	Construction Manager Operation Manager Environment Officer
Construction	Weed and pest alerts to be included in environmental induction training for all staff	Construction Manager Environment Officer
Construction	Design construction processes and works to minimise opportunities for weed invasion and establishment.	Design Manager Environment Officer
Construction	Vegetation cleared (inclusive of woody vegetation that may be mulched) during construction will be retained where possible within the vicinity from which it was removed and will not be transported throughout the corridor so as to avoid the movement of weeds within the Project area.	Construction Manager Environment Officer
Construction	Environmental Control Plans will be developed/implemented which outline go/no go areas, environmentally sensitive areas, and specific construction methods/techniques/mitigation measures.	Construction Manager Environment Officer
Construction/ Operation	Any landscaping or rehabilitation will not use declared weed species, and any topsoil brought to the site must have certificates to demonstrate it is weed free. Topsoil retained from earlier processes may be used within the vicinity from which it was removed if it determined to be free of declared weed species.	Construction Manager Environment Officer

2.6 Performance Indicators

The performance indicators for this WMP include:

- No taxa are introduced to the Project area and if so they are contained and removed appropriately to limit spread
- Existing infestations are to be identified, appropriately managed and controlled
- Existing infestations present within the Project area are not to be spread along the Project corridor and associated access areas or to adjacent properties.

2.7 Monitoring

To evaluate the effectiveness of the management actions suggested in this WMP the following monitoring techniques will be undertaken:

- During construction, work areas will be regularly inspected to assess the implementation of management actions;
- During operation undertake weekly observations of the Project area where feasible for the first 2 months to detect possible invasive weed or other pest species;
- For areas that may be rehabilitated, a photographic record will be prepared prior to any disturbance for use as a baseline against which the success of rehabilitation and lack of pest incursion can be measured; and
- Visual inspection every two months of any rehabilitated areas at the completion of works (for 12 months) to detect pest species, which, if detected, will trigger determination of an appropriate management strategy suitable to the type and extent of pest incursion.

2.8 Reporting

Weed management summary reports will be produced throughout the duration of all phases of the Project and kept on record for inspection by the relevant regulatory authority when required. Reports should include, but not be limited to:

- Records and results of weed management monitoring events and updates in the form of a monthly verbal/memo report by the monitoring agent to onsite environment manager;
- A record of management actions undertaken, their relative success, and any measures taken to further mitigate impacts relating to the proposed Project;
- A record of any infringements to the proposed weed management objectives, management actions or performance indicators stated within the WMP;
- Development of a weed management complaint register detailing origin of complaint, investigative details and resulting actions; and
- Final report by monitoring agent upon completion of program.

Appendix A

Weeds of Concern: A Quick Reference

See facts sheets at Appendix B for more information

Photo	Plant Species	Class	Description	Habitat	Means of spread
	*Acacia nilotica* (Prickly Acacia)	2	◗ A thorny shrub or small tree which grows up to 5m, occasionally up to 10 m ◗ Has pairs of stout thorns generally around 1-5 cm long ◗ Golden-yellow ball-shaped flowers grow on stems from leaf joints with 2-6 flowers per group ◗ Has fern-like leaves, 4-10 pairs of leaf branches, 10-20 pairs of narrow green leaflets on each branch ◗ Pods are flat, 10-15 cm with narrow constrictions between seeds and are greyish when ripe ◗ Bark on saplings has a tinge of orange and/or green, and older trees have dark, rough bark	Large tree found in all habitat types	Seeds can spread by water, wind, stock, feral and native animals.
	*Bryophylum delagoense* (Mother of Millions)	2	◗ An erect, smooth, fleshy, succulent plant growing to 1 m or more in height ◗ Has tall flower spikes with clusters of bell-shaped flowers ◗ Produces small plantlets along the edges of leaves ◗ Flowers are orange-red in a cluster at the top of the stem	Spreads by flood water and establishes if pastures are run down	Affects pasturelands in the Central Highlands, establishes well in leaf litter or other debris on shallow soils in shady woodlands. Found on roadsides, fence lines and around old rubbish dumps and is adaptable to dry conditions.

Photo	Plant Species	Class	Description	Habitat	Means of spread
	*Cryptostegia grandiflora* (Rubbervine)	2	◗ 1-2 m high and can scramble up to 30 m high in trees ◗ Has glossy dark-green leaves, 6-10 cm long by 3-5 cm wide in opposite pairs ◗ Stems, leaves and unripe pods exude a white, milky sap when broken or cut ◗ Flowers are large and showy with five white to light purple petals arranged in a funnel shape ◗ Seed pods are rigid and grow in pairs at the end of a short stalk ◗ Pods have a tuft of long, white silky hairs, are 10-12 cm long by 3-4 cm wide and contain up to 450 brown seeds	Infestations found throughout river systems of southern Cape York and the Gulf of Carpentaria, south along the coast to the Burnett River.	Spread by wind and water
	*Lantana camara* (Lantana)	3	◗ Stems are square with small, recurved prickles ◗ Leaves are bright green, about 6 cm long, with roundtoothed edges and grow opposite one another along the stem ◗ Flowers vary in colour from pale cream to yellow, white, pink, orange, red, lilac and purple, about 2.5 cm in diameter ◗ Fruits are glossy, rounded, fleshy, purplish-black when ripe.	Grows in a wide variety of habitats, from exposed dry hillsides to wet, heavily shaded gullies.	Not specified

Photo	Plant Species	Class	Description	Habitat	Means of spread
	*Opuntia* sp (Prickly Pear)	1	◗ Leafless succulent shrub ◗ Has spiny and pear-shaped fruit ◗ Stems are divided into segments (pads or joints) ◗ Flowers are large and vary from yellow, orange, red, pink, purple to white seen during spring Fruits vary from red, purple, orange, yellow to green	Is spread by birds and animals eating the fruit and excreting viable seed.	Infestations covered 4 million ha by 1900, 24 million ha by 1920 and advances at a rate of 400,000 ha per year.
	*Parkinsonia aculeata* (Parkinsonia)	2	◗ Grows up to 10 m tall, with branches that are slender, zig-zagged and have sharp spines ◗ Leaves have a short, spine-tipped stalk leaf branches are 20-40 cm long ◗ Flowers are yellow, fragrant, five-petalled, each on a long, slender drooping stalk ◗ Seed pods are pencil-like, 5-10 cm long and constricted between seeds ◗ Seeds are oval, about 15 mm long, have a thick and extremely hard coat remaining viable until favourable conditions occur	Adaptable to a wide range of soil types found along watercourses in sub-humid and semi-arid areas of Queensland.	Flowers in early summer of its second or third year of growth then exploits variable seasonal conditions. Pods mature in late summer and are readily dispersed by flood waters.

Photo	Plant Species	Class	Description	Habitat	Means of spread
	*Parthenium hysterophorus* (Parthenium)	2	◗ Grows up to 5 m in height, developing many branches in its top half when mature ◗ Pale-green leaves, deeply lobed and covered with fine soft hairs ◗ Small creamy white flowers on stem tips ◗ Flowers contain 4-5 black seeds that are wedge-shaped, 2 mm long with 2 thin, white scales CAUTION – Flowering plant can cause breathing difficulty and Asthma. Do not enter area if you are unsure or feel symptoms	Grows in most soil types, most dominant in alkaline, clay and loam soils.	Seeds can spread by water, vehicles, machinery, stock, feral and native animals and in feed and seed.
	*Sporobolus fertilis* (Giant Parramatta Grass)	2	◗ A clumping grass ◗ Grows up to 0.8-1.6 m high ◗ seed head up to 50 cm long and 1-2 cm wide Branches of seed head pressed to the axis and overlapping. Lower ones spread at maturity	Adapts to a wide range of soils and conditions, and suited to conditions present in 60% of Queensland.	Can set seed throughout the frost-free period of the year, spread by livestock, feral and native animals, vehicles, machinery and fast-flowing water.

Photo	Plant Species	Class	Description	Habitat	Means of spread
	*Sporobolus pyramidalis* (Giant Rat's Tail Grass)	2	◗ Very similar in appearance to other *Sporobolus* grasses ◗ Grows to a height of 0.6-1.7 m ◗ Seed head is up to 45 cm long and 3 cm wide ◗ Seed heads change shape from a 'rat's tail' when young to an elongated pyramid shape when mature Unlike Parramatta grass and giant Parramatta grass, GRT does not develop sooty spike on its seed heads.	Adapts to a wide range of soils and conditions, and suited to conditions present in 60% of Queensland.	Can set seed throughout the frost-free period of the year, spread by livestock, feral and native animals, vehicles, machinery and fast-flowing water.
	*Eriocereus* spp (Harrisia cactus)	1	◗ Spiny, fleshy-jointed stems form tangled mats about 0.5 m high and are ribbed lengthwise with six ribs. Each rib has low, thick, triangular humps at regular intervals. Humps have cushions of grey felty hairs, three to five short spines lying flat, and one to three erect, stiff, sharp spines 2.5-3 cm long ◗ Large pink, funnel-shaped flowers with a tinge of white , grow singly on a slender scaly grey/green tube 12-15 cm long Fruit is red, round, 4-5 cm across, with scattered bumps with hairs and spines. Numerous small black seeds are embedded in the fruit's white, juicy pulp.	A pest of Brigalow and associated softwood country, infestations also appear in box and ironbark stands and in pine forests. Branches take root where they touch the ground.	Fruit spread by birds and animals

Photo	Plant Species	Class	Description	Habitat	Means of spread
	*Ziziphus mauritiana* (Chinese apple)	2	◗ A large shrub or small spreading tree up to 8 m high and 10 m in canopy diameter ◗ Densely branched ◗ Zig-zagged shaped branches have a leaf and thorn at each angle ◗ Leaves rounded, growing on alternating sides of branches, glossy green above and almost white underneath ◗ Unpleasant smelling greenish-white flowers small and inconspicuous ◗ Edible fruits similar to a cherry but pale yellow or orange when ripe	Occurs in towns in drier parts of North and Central Queensland, restricted to drier tropics and spreads along watercourses and grows into dense stands on dry exposed hillsides does not establish under canopies of other trees.	Mature trees produce many fruit, which are spread by animals and birds, form thorny thickets along waterways.
	*Jatropha gossypiifolia* (Belly-ache Bush)	2	◗ Squat, thick-stemmed shrub 2.5-4 m tall ◗ Develops from a short, single-stemmed plant with three or four young leaves sprouting from the top ◗ Young leaves deeply divided into three rounded lobes and are purple and sticky ◗ Older leaves bright green, about 10 cm in diameter, having up to five lobes, the edges covered in coarse, dark brown hairs ◗ Flowers small, red with yellow centres ◗ Flowers in small clusters throughout the upper part of the plant ◗ Seed pods smooth and oval, about the size of a cherry Seed pods 12 mm across, containing three to four seeds about 8 mm long	Common along riverbanks and roadways.	Has escaped from gardens and become naturalised in various areas of North Queensland.

Photo	Plant Species	Class	Description	Habitat	Means of spread
	*Xanthium pungens* (Noogoora Burr)	-	◗ Up to 2.5 m in height with blotched purple stems ◗ Leaves are dark green on upper surface, 15 cm in diameter and roughly textured with minute bristles ◗ Flowers are inconspicuous, in leaf axils towards the end of the branches Flowers develop into hard, woody, spiny burrs, 1.2 cm to 2 cm long with hooked spines	Widespread in QLD occurring in tropical central area.	Spread by seeds in burrs. Burrs are spread by attaching to animals and clothing.
	*Leucaena leucocephala* (Lead Tree)	-	◗ Grows up to 6 m in height ◗ Leaves are about 25 cm long and bipinnate, with dull, greyish-green leaflets ◗ Flower heads are spherical, creamy-yellow and on short stalks about 5 cm long ◗ Flattened pods up to 15 cm long, in dense clusters Each pod contains about 20 glossy-brown, flat seeds that scatter when ripe	Native to Central and South America Listed as a weed in New Guinea, Hawaii, western Polynesia and the US Has naturalised throughout many areas of the Australian mainland and on a number of offshore islands Found at many disturbed sites and creek lines	Rapidly spreads to adjacent areas unless heavily grazed or otherwise controlled

Photo	Plant Species	Class	Description	Habitat	Means of spread
	*Prosopis spp* (Mesquite)	2	◗ Small branches have smooth, dark-red or green bark and a zigzag shape ◗ Has fernlike leaves, 1-4 pairs of leaf branches, 6-18 pairs of individual leaflets ◗ Has dark-green foliage but can vary to bluish-green ◗ Paired thorns occur just above each leaf axil Seed pods are 10-20 cm long, straight to slightly curved, smooth, with slight constrictions between the seeds.	Native to North and South America Introduced into Australia as an ornamental and for use in soil stabilisation programs Found along waterways, floodplains, roadsides and in horse paddocks near homesteads	Quickly invades upland country Spreads by dispersal of seeds in the faeces of stock, some feral and native animals.
	*Argemone orchroleuca* (Mexican Poppy)	-	◗ Erect annual herb to 1.5 m high. Leaves 6–20 cm long, mottled white and dark green, with undulate margins and yellow-spined lobes. ◗ Capsule 1.5–4 cm long, ovoid, with a remnant style (often attached after capsule has split), splitting from the top on maturity. Seeds dark brown or black, finely pitted on the surface.	Native to Mexico this plant has spread thoughout NSW, much of QLD and WA.	Spreads by movement of seed.

Photo	Plant Species	Class	Description	Habitat	Means of spread
	*Mimosa Pigra* (Giant Sensitive Tree)	1	◗ An erect, branched shrub, up to 6 m tall ◗ Has a branching tap root extending 1-2 m deep ◗ Has rose-like thorns, 5-10 mm long ◗ Leaves are bright green, fern-like, 20-25 cm long ◗ Prickly central leaf stalk ◗ Flowers are round, fluffy, pink, 1-2 cm wide ◗ Each flower produces a cluster of 10-20 thickly-haired seed pods, 6-8 cm long Each pod contains 20-25 oblong-shaped seeds, 4-5 mm long and 2 mm wide	Native to tropical America potential to colonise wetlands of tropical Australia found in moist situations, such as floodplains and river banks	Spread is by seeds and pieces, often carried by water, or when the infested crop is harvested.
	*Mimosa invisa* (Giant Sensitive Plant)	2	◗ Stems bunching, scrambling over other plants, four-angled ◗ Angles have a line of sharp, hooked prickles ◗ Leaves alternate, bright green, feathery and fern-like ◗ Each leaf divided into 5-7 pairs of segments ◗ Segments carry about 20 pairs of very small leaflets which close up when disturbed, injured or at nightfall ◗ Round, fluffy, ball-shaped, small pale-pink flowers, 12 mm across ◗ Flowers on short stalks in the leaf joints ◗ Numerous pods clustered, each about 25 mm long and 6 mm wide	Seeds can lie dormant for up to 50 years Now naturalised in high rainfall areas of coastal North Queensland from Ingham to Cooktown and also around Mackay Shires of major infestation: Cassowary Coast, Cook, Cairns, Hinchinbrook, Mackay, Whitsunday and the Tablelands Heaviest infestations in Johnstone and Cardwell shires	Seeds can lie dormant for up to 50 years An annual which usually flowers and seeds from April through to the end of June In cold weather, plants will seed from April through to December Some plants only 10 cm high can set seeds

Photo	Plant Species	Class	Description	Habitat	Means of spread
	*Xanthium spinosum* (Bathurst Burr)	-	◗ Erect, much branched annual herb ◗ Can grow up to 1 m high but usually 30-60 cm ◗ Leaves dark green on upper surface, paler green on the under surface, up to 7 cm long and usually three lobed ◗ Stems branched with one or two three-pronged yellow spines at base of each leaf stalk ◗ Flowers creamy green ad small, developing into straw coloured burrs ◗ Burrs 1-1.5 cm long, with numerous yellow-hooked spines ◗ Each burr contains two seeds	Germinates late spring to early summer Produces burrs in February and dies in early winter Seeds can germinate out of season Widespread in Australia, particularly in Queensland Occurs in southern, western and central areas of Queensland but seldom in the tropics Prefers drier areas such as well-drained contour banks and lighter soils	Burrs attach to animals, clothing etc, easily dispersing seed Burrs float and can spread along watercourses
	*Schinus terebinthifolia* (Broad Leaved Pepper Tree)	3	◗ Large spreading trees up to 10 m high and broad ◗ Leaves consist of 5-9 dark-green leaflets ◗ Small whitish flowers grow at the end of branches ◗ Bunches of glossy round red fruits 6 mm across ◗ Not all trees bear fruit	Trees can be male or female Grows well in coastal dune areas, wetlands and along stream banks	Birds main method of dispersal of berries

Photo	Plant Species	Class	Description	Habitat	Means of spread
	*Sporobolus spp*	2	◗ Very similar in appearance to other Sporobolus grasses ◗ Grows to a height of 0.6-1.7 m ◗ Seed head is up to 45 cm long and 3 cm wide ◗ Seed heads change shape from a 'rat's tail' when young to an elongated pyramid shape when mature ◗ Unlike Parramatta grass and giant Parramatta grass, GRT does not develop sooty spike on its seed heads	Current distribution *S. natalensis* - Rockhampton (Queensland) to Port Macquarie (New South Wales); *S. pyramidalis* - Cooktown (Qld) to central coast (NSW)	Capable of producing up to 85,000 seeds per square metre in a year, with initial seed viability of about 90% Significant portion of seed can remain viable for up to 10 years Seeds spread by livestock, manure, feral and native animals, vehicles, machinery and fast-flowing water Suits a wide range of soils and conditions
	*Sphangneticola tribobata* (Singapore Daisy)	3	◗ Leaves are lush, glossy green, usually 3-lobed and in pairs along the stem ◗ Flowers are yellow to orange-yellow, daisy-like, 2 cm wide, on short stalks above the leaves Variable amounts of seeds are produced		Spreads mainly by cuttings from slashing and pruning

Appendix B

Fact Sheets

Declared weeds identified within the Project area

Chinee apple

Harissia cactus

Lantana

Parkinsonia

Parthenium

Prickly pear

Rubber vine

Fact sheet

DECLARED CLASS 2 PEST PLANT

Chinee apple

Indian jujube

Ziziphus mauritiana

Dense infestations of chinee apple (or Indian jujube) create impenetrable thickets that seriously hamper stock management and reduce pasture production and accessibility. Mature trees produce large quantities of fruit that are readily eaten by stock, feral pigs, wallabies and birds, which assists the spread of the seed. Damage to top parts of the plant usually ensures regrowth from lignotubers or cut roots.

Declaration details

Chinee apple weed is a declared Class 2 plant under *Land Protection (Pest and Stock Route Management) Act 2002*. Declaration requires landholders to control declared pests on the land and waters under their control. A local government may serve a notice upon a landholder requiring control of declared pests.

PP26 September 2009

Queensland Government

Description and general information

Chinee apple is a large shrub or small spreading tree up to 8 m high and 10 m in canopy diameter. The plants are densely branched, from ground level in some cases. Stands of chinee apple grow as open forests or form thorny thickets along waterways. Branches are zig-zag in shape and have a leaf and a thorn at each angle.

Leaves are rounded, glossy green on top and almost white underneath, and grow on alternate sides of the branches. Flowers are small and inconspicuous, greenish-white and emit an unpleasant smell. The edible fruits are similar in size and structure to a cherry, but pale yellow or orange when ripe.

Habitat and distribution

Chinee apple is native to southern Asia and eastern Africa. It was first recorded in the Torres Straits in 1863 and in Townsville in 1916.

The species is widespread in north Queensland, mainly in the areas surrounding towns associated with mining early this century. The largest areas of dense chinee apple are around Charters Towers, Mingela, Ravenswood and Hughenden, but the plant also occurs around many other towns in the drier parts of north and central Queensland.

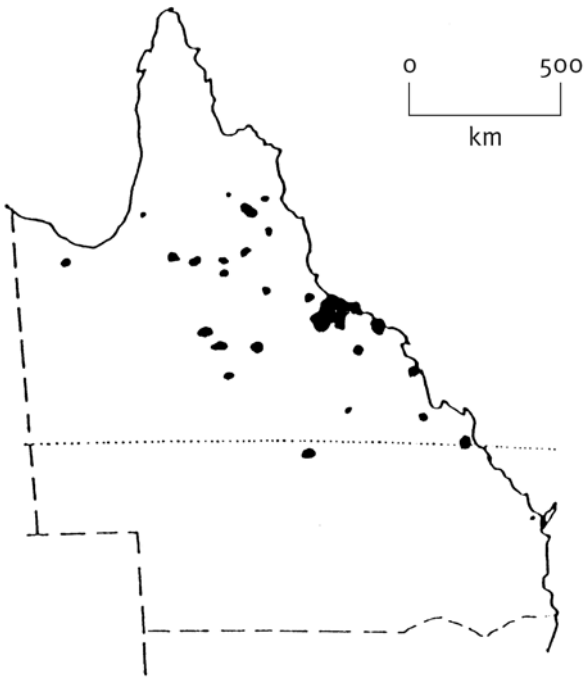
Chinee apple is restricted to the drier tropics with an annual rainfall of less than 1–200 mm. It also grows in areas with an annual rainfall as high as 470 mm. During the dry season, the plant drops most of its leaves in response to water stress but rapidly produces new leaves with the opening rains of the wet season. Although the species does have a tendency to spread along watercourses in the drier regions, it is also capable of growing into dense stands on dry, exposed hillsides.

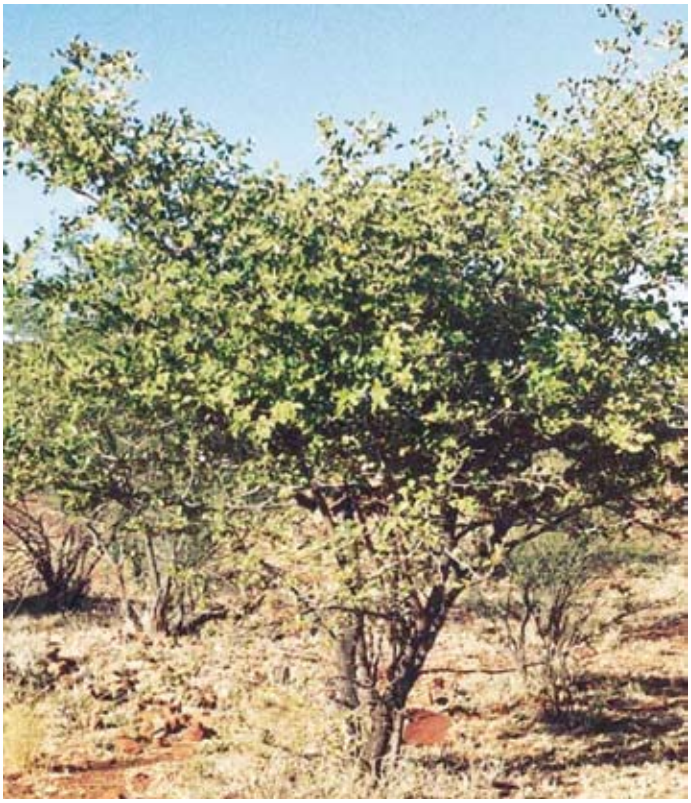
Chinee apple occurs in a wide range of soil types in association with different vegetation groups. It has successfully established on coarse-textured, gravelly mullock heaps; deep coarse-textured sands; deep alluvial soils; shallow-surfaced solodic soils; and cracking clay soils. The pattern of spread away from the towns has shown no marked preference for any soil type or vegetation association.

The major factor that appears to affect the growth of chinee apple is the density of the associated vegetation. Chinee apple does not establish successfully under the canopy of other trees and the species is normally restricted to areas that have sparse tree cover or where the other tree vegetation has been removed.

The old mining centres provided ideal conditions for establishment of chinee apple with the complete removal of all trees for pit timber and fuel. Chinee apple is now virtually the only tree species growing for several kilometres around these centres.

Figure 1 Distribution of chinee apple





Control

Effective control of chinee apple can be achieved through a combination of mechanical and herbicide treatments, or by herbicide treatment alone. All areas treated must be periodically checked and any regrowth treated or the initial treatment efforts will be wasted. Follow-up is esential to ensure a successful control program.

Mechanical control

Dense infestations can be initially cleared by stick raking, ripping or using a cutter bar (if the terrain and soil type permit). Remaining broken and exposed stems should be treated by basal bark spraying as soon as possible following clearing.

In order to ensure a successful control program, regrowth must be sprayed.

Cultivation and planting crops or improved pasture will assist in the prevention of re-infestation. Herbicide treatment of regrowth should still be carried out and maintained so the initial program is not wasted.

Fire will cause some damage to the plant but regrowth is normally rapid and few plants are killed. Seedlings may be more susceptible to fire but the survival of mature plants will maintain the existing problem.

Herbicide control

The methods of chemically treating chinee apple are described below. The herbicides registered for these methods are listed in Table 1.

Basal bark spray

For stems up to 15 cm in diameter, carefully spray completely around the base of the plant to a height of 40 cm above ground level. It is important to thoroughly spray into the crevices of multi-stemmed plants. Larger trees may be controlled by spraying to a greater height, up to 100 cm above ground level. The best time for treatment is during autumn when plants are actively growing and soil moisture is good.

Cut stump treatment

At any time of year, cut the stems off horizontally as close to the ground as possible and immediately (within 15 seconds) swab or spray the cut surfaces and associated stem with the herbicide mixture.

Soil application

Apply granules over an area extending from the main stem to 30 cm outside the canopy drip line to cover the main part of the root system. Treated plants will not be affected until sufficient rainfall moves the herbicide into the root zone. Do not use residual herbicides within a distance of twice the height of desirable trees.

Further information

Further information is available from your local government office, or from your local primary industries and fisheries biosecurity officer: contact details available through 13 25 23.

Table 1 Herbicides registered for the control of chinee apple

Situation	Herbicide	Rate	Optimum stage and time	Comments
Basal bark/ cut stump	Access®/ triclopyr and picloram	1 L/60 L diesel	Basal bark spray when actively growing Cut stump any time of year	Thoroughly spray all crevices. Basal bark spray plants with up to 15 cm basal diameter. Cut stump plants with greater than 15 cm basal diameter. For cut stump, spray immediately after cutting.
	Starane 200®/ fluroxypyr	3 L/100 L diesel		Spray plants with up to 15 cm basal diameter. For cut stump, spray immediately after cutting.
	Tomigan 200EC®/ fluroxypyr	3 L/100 L diesel		
	Garlon 600®/ triclopyr	1 L/60 L diesel	Basal bark spray when actively growing Cut stump any time of year	Thoroughly spray all crevices. For cut stump, spray immediately after cutting.
	Invader 600®/ triclopyr	1 L/60 L diesel		Basal bark spray suckers and seedlings with up to 5 cm basal diameter. Cut stump suckers or seedlings with greater than 5 cm basal diameter. Spray immediately after cutting.
	Hurricane 600®/triclopyr	1 L/60 L diesel		
	Redeem 600®/ triclopyr	1 L/60 L diesel		Basal bark spray plants with up to 5 cm basal diameter.
	Triclon®/ triclopyr	1 L/60 L diesel		Basal bark spray plants with up to 5 cm basal diameter. Cut stump plants with greater than 5 cm basal diameter. Spray immediately after cutting.
	Tryclops®/ triclopyr	1 L/60 L diesel		
	Safari 600EC®/ triclopyr	1 L/60 L diesel		
Basal bark spray only	AF Rubber Vine Spray®/2,4-D	1 L/10 L diesel	When actively growing	Basal bark spray plants with up to 5 cm basal diameter.
High volume spray	Grazon DS®/ triclopyr and picloram	0.35 L/100 L water	Seedling regrowth to 2 m Spray when plants are actively growing	A wetting agent is recommended to increase effectiveness.
Soil application	Tordon® granules/ picloram-triethanolamine	35–45 g/m^2	Apply prior to expected rain	Refer to label for critical comments.

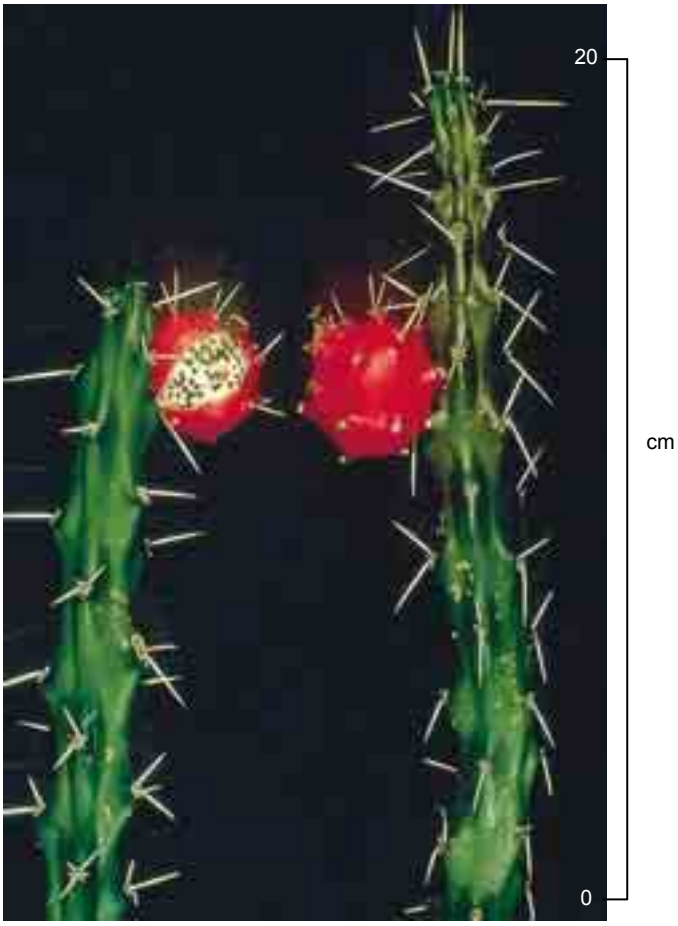
PR09_4284

Harrisia cactus

Moonlight cactus

Eriocereus martinii and *Eriocereus tortuosus*

DECLARED CLASS 2



Harrisia Cactus is a native of South America and was introduced to Queensland as a pot plant in the 1890s.

Dense infestations choke out pasture. The sharp spines, even in light infestations, make pasture unfavourable to stock and interfere with operations such as mustering.

The plant fruits prolifically and seeds are spread widely by birds and animals. Harrisia cactus can also reproduce by stem sections taking root. A deep, underground, tuberous root system allows the plant to survive catastrophes which may kill the above ground parts.

Description

Harrisia cactus is a perennial. The spiny fleshy stems are jointed and form tangled mats about half a metre high. Many branches often lay flat and take root where they touch the ground. Each section is ribbed lengthwise with six ribs; each rib has low, thick, triangular humps at regular intervals. These humps have cushions of grey felty hairs, three to five short spines lying flat, and one to three erect, stiff, very sharp spines 2.5−3 cm long.

The large flowers open at night. Flowers are pink, funnel shaped with a tinge of white. These grow singly near the ends of the stems on a scaly but spineless slender grey/green tube 12−15 cm long.

Round red fruits 4−5 cm across have scattered bumps with hairs and spines. Numerous small black seeds are embedded in the white, juicy pulp of the fruit which splits open when ripe.

Harrisia cactus roots are of two types. Shallow feeding roots up to 3 cm thick and 30 cm−2 m long grow mostly horizontally off a crown, up to 15 cm below ground level. Swollen tuberous storage roots descend to a depth of 15−60 cm.

The problem

Harrisia cactus can form dense infestations that will reduce pastures to a level unsuitable for stock. Harrisia cactus will choke out other pasture species when left unchecked.

The spines are a problem for stock management, interfering with mustering and stock movement.

Harrisia cactus produces large quantities of seed that is highly viable and easily spread by birds and other animals. As well as reproducing from seed, Harrisia Cactus has long trailing branches that bend and take root wherever they touch the ground. Any broken off portions of the plant will take root and grow.

Control of this plant is difficult as Harrisia Cactus has a deep underground tuberous root system.

Life cycle

Harrisia cactus bears a bright red fruit containing from 400−1000 small black seeds. Fruit and seed are readily eaten by birds and to a lesser extent by feral pigs. Plants are easily established from seed dropped by these animals. Seeds germinate soon after rain.

Seedlings quickly produce a swollen tuberous food storage root that develops as the plant grows. Branches take root where they touch the ground and new plants will grow from broken branches and sections of underground tubers.

Counts of tubers in dense cactus infestations have shown over 125 000 per hectare. Each plant houses many dormant underground buds that are all capable of reshooting when the tip growth dies, any small portion of the tuberous root is left in the soil will grow.

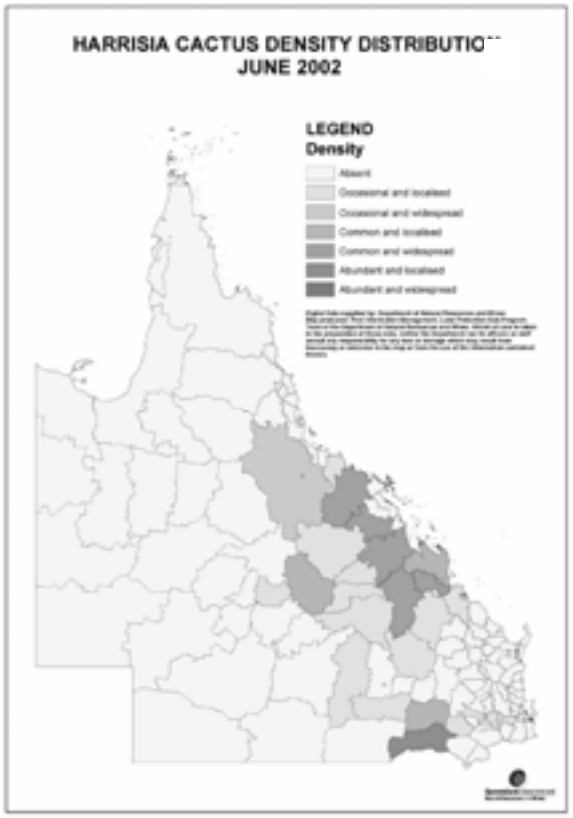
Habitat and distribution

Harrisia cactus is a native of Argentina and Paraguay, South America. It was introduced to Australia as a pot plant in the 1890s. In 1935 it was first recognised as a serious pest in the Collinsville district and by the 1950s was rapidly spreading south.

Harrisia cactus is mainly a pest of brigalow and associated softwood country. However, infestations are now appearing in box and ironbark stands and also in pine forests. The cactus is shade tolerant and reaches its maximum development in the shade and shelter of brigalow scrub, though established infestations can persist once scrub is pulled.

Harrisia cactus is found in the Collinsville, Nebo, Moranbah, Dingo, Blackwater and Goondiwindi districts with minor infestations occurring at Millmerran, Greenmount, Gatton, Ipswich, Rockhampton, Rannes, Mt Morgan, Alpha and Mitchell (see map).

FIGURE 1 – DISTRIBUTION OF HARRISIA CACTUS IN QUEENSLAND



Declaration details

Harrisia cactus is a declared plant under *Land Protection (Pest and Stock Route Management) Act 2002*. Declaration requires landholders to control declared pests on the land and waters under their control. A Local Government may serve a notice upon a landholder requiring control of declared pests.

Control

Mechanical control

Dig out plants completely and burn. Ensure that all tubers that can grow are removed and destroyed.

Ploughing is not considered an effective means of control unless followed by annual cropping.

Biological control

Two introduced insects have become established in the field:

- a stem boring longicorn beetle *Alcidion cereicola;* and
- a mealy bug *Hypogeococcus festerianus*.

The stem-boring beetle only attacks older woody stems. In the Collinsville area large beetle colonies developed and contributed to the collapse of dense areas of cactus. Populations of *Alcidion cereicola* have declined with the reduction in the cactus in recent years.

The most successful biological control agent is the mealy bug *Hypogeococcus festerianus* which is now present in harrisia cactus in Collinsville, Dingo, Moranbah, Blackwater, Nebo, Charters Towers and Goondiwindi districts with small colonies established at Alpha, Capella, Rannes, Gatton, Greenmount, Millmerran and Rockhampton.

How mealy bug works
The mealy bug aggregates and feeds in the tips of stems and buds, where it limits growth and causes distortion. This results in the knotting of the stem. The plants response is to utilise energy reserves within the tuber system to produce new growth. Eventually the plant dies, as it is unable to support the high continuous energy demands.

Dry weather reduces the effectiveness of the mealy bug. When dry the plants tuber system becomes dormant. Consequently, mealy bug damage does not result in new growth and the energy reserves within the plant are not affected. Instead the bug may damage all vegetative parts and eventually die out. The tuber will remain dormant until adequate moisture returns when it will reshoot.

How to spread the bug
Mealy bug disperses naturally via wind although landholder assistance is necessary for its continuous spread, particularly between patches. The bug is manually spread by cutting infected stems and placing them into healthy plants. The best pieces for starting new colonies are large knobs of twisted and distorted cactus that contain many mealy bugs well protected inside knots. Stem tips covered by white, woolly masses of bug are also good. To collect the bug cut infected stems approximately 15 cm from the distorted knob and place segments in green, plump sections of the healthy plant. Avoid placing mealy bug in stressed or dried out stems. Small cactus plants require at least one large knot, with larger plants requiring three knots per plant. Where possible landholders should infest every cactus clump as this ensures a rapid reduction in growth and fruiting potential. When cactus infestations are light, chemical control may be a preferable option.

Cut pieces can be transported in boxes or open vehicles. They are not delicate but are better kept in the shade. Avoid keeping them in large heaps, direct sunlight, under tarpaulins or in closed containers for long periods. Such conditions will promote rotting of the stems, leading to poor results or failures. Ideally, stems should be put out within 3 days and a maximum of 5 days.

When to infest
Best results come by infesting new areas during spring and early summer, from September to December. Maximum growth and spreading occurs in the summer months of December to February. During the drier and colder months of April to August the mealy bug does not die, but little growth and multiplication occurs. Introduction of mealy bug during autumn and winter will not be lost but little effect is seen until the following summer.

How soon to expect results
As mealy bugs are generally more active and effective on Harrisia Cactus growing underneath shrubs and trees, results will be seen more quickly in these areas than in cactus growing in the open. Best results are obtained when infesting plants that have actively growing new shoots.

During wet summers in northern and central Queensland, the growing points of stems will begin to curl after about six weeks.

By the end of the first summer, damage (severe twisting) will be widespread in infested plants. If the initial infestation was sufficiently heavy, no fruit or growth will occur during the second year, and the cactus will begin to die during the third year. Seedlings and regrowth shoots will continue to be present but by the end of the fourth year there should be very little cactus left.

In the southern portion of the State, where temperatures are lower, the mealy bug still provides control but the process takes longer. Also the mealy bug does better on cactus in the open rather than in the shade as temperatures are higher in the open.

Where to obtain mealy bugs
If you cannot obtain mealy bugs from your own property or neighbour contact the vegetation management/weed control/environmental staff at your local government.

Chemical control

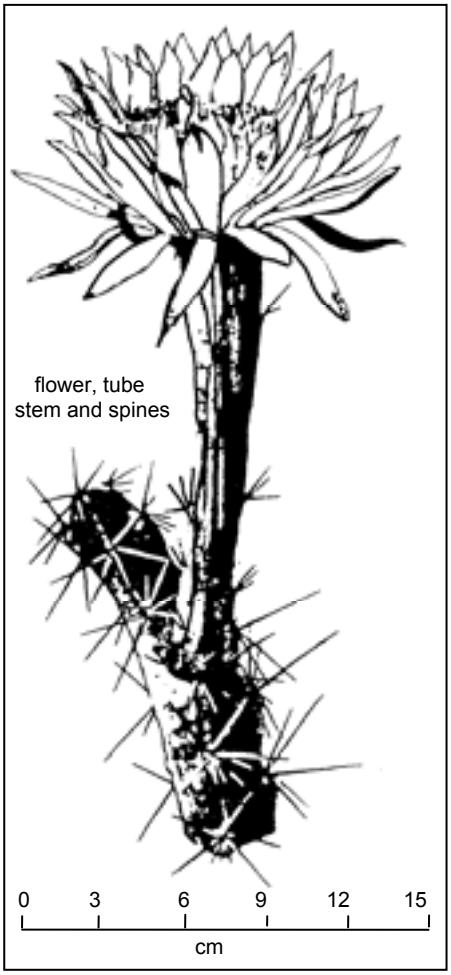
Before using any herbicide always read the label carefully. All herbicides must be applied strictly in accordance with the directions on the label.

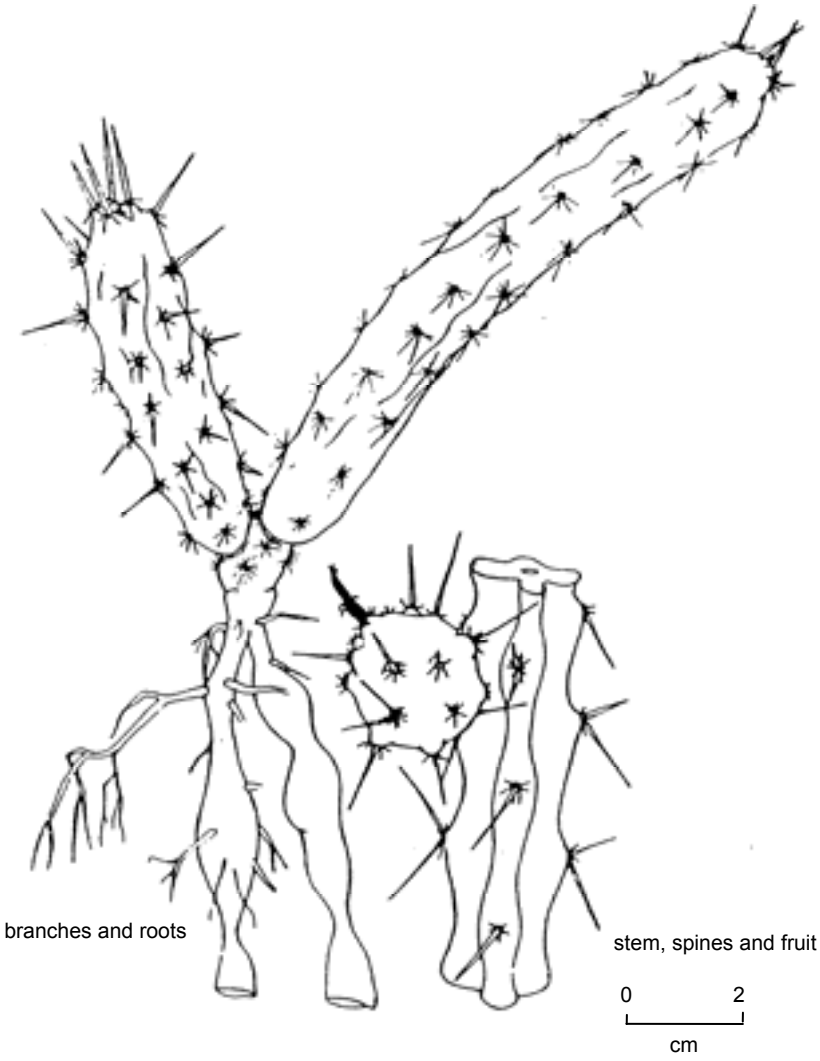
Further information

Further information is available from the vegetation management/weed control/environmental staff at your local government.

TABLE 1 – HERBICIDES REGISTERED FOR THE CONTROL OF HARRISIA CACTUS

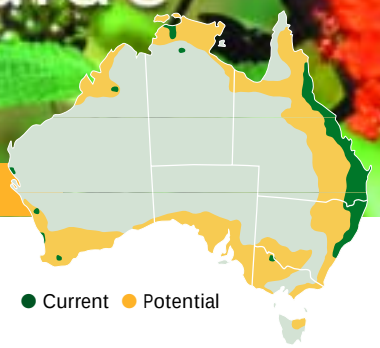
Situation	Herbicide	Rate	Comments
pastures; non agricultural land	Metsulfuron (eg. Aim WDG, Brush-off)	20 g/100 L water + surfactant	Spray plant when actively growing to run-off point A follow-up treatment may be necessary
pastures; non agricultural land	Access	1 L/60 L diesel	Spray plant when actively growing. Apply as overall spray, wetting all areas of the plant to ground level
pastures; non agricultural land	Tordon TCH Tordon DSH	5 L/100 L water 2.5 L/100 L water	Spray plant when actively growing. Treat all stems thoroughly





Weed Management Guide

Lantana – *Lantana camara*



Lantana (*Lantana camara*)

The problem

Lantana is a *Weed of National Significance*. It is regarded as one of the worst weeds in Australia because of its invasiveness, potential for spread, and economic and environmental impacts.

Lantana forms dense, impenetrable thickets that take over native bushland and pastures on the east coast of Australia. It competes for resources with, and reduces the productivity of, pastures and forestry plantations. It adds fuel to fires, and is toxic to stock.

Lantana is a serious threat to biodiversity in several World Heritage-listed areas including the Wet Tropics of northern Queensland, Fraser Island and the Greater Blue Mountains. Numerous plant and animal species of conservation significance are threatened. It is listed as the most significant environmental weed by the South-East Queensland Environmental Weeds Management Group.

It is a problem in gardens because it can cross-pollinate with weedy varieties to create new, more resilient forms.

The weed

There are two main forms of lantana in Australia: a cultivated form planted in gardens and a weedy variety found in bushland and pastures. The cultivated form of lantana is non-thorny, produces few seeds and is compact in shape. The weedy form is a prolific seeder with straggly, thorny stems. Both forms include many varieties, which differ from each other in shape, flower colour, prickliness, response to enemies and toxicity.

Lantana is a significant weed of woodlands and pastures east of the Great Dividing Range.
Photo: Qld DNRM

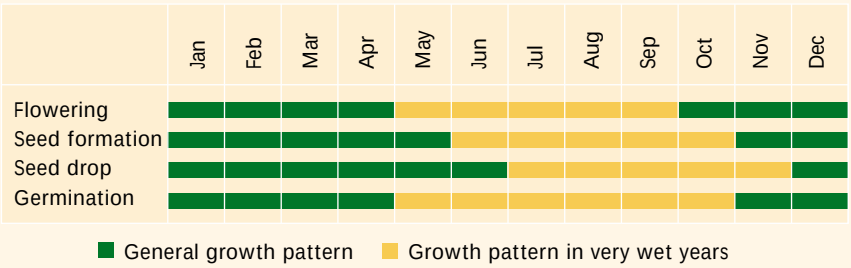
Weedy lantana is a much branched, thicket-forming shrub, 2–4 m tall. The woody stems are square in cross-section and hairy when young but become cylindrical and up to 150 mm thick with age. The ovate (ie tear-shaped) leaves (20–100 mm long) occur in opposing pairs along the stem. The leaves are rough and finely hairy and emit a pungent odour when crushed. Each flower head is made up of 20–40 flowers, ranging in colour from white, cream or yellow to orange, pink, purple and red. The fruit has many berries, which ripen from green to shiny purple-black and contain a single pale seed. Lantana has a short taproot and a mat of many shallow side roots.

Key points

- Lantana is a thicket-forming shrub that has spread from gardens into pastures, woodlands and rainforests on the east coast.
- It typically invades disturbed land and river margins, extending its range in response to rainfall.
- It threatens agriculture and pastoral production, forestry and biodiversity of conservation areas, and may be toxic to stock.
- The highest priority for lantana control is preventing its spread into northern Australia and west of the Great Dividing Range.
- Integrated control should combine fire, mechanical, chemical and biological methods, and revegetation.

Natural Heritage Trust
Helping Communities Helping Australia
An Australian Government Initiative

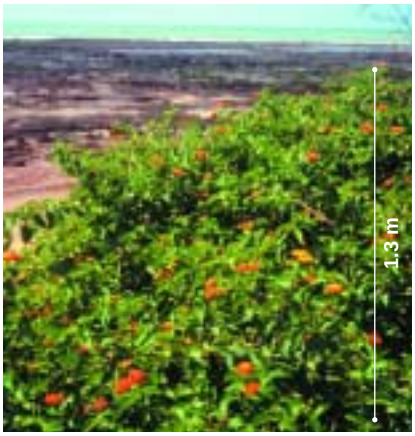
Growth calendar



Lantana flowers whenever the soil is moist and the air is warm and humid. For much of its range along the Queensland and New South Wales coasts, this results in almost continuous flowering and fruiting. Further inland, peak flowering occurs several weeks after soaking rain (25 mm or more) and is usually accompanied by good fruit set.

Germination most frequently occurs following the first summer storms, but may occur at any time of the year when sufficient moisture is present. Initial seedling growth is slow until the roots become established, after which close stems intertwine and begin to form thickets. Flowering does not usually commence until early in the following summer and then continues until March or April.

Lantana can resprout from the base if the shoot dies, extending the life of individual plants.



Flowering lantana infestation in Darwin, NT, in December.
Photo: Colin G. Wilson

How it spreads

Lantana spreads in two ways. Layering is a form of vegetative reproduction where stems send roots into the soil, allowing it to quickly form very dense stands and spread short distances. Also, birds and other animals such as foxes consume and pass the seed in their droppings, potentially spreading it over quite large distances. The germination rate of fresh seed is generally low, but improves after being digested.

Butterflies, bees and other insects are attracted by the nectar and pollinate lantana flowers. About half of the flowers produce seeds, typically 1–20 seeds on each flower head. Mature plants can produce up to 12,000 seeds every year. Seeds are thought to remain viable for several years under natural conditions.

Lantana is allelopathic and can release chemicals into the surrounding soil which prevent germination and competition from some other plant species.

First recorded in the Adelaide Botanic Gardens in 1841, lantana spread to east coast gardens and was recorded as a weed in Brisbane and Sydney in the early 1860s. It is now found across four million hectares of land east of the Great Dividing Range, from Mount Dromedary in southern New South Wales to Cape Melville in northern Queensland. Isolated infestations exist in the Top End of the Northern Territory, around Perth in Western Australia, and on Lord Howe and Norfolk Islands. Although present Australia wide as a garden ornamental, it has not naturalised to any serious extent elsewhere.

When ripe, birds and animals consume fruit and spread seed.
Photo: Colin G. Wilson

Where it grows

Lantana can grow in high-rainfall areas with tropical, subtropical and temperate climates. It does not tolerate salty or dry soils, waterlogging or low temperatures (<5ºC). It thrives on rich, organic soils but also grows on well-drained clay and basalt soils. Sandy soils tend to dry out too rapidly for lantana unless soil moisture is continually replenished. It has been reported at altitudes up to 1000 m in Queensland.

Lantana invades disturbed sites, especially open sunny areas, such as roadsides, cultivated pastures and fencelines. From there it can invade the edges of forests, but it does not fare as well under a heavy canopy as it is not very shade tolerant. Therefore, it is not a problem in intact tropical rainforest but can quickly spread there if the canopy opens out.

Lantana occurs naturally in Mexico, the Caribbean and tropical and subtropical Central and South America. It is considered a weed in nearly 50 countries.

Another weedy species of lantana

Another species of lantana is a popular ornamental that is considered a weed when present in natural ecosystems. Creeping lantana (*Lantana montevidensis*) occurs in coastal and subcoastal Queensland and as far south as Sydney. It is fairly similar to *Lantana camara* but does not have thorns, has mainly pink or purple flowers and trails along the ground, only growing to a height of half a metre. It is also toxic and readily displaces native vegetation.

Creeping lantana (*Lantana montevidensis*) is naturalised in coastal and subcoastal Qld and only grows to a height of half a metre. It is toxic and readily displaces native vegetation. Photo: John Swarbrick

Potential distribution

Lantana may be able to spread west of the Great Dividing Range, and could expand its range throughout southern Victoria, South Australia and southwestern Western Australia.

What to do about it

Lantana is extremely widespread and abundant. Because it is so well established on the east coast, and prevention of spread is the most cost-effective weed management tool, the highest priority for lantana management is to prevent its spread into uninfested areas. This will require three main actions.

1. Restricting further importation of lantana into Australia. Any new varieties brought in could escape cultivation and naturalise, or could cross-breed with naturalised varieties, leading to hardier new varieties more resistant to control.
2. Restricting the sale and use of lantana in gardens as these are potential sources of new infestation and new varieties. There are native and less weedy exotic ornamental alternative species.
3. Strategically controlling infestations that threaten areas where lantana is not yet a weed. Control methods are outlined below.

Integrated management

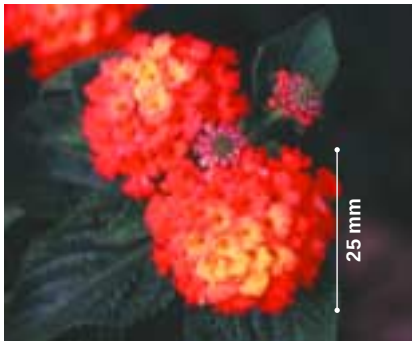
An integrated approach that uses a variety of control methods gives best results when dealing with lantana. A range of methods including herbicides, mechanical removal, fire, biological control and revegetation should be used. Best results are obtained by working from areas of light infestation towards heavier infestation, and long-term follow-up control is required after initial attempts. Minimise both disturbance to land and excessive use of fire to retain vigorous native vegetation and reduce the opportunity for lantana to become established.

Herbicide control – effective but expensive

There are many herbicides registered for lantana control and three main application techniques. Spraying the entire plant (foliar spraying) usually kills plants that are less than 2 m high. Herbicides applied to the lower bark of the stems (the basal bark technique) or immediately painted onto a freshly cut stump (the cut-stump technique) are useful for larger plants. Both of these techniques are time consuming because they require treatment of each stem, which can be difficult to access in large stands of lantana. High costs make herbicide control uneconomical for large infestations, except when there are no other options (eg on steep slopes, where helicopter spraying may be required).

For best results, integrate fire, mechanical, chemical and biological control and revegetation

Herbicides, especially those that are foliar applied, are most effective when plants are actively growing. With lantana, best results are obtained six weeks after good rains (at least 35 mm) when minimum temperatures exceed 15ºC. In Queensland the spraying season generally lasts from early summer to autumn, but earlier control will potentially allow follow-up in the same growing season.



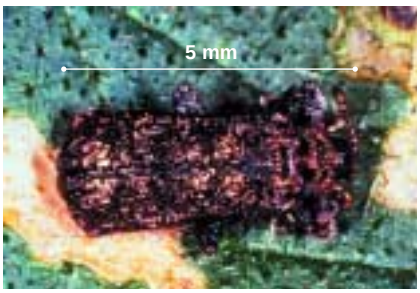
Lantana flowers can be one colour (*left*), or a mix of two (*centre*) or more colours (*right*). Photos: Colin G. Wilson

Weed control contacts

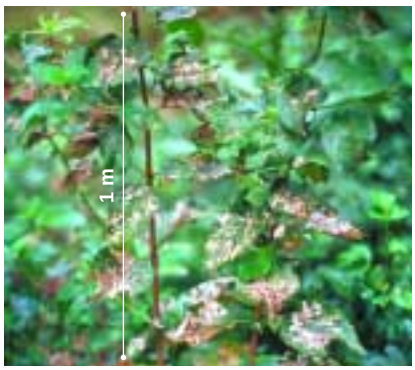
State / Territory	Department	Phone	Email	Website
ACT	Environment ACT	(02) 6207 9777	EnvironmentACT@act.gov.au	www.environment.act.gov.au
NSW	NSW Agriculture	1800 680 244	weeds@agric.nsw.gov.au	www.agric.nsw.gov.au
NT	Dept of Infrastructure, Planning and Environment	(08) 8999 5511	weedinfo.ipe@nt.gov.au	www.nt.gov.au
Qld	Dept of Natural Resources and Mines	(07) 3896 3111	enquiries@nrm.qld.gov.au	www.nrm.qld.gov.au
SA	Dept of Water, Land and Biodiversity Conservation	(08) 8303 9500	apc@saugov.sa.gov.au	www.dwlbc.sa.gov.au
Tas	Dept of Primary Industries, Water and Environment	1300 368 550	Weeds.Enquiries@dpiwe.tas.gov.au	www.dpiwe.gov.au
Vic	Dept of Primary Industries/Dept of Sustainability and Environment	136 186	customer.service@dpi.vic.gov.au	www.dpi.vic.gov.au www.dse.vic.gov.au
WA	Dept of Agriculture	(08) 9368 3333	enquiries@agric.wa.gov.au	www.agric.wa.gov.au
Australia wide	Australian Pesticides and Veterinary Medicines Authority	(02) 6272 5852	contact@apvma.gov.au	www.apvma.gov.au

Note that herbicides vary in their effectiveness on different lantana varieties. The red flowered varieties are normally the least susceptible to herbicides while the pink forms are the easiest controlled. Consult your local council or state/territory weed management agency about which herbicides and applications are most suitable for your infestation of lantana. State and territory contact details are listed above, including contacts for the Australian Pesticides and Veterinary Medicines Authority, which hosts the PUBCRIS database. This database contains information on all herbicides that are registered for use on weeds in each Australian state and territory.

When using herbicides always read the label and follow instructions carefully. Particular care should be taken when using herbicides near waterways because rainfall running off the land into waterways can carry herbicides with it. Permits from state or territory Environment Protection Authorities may be required if herbicides are to be sprayed on riverbanks.



Both adults (*above*) and larvae of the leaf-mining beetle *Octotoma scabripennis* feed on lantana leaves. It is present in most lantana infestations, particularly where it is shady and wet in subtropical, coastal areas.
Photo: Michael Day, Qld DNRM



Damage to lantana leaves caused by the leaf-mining beetle *Octotoma scabripennis*.
Photo: Michael Day, Qld DNRM

Mechanical and physical control – suitable for small infestations

Lantana can be removed mechanically or physically in several ways, including stickraking, bulldozing, ploughing and grubbing. These techniques are mainly suited to medium-sized infestations and require extensive follow-up, as they invariably lead to regrowth if the rootstock is not removed, or seedling germination when heavy machinery disturbs the soil. Any soil disturbance should be avoided on steep inclines or in gullies. A permit may be required if native plants are to be affected by mechanical control – check with your local council or state/territory weed management agency.

Fire – inexpensive but caution must be exercised

Fire is often used prior to mechanical or herbicide control to improve their effectiveness, or as a follow-up to such methods. It can also provide some control when used on its own under the right conditions. It is most effective when fires are hot and the lantana is actively growing. In southeastern Queensland best results from fire are achieved during early summer. In New South Wales controlled burns are used opportunistically, mainly in late winter and spring before conditions become too dry and fires could escape control.

Fire is relatively inexpensive and well suited to dense infestations, but the risks to people and property must be carefully managed. Burning is not recommended in rainforest and vine thickets because they are highly sensitive to fire. Disturbance in these habitats may actually promote lantana if the canopy is opened up. A permit may be required to burn – check with your local council or state/territory weed management agency.

Biological control

In 1902 the first attempt at biological control of a weed targeted lantana in Hawaii. In Australia biological control agents were first introduced in 1914; so far, 30 species have been introduced. Research into biological control is ongoing, and several agents are currently being examined for suitability of release.

Of the 16 species that have established, four insects have had a major impact on lantana. They are:

- a sap-sucking bug (*Teleonemia scrupulosa*) (Sydney to northern Queensland).
- a leaf-mining beetle (*Uroplata girardi*) (northern Queensland to Sydney).
- a leaf-mining beetle (*Octotoma scabripennis*) (Sydney to south of Rockhampton).
- a seed-feeding fly (*Ophiomyia lantanae*) (southern New South Wales to northern Queensland).

The biological control agents vary in their effectiveness against the many different types of lantana. For example, lantana can drop its leaves when stressed, depriving some agents of their food.

Revegetation – useful in pastures and forests

Revegetation of a treated site is a key component of a lantana management program. Revegetation helps to reduce erosion, adds fuel for future burning in pastures and is vital in limiting the re-establishment of lantana and other weeds. Sowing an improved pasture that outcompetes and smothers lantana seedlings is assisted by withholding grazing for the first six months, and only allowing light grazing for the next 12–18 months. In forested areas either planting trees or encouraging naturally occurring seedlings will help to shade out lantana in the longer term. Check with your local council or state/territory weed management agency about appropriate species for revegetating pastures or forests in your area.

Follow-up

Follow-up control after an initial effort may include any or all of the above methods. Established pastures can be burnt to control significant lantana regrowth, and any small patches can be spot sprayed with a registered herbicide or grubbed out. In forested areas herbicides are recommended to control regrowth, typically requiring three follow-up sprays after the initial control effort.

Legislation

Landholders are required to reduce lantana infestations throughout some regions of Queensland, New South Wales and the Northern Territory. The sale of lantana in Queensland was banned in late 2003. Lantana importation is prohibited in Western Australia. Check with your local council or state/territory weed management agency for relevant details.

Acknowledgments

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Maps: Australian Weeds Committee.

...case study

Lantana control at Towra Point, Botany Bay, New South Wales

Towra Point Nature Reserve in Botany Bay contains habitats of high conservation status, including wetlands of international importance and open woodlands that are unique in the Sydney region. A coastal rainforest in the region was recently listed as an endangered ecological community under the New South Wales *Threatened Species Conservation Act 1995*. It includes the magenta brush cherry (*Syzygium paniculatum*), a vulnerable tree species.

By the 1990s, lantana made up almost 75% of the vegetation cover in some parts of the reserve and was limiting the regeneration of native species, particularly around a freshwater wetland called Weedy Pond. The Friends of Towra, a volunteer group, commenced weed control in the Weedy Pond rainforest in 1996. In 1998 the Sutherland Shire Environment Centre, working in conjunction with the National Parks and Wildlife Service, gained Coastcare funding to supplement the volunteer program.

Beginning in March 1998, weed control focused on a corridor connecting the rainforest and a casuarina/banksia forest, following up on previous control and initiating new efforts. Lantana was controlled by a combination of cut-stump herbicide application and manual removal of smaller plants. Other weeds were also controlled when they were encountered.

Work was undertaken about every two months throughout 1998 by volunteers and members of local community groups. Follow-up hand weeding and spot spraying, and further control of primary lantana infestations, were also undertaken throughout 1999. This work involved international backpackers, unemployed people from Green Corps 2000, students and personnel from private enterprise, all of whom volunteered their time. The total area cleared of lantana and other weeds was approximately 75 m wide and 100 m long.

In May 2000 the cleared areas were planted with native vegetation by local Cub Scouts and Venturers and members of the Friends of Towra. Approximately 200 banksias were planted. The training of volunteers and community groups on such issues as weed control techniques, bush regeneration and plant identification was another significant outcome.

At each quarterly follow-up visit to the site, approximately 24 man-hours are required to keep on top of any reshooting and newly germinated lantana, and encourage regeneration of native species. It is expected that lantana will become disadvantaged as canopy cover and shade increases, and less work will be required in the future.

How to control lantana

Quick reference guide

Minimise spread and future impacts

Although lantana is widespread on the east coast of Australia, it is still absent from parts of its potential range. These areas should be protected by:

- preventing the importation of further varieties and species of lantana
- stopping more planting of lantana in gardens
- strategically controlling infestations which threaten uninfested areas.

A control program for dense infestations in pastures

The Queensland Department of Natural Resources and Mines has produced a pest series fact sheet on lantana (PP#34). They advise that herbicides are too expensive to treat large lantana infestations.

A combination of fire and mechanical control makes spot treatment of small patches with herbicides more cost-effective. The following suggested control program for dense infestations in pastures is based on the fact sheet:

1. Exclude stock to allow a fuel load to build up.
2. Bulldoze, stickrake or plough the infestation to add to the fuel load.
3. Burn the infestation after obtaining a permit. Summer burns are more effective than winter burns.
4. Sow an improved pasture. Seek advice of local council or state/territory government agencies for selection of non-weedy pasture species.
5. Continue stock exclusion until pasture has established and set seed.
6. Burn the infestation again after obtaining a permit.
7. Spot spray or grub out any regrowth or seedlings. Spraying is most effective between summer and autumn.
8. Follow-up burning, spraying and/or grubbing will be required for several years.

Lantana can escape from garden plantings into surrounding bushland.
Photo: Tim Schultz

Control options

Type of infestation	Physical	Mechanical	Chemical	Fire	Biological
Small (few plants, small area)	Hand grubbing only suitable for seedlings. Wear gloves for protection from thorns.	Not suitable.	Spot spray plants less than 2 m in height between summer and autumn with a registered herbicide.	Not suitable.	There are four useful biological control agents. They are already distributed throughout their potential range.
Medium (medium density, medium total area)		Bulldoze, plough, stick-rake or slash infestations. Soil disturbance will lead to mass seed germination, so follow up with further controls. Do not use mechanical control in areas susceptible to erosion. A permit may be required.	Spraying is uneconomical for medium or large infestations. Helicopter spraying is used when there is no access for mechanical control, eg very steep slopes.	Under permit, burn in summer with good fuel load of grass and/or mechanically cleared lantana. Also use as follow-up. Do not burn in rainforests.	
Large (many plants, many ha)					

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CRC Weed management

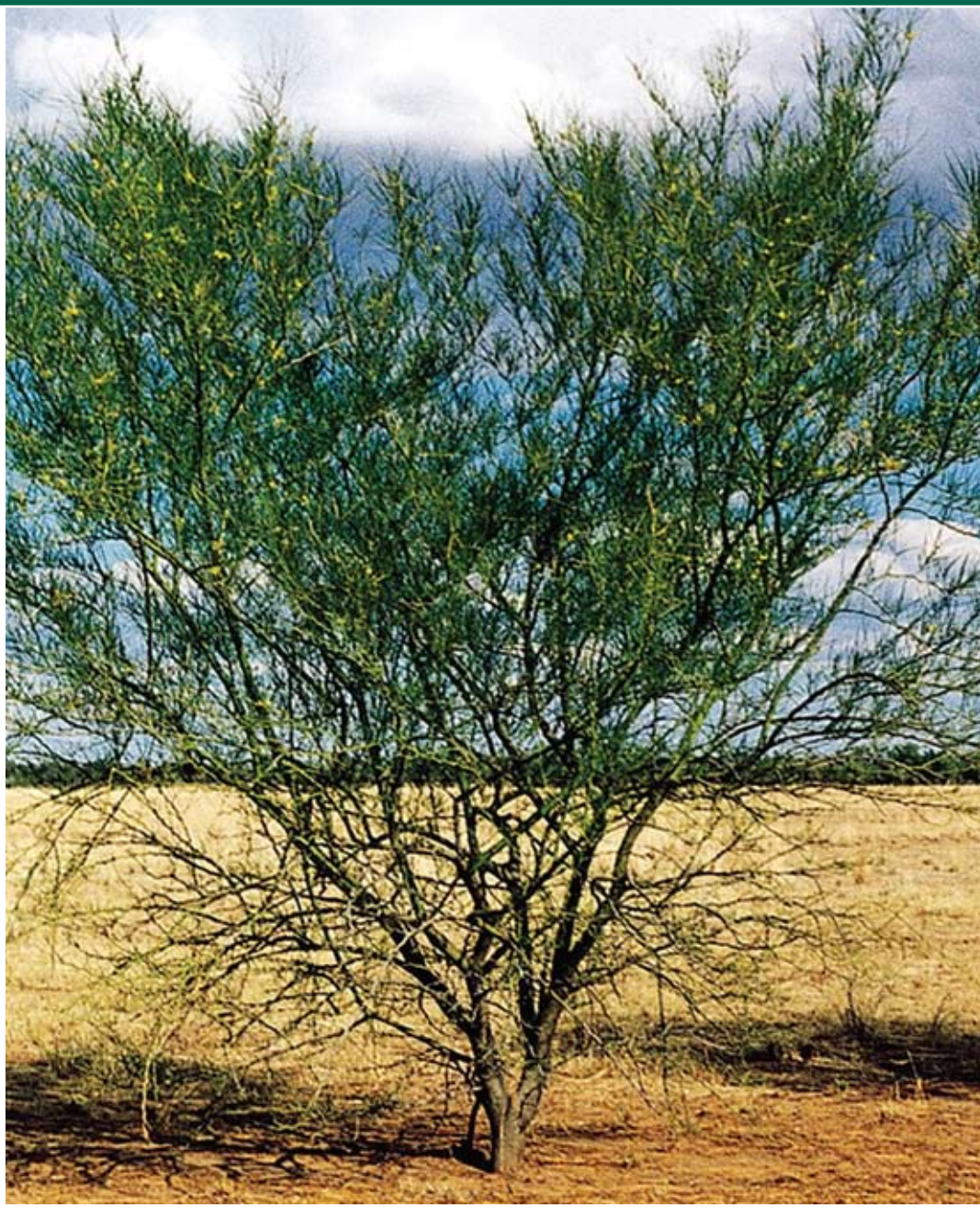
Fact sheet

DECLARED CLASS 2 PEST PLANT

Parkinsonia

Jerusalem thorn or jelly bean tree

Parkinsonia aculeata



Parkinsonia is thought to be native to tropical America but has spread throughout the world as an ornamental and shade tree. It has been recognised in Australia as a Weed of National Significance.

Declaration details

Parkinsonia is a declared Class 2 plant under *Land Protection (Pest and Stock Route Management) Act 2002*. Declaration requires landholders to control declared pests on the land and waters under their control. A local government may serve a notice upon a landholder requiring control of declared pests.

WEEDBUSTERS

Queensland Government

PP36 April 2009

Description and general information

Size and appearance

A hairless shrub or small tree that rarely grows any more than 10 m high, Parkinsonia has slender green photosynthetic zigzag branches armed with sharp spines.

Leaves

Its leaves have a short, spine-tipped stalk, with leaf branches 20–40 cm long, flattened with small, oblong leaflets along each edge.

Flowers

Parkinsonia flowers are yellow, fragrant, five petalled, each on a long, slender drooping stalk. Seeds are oval and hard, about 15 mm long, and borne in pencil-like pods 5–10 cm long, constricted between the seeds.

Lifecycle

Parkinsonia is fast growing and may flower in early summer of its second or third year of growth. Once established, flowering can occur opportunistically to exploit variable seasonal conditions. Pods mature in late summer, float on water and hence are readily dispersed by flood waters.

Seeds have a thick and extremely hard coat and so remain viable for many years to allow germination under favourable conditions. Seeds require wet soil conditions for several days to induce germination.

Habitat and distribution

As parkinsonia is adapted to an extremely wide range of soil types, there is little doubt that it will continue to spread through watercourses and adjoining areas throughout the sub-humid and semi-arid environments of Queensland.

The most vulnerable areas are the Gulf region, Channel Country and downstream into the Lake Eyre catchment.

Control

Biological control

Three species of insects have been introduced into Australia as biological control agents against parkinsonia.

Parkinsonia seed beetles *Penthobruchus germaini* and *Mimosetes ulkei*.

Both *Penthobruchus germaini* and *Mimosetes ulkei* are seed beetles that attack only parkinsonia and whose larvae destroy mature parkinsonia seeds.

Penthobruchus germaini is a small (5 mm – 6 mm long) brown beetle from Argentina. It was first released in 1995 and has established much more readily than *Mimosestes*. It has established readily at all release sites and spreads rapidly.

Penthobruchus exerts heavy pressure on parkinsonia seed banks and research has demonstrated up to 95% of seed destroyed at some sites. *Penthobruchus* may become a very important tool in the integrated management of this weed. In the field its presence is indicated by white eggs against the darker background of the pods. Round holes in the pods indicate that beetles have emerged.

Mimosestes ulkei is a small (about 5 mm long) two-tone grey beetle from the USA. While it is established at several sites, it does not establish as readily as *Penthobruchus*. It has potential to contribute to the destruction of parkinsonia seeds. In the field, round emergence holes are the only external indication of its presence.

Parkinsonia leaf bug *Rhinacloa callicrates* *Rhinacloa callicrates* is a small green bug (about 3 mm long) imported from the USA. It feeds on leaves and shoots of parkinsonia resulting in tiny round white spots where it destroys photosynthetic tissue. It is well established in Queensland but it has no significant impact on parkinsonia.

Mechanical control

Initial clearing by stick raking, blade ploughing or ripping is effective, however:

- it is restricted to reasonably level areas away from watercourses
- clearing will hasten seed germination, necessitating follow-up control either mechanically or chemically.

Establishing improved pasture will aid in managing parkinsonia by competition.

Fire will destroy seedlings if sufficient fuel load is present, but mature plants will usually survive.

Herbicide control

Herbicides registered for the control of parkinsonia are listed in Table 1.

Aerial application

Aerial application is undertaken by purpose-built applicators by helicopter. This is useful for dense, strategic infestations although it may be expensive on a broad scale.

Foliar (overall) spray

This is an effective control method for seedlings up to 1.5 m tall. Spray leaf and stems to point of runoff. A wetting agent must be used.

Basal bark spray

For stems up to 15 cm diameter, carefully spray around the base of the plant to a height of 30 cm above ground level. Larger trees may be controlled by spraying to a greater height, up to 100 cm above ground level.

Plants should be actively growing and preferably flowering. Field experience has shown that good soil moisture is essential for effective control.

Because parkinsonia infested areas are often subject to flooding, care is needed to ensure mud and flood debris does not prevent spray penetration to the bark. The trunk may need to be cleared before spraying. Addition of petrol or A-1 jet fuel will aid penetration.

Cut stump treatment

Cut stump treatment may be performed at any time of the year. Cut stems off horizontally as close to the ground as possible. Immediately (within 15 seconds) swab or spray the cut surface and associated stem with herbicide mixture.

Soil application

Use one dose of herbicide per metre of tree height. Place doses close to tree trunk, either with spot gun on clear bare ground, or underground with ground injector. Rain or sufficient soil moisture is required before herbicide is taken up by the plant.

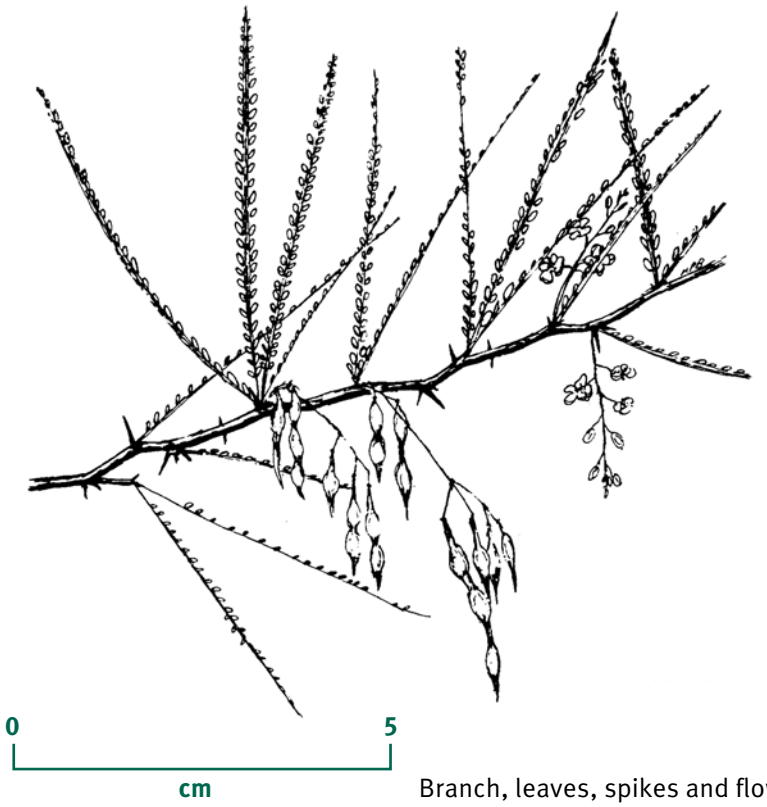
Do not use near watercourses or within a distance equal to at least twice the height of desirable trees.

Further information

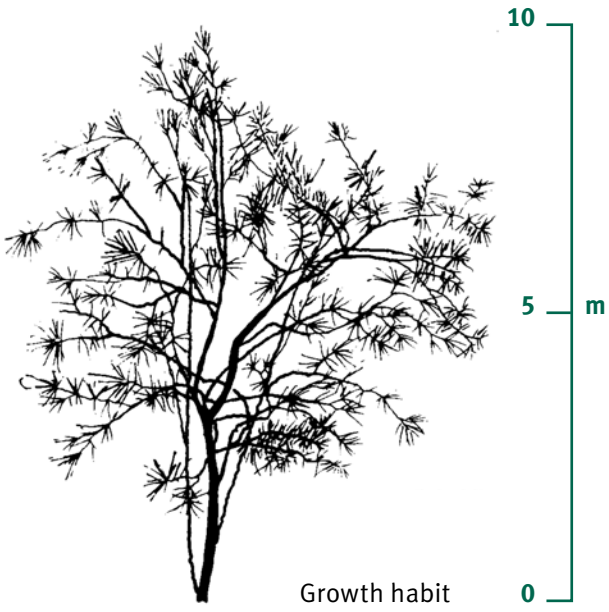
Further information is available from your local government office, or from your local primary industries and fisheries biosecurity officer: contact details are available through 13 25 23.

Table 1 Herbicides registered for the control of parkinsonia.

Situation	Herbicide	Rate	Optimum stage and time	Comments
Aerial application	Grazon DS®/picloram and triclopyr	3 L/ha	Seedlings 1–2 m tall, or 12–24 months old	Application by helicopter only. Addition of 1 L/ha of Uptake® wetting agent
	Reclaim®/hexazinone	1 kg/ha	Trees up to 3 m tall	Apply early in wet season, after initial rains but before inundation
Foliar (overall spray)	Grazon DS®/picloram and triclopyr	0.35 L/100 L water	Seedlings less than 2 m tall and actively growing	Wet plant thoroughly. Use wetting agent
Basal bark spray	Access®/triclopyr and picloram	1 L/60 L diesel	As above. Stems up to 5 cm diameter	Do not treat wet stems
Cut stump	Access®/triclopyr and picloram	1 L/60 L diesel	Any time of year	Cut close to ground level and treat **immediately**
Soil application	Velpar L®/hexazinone (via spotgun)	4 ml per spot—1 spot for each shrub/tree	Any time, but needs moisture to activate chemical	Shrubs/trees up to 5 m tall
	Graslan®/tebuthiuron	1 to 1.5 g/m^2	Any time, but needs moisture to activate chemical	Refer to label for critical comments



Branch, leaves, spikes and flowers



Growth habit

Fact sheets are available from Queensland Primary Industries and Fisheries service centres and the Queensland Primary Industries and Fisheries Business Information Centre (telephone 13 25 23). Check our website at www.dpi.qld.gov.au to ensure you have the latest version of this fact sheet. The control methods referred to in this pest fact should be used in accordance with the restrictions (federal and state legislation, and local government laws) directly or indirectly related to each control method. These restrictions may prevent the use of one or more of the methods referred to, depending on individual circumstances. While every care is taken to ensure the accuracy of this information, Queensland Primary Industries and Fisheries does not invite reliance upon it, nor accept responsibility for any loss or damage caused by actions based on it.

PR09_4542

Guideline

for the management of parkinsonia

(*Parkinsonia aculeata*)

Purpose and scope

This guideline has been prepared under section 15 of the *Land Protection (Pest and Stock Route Management) Act 2002 (Qld)* to support successful management of parkinsonia, a Class 2 declared pest. It sets out an objective, and statutory and non-statutory actions which are consistent with the eight principles of pest management listed in section 9 of the Act.

Operational objective

- **To prevent the spread of parkinsonia into areas at risk of invasion.**
- **To gradually reduce the size of existing infestations.**

Operational actions

1. Integration

- Integrate the management of parkinsonia with broader land management programs designed to reduce overgrazing and to reintroduce regular fires into native pasture systems.

2. Public awareness

- Raise awareness so that the public are able to identify parkinsonia, and have knowledge of its impacts and management.
- Target awareness campaigns at landholders in areas at risk of invasion so they can recognise parkinsonia and prevent its spread.

3. Commitment

- Enforce compliance when landowners do not take reasonable steps to control parkinsonia.

4. Consultation and partnership

- Build working partnerships between key stakeholders to generate a holistic approach to the management of parkinsonia and a sense of community ownership of the problem.
- Ensure adequate representation on the National Prickle Bush Management Group.

5. Planning

- Refer to the national *Parkinsonia Strategic Plan* for additional guidance.
- Map the extremities of parkinsonia infestations.
- Monitor areas potentially at risk of new parkinsonia infestations.
- Ensure that parkinsonia management plans are consistent with plans in neighbouring areas.
- Secure adequate resources (i.e. time, funds and personnel) to carry out the actions in this guideline.

6. Prevention

- Ensure that parkinsonia is not grown as a shade or ornamental tree.

Guideline

7. Best practice

- Collate and distribute best practice information to landowners.
- Put in place measures to prevent any degradation of land, water, and desirable vegetation by control methods.

8. Improvement

- Research the ecology of parkinsonia.
- Develop and monitor integrated management of parkinsonia.

Background

Parkinsonia (*Parkinsonia aculeata*) is a thorny shrub native to South and Central America, which has been named a Weed of National Significance (WONS) in Australia. In Queensland, parkinsonia is found in at least 35 local government areas and covers over 80 000 hectares. Heavy infestations are present in the Fitzroy, Burdekin, Lake Eyre, and Gulf Rivers catchments. The catchment areas of the Balonne and Maranoa rivers that flow into Murray–Darling system and the rivers that flow into the Gulf of Carpentaria are mostly free, but isolated infestations in central and western Queensland have the potential to spread across large areas.

Under favourable conditions, it can form dense thickets along creeks and rivers and around dams, replacing any pasture grasses and hindering stock movement. Complete eradication from Queensland is not practical, given the size and remoteness of infestations; possible and desirable, however, is reducing its rate of spread and adverse effects, and protecting areas at risk through enforced management and control.

Responsibility

Landowners: destruction of infestations.
Local governments: compliance, surveillance, local planning, mapping, and raising awareness.
DEEDI: statewide planning, mapping, coordination, raising awareness, and research.

References

Commonwealth of Australia and National Weeds Strategy Executive Committee 2001, *WONS: Parkinsonia Strategic Plan*, National Weeds Strategy Executive Committee, Launceston.

Parkinsonia fact sheet available at www.dpi.qld.gov.au

Maps

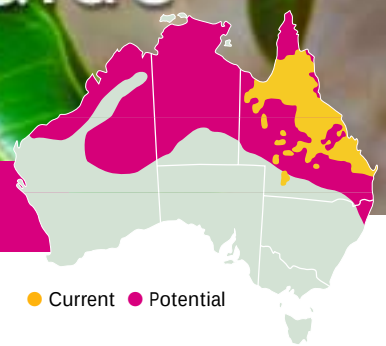
- Current distribution of parkinsonia, available at www.dpi.qld.gov.au > Biosecurity > Weeds, pest animals and ants > Pest Mapping > Annual pest distribution maps > search for a map > select parkinsonia species.
- Potential distribution of parkinsonia, available at www.dpi.qld.gov.au > Biosecurity > Weeds, pest animals and ants > Pest Mapping > Predictive pest maps > Search for a weed map. Weeds are listed by common name.

The maps are updated as new information becomes available, and the latest maps must be accessed from the website.

Date of approval: February 2004

Weed Management Guide

Rubber vine –
Cryptostegia grandiflora



Rubber vine (*Cryptostegia grandiflora*)

The problem

Rubber vine is a *Weed of National Significance.* It is regarded as one of the worst weeds in Australia because of its invasiveness, potential for spread, and economic and environmental impacts.

Rubber vine has impacts on pastoral and conservation areas of northeastern Australia. Its main impact on pastoralism is the loss of grazing country, which in 1995 was estimated to cost the Queensland beef industry $18 million. It also increases the costs of mustering and fencing.

Rubber vine threatens waterways, woodlands and rainforests throughout northeastern Australia, including significant conservation areas such as the Wet Tropics World Heritage Area and Cape York. It also severely threatens riverine vegetation, and can potentially displace the plants and animals that inhabit riverbanks, thereby affecting the water quality of streams. The whole ecological integrity of native vine thickets and riverine systems of northern Australia is under threat from rubber vine.

Rubber vine smothers and kills native vegetation. It is a severe threat to biodiversity in northern Australia: Burdekin River, Qld.
Photo: Colin G. Wilson

The weed

Rubber vine is a many stemmed shrub which can climb 30 m into tree canopies, or grow 1–3 m high when unsupported in open areas. The stems are greyish brown with a smooth bark and have two forms: a leaf-bearing branched stem and a longer unbranched 'whip' with fewer leaves that extends onto nearby adjacent vegetation. The plant exudes a milky sap if scratched or broken.

The leaves occur in pairs and are a glossy dark green in colour. They are oval-shaped with tapered ends (elliptical), 60–100 mm long and 30–50 mm wide. The trumpet-shaped flowers are quite large, up to 50 mm long and wide, with five light purple to white petals.

The seed pods are rigid and usually occur in opposing pairs at the end of short stalks, but are quite common as single pods and occasionally triple pods. The pods are up to 120 mm long and 40 mm wide. The brown seeds are flat with a tuft of long, white, silky hairs at one end. Roots grow to a depth of 12 m.

Key points

- Rubber vine threatens to choke the waterways, vine forests and pastures of northern Australia.
- Its westward spread must be prevented to protect environmental and economic interests in the Northern Territory and northern Western Australia.
- A containment line helps to prioritise infestations for control and to monitor progress.
- Existing control techniques (chemical, mechanical, biological and fire) should be integrated for maximum effect.
- Follow-up work needs to be ongoing, especially if seeds re-enter the site.

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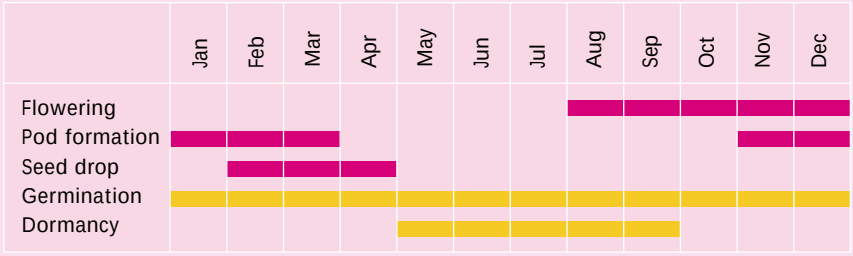
Growth calendar



Rubber vine seedlings do not flower until the diameter of the stem at its base is at least 15 mm. Under normal conditions in Queensland this occurs shortly after the first year of growth. Although rubber vine can flower at almost any time of the year, most flowering takes place in summer. Seed pod formation usually occurs from summer to late autumn. Seed pods are not generally formed until the stem diameter has reached 35 mm at its base. The pods dry out and are ripe after about 200 days, when they split open and release the seeds.

Germination occurs following good rain. Seeds need between 5 and 15 days exposure to moist, warm (20–30ºC) conditions before they will germinate. Wet, shaded areas that protect the seeds from drying out are therefore ideal for rubber vine.

Rubber vine plants are thought to live for up to 80 years.

Rubber vine mainly flowers during summer: Charters Towers, Qld, in December.
Photo: Colin G. Wilson

Rubber vine was first planted in the gardens of mining towns of northern Queensland in the late 1860s. Weedy infestations were reported by 1917. During the Second World War rubber vine was cultivated as a potential source of rubber, contributing to its spread.

In 1991 the total area of rubber vine infestation was estimated at over 700,000 ha of tropical and subtropical Queensland, although it was present over an area 50 times as large. Two infestations, since controlled, were also found in northern Western Australia in the 1990s.

How it spreads

About 95% of seed produced by rubber vine is viable. It is scattered short distances from the parent plant by wind that catches the tufts on the seed ends, or longer distances by floating on floodwaters. Most seed remains viable even after the pods have floated on fresh or salt water for over a month, potentially leading to spread between catchments.

Seeds can also be potentially spread by birds, or in mud attached to vehicles, machinery and animals.

With each seed pod producing between 340 and 840 seeds, a hectare of rubber vine can produce millions of seeds every year. However, the seed is not long lived. If conditions are too dry to allow germination, most of the seed will die after one year.

Each seed pod can produce over 800 seeds, which are spread short distances when the tufts are blown by the wind.
Photo: Colin G. Wilson

Where it grows

Rubber vine typically invades new areas when seed is blown in or transported down a waterway. Seed germinates readily on riverbanks and other moist areas, and the young plants rapidly grow over and smother other plants, often completely dominating the vegetation. It then spreads aggressively from the riverbank to adjoining open woodland and/or pastures.

Currently, rubber vine is restricted to areas receiving between 400 and 1400 mm of mainly summer rain. It grows on all soil types, but is more likely to germinate on soils that retain moisture.

Rubber vine is native to southwestern Madagascar. It has become weedy in other countries throughout East Africa, South-East Asia, the United States, and Central and South America.

Potential distribution

Based on its climatic requirements, rubber vine has a potential distribution covering all of northern Queensland and northern Northern Territory, and most of the Kimberley and Pilbara regions of Western Australia. Parts of northeastern New South Wales could also be affected.

What to do about it

Prevention of spread outside the Rubber Vine Containment Line

Prevention is the cheapest form of controlling rubber vine. The Rubber Vine Containment Line was surveyed in the early 1990s to highlight areas infested with the weed and help plan control efforts. Strategies inside the containment line are focused on managing its impact. Any infestations outside the containment line are targeted for control to prevent its spread into new areas.

Other ways to prevent the spread of rubber vine include:

- preventing its sale and planting by declaring it a weed across all states and territories
- preventing further importation
- raising public awareness of the problems.

How to control rubber vine

Early efforts to control rubber vine have improved our understanding of control techniques and how to combine, or integrate, different methods to give the best results. There are four main methods that are used to control the weed: biological, chemical, fire and mechanical.

The longer unbranched 'whip' extends out of the top of vines. It has few leaves but is used to climb onto other vegetation.
Photo: Joe Vitelli, Qld DNRM

A strategic plan for integrated management of rubber vine

The Queensland Department of Natural Resources and Mines and the National Rubber Vine Management Group have developed the 'Rubber Vine Management Manual – Control and Case Studies', with funding contributed by the National Weeds Program of the Natural Heritage Trust. It contains the five-step approach to planning which is summarised below.

Accurate mapping of all infestations is an ideal starting point that will provide the information required to identify infestations as priorities for control.

Control attempts should aim to kill plants before they set seed, first targeting outlying or small infestations and working towards the centre. Because wind and water are the main ways in which seed is spread, prioritise infestations that are likely to be a source of seeds (eg in upper catchments, or upwind in relation to prevailing winds). Infestations that have severe impacts on property maintenance (eg watering or mustering points) or primary production might also be high priorities for control.

Choosing appropriate control methods is a key part of the strategic plan. Aiming for maximum effect with minimum cost, it is important to first evaluate what resources (eg labour, herbicides, spray equipment, machinery) are available. Part of this evaluation will be assessing the different costs of each control method and of each of the identified priorities, and developing a financial plan for both the short and long terms.

Finally, it is important to target control efforts to suitable times of the year to take advantage of differences between seasons or any abnormal fluctuations (such as drought or flooding). For example, good rains generate pasture growth, which can be used to fuel fires.

Larvae of the biological control agent *Euclasta whalleyi* feeding on rubber vine leaves, Charters Towers, June.
Photo: Rachel McFadyen

Adult *Euclasta whalleyi* are active at night, and are recognisable by a black spot on the wing and their habit of resting with their wings at an angle of 45º to a vertical surface.
Photo: Rachel McFadyen

Biological control reduces rubber vine's vigour

Two biological control agents have become widespread in Queensland since their release in the early 1990s. The rubber vine rust *Maravalia cryptostegiae* forms on the underside of leaves and causes them to turn yellow and drop. The rust thrives during the wet season but is less active over the dry season. Frequent showers early in the season should result in heavy infestations of rust.

The other agent is the moth *Euclasta whalleyi*, whose caterpillars feed on rubber vine leaves between March and October. The moth has a black spot on each wing and characteristically rests with its wings folded at 45º to a vertical surface. The caterpillars tend to feed on the underside of new leaves, often leaving fine silken threads and black bead-like droppings.

Both agents, especially the rust, cause damage (eg reduced flowering, seed pod production and leaf cover) and occasionally the death of established plants. However, their effectiveness varies with climatic conditions.

Herbicides are effective but expensive

The strategic use of a range of registered herbicides is an effective method of controlling isolated or outlying rubber vine plants. Foliar spraying the entire plant from the ground and aerial spraying are most effective on smaller plants (less than 2 m tall, stem diameter less than 35 mm). However, note that leaves infected by the biocontrol rust will not take up herbicides. The basal bark technique, which uses spraying around the lowest bark up to a height of 500 mm (knee height), is effective on plants of stem diameter less than 35 mm at the base. For thicker rubber vine, up to 90 mm stem diameter at base, basal bark spray to 1 m high. Foliar, aerial and basal bark spraying should only be conducted when rubber vine is actively growing.

When the stem diameter at the base exceeds 90 mm, or if the stems are heavily intertwined, the cut-stump method is preferred. The stems should be cut as close to the ground as possible using a machete or chainsaw, and immediately painted with herbicide. The cut-stump method uses minimal herbicides and is effective at all times but is labour intensive and therefore best suited to scattered infestations.

Soil-applied residual herbicides are effective when applied before rain. Soil type limits their effectiveness, and there are other important considerations such as run-off and impacts on non-target trees. It is highly recommended that advice is obtained from the relevant state/territory weed management agency prior to the use of soil-applied herbicides.

Fire is relatively inexpensive and kills rubber vine

Fire is an especially valuable part of the integrated control of rubber vine because it kills surface seeds, seedlings and adult plants, yet is relatively inexpensive. If there is sufficient fuel, rubber vine can be burnt whilst green with good success. Infestations may require an initial burn to open them out, a follow-up burn to control regrowth and seedlings in the next 12 months, and another burn several

Weed control contacts

State / Territory	Department	Phone	Email	Website
NSW	NSW Agriculture	1800 680 244	weeds@agric.nsw.gov.au	www.agric.nsw.gov.au
NT	Dept of Infrastructure, Planning and Environment	(08) 8999 5511	weedinfo.ipe@nt.gov.au	www.nt.gov.au
Qld	Dept of Natural Resources and Mines	(07) 3896 3111	enquiries@nrm.qld.gov.au	www.nrm.qld.gov.au
WA	Dept of Agriculture	(08) 9368 3333	enquiries@agric.wa.gov.au	www.agric.wa.gov.au
Australia wide	Australian Pesticides and Veterinary Medicines Authority	(02) 6272 5852	contact@apvma.gov.au	www.apvma.gov.au

For up-to-date information on which herbicides are registered to control rubber vine and the best application methods and dosages, contact your state or territory weed management agency or local council. This information varies from state to state and from time to time. Contact details are listed above, including contacts for the Australian Pesticides and Veterinary Medicines Authority, which hosts the PUBCRIS database. This database contains information on all herbicides that are registered for use on weeds in each Australian state and territory.

When using herbicides, always read the label and follow instructions carefully. Particular care should be taken when using herbicides near waterways because rainfall running off the land into waterways can carry herbicides with it. Permits from state or territory Environment Protection Authorities may be required if herbicides are to be sprayed on river banks.

years later to continue the follow-up. In a fire research experiment west of Chillagoe in Queensland, 80% of rubber vine was killed in an initial fire (October 1997). A follow-up burn one year later resulted in a 99% kill rate.

The timing of fire is crucial to its success as fires must be hot enough to kill mature rubber vine. The fuel load should be about 1500 kg/ha, the equivalent of a relatively thin pasture. Pasture may need to be fenced off, or spelled, before burning to allow it to build to high enough levels. These costs, and the construction of fire breaks, make up the bulk of the costs associated with fire.

Fire combined with biocontrol provides cost-effective control of rubber vine

It is advisable to burn after first rains as this reduces the risk of prolonged periods of bare earth and erosion. Other factors that must be considered when using fire include its impacts on pastures and natural ecosystems, risks to stock and property, and loss of nutrients. Permits may be required to light fires – check with your local council or state or territory weed management agency.

With sufficient fuel (grasses, rubber vine leaves, other vegetation), fire can successfully control rubber vine. Fire is especially efficient in combination with rubber vine rust.
Photo: Joe Vitelli, Qld DNRM

Mechanical control helps gain access

Blade or disc ploughs and cutter bars provide reasonable control of rubber vine, but are most often used to penetrate very dense infestations to allow easier access or to open up the canopy. Slashing harms the plant but often does not kill it.

Mechanical control is mainly used to open up infestations and allow better access to rubber vine for herbicide application or to help provide fuel for fires.
Photo: Joe Vitelli, Qld DNRM

The seed pods normally form between December and April, and occur in pairs at the end of stems.
Photo: Rachel McFadyen

Mechanical control is not suited to core problem areas such as gullies and creeks because it can lead to erosion. Also, care must be taken not to inadvertently bury plant material (eg seeds, stems) that could be protected from a fire. Permits may be required to conduct mechanical control if native species will be affected. Weed control contacts (see table p. 5) will be able to provide relevant advice.

Chemical, mechanical and biological control, fire and grazing management can be integrated together to manage rubber vine in the long term

Integrated management is most effective

Recent research has shown that the use of fire after biological control can be highly effective. The biocontrol rust causes leaf drop, which opens up infestations and allows grasses to grow underneath. Combined with the rubber vine leaf litter, these grasses can provide the perfect environment for fires, resulting in excellent, cost-effective control.

However, there is no single method of integrating techniques that is suitable for all infestations; control programs should be tailored to the location, size, intensity and age of each situation. Other factors that must also be considered are the effects on other vegetation and the availability of resources for control and follow-up operations. Landholders should contact their local weeds officer or lands protection officer for the most appropriate strategy.

Controlling rubber vine is hard work and requires ongoing commitment. The benefits of controlling it include: recovered pasture, increased production, reduced mustering costs and the protection of natural ecosystems, plants and animals.

Cryptostegia madagascariensis is similar in appearance to rubber vine, and poses similar threats as it escapes from gardens.
Photo: Colin G. Wilson

Another weedy species of *Cryptostegia*

Cryptostegia madagascariensis is closely related to rubber vine, and also occurs either in gardens or as a naturalised weed in Western Australia, the Northern Territory and Queensland. Its flowers are slightly smaller and a deeper pink colour but it is otherwise difficult to separate the two species. The risks posed by *Cryptostegia madagascariensis* are high, especially because it could cross-breed with rubber vine. Note that the common name 'rubber vine' may also be used for other unrelated nursery plants.

...case study

Protecting the Channel Country

Holmleigh Station is a cattle property south of Prairie in the uplands of Tower Creek in northern Queensland. John and Bub Teakle run about 600 head on the 15,600 ha station, which forms part of the very upper Lake Eyre Basin.

The Teakles did not take much notice of the rubber vine when they first took over the station in 1989. The extent of the problem was revealed in 1992 when the Strategic Weed Eradication and Education Program (SWEEP) helped to map the infestation, and found that it followed Tower Creek through Holmleigh and adjoining stations for about 9 km.

According to John Teakle, one of the main problems with rubber vine is that "the cattle get hidden in it when mustering – once they know it's there the cattle will look for it". Although both biocontrol agents are present, it is too dry for the rust and the moth is prone to parasitism.

In the Tower Creek area SWEEP provided an initial control effort aimed at knocking out the bulk of the rubber vine stands. The SWEEP team used foliar applied herbicides, but could not get access to some very dense infestations. Although they made some progress, upstream plants continually reinfested treated areas, and the ongoing follow-up that was required was beyond the resources of most of the landholders.

Since that initial control attempt, John Teakle has used fire to gain better access and help thin out dense infestations. "Fire is the first thing anyone should do…Burn any time you can get a fire to burn and it's safe to burn", he says. It is crucial that the fires are intense enough to burn up through the green rubber vine and kill it. Fire is a relatively inexpensive method of control and can help to reduce the amount of seed produced.

With funding secured through the Natural Heritage Trust, the Teakles have employed contractors to help with chemical control of rubber vine, using the cut-stump technique for plants over 30 mm diameter and basal bark spraying for anything smaller.

The Teakles are not seeking major economic gains from rubber vine control as it does not spread into their pastures. They mainly see the benefits in clearing their property and protecting the downstream Channel Country.

Rubber vine infestation in Qld, where the total area of infestation was estimated at 700,000 ha in 1991. Its total range extends across some 35 million ha, or 20% of the state.
Photo: Joe Vitelli, Qld DNRM

Legislation

Landholders throughout Western Australia, the Northern Territory and Queensland are required by law to control both species of *Cryptostegia* that occur on their land. Check with your local council or state/territory government agency about its requirements for rubber vine control.

Acknowledgments

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Other assistance from Rachel McFadyen (Weeds CRC), Sandy Lloyd (Dept of Agriculture WA/Weeds CRC), John and Bub Teakle (Holmleigh Station), Michele Deveze (Qld DNRM) and John Thorp (National Weeds Management Facilitator).

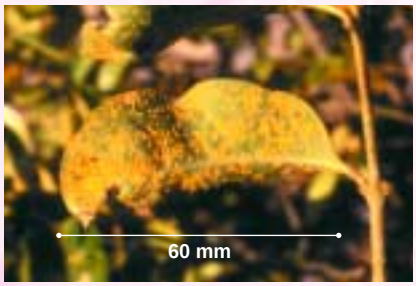
Maps: Australian Weeds Committee.

How to control rubber vine

Quick reference guide

Prevent spread outside the containment line

All infestations outside the Rubber Vine Containment Line should be controlled to prevent further spread. Monitoring and early detection are required to target these infestations. Communication and education are critical to achieving early detection in new areas.



The rubber vine rust *Maravalia cryptostegiae* appears as yellow blotches on the underside of the leaves. It thrives in the wet season, particularly after steady early rains.
Photo: Rachel McFadyen

Integrated management within the containment line

Infestations within the Rubber Vine Containment Line should be managed to minimise impacts and reduce the amount of seed produced. Integrated control using a mix of fire, biological, mechanical and chemical methods is the most cost-effective long-term approach.

The five step approach to planning

Use the five step planning approach, as devised by the Queensland Department of Natural Resources and Mines and the National Rubber Vine Management Group:

1. Map infestations on your property.
2. Target sites that are sources of seed spread, strategically important or essential for property management.
3. Determine the availability of resources (eg herbicides, labour) and suitability of methods for different infestations (eg herbicides are too expensive for very dense or large infestations, fire is especially effective after rust infection).
4. Estimate the cost of the program and incorporate into the short- and long-term property budget.
5. Calendar control efforts for maximum results and minimum effort. For example, wait until an adequate fuel load exists before using fire.

Ongoing follow-up

Follow-up control must be diligent and ongoing, as rubber vine can quickly reinfest.

Control options

Type of infestation	Fire	Mechanical	Chemical	Biological
Light (less than 1000 plants per ha)	Moderately hot fires using grass as a fuel will give good kill rates.	Slashing kills only about 50% of rubber vine. Consider other methods.	Foliar or basal bark spray, or use cut-stump method with registered herbicide when actively growing.	Two biological agents are having an impact in reducing the health and spread of rubber vine – the rubber vine rust and the rubber vine moth. An additional benefit of the rust is that it opens up the canopy to allow flammable undergrowth to grow. However, biocontrol agents will only rarely kill mature rubber vine plants on their own.
Medium (1000–2000 plants per ha)	Hotter fires are required to ignite and kill rubber vine in denser infestations. Either exclude stock to build up fuel, or burn after rust has defoliated rubber vine. Ideally, burn in late spring or after rain to avoid bare earth and erosion.	Cutter bar gives best control. Do not use on steep slopes.	Foliar or aerial spray, or apply registered herbicide to soil when actively growing.	
Heavy (more than 2000 plants per ha)		Blade ploughing can kill most rubber vine, but is mainly used to open up infestations and allow better access. Do not use on steep slopes.	Aerial spray or apply registered herbicide to soil. Note it is very expensive to control large infestations with herbicides, and foliar sprayed herbicides are less effective on rubber vine infected with rust.	

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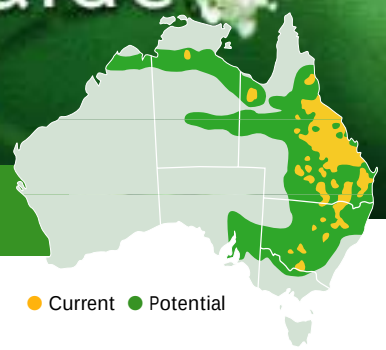
CRC Weed management

Weed Management Guide

Parthenium weed –
Parthenium hysterophorus



Parthenium weed (*Parthenium hysterophorus*)

The problem

Parthenium weed is a *Weed of National Significance*. It is regarded as one of the worst weeds in Australia because of its invasiveness, potential for spread, and economic and environmental impacts.

Parthenium weed is a major problem in rangelands and summer cropping areas of Queensland. It has a serious impact on the pastoral industry, costing farmers and graziers in Queensland over $22 million a year in reduced production and increased management costs. Some people suffer severe allergic reactions to the plant or its pollen; it can cause dermatitis, hay fever and asthma. Parthenium weed is toxic to cattle, and meat from livestock that eat the weed can be tainted. It also threatens biodiversity in the Einasleigh Uplands bioregion and native grasslands in the central highlands of Queensland.

The weed

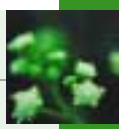
Parthenium weed is native to the subtropics of North and South America. It is a fast-maturing annual (or, under certain conditions, a short-lived perennial) with a deep tap root and an erect stem that becomes woody with age. It may eventually reach a height of 2 m. Its leaves are pale green, branched and covered with soft fine hairs. The small white flowers (4 mm across) have five distinct corners and grow on the stem tips. Each flower produces four or five black wedge-shaped seeds that are 2 mm long with thin white scales.

Its large and persistent soil seedbank, fast germination rate and ability to undergo dormancy make it well adapted to semi-arid environments. It also releases chemicals that inhibit the germination and growth of pasture grasses and other plants.

Parthenium weed matures quickly and produces large quantities of seed (up to 100,000 seeds per plant).
Photo: Larry K. Allain

Key points

- Parthenium weed can germinate, grow, mature and set seed in four weeks.
- Parthenium weed is toxic to stock and contact with parthenium weed, particularly its pollen, can cause allergic reactions such as dermatitis, hay fever and asthma in people.
- The best way to prevent an allergic reaction to parthenium weed is to avoid contact with it, especially breathing pollen from flowering plants.
- Pay close attention to property hygiene. Weed seeds are spread very easily by vehicles, machinery, stock, grain and fodder.
- Use mechanical, chemical and biological control and grazing to manage parthenium weed.



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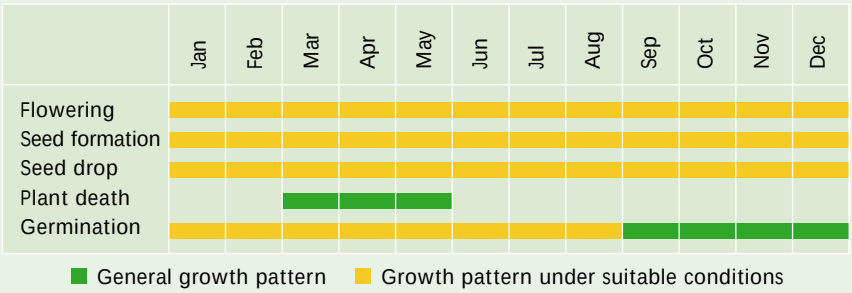
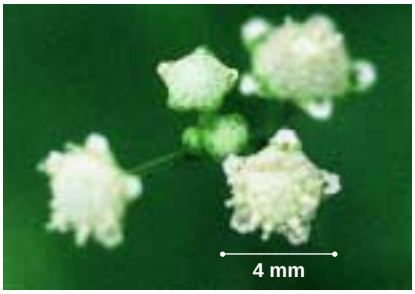
Growth calendar



Parthenium weed normally germinates in spring and early summer, produces flowers and seed throughout its short life and dies in late autumn. However, with the right conditions (rain, available moisture, mild soil and air temperatures), parthenium weed can grow and produce flowers at any time of the year. In a good season, four or five generations may emerge. In summer, if plants are stressed (eg due to lack of water), parthenium weed can complete its life cycle in four weeks. Buried seeds have been found to last much longer than seed on the soil surface, and a significant proportion can still germinate after eight to ten years.



Parthenium weed can flower year round.
Photo: Colin G. Wilson

Potential distribution

Parthenium weed is best suited to areas with an annual summer rainfall greater than 500 mm. Based on climate suitability, it could potentially grow in all mainland states and territories.

How it spreads

Parthenium weed can produce large quantities of seed, up to 100,000 per plant. More than 340 million parthenium weed seeds per hectare can be present in the surface soil, compared to 120,000 native grass seeds.

The seed is easily spread by vehicles, machinery and animals, and in pasture seed, stock feed and water. Most long distance spread is in produce, vehicles and farm machinery. It can also be spread by flooding and by animals.

Parthenium weed was first discovered in Queensland in 1955. In a short time it spread from isolated outbreaks to establish core infestations across the Central Highlands of Queensland and into New South Wales and the Northern Territory.

Where it grows

Parthenium weed infests more than eight million hectares of central Queensland with serious outbreaks in the south and north of the state. Outbreaks, many of which have been controlled, have been found throughout New South Wales as far south as the Victorian border.

In Queensland it grows best on alkaline, clay-loam to heavy black clay soils but tolerates a wide variety of soil types. It aggressively colonises areas with poor groundcover and exposed soil such as wastelands, roadsides and overgrazed pastures. It does not usually become established in undisturbed vegetation or vigorous pastures. Drought, and subsequent reduced pasture cover, create the ideal opportunity for parthenium weed to establish. Flooded country is also very prone to parthenium weed distribution and flooded pastures may need to be spelled from grazing to gain their competitive edge.

What to do about it

Preventing spread into new areas

Preventing the spread of parthenium weed is the most cost-effective management strategy.

There is a high risk of spreading parthenium weed by the movement of vehicles, machinery, livestock, grain and other produce. Queensland has a number of washdown facilities and contractors are required to clean harvesters and other equipment before leaving the state. All harvesters are inspected as they cross the Queensland – New South Wales border.

Parthenium weed can germinate, grow, mature and set seed in four weeks.
Photo: Sheldon Navie

Property hygiene is also important. Double-check machinery (including the interior of the vehicle) moving onto your property and drive visitors around in your own vehicle. Always wash down vehicles and machinery in the same area to allow easy follow-up control of any seeds that may germinate. Ensure that service provider vehicles (eg telephone, electricity, gas) are free of parthenium weed seed.

Avoid moving cattle in wet weather as they readily transport seed in muddy soil. When new stock arrive on a property, hold them in yards or small paddocks to let seed drop from their coats and tails before releasing them into large paddocks. Always feed stock in the same area to contain weeds imported in contaminated fodder.

When you are buying hay or seed, be aware of what you are buying. In Queensland landowners are required to supply a vendor declaration to state whether their produce is free of parthenium.

Recent experience with parthenium weed

The Queensland Department of Natural Resources and Mines and the Parthenium Action Group have developed management and control techniques for parthenium weed, which include a combination of biological control agents, pasture management, cultivation and herbicides. Small infestations can be eradicated by early detection and monitoring. An ongoing commitment is needed to remove any seedlings and ensure new infestations do not establish. The extent of parthenium weed in New South Wales has been significantly reduced in recent years; all known roadside infestations have been suppressed and all known infestations on private land are under active control. In the Northern Territory, parthenium weed has been eradicated from previous infestations on the Roper River, at Katherine and in the Gulf of Carpentaria. However, although the area infested with parthenium weed is being reduced, the number of new infestations is increasing.

Large parthenium weed infestation in central Qld. Photo: Qld DNRM

Parthenium weed's large and persistent soil seedbank and fast germination rate make it well adapted to semi-arid environments. Photo: Colin G. Wilson

Control of new outbreaks

Once parthenium weed has been positively identified, treat isolated patches immediately with herbicides recommended by the local council weeds officer. Watch the area closely for at least seven years as repeated spraying may be necessary to kill new germinations. Don't pull up plants by hand, particularly if they have already set seed. There is a danger that mature seeds will drop off the plant and increase the area of infestation.

Control in pasture...

Control in pasture requires timely herbicide application and pasture management. Conservative stocking to keep a good pasture cover is the best way of controlling large-scale parthenium weed infestations and preventing new infestations in clean areas. Areas where stock congregate, such as watering points, often have low groundcover and are highly susceptible to parthenium infestation. To overcome this problem, establish several stock water points per paddock and rotate stock between them.

Breaking up large paddocks by fencing into single units of similar land type can even out grazing and thus avoid bare patches where weeds can invade. It also allows more flexible management strategies, such as spelling pasture and applying herbicide.

...and control in crops

Parthenium weed is becoming a significant problem in crops due to the threat to exports from contaminated grain or other produce. Once in a crop it is very difficult to eradicate, so try to keep crops clean by spraying selective, pre-emergent herbicides where possible and cleaning equipment and machinery such as harvesters. Do not purchase seed that does not comply with the relevant seed Acts. For further information on parthenium weed control in crops, consult your local crop agronomist.

Herbicides

Timing of chemical control is critical. Parthenium weed should be treated when plants are small and have not produced seed, and when grasses are actively growing to recolonise the infested area (eg early summer). Maintaining competition is important for control of parthenium weed, so spraying with a selective herbicide that will not kill other species is recommended. Keep a close watch on treated areas for at least seven years and spot spray isolated outbreaks. A number of herbicides are recommended for parthenium weed control. Contact your local authority for details.

Weed control contacts

State / Territory	Department	Phone	Email	Website
ACT	Environment ACT	(02) 6207 9777	EnvironmentACT@act.gov.au	www.environment.act.gov.au
NSW	NSW Agriculture	1800 680 244	weeds@agric.nsw.gov.au	www.agric.nsw.gov.au
NT	Dept of Infrastructure, Planning and Environment	(08) 8999 5511	weedinfo.ipe@nt.gov.au	www.nt.gov.au
Qld	Dept of Natural Resources and Mines	(07) 3896 3111	enquiries@nrm.qld.gov.au	www.nrm.qld.gov.au
SA	Dept of Water, Land and Biodiversity Conservation	(08) 8303 9500	apc@saugov.sa.gov.au	www.dwlbc.sa.gov.au
Vic	Dept of Primary Industries/Dept of Sustainability and Environment	136 186	customer.service@dpi.vic.gov.au	www.dpi.vic.gov.au www.dse.vic.gov.au
WA	Dept of Agriculture	(08) 9368 3333	enquiries@agric.wa.gov.au	www.agric.wa.gov.au
Australia wide	Australian Pesticides and Veterinary Medicines Authority	(02) 6272 5852	contact@apvma.gov.au	www.apvma.gov.au

For up-to-date information on which herbicides are registered to control parthenium weed and the best application methods and dosages, contact your state or territory weed management agency or local council. This information varies from state to state and from time to time. Contact details are listed above, including contacts for the Australian Pesticides and Veterinary Medicines Authority, which hosts the PUBCRIS database. This database contains information on all herbicides that are registered for use on weeds in each Australian state and territory.

When using herbicides always read the label and follow instructions carefully. Particular care should be taken when using herbicides near waterways because rainfall running off the land into waterways can carry herbicides with it. Permits from state or territory Environment Protection Authorities may be required if herbicides are to be sprayed on riverbanks.

Mechanical removal

Ploughing the weed in before plants reach flowering stage and then establishing pasture may be effective. Before crops are planted, parthenium weed is normally ploughed in, or pre-emergent herbicides can be used.

Biological control

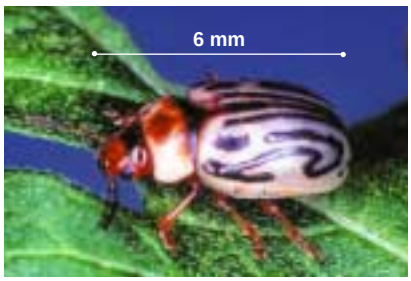
Biological control of parthenium weed has been investigated in Australia for more than 20 years. Nine insect species and two rusts have been released. Most insects and both rusts have established.

Biological control is one tool that forms part of an integrated management program for large-scale scattered and dense infestations. However, biological control on its own will not eradicate parthenium weed infestations.

The leaf beetle *Zygogramma bicolorata* and the stem moth *Epiblema strenuana* cause the most damage. The beetle emerges in late spring and is active until autumn. The moth is established in all parthenium weed areas. Its larvae (grubs) feed inside the stem, stunting the plant's growth and reducing its competitiveness and seed production. Other species are: a stem boring weevil from Argentina, *Listronotus setosipennis*, which is having limited success; a seed-feeding weevil, *Smicronyx lutulentus*, which lays eggs in the flower buds, leaving the newly hatched grubs to feed on the seed heads; a leaf mining moth, *Bucculatrix parthenica*, from Mexico, whose grubs feed on the leaves of parthenium weed; a stem-galling weevil, *Conotrachelus albocinereus*, from Argentina, which is still becoming established; and *Carmentia ithacae*, a stem boring moth from Mexico released from quarantine in 1999 and still becoming established in the Central Highlands.

Seasonal conditions and the need for green plants for insect survival play a major role in the effectiveness and abundance of biological control agents. This is highlighted during long dry periods when insect populations are reduced and need time to recover.

Puccinia abrupta, a winter rust from Mexico, infects and damages leaves and stems. It is established over a wide area in Queensland, south from Clermont. The release program for a second rust, *Puccinia melampodii*, a summer rust, began in 1999 and is continuing. Its establishment has been hindered by drought but further releases have been made in some areas following better rainfall. Its impact is expected to improve if rainfall increases



The leaf beetle *Zygogramma bicolorata* emerges in late spring and is active until autumn.
Photo: Rachel McFadyen

The leaf beetle *Zygogramma bicolorata* can remove virtually all of parthenium weed's foliage.
Photo: Rachel McFadyen

in the areas infested with parthenium weed. The rust weakens the plant by damaging the leaves over the summer growing season.

Field collection and distribution of biological control agents will help reduce local parthenium weed infestations. For best results a nursery site to raise biological control agents should be developed. Good nursery sites can be as simple as a leaking pipe or tank. Other ideal sites are infested black soil creek flats, gullies or swampy areas. At the same time, ensure that your nursery site does not become a source for further parthenium weed infestations. Contact your state/territory weed management agency or local council for assistance in collecting and rearing biological control agents for parthenium weed.

The distinctive branched leaves are covered with soft, fine hairs.
Photo: Sheldon Navie

Burning

Burning is not a useful control strategy for parthenium. However, research suggests that burning for other purposes (eg woody weed control) will not result in an increased infestation of parthenium so long as the pasture is allowed to recover before stock are introduced. Stocking of recently burnt areas known or suspected to contain parthenium weed decreases competition, ultimately creating a more serious infestation. Permits may be required to burn, so check with your state/territory weed management agency or local council.

Legislation

Parthenium weed is declared a noxious weed in all mainland states and territories, and landowners are required to control it. Its introduction into Australia is prohibited. Legislation introduced into Queensland recently makes it a legal requirement for suppliers of stock, machinery, soil, water or other products likely to transport weed seeds to complete a declaration stating whether or not the material is clean of parthenium weed. In New South Wales landowners must report the presence of parthenium weed to the local control authority within three days. This agency will then advise the necessary action to be taken to eradicate the infestation.

Acknowledgments

Information and guide revision: Darren Moor (Qld DNRM), Gail Godwin Smith (Parthenium Action Group) and other members, Rachel McFadyen (Weeds CRC), Richard Carter (NSW Agriculture/Weeds CRC), Sheldon Navie (University of Queensland), Dhileepan Kunjithapatham (Qld DNRM) and John Thorp (National Weeds Management Facilitator).

Maps: Australian Weeds Committee.

...case study

Management of parthenium weed at Mt Panorama

While parthenium weed is certainly something landholders should try and prevent invading their properties, it can be managed. This is the message from Gail Godwin Smith, project officer with the Parthenium Action Group. Gail and her husband Howard Smith are farmers and graziers at Rolleston in central Queensland.

In 1988, when Howard and his family bought 'Mt Panorama', it was infested with parthenium weed. Today, they regard the weed as an indicator species which appears if pasture is being overgrazed.

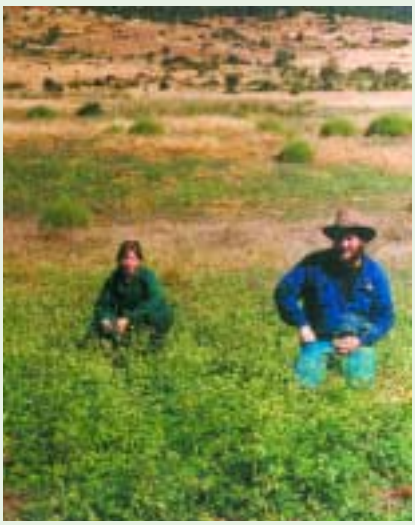
'Mt Panorama' has been a trial property for the release of biological control agents, two of which (the *Zygogramma* beetle and summer rust) have had a big impact on the weed.

However, changing management practices has been the major factor in controlling parthenium, says Gail. The main infestations on the property now occur along waterways. Many of these waterways have been fenced off to allow native vegetation to compete with parthenium and they are grazed seasonally to reduce any fire risk.

Favourable seasonal conditions allow spelling of paddocks and rotation of cattle so that healthy pasture is maintained and no one paddock gets eaten out.

Parthenium weed is no longer a problem on the cultivated country either, where minimum tillage is used and pre-emergent herbicide sprayed for other weeds.

The Smith family recognise that they are unlikely to totally eradicate parthenium weed, and so they must live with it and manage it appropriately.



Changing management practices has been the major factor in controlling parthenium weed on 'Mt Panorama'.
Photo: Qld DNRM

How to control parthenium weed

Quick reference guide

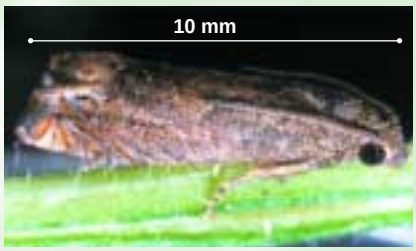
Parthenium weed – *Parthenium hysterophorus*

Prevention

Maintaining good hygiene on your property can prevent the spread of parthenium weed seed – check vehicles and machinery moving onto the property, drive visitors around in your own vehicle and always wash down vehicles and machinery in the same place. Always feed stock in the same area to contain weeds carried in contaminated fodder and place new stock into a small holding paddock until seed has dropped from their coats and tails.

New outbreaks

Treat immediately with a herbicide recommended by the local council weeds officer. Apply herbicides when plants are actively growing and before they set seed; keep a close watch on treated areas for at least seven years. Spot spray one to two weeks after rain, when plants are large enough to see but before they produce seed.



The stem moth, *Epiblema strenuana*, is established in all parthenium weed areas. Photo: Rachel McFadyen

In pasture

Stock conservatively to keep a good pasture cover, which will help prevent invasions of parthenium weed. Some strategies to improve pasture competition are to: spell pastures in the growing season, use rotational grazing, and spray herbicide to encourage grass seed production and reseeding.

To overcome high grazing pressure points, establish several stock water points per paddock and rotate stock between them.

Fencing different land types enables better grazing management.

In crops

Keep crops free of parthenium weed by spraying selective, pre-emergent herbicides where possible and cleaning equipment and machinery such as harvesters.

Biological control

Researchers in Queensland have located and tested a number of biological control agents against parthenium weed. Landowners can collect and distribute biological control agents to help reduce local infestations.

Control options

Type of infestation	Chemical	Biological	Physical	Pasture management	Mechanical
Light – few plants, over a small area	Spot spray before seeds set.	Not suitable.	Hand pulling is not recommended because of the health risks associated with parthenium weed. Use strategic fencing to separate different land types and improve grazing management.	Maintain good pasture cover by not overgrazing.	Some landholders have achieved success by ploughing in parthenium weed in the rosette stage before it seeds, but this must be followed up by sowing a crop or direct seeding perennial pasture.
Medium – plants over a medium area	Spray before seeds set.	Release biological control agents.			
Heavy – large number of plants	Spray before seeds set.	Establish a nursery site for biological control agents if possible.			

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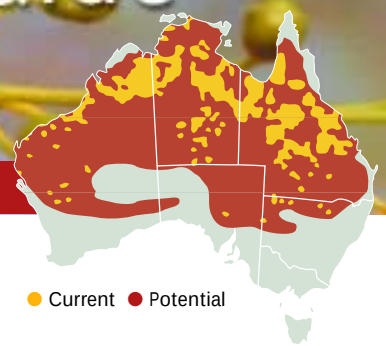
CRC Weed management

Weed Management Guide

Parkinsonia – *Parkinsonia aculeata*



Parkinsonia (*Parkinsonia aculeata*)

The problem

Parkinsonia is a *Weed of National Significance*. It is regarded as one of the worst weeds in Australia because of its invasiveness, potential for spread, and economic and environmental impacts.

Parkinsonia threatens rangelands and wetlands around Australia. If left untreated, it displaces native vegetation and reduces access to land and waterways.

Economic costs to landholders stem from an increased difficulty in mustering stock, a reduction in stock access to watering points and a decrease in primary production of grasses that are replaced by parkinsonia. Additionally, parkinsonia infestations provide refuges for feral animals, especially pigs.

The environmental impacts of parkinsonia are numerous. Native plant species are replaced, leading to lower quality habitat for animals. Wetlands are particularly vulnerable because parkinsonia can dam watercourses, cause erosion, lower watertables and take over vast tracts of floodplain. Threatened areas include national parks and other regions of high aesthetic, indigenous and tourist value.

The weed

Parkinsonia can grow to 8 m, although smaller plants are more common. It can be single- or multi-stemmed. The smooth, green stems are slender and tend to droop and zig-zag. Its leaves are quite different to the ferny leaves of the three other prickle bushes (see back page). Parkinsonia leaves consist of a flat, green leaf stalk up to 300 mm long and 2–3 mm wide with numerous small (4–10 mm) green oblong leaflets staggered along both sides. The leaf base is protected by sharp, recurved spines, 5–15 mm long, which persist in older branches.

Parkinsonia flowers are about 20 mm across, with four yellow petals and one erect orange or orange-spotted petal. Seed pods (30–130 mm long) are straight with bulges around seeds and points on both ends, and are straw-brown when ripe. They generally contain 1–4 seeds, but occasionally up to 11. Seeds are olive-green to brown and oblong-shaped (10 mm by 4 mm). The roots are generally shallow.

Parkinsonia produce up to 5000 seeds per year: Alroy Downs, in the Barkly Tablelands, NT.
Photo: Colin G. Wilson

Key points

- Parkinsonia is one of four prickle bushes that are weeds throughout semi-arid Australia. (See the back page for more information.)
- Dense infestations around watercourses prevent stock from accessing water and hinder mustering.
- Parkinsonia control is expensive – prevention of spread is more cost-effective.
- Control must be tailored to suit the landscape:
  - In rangelands use blade ploughing in the early dry season.
  - On riverbanks, chemicals should be applied to individual trees.
  - Fire may also be a good control option.
- Follow-up will be required to control seedlings.

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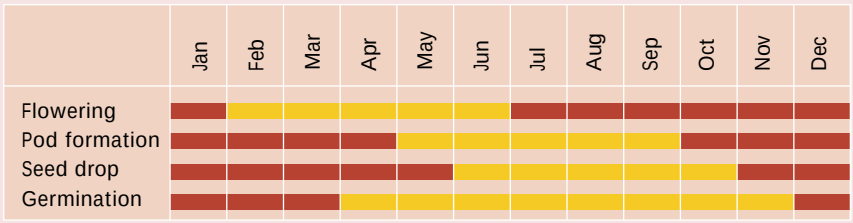
Growth calendar



There is a lot of variation in the timing of flowering and fruiting in parkinsonia across Australia, and therefore the growth calendar may vary in different areas. The general pattern is that flowering occurs in the warmer months after winter and seed pods develop soon afterwards. The seed pods ripen and drop some three to four months after flowering. However, established trees can have a few flowers and/or fruit at any time of the year.

Parkinsonia seeds germinate in response to prolonged (at least several days) moisture. Although they can germinate year round, most germination occurs during the hot, wet season, which may vary between sites and between years. Some seeds will germinate soon after being dropped, while others can remain dormant for several years. The seedling emerges as a single thorny stem and flowering first occurs in its second or third year.

Parkinsonia's five-petalled flower always has a single orange, or orange-spotted, erect petal and four yellow petals.
Photo: Colin G. Wilson

How it spreads

Parkinsonia reproduces by seeds. Mature trees typically produce about 5000 seeds per year, but can produce in excess of 13,000. The pods float and can be carried large distances downstream from upper catchment infestations, especially during floods. Seed can also be moved away from the parent plant in mud attached to animals or machinery. The pods are relatively unpalatable, so spread by animals consuming the seed is not very likely.

Parkinsonia was first introduced into many areas around Australia from Central America in the late 1800s. It was used for hedges and was also planted around homesteads and watercourses as an ornamental and shade tree. It is now naturalised across much of northern Australia.

Where it grows

Parkinsonia can thrive in a wide range of conditions. It occurs in climates varying from the moist sub-humid tropics to the harsh arid interior. It especially thrives around watercourses such as drainage lines, dams, rivers and bores. However, it can potentially invade uplands that are never inundated, floodplains and areas of run-off, and form dense thickets in all regions. Although it grows best on clay, it is found on a wide variety of soils.

Parkinsonia has been introduced into many regions worldwide, including Hawaii, tropical Africa, India, Pakistan, the Middle East, Italy and Cyprus. In Australia infestations occur mainly throughout coastal, central and western Queensland, central and northern Northern Territory, and the Kimberley and Pilbara regions of Western Australia. Small outbreaks have also been recorded from isolated areas of South Australia and far western New South Wales. At least 800,000 ha of land is now infested with parkinsonia.

Potential distribution

Based on the suitability of climate, all mainland states and territories except Victoria and the Australian Capital Territory are suitable for widespread parkinsonia infestation. It has naturalised in most, but not all, climatically suitable catchments, and its distribution within many of those catchments is likely to increase.

What to do about it

The economic costs of control are high once parkinsonia becomes established. The prevention of spread within and between catchments, early detection and control of small manageable outbreaks are thus high priorities when considering management strategies.

How to prevent the spread of parkinsonia

Soil or sand which could contain parkinsonia seeds should not be removed from infested areas. Any transport or machinery used in infested areas should be thoroughly cleaned before moving to other areas. Because water is responsible for much of the spread of parkinsonia, outbreaks on watercourses, particularly in upper catchments, are a priority for control.

Seed pods generally contain 1-4 seeds and ripen at the end of the wet season.
Photo: Colin G. Wilson

Preventing spread into uninfested catchments

The highest priority parkinsonia outbreaks are those that occur in catchments where it is not widespread or has not been previously found. These outbreaks have the greatest potential to cause damage. Such areas include the Lake Eyre and Murray–Darling basins, the Cape York region, parts of the Barkly Tablelands and southern regions of Australia.

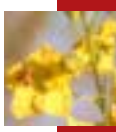
Controlling existing infestations

If the spread of parkinsonia is not carefully managed, it can form dense stands that exclude all other forms of vegetation. Research into parkinsonia control commenced in the 1950s and has been ongoing. The results from this research have shown that seedlings are particularly susceptible to different forms of control, especially fire, drought or inundation, soon after germination. An integrated approach using several weed management techniques (eg mechanical and chemical control, fire) is the most effective way to deal with dense infestations of parkinsonia. However, the characteristics of the infestation (eg size, density, location, position within the catchment) and the availability of resources will determine the exact course that control should take.

Infestations, such as in the Gulf country in northwestern Qld, restrict access and are expensive to control.
Photo: Cathy Lockett

Target watercourses, especially in upper catchments

Infestations along watercourses, especially in upper catchments, are the highest priority for parkinsonia control, as these have the greatest potential to infest new areas and replenish previously controlled areas with new seeds.



Parkinsonia was originally planted as shade trees in places such as Rockhampton Downs in the NT.
Photo: Colin G. Wilson

Mechanical control is effective…

Small parkinsonia plants can be relatively easily removed by manual means (hand pulling or grubbing with a mattock). Larger plants can be bulldozed, stickraked, blade ploughed or chain pulled. The roots must be removed to a depth of about 200 mm to prevent regrowth. In general, mechanical control of large infestations is more cost-effective than chemical control. Tree clearing permits may be required if native species are to be affected by mechanical control.

Blade ploughing gives excellent kill rates and is effective in treating large, thick infestations. Chain pulling kills mature trees, but many smaller plants are just bent over and straighten up once the chain has passed over.

The best time to attempt mechanical control is when the infestation first becomes accessible to heavy machinery at the start of the dry season. There should still be enough moisture in the soil to allow the roots to be easily removed, and the dry period following control will further stress any damaged plants and prevent immediate germination of seeds from the seedbank.

If the roots are not removed, parkinsonia can reshoot, producing multiple stems from the base. These multi-stemmed plants are actually more resilient and harder to remove.

…but requires follow-up control

Mechanical control is not generally suited to uneven ground, and is not advised for controlling parkinsonia along river banks due to the potential to cause erosion and damage non-target species. Because seedling germination in areas where the ground has been disturbed by mechanical control can be prolific, follow-up chemical or careful mechanical control will be required to treat seedlings or any surviving adult plants. Where feasible, cultivation and sowing of a suitable perennial pasture will reduce parkinsonia regrowth.

A range of herbicides and methods of chemical control are suitable for parkinsonia

There is a wide range of herbicides registered for parkinsonia control, with several different application methods. Herbicides are useful for controlling dense high priority infestations but otherwise may be too expensive for widespread use.

Complete overall (foliar) spraying provides effective control for seedlings that are less than 2 m tall and actively growing. Aerial application by helicopter provides similar results.

Larger trees can be treated with a liquid or granular herbicide applied near the roots just prior to the wet season in northern Australia. Note that these residual herbicides can also affect nearby non-target species.

Mechanical control with an Ellrott front-mounted bladeplough.
Photo: John McKenzie

Weed control contacts

State / Territory	Department	Phone	Email	Website
NSW	NSW Agriculture	1800 680 244	weeds@agric.nsw.gov.au	www.agric.nsw.gov.au
NT	Dept of Infrastructure, Planning and Environment	(08) 8999 5511	weedinfo.ipe@nt.gov.au	www.nt.gov.au
Qld	Dept of Natural Resources and Mines	(07) 3896 3111	enquiries@nrm.qld.gov.au	www.nrm.qld.gov.au
SA	Dept of Water, Land and Biodiversity Conservation	(08) 8303 9500	apc@saugov.sa.gov.au	www.dwlbc.sa.gov.au
WA	Dept of Agriculture	(08) 9368 3333	enquiries@agric.wa.gov.au	www.agric.wa.gov.au
Australia wide	Australian Pesticides and Veterinary Medicines Authority	(02) 6272 5852	contact@apvma.gov.au	www.apvma.gov.au

For up-to-date information on which herbicides are registered to control parkinsonia and the best application methods and dosages, contact your state or territory weed management agency or local council. This information varies from state to state and from time to time. Contact details are listed above, including contacts for the Australian Pesticides and Veterinary Medicines Authority, which hosts the PUBCRIS database. This database contains information on all herbicides that are registered for use on weeds in each Australian state and territory.

When using herbicides always read the label and follow instructions carefully. Particular care should be taken when using herbicides near waterways because rainfall running off the land into waterways can carry herbicides with it. Permits from state or territory Environment Protection Authorities may be required if herbicides are to be sprayed on riverbanks.

Chemical control near waterways

Basal bark and cut-stump treatments generally provide more effective control than foliar spraying. Although they are more time consuming they are the main methods recommended for use near waterways, as foliar applied herbicides can drift onto non-target plants or into water.

When applying the basal bark technique to stems up to 150 mm diameter, drench the herbicide around the trunk to a height of 300 mm above the ground. For larger trees spray up to 1 m above the ground. Before spraying ensure that the bark is dry and clear of dirt or debris as this will reduce the effectiveness of the treatment. For best results soil should be moist and plants should be actively growing.

When using the cut-stump technique, be sure to swab the entire cut surface of the stump immediately after cutting as this ensures that the herbicide reaches the roots.

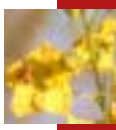
Helicopter spraying of a large infestation in central Qld.
Photo: John McKenzie

Fire offers much potential

Fire kills seedlings and seeds on the surface and is an excellent form of follow-up control after mechanical or chemical control. With mature plants, however, the results are mixed. Although fire in its own right offers excellent potential to control mature plants, little is known about the timing or conditions that are required to get good kill rates. In some cases only the above-ground vegetation is killed and the plant regrows from many stems at the base. The Queensland Department of Natural Resources and Mines is currently researching which fire regimes give maximum kill rates of mature parkinsonia in central Queensland.

As long as intense fires can be generated, it is expected that fire on its own will become an important method of controlling parkinsonia in the future. As for other weed species controlled by fire (eg mimosa, mesquite, rubber vine), fuel to increase fire intensity can be provided by reduced grazing, which allows grasses to build up, or by mechanically or chemically killing a small amount of the weed and using that as fuel. Dry windy conditions are best for generating hot fires.

One of the advantages of fire is that it is relatively inexpensive. However, it must be managed carefully to prevent loss of stock and property, and minimise the effects on other vegetation and the potential for erosion when heavy rain follows soon after burning. Permits may be required to light fires; check with your local council or state/territory government agency.



Parkinsonia undergoing seasonal inundation in central Qld.
Photo: Cathy Lockett

Biological control is not yet effective

A biological control program for parkinsonia has been under way since 1983 in a joint study by the Queensland, Western Australian and Northern Territory governments. Three insects have been released so far into parkinsonia infestations. While all have established, impacts on the weed do not appear to be significant. One species, the seed feeding beetle *Penthobruchus germaini*, killed large proportions of seeds soon after it was first released in central Queensland. However, the beetle's eggs are now being attacked by a native wasp and it is no longer having an impact on parkinsonia. The CSIRO is currently conducting surveys in Central America to see if more potential biological control agents are available.

Grazing management systems

Cattle only consume parkinsonia when no other feed is available. Therefore, this is not a suitable management technique because it would cause severe environmental damage through the loss of other vegetation. Recently, a few landholders have grazed camels on parkinsonia, with some success in terms of reduction of growth and seed production. Wallabies also selectively graze the seedlings and small plants in some areas.

The benefits of long-term planning

Control of parkinsonia is difficult, expensive and requires ongoing commitment. However, the benefits include recovered pasture, increased production, reduced mustering costs, and the protection of natural ecosystems, plants and animals. The short-term costs of control will probably exceed the short-term benefits. For this reason, weed management needs to be integrated into the long-term property management plan.

Parkinsonia has green stems, which allow it to continue growing even with no leaves.
Photo: Colin G. Wilson

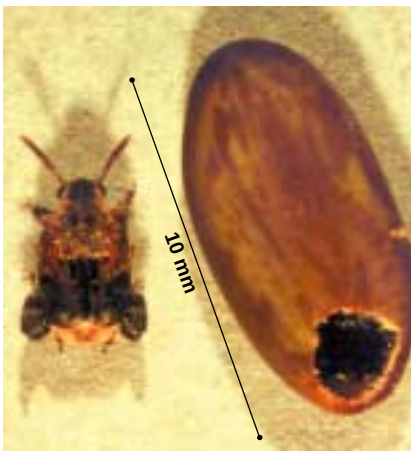
Legislation

In Queensland, the Northern Territory, Western Australia, South Australia and New South Wales, landholders are required by law to contain parkinsonia within dense infestations and eradicate all smaller outbreaks. Check with your local council or state/territory government agency about its requirements for parkinsonia control.

Acknowledgments

Information and guide revision: Shane Campbell (Qld DNRM/Weeds CRC), Rieks van Klinken (CSIRO/Weeds CRC), Nathan March (Qld DNRM), Tony Grice (CSIRO/Weeds CRC), Richard Carter (NSW Dept Agriculture/Weeds CRC), Tim Heard (CSIRO/Weeds CRC), Jonathon Peart (NT DIPE), John Gavin (NT DIPE) and John Thorp (National Weeds Management Facilitator).

Maps: Australian Weeds Committee with additional data from Lands Protection, Qld DNRM.



The biocontrol agent *Penthobruchus germaini* feeds on parkinsonia seeds.
Photo: Cathy Lockett

...case study

Pastoralism and parkinsonia on the Barkly Tablelands in the Northern Territory

The Barkly Tablelands is a large (275,000 km^2) cattle grazing region to the northeast of Tennant Creek in the Northern Territory. The tablelands are naturally tree-less, and parkinsonia was planted as a shade tree around homesteads in the late 1800s – early 1900s. It is now the most serious weed in the region, particularly along watercourses and around bores, where it stops cattle from watering and hinders mustering activities.

A concerted effort to control parkinsonia in the Barkly Tablelands was undertaken in 2000–01 as part of a project jointly funded by the Commonwealth Government's Natural Heritage Trust and landholders. Landholders worked together with regional weeds officers of the Northern Territory Department of Infrastructure, Planning and Environment and an external contractor to eradicate as many infestations as possible. Follow-up control was funded by landholders.

Because the spread of parkinsonia is due in part to seeds being carried downstream during floods, upstream infestations were targeted first for control. Nuisance plants around stock watering points were also removed.

Herbicides were most commonly used to control parkinsonia, with basal bark application the most favoured technique. This provides rapid control and there are no impacts on non-target species, but follow-up control must be undertaken in the following year as seedling germination is prolific. Control was undertaken when the infestations were accessible in the dry season, either by quad bike or 4WD.

Soil-applied granular herbicides have also been used. These are residual and can control seedlings for several years. Disadvantages include the reliance on rainfall to activate the herbicide, and impacts on grasses that could otherwise shade out parkinsonia seedlings, especially if the grasses are left ungrazed.

Despite early successes, biocontrol is not currently effective in helping control parkinsonia. Continual follow-up, using an integrated approach, will be required to stay on top of the weed in the Barkly.

Measuring the effectiveness of biological control agents in the Barkly Tablelands in January.
Photo: Jonathon Peart

How to control parkinsonia

Quick reference guide

When to treat parkinsonia

Chemicals should ideally be applied when the plant is actively growing, generally in the hot, wet season.

Mechanical control is more suited to the early dry season, ideally as soon as the infestation becomes accessible, when roots can be pulled easily. The extended dry season following control places further stress on treated plants and minimises germination.

The best control method depends on habitat

Rangelands, especially level areas, are well suited to mechanical control such as blade ploughing. Seedling germination of parkinsonia is often prolific following mechanical control, and follow-up work will therefore be required.

However, mechanical control can cause bank erosion and damage to non-target species around waterways. Here, individual trees should be targeted for chemical control with either the basal bark or cut-stump technique. Foliar spraying with chemicals is not recommended near waterways.

Fire, already known to be effective against surface seeds and seedlings, is being further investigated for controlling mature parkinsonia.

Follow-up control

Numerous seedlings will germinate after initial control efforts. Follow-up control could include either mechanical or chemical treatment or fire. Seeds can probably remain viable for ten or so years, so follow-up work is an ongoing concern that needs to be incorporated into any weed management plan.

How to identify the prickle bushes

Parkinsonia is one of four prickle bushes that are yellow-flowering, seed pod forming, woody weeds of northern Australia. The Queensland Department of Natural Resources and Mines produces a Fact Sheet (PP40) titled 'Identification of Prickle Bushes' which clearly outlines the distinguishing characteristics of each prickle bush. Parkinsonia can be distinguished by its distinctive green, flattened leaf stalks with green, oblong leaflets and straight straw-coloured seed pods with long thin constrictions. The following table summarises the fact sheet.

Feature	*Mesquite *Prosopis* spp.	Mimosa bush *Acacia farnesiana*	Parkinsonia *Parkinsonia aculeata*	*Prickly acacia *Acacia nilotica*
Pod size and shape	Up to 200 mm, very slight constrictions between seeds	Up to 60 mm, cigar shaped, slightly curved	Up to 100 mm, straight, long thin constrictions between seeds	Up to 230 mm, large constrictions between seeds
Pod colour, hairiness	Straw coloured, sometimes purple; no hairs	Brown to black; no hairs	Straw coloured; no hairs	Grey-green; fine hairs
Flowers	Greenish cream – yellow 'lambs tail' cylindrical flower spike, 50–80 mm	Golden yellow, ball shaped, 10 mm across	Four all yellow petals and one erect petal, either orange or yellow with an orange spot	Golden yellow, ball shaped, 10 mm across
Leaves	Fern-like, paired (1–3 pairs, often with a gap between leaves)	Fern-like, paired (2–4 pairs with a gap between leaves)	Narrow, flat, paired (1–3 pairs) green leaf stalks with small green oblong leaflets	Fern-like, paired (3–10 pairs at each point along the stem)
Bark	Young: smooth dark red–green Mature: rough grey	Grey with prominent white spots	Smooth and green, straw coloured at base of older trees	Young: a tinge of orange and/or green Mature: dark, rough
Tree shape and size	Untidy spreading tree, up to 15 m, single or multi-stemmed	Rounded shrub to 3 m, usually multi-stemmed	Shrub or small tree to 8 m, single or multi-stemmed	Spreading tree to 10 m, usually single-stemmed

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* See other guides in this series on these *Weeds of National Significance*.

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CRC Weed management

Disclaimer

Appendix C

Queensland Checklist for Cleandown and Inspection Procedures

(DPI, 2000)

Queensland checklist for cleandown procedures

Queensland checklist for inspection procedures

QUEENSLAND WEED SEED SPREAD PROJECT

July 2000

Queensland checklist for

CLEANDOWN PROCEDURES

Queensland Government

Department of Natural Resources

Contents

Cleandown procedures

Mobile/on site

The cleaning of vehicles and machinery on site prevents weed seed contaminants being spread to an adjoining weed free or less infested area/property/road.

Mobile/field site selection

- The most important point to consider is run off. Ensure the site is away from watercourses and drains. This will prevent weed seeds, grease and detergents polluting the stream.
- The site should be relatively flat (a slight slope or railway sleepers may prevent water logging) to help prevent run off and for safety reasons.
- The site must be easily identified for future reference as this location will need monitoring for future outbreaks in the following seasons. The landholder/trustee of the land should also be notified o this location. (a painted post, tree, distinguished landmark or GPS recording is ideal)
- An area that is well grassed will reduce mud during cleaning down and assist as competition for any weed seed that later germinates.
- Landholders should be consulted to determine a suitable cleandown site
- The site should be close to the infested area to prevent further spread.
- Avoid crossing the property boundary prior to cleaning-down (unless the infestation is also located on the adjoining property at similar or higher densities)
- Small cleandowns may be conducted at the landholders shed facilities (with permission) prior to leaving the property.

Suggested equipment

- A mobile water tanker or spray unit is ideal
- Water may also be pumped from a dam or cattle trough/tank
- High pressure water from a gurney or pump
- An air compressor for removing dry material (radiators and grain headers)
- Broom/dust pan (cleaning cabins)
- A garden hose may be adequate for small cleandowns

Public cleandown facilities

- Throughout Queensland there are numerous cleandown facilities available for public/industry use for the purpose of cleaning vehicles and machinery to prevent weed seed spread.
- Some facilities are of suitable standard (listed below) and contain high pressure water and air compressors.
- Where possible these facilities should be utilised as they are equipped with grease and silt traps for environmental protection.
- Most towns have a wash-down pad (eg at saleyards/ council depots) that may be of adequate standard to cleandown machinery and vehicles. (**NB – Council permission may be required)**

Washdown facilities

Location	Standard	Shire
Emerald – saleyards	New Facility – suitable standard	Emerald
Biloela – saleyards	New facility being built	Banana
Rolleston – water treatment works	Suitable Standard – possible upgrade	Bauhinia
Gracemere – saleyards	New facility being built	Fitzroy
Alpha	New facility being built	Jericho
Monto – water treatment works	Unknown Standard	Monto
Charters Towers – Dalrymple saleyards	Suitable Standard	Dalrymple
Springsure – saleyards	Suitable standard – possible upgrade	Bauhinia
Baralaba – saleyards	Suitable Standard	Banana
Moura – water treatment works	Suitable Standard	Banana
Injune – saleyards	New Facility – suitable standard	Bungil
Taroom – saleyards	New Facility – suitable standard	Taroom
Bedourie	Suitable standard	Diamantina
Barcaldine	Suitable standard	Barcaldine
Dululu	Suitable standard	Banana
Theodore	Suitable standard	Banana
Charleville	New facility	Murweh
Roma	Suitable	Roma Town
Stanthorpe	Suitable	Stanthorpe
Pomona	Suitable	Noosa
Eumundi	Suitable	Noosa
Mareeba	Washdown pad	Mareeba
Richmond	Washdown pad	Richmond
Cloncurry	Washdown pad	Cloncurry
Tambo	Washdown pad	Tambo
Eromanga	Washdown pad	Quilpie
Quilpie	Washdown pad	Quilpie
Mitchell	Washdown pad	Booringa
Surat	Washdown pad	Warroo
Chinchilla	Washdown pad	Chinchilla
Gympie	Washdown pad	Cooloola
Kingaroy	Washdown pad	Kingaroy
Dalby	Washdown pad	Dalby Town
Crow's Nest	Washdown pad	Crow's Nest
Carlovers and other private facilities	Suitable for cars and light trucks only	Various

For further information or for permission to use these facilities contact should be made with the respective shires.

Cleaning procedure

(guide only) – ensure all safety precautions are taken (read vehicle/machine/equipment operating manual prior to cleaning).

- Place vehicle/machine in a safe position - stable and immobile
- Stop engine, apply park brake, chock wheels and lower all implements or secure/chock them if they are required up for cleaning (eg slasher)
- Ensure the area is free of obstructions/objects that may cause injury (logs, powerlines etc)
- Examine the item for cleaning to determine extent of mud, dust and plant material build up.
- Identify any points that require specific attention eg behind guards and protective plates, radiato rs, spare tyres etc these may be difficult to locate and access.
- Remove necessary guards/belly plates to access areas for cleaning.
- Identify areas that may require cleaning with compressed air rather than water. Do these first.
- Clean under guards and underneath machinery/vehicle and then do the cabin, upper body and implements.
- Tool boxes and storage compartments may also require cleaning.
- Move vehicle/machine with caution. Avoid re-contamination, wash remaining mud etc o tyres/tracks.
- Carry out final inspection to ensure all areas have been cleaned.
- Replace guards (belly plates and other guards on heavy machinery may need to be replaced prior to moving the machinery).

Maintenance work

- A hard surfaced area such as a gravel area beside the property owner's shed is ideal for this situation as it allows work to be carried out, parts may be removed and the area can be monitored.
- If the maintenance work is to be done in the field/paddock, the area should also be noted or marked as a reference for future monitoring.
- During maintenance, weed seeds may fall off the machinery as a result of guards etc being removed.

Machinery and vehicle cleandown

Points to consider when cleaning-down vehicles and machinery:

No procedure or work instruction can list all the parts to consider during cleandown of vehicle, machinery and equipment due to factors such as:

- Numerous different models and new models
- Different attachments (eg. Different types of blades on dozers)
- Different modifications, either in the factory or frequently by the previous owner
- Varying condition of the machinery, eg. Rusted parts allowing entry of contaminants into sections usually sealed etc.

The following areas are provided as an initial guide only to be considered as a minimum when cleaning down the following:

Headers and harvesters

All harvesters

1. The area under the skid plate
2. Each header knife and finger
3. The auger located horizontally across the header
4. The area behind any cover on the header
5. The area within any belts on any draper front (if fitted)
6. The feeder house
7. The driver's cab compartment floor area
8. The cleaning fan and the area between the bottom of the fan housing and any shield under the fan housing
9. The chassis, including the inside of any chassis rail ledges, back axle-beam and undercarriage areas
10. Any tailing auger
11. Any sieve area, including the full length and width of the grain pan
12. Any grain bin area, including any auger
13. The engine compartment, including the radiator core
14. Any grain or repeat elevator including any cups and rubber flights
15. Any straw spreader or chopper
16. Any tyres and rims.

Conventional harvester

17. The threshing or separating area, including the drum and concaves behind the rasp bars and lead-in plates and around concave wires.
18. The beater drum, including the area between the drum and walkers.
19. The straw walkers, including the beater and the chaff pan, underneath any straw walker and any concealed areas under rubber air flaps.

Rotary harvesters

20. The external top and sides of the conical section of the rotor cage
21. The areas inside the top of the conical section
22. The threshing or separating area, including along the rotor cage.

Cotton pickers

The following areas are provided as an initial guide:

1. Row units

- Examine the picking heads externally for cotton trash/plant residues/soil
- Open all picking head inspection doors to expose moisture racks, doffers, spindle bars and rotor assemblies
- Manually rotate and inspect the rotor assemblies
- Open rear inspection doors on air ducts located at rear of picking heads
- Raise picking heads to inspect underside.

Note: the picking heads are held up by hydraulics – DO NOT climb underneath unless heads are safely blocked
in the raised position.

2. Drivers cab

- Check externally under and around drivers cab, check under mats in cab, check the air conditioning system (where fitted) including ducts and filters.

3. Horizontal air ducts

- Remove/open all cover inspection panels (these ducts convey cotton from the front picking section to the basket).

4. Basket

- Inspect basket roof.
- Access the internal parts of the basket through hinged door on the roof (ladder required to climb into the basket).
- Tip or elevate basket (depending on model) to inspect underside, drive shaft assemblies, blower fan, and hollow basket support frames located on the LHS of some models.

Note:
1. The meshed surface area of the basket will NOT support a person's weight – walk on the perforated metal walkways ONLY which run from back to front of the machine.
2. The basket is lifted by hydraulics – DO NOT climb under basket unless it is properly and safely secured in its raised position.

5. Inspect air ducts from the top.

6. Undercarriage/chassis

- Check all underside of machine, chassis rails, and telescopic rear axle if fitted.

7. Engine

- Remove cover panel to expose top of radiator (this can be done when basket is in raised position).
- Remove or open all screens on the engine, radiator and fuel bays.

8. Tyres

- Check for any soil or other contaminants.

Wheeled tractors

The following areas are provided as an initial guide:

1. **Tyres and Rims** – inspect all parts of tyres and rims, including inner side of rim.

    - Between dual wheels (if fitted).
    - Check for wheel mounted counter – weights.
    - Gashes or cuts in tyres.

2. **Engine**

    - Check radiator core and grill for residues.
    - Check for void between oil cooler and radiator (oil cooler may be hinged or on slide).
    - Remove and check air filters/cleaners, pre-cleaners and cyclone style dust separators (if unable to clean satisfactorily, these may require destruction).
    - Inspect sound deadening foams and heat shields for soil and trash (foams become impregnated with dust).

3. **Drivers cab** (where present)

    - Check externally under and around drivers cab.
    - Check under mats in cab and void space and skirt under suspended seats.
    - Check air conditioner filters (i fitted), (most large tractors will have a false cabin roof housing the air-con unit, remove or open false roof).
    - Check integrity of rubber door and window seals, if torn, trash and dirt will be sucked into them and trapped.
    - Check void space behind consoles and dash for trash and dirt residues.

4. **Chassis and vehicle body**

    - Check inside of chassis rail ledges and back axle -beam and undercarriage of this area.
    - Check for hollow sections in front axel tubes.
    - Inspect all tool boxes and battery boxes often under the cab steps or in engine bay.
    - Check for void spaces in rear brake assemblies.
    - Hollow sections in drawbars and hollow sections in retractable/extendable type three point linkages.
    - Inspect single counter-weights, multiples may need to be removed to facilitate cleaning of void spaces.
    - Inspect mud guards and wheel flares for hollows and crevices.
    - Inspect roll cages or roll over bars for holes and gaps where attached to the vehicle.
    - If 4WD drive, check for torque tube (front drive shaft guard) for holes or poor attachment.
    - Inspect PTO (Power Take Off) area, PTO shaft, universal joints, shaft covers/PTO tubes.
    - Inspect wiring looms in split protective conduit for trash and dirt residues.

Note: some agricultural tractors will have a rear carry-all mounted on the three point linkages or a forward mounted forklift or bucket/scoop attachment – these should be inspected carefully. Particular attention should be given to the following:

5. **Buckets, blades, scoops**

    - Inspect all areas of the blade for holes or double skins.
    - Inspect and remove cutting teeth, adaptors and wear plates on blades.
    - Inspect hydraulic arms and supports for hollows that may contain soil and trash.

6. **All areas**

    - Check if any sections or channels are hollow and determine if there is a possible entry point for contamination. Check if plates are covering a compartment or space that may have collected dirt/trash.

Mini tractors

The following areas are highlight some of the main areas of concern on mini-tractors:

1. **Tyres and rims** - inspect all parts of tyres and rims, including inner side of rim.

    - Check for gaps in split type rims.
    - Cuts and gashes in tyres.
    - Wheel mounted counterweights.

2. **Chassis** – check inside of chassis rail ledges.

    - Carefully inspect the chassis for hollow areas and cover plates that may conceal void spaces.
    - Void spaces in the area between gearbox and engine (several models have a large void opening accessible from underneath).
    - Void spaces in counter-weights, multiples may need to be removed to facilitate cleaning.
    - Hollow sections in subframe under motor linking the chassis rails.

3. **Engine**

    - Remove grill (usually 2 wing nuts) and clean, inspect and remove wire mesh screen from front of radiator and clean, inspect fan shroud at rear of radiator.
    - Remove and inspect air filter cover, remove dust dish from air filter cover, remove and check air filter/cleaner (if unable to clean satisfactorily, these may require destruction).
    - Check around fuel tank and brackets for dust and trash build ups.
    - Inspect all areas in bonnet and in engine bay for hollows.

4. **Other**

    - External rear brake assemblies and common shaft for brake and clutch pedals
    - Foot plates and mounting brackets.
    - Hollow sections in mudguards, joints between mud flaps and guard, wiring looms under guards.
    - Inspect tool box under seat or under fuel tank, remove contents to allow cleaning.
    - Inspect torn seats and exposed foam at rear of seat (seed and soil can become lodged in the cushioning).
    - Inspect rear axels for track width adjustment pin holes.
    - Inspect the drawbar and mounting.
    - Inspect the three point linkages and operating levers.

Implements – PTO rotary hoe

The following areas highlight some of the main areas of concern on Power Take-Off (PTO) driven rotary hoes:

- Inspect rotary tynes and mounting bolts for soil, tynes may need to be removed or loosened from their adaptors on the horizontal shaft to allow removal of soil from the void.
- Remove or loosen the skid/wear plate from the vertical gear casing (note that this casing is oil filled, thus remove or loosen only those bolts securing the plate).
- Inspect the body of the hoe for double skins or void spaces that could contain soil due to inadequate or incomplete weld joints etc.
- Inspect all areas where mud flaps are attached or plates overlap.
- Check for hollow section reinforcing ribs.
- Inspect the three point linkage attachment points and PTO knuckles and tube, universal joints and shafts.
- Inspect all ground engaging areas of the hoe for signs of wear for the ingress of soil or plant material.
- Rotate the rotary shaft and probe for plant material that may be caught in the bearing housings at the ends or middle if twin shafted.
- Inspect the frame and supports and mounts for the trailing wheels – these are often hollow sections.
- Inspect the trailing wheels for the rotary hoe, these wheels are usually hollow and made from two pieces of metal welded together – with wear the metal and welds crack and the wheels fill with soil.

Remember, the key to a successful cleaning is more than just checking the above areas – you must ensure that your inspection is thorough, systematic and consistent.

Track type dozers

1. **Drivers cab**

   - Check externally under and around driver's cab.
   - Check under mats in cab.
   - Remove/lift seat; remove/lift floor pans to allow checking to top of transmission.
   - Check air conditioner filter (i fitted) – shake/tap filter to check if clean.

2. **Tracks/track frame**

   - Examine tracks carefully.
   - Ensure inspection/cover plates are removed to allow inside track area.
   - Check idler wheels (these support the tracks).

3. **Belly plates** should be removed to allow inspection and cleaning.

4. **Rear plates** at back of dozer should be removed to allow inspection and cleaning.

5. **Hydraulic cover plates** should be removed to allow inspection and cleaning.

6. **Engine**

   - Check radiator core and engine area for residues.
   - Remove and check the air filter/cleaner (these often require replacement where they are clogged with contaminants).
   - Check carefully the void space between the oil and radiator cores.

7. **Battery box**

   - Lift/remove the battery to check for contamination (battery box may be at side/rear or under seat).

8. **Fuel cells**

   - Are removable therefore dirt etc can pack between the tank and the frame.

9. **Blade**

   - Ensure that edge of blade top/bottom is not split – this allows soil to be packed very tightly in the hollow.
   - Check cutter points/wear blades.
   - Check trunction arms.
   - Check carefully the pivot points and adaptors at the rear of the front blade – these allow the blade to change height and angle. Sometimes soil has compacted and is difficult to dislodge.
   - Check all hollow sections.

10. **Ripper support frame** is usually hollow.

    - Check carefully if any contaminants have entered this section. The tynes may need to be remove.

11. **Tynes**

    - Tynes need careful inspection. Contamination may often be removed by water blasting, but tynes may need to be removed in some cases.

12. Ripper points

- A pin holds on the ripper points. Dirt can compact under the ripper points.

13. All areas

- Check if any sections or channels are hollow and determine if there is a possible entry point for contamination. Check if plates are covering a compartment or space that may have collected dirt/trash.

Remember, the key to a successful cleaning is more than just checking the above areas – you must ensure that your inspection is thorough, systematic and consistent.

Excavators

Check all areas, with special attention to:

1. **Hollow section chassis channels.**
2. **Turret pivot area.**
3. **Channels for hydraulic hoses from drive motor.**
4. **Counterweight void spaces.**
5. **Engine bay floor.**
6. **Fan shroud and radiator cores.**
7. **Glacier plate (near radiator).**
8. **Air filters (shake/tap filters to determine if clean).**
9. **Removable track adjuster guards and lubrication points.**
10. **Tool box**
11. **Arms/booms – usually the pivot points are the only area of concern.**
12. **Bucket/blade**

- Between teeth of adapters.
- Wear plates.

13. Rear blade (stabiliser)

- Wear plates.
- Hollow section arms.
- Hollow section blade.

14. Mini – excavator

- Hydraulics console.
- False floor.
- Turn table – running gear/tracks – internal gaps.

Wheeled loaders and compactors

Check all areas, with particular attention to the following:

1. **Feet of adaptors on compactors**
2. **Hydraulic points**
3. **Articulation points of hydraulics**
4. **Brake assemblies**
5. **Blade wear plates**
6. **Blade teeth and adaptors**
7. **FOPS and ROPS canopy**
    - Hollow channels.
    - Void space between cab and body (bird's nests have been foun d here).
8. **Air cleaner and air filters**
9. **Internal of cab, floor and mats**
10. **Air conditioner unit**
11. **Counterweight void spaces**
12. **Under and around removable fuel cells**
13. **Between dual wheels (where applicable)**
14. **Check for water filled between wheels or drums**

Dump trucks

Check all areas, with particular attention to the following:

1. **Internal of cab, floor and mats, behind and under seats.**
2. **Air cleaner**
3. **Air conditioner unit**
4. **Hollow channels in tray frame**
5. **Between dual wheels (where applicable)**
6. **Body and tipper**

Cars, trucks and 4WD

1. **Inspect the interior of the vehicle, especially:**

    - Footwells, check carpets and mats for burrs, seeds, mud, water etc.

2. **Inspect inside the boot of the vehicle.**

    - Carpet (deposits of hay, weed seeds, burrs and/or soil or water).
    - Spare tyre area.
    - Other recesses in the boot/rear of the vehicle.

3. **Inspect the engine bay, especially:**

    - Radiator
    - Grill
    - Top of transmission gearbox
    - Recess under windscreen wipers
    - Air filters

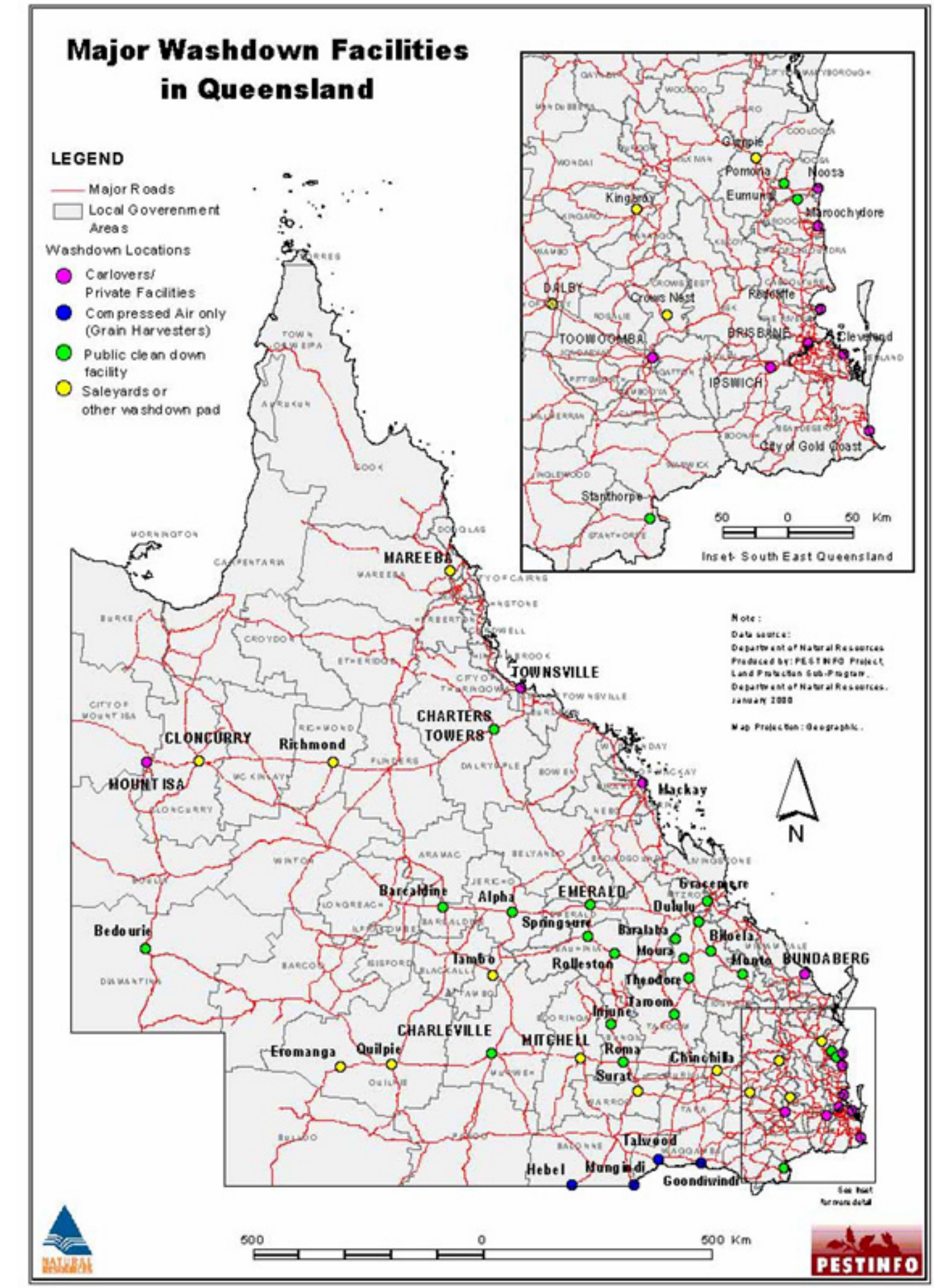
4. **Inspect the underside of the vehicle, especially:**

    - Wheel arches, wheel trims, flares, step treads, bumpers
    - Mud flaps
    - Tyre rims (particularly the rear side)
    - Axels and diffs
    - Spare tyres on 4WD's and station wagons are often suspended underneath. **Note:** these are potentially a high risk area as contaminants collect inside the horizontally-positioned rim.

5. Inspect tool boxes, ladders and storage compartments.

6. Inspect the back/tray of trucks and 4WD for soil, seed and plant material.

Major Washdown Facilities in Queensland



QUEENSLAND WEED SEED SPREAD PROJECT

July 2000

Queensland checklist for

INSPECTION PROCEDURES

Queensland Government

Department of Natural Resources

Contents

Inspection procedures

Training

All inspectors will complete the approved inspection course and receive a satisfactory assessment before inspecting any items.

Purpose

These procedures are designed to implement a consistent approach across Queensland for the Inspection of vehicles, equipment and machinery. This will allow authorised inspectors to carry out a thorough routine inspection of these items to reduce the potential for the spread of weeds and their seeds. This document may also assist users of the inspection service to understand and fulfil their requirements, comply with legislation and address their duty of care.

Background

The movement and transport of machinery, vehicles and equipment that are co ntaminated with weed seed is a source of spreading declared plants from infested areas to clean locations or areas with minimal infestations. Many isolated outbreaks throughout Qld are a result of poor vehicle, machinery and equipment hygiene. This metho d of spread has the potential to move declared plant's reproductive material long distances from the original source or a core infestation area. As a result there have been many new outbreaks that have now spread beyond controllable methods. Each year nu merous outbreaks of parthenium weed are discovered along roadsides after viable seeds have fallen from contaminated vehicles. There is an ongoing risk that weed seeds will fall from contaminated machinery or vehicles on private properties or remote locations and go undetected resulting in a major outbreak that cannot be contained.

There is a current demand for the continuation of this service from service providers, companies and industry to meet client demands and satisfy interstate legislation and addre ss their relevant duty of care and client requests.

Weeds cost Qld in lost production, land degradation, control costs and the spread of weed seed continually threatens our primary industries and environment.

The potential for litigation is a real thre at for industry groups and government departments as negligence has the potential to result in legal action or large compensation settlements.
Both parthenium weed and GRT are declared plants that require special consideration in regards to preventing their spread. Being prolific seed producers, highly competitive and forming dense infestations they are a high risk for contaminating vehicles and machinery that are driven through infested areas.

Criteria

After completing the competency based training, o ficers will be able to carry out the following:

- Handle enquires relating to vehicle, machinery and property inspections
- Arrange suitable venues and equipment required to carry out inspections of vehicles and machinery.
- Identify specific areas on a range o f vehicles and machinery that require careful examination for a thorough inspection.
- Complete a thorough inspection process for vehicles, machinery and property for weeds or weed seed contaminants.
- Complete inspection forms and record documentation for det ails of inspection.
- Provide advice on vehicle and machinery cleandowns, procedures and recommended equipment.

Possible sources of contamination

- Heavy machinery may contain weed seed contaminated mud on the tracks/tyres or implements (eg. dozers, excavators, graders)
- Farm machinery and vehicles that have been used in infested paddocks are at risk of contamination via mud on wheels, seeds trapped in radiators, cabin floor mats. (eg. tractors, 4WD)
- Implements such as slashers, ploughs, mulchers, post-hole diggers may be contaminated with weed seeds after being used in infested paddocks and should be cleaned prior to moving to other areas.
- Harvesting machinery and headers may contain weed seed in augers, bins, behind guards etc i harvesting crops that are infested with weeds.
- Wheeled loaders, mining and construction equipment may contain contaminated mud trapped on these items
- Cars, trucks and 4WD that have driven o -road through weed infestations may contain weed seed in radiators, mud guards, tyres and underbody.
- Trucks that have transported livestock from infested areas may contain viable seed that has fallen or been passed through stock. (eg. prickly acacia, giant rats tail grass)

Areas of high risk

Vehicles, machinery and equipment that have been used, driven or sourced from the Central Highlands are at greater risk of being contaminated with parthenium weed seed. Coastal and sub-coastal areas from the NSW border to Rockhampton, and areas near Moura, Mackay, Townsville, Ingham and Mareeba contain current infestations of giant rats tail grass.

How to minimise the risk of transporting weed seeds on vehicles and machiner

- Avoid driving off the road in areas known to contain giant rats tail grass, parthenium weed or other declared plants that present a risk of contamination.
- Do not drive through infested paddocks
- Ensure clothing and footwear are free of mud and seeds before stepping in vehicles
- Avoid driving or working in contaminated areas in wet or dewy conditions
- Clean vehicles, machinery and equipment suspected of carrying weed seed
- Work clean areas or start in areas with the least amount of infestation and work towards infested or high density areas.
- Keep roads, laneways and buffer zones free of weeds.
- Where possible work infested areas separately and cleandown prior to moving
- Avoid slashing and other works through infestation during peak seed production times.
- Clean down machinery and implements before proceeding into clean areas.
- Secure loads (eg. grain, fodder) if they are suspected of containing weed seed.
  (*Refer to Cleandown Procedures and Queensland Guideline for Weed Seed Spread)*

What is an inspection

Weed seeds such as parthenium weed seed is small and can lodge behind or within many mechanical or structural components of machines. The objective of the cleandown and inspection of vehicles, machinery and equipment is effective risk management. It cannot eliminate risk.

The inspection involves authorised officers examining the vehicle, machinery or equipment presented for inspection to ensure it has been adequately cleaned to reduce the potential for weed seed spread. An inspection cannot guarantee that an item is free of weed seed due to:

- Inaccessible areas that may not be visible during cleaning and inspection
- Holes or rusted parts where weed seed may be located and go undetected.

Why

- There is an ongoing demand for this service to be carried out to ensure adequate precautions have been taken to reduce the potential for introducing weeds and declared plants into areas with minimal or no infestations.
- Landholders and clients are demanding companies and industries complete cleandowns and inspection prior to commencing work or projects on their properties. Other companies and organisations demand their contractors cleandown prior to entering job sites.

Who

Authorised officers under the *Rural Lands Protection Act?*

Safety and location

- The area where the inspection is to be conducted must be a safe working area for the officer completing the inspection and others present.
- Consideration must also be given to surrounding traffic conditions.
- The inspector must wear adequate protective clothing (appropriate footwear, eye protection).
- This location must be free of mud and water to allow the inspection to be carried out and to avoid re-contamination of the item.

Process

1. The client must contact the inspector to arrange the date and time for the inspection and to provide details of the items being presented for inspection
2. The item must be cleaned prior to being presented for inspection
3. The client should be encouraged to clean down on site/farm or at an approved cleandown facility. (refer to cleandown procedures)
4. The inspector shall direct the person in charge of the item/s to an appropriate location for inspection taking into consideration traffic conditions and personal safety of those present.
5. The machine must be completely switched off and the inspector shall not attempt to enter or inspect machinery unless another person is present.
6. First confirm that the description and identification numbers of all items to be inspected are correct. Record the identification number on the inspection form
7. An Inspector may request the operator to remove guards or standard inspection plates or to position moving components of the item as necessary to facilitate inspection.
8. A separate inspection form shall be completed for each item to indicate parts of the item that have passed or failed the inspection.
9. Every relevant part listed on the inspection form must be checked to a sufficient degree to determine whether or not the part has been cleaned.
10. If the inspector is satisfied that the part has been cleaned the form should be completed.
11. If the inspector is not satisfied that the part has been sufficiently cleaned, the nature of the problem must be briefly noted on the Inspection Form.

12. If only minor additional work is required (material shaken down during transport) then the inspection may be completed once the contaminant has been removed.
13. If the item is in bad condition and requires further cleaning the inspection should stop and direct the operator to carry out further cleaning.
14. Should the item be failed, it must be cleaned and reinspected at a later convenient time/date for all parties. A new inspection checklist and inspection form will be issued.
15. On completion, an inspection form/certificate will be issued to the person in charge of the item and a duplicate retained by the inspector.

Property inspections

Product sales, such as hay, grain, seed, livestock, turf or the actual sale of the property often drives the demand for property inspections. An inspection of a paddock or entire property cannot guarantee that a particular weed or declared plant (eg. giant rats tail grass or parthenium) in not present. It is difficult to detect small seedlings or plants that are not in flower or have mature seed heads.

The main purpose of a property or paddock inspection is to identify established infestations or mature plants that contain viable seeds that may cause contamination.

This is particularly important for inspections requested prior to the sale or purchase of land. In this case an inspection may be required to determine the presence of weeds or declared plants and the extent of the infestation. Prospective buyers use this information to determine the potential impact of any weeds present and the cost of eradicating or controlling the weeds.

In ideal conditions weeds may germinate or reach maturity shortly after the inspection. Therefore inspections of properties or land are only valid for a short period surrounding the actual date of inspection. This must be explained and documented to avoid confusion and litigation.

Process

1. At the point of inquiry determine the reason for inspection and the declared plant/s that the property is being inspected for.
2. Arrange location and time for inspection.
3. Obtain a map of the property or parcel of land to be inspected (eg. Blin map).
4. Identify and mark the area to be inspected on the map.
5. Ensure the landholder or representative is present at the time of inspection.
6. Document or mark on the map declared plants located within the area of inspection.
7. It is recommended to take photos during the inspection for evidence of the area inspected, to document any declared plants found and to record the state of the land at the time of inspection (eg. a paddock of lucerne that was ready for cutting).

Cotton pickers

The following areas are provided as an initial guide:

1. Row units

- Examine the picking heads externally for cotton trash/plant residues/soil
- Open all picking head inspection doors to expose moisture racks, doffers, spindle bars and rotor assemblies
- Manually rotate and inspect the rotor assemblies
- Open rear inspection doors on air ducts located at rear of picking heads
- Raise picking heads to inspect underside.

Note: the picking heads are held up by hydraulics – DO NOT climb underneath unless heads are safely blocked in the raised position.

2. Drivers cab

- Check externally under and around drivers cab, check under mats in cab, check the air conditioning system (where fitted) including ducts and filters.

3. Horizontal air ducts

- Remove/open all cover inspection panels (these ducts convey cotton from the front picking section to the basket).

4. Basket

- Inspect basket roof.
- Access the internal parts of the basket through hinged door on the roof (ladder required to climb into the basket).
- Tip or elevate basket (depending on model) to inspect underside, drive shaft assemblies, blower fan, and hollow basket support frames located on the LHS of some models.

Note:
1. The meshed surface area of the basket will NOT support a person's weight – walk on the perforated metal walkways ONLY which run from back to front of the machine.
2. The basket is lifted by hydraulics – DO NOT climb under basket unless it is properly and safely secured in its raised position.

5. Inspect air ducts from the top.

6. Undercarriage/chassis

- Check all underside of machine, chassis rails, and telescopic rear axle if fitted.

7. Engine

- Remove cover panel to expose top of radiator (this can be done when basket is in raised position).
- Remove or open all screens on the engine, radiator and fuel bays.

8. Tyres

- Check for any soil or other contaminants.

Wheeled tractors

The following areas are provided as an initial guide:

1. **Tyres and Rims** – inspect all parts of tyres and rims, including inner side of rim.

    - Between dual wheels (if fitted).
    - Check for wheel mounted counter – weights.
    - Gashes or cuts in tyres.

2. **Engine**

    - Check radiator core and grill for residues.
    - Check for void between oil cooler and radiator (oil cooler may be hinged or on slide).
    - Remove and check air filters/cleaners, pre-cleaners and cyclone style dust separators (if unable to clean satisfactorily, these may require destruction).
    - Inspect sound deadening foams and heat shields for soil and trash (foams become impregnated with dust).

3. **Drivers cab** (where present)

    - Check externally under and around drivers cab.
    - Check under mats in cab and void space and skirt under suspended seats.
    - Check air conditioner filters (if fitted), (most large tractors will have a false cabin roof housing the air-con unit, remove or open false roof).
    - Check integrity of rubber door and window seals, if torn, trash and dirt will be sucked into them and trapped.
    - Check void space behind consoles and dash for trash and dirt residues.

4. **Chassis and vehicle body**

    - Check inside of chassis rail ledges and back axle -beam and undercarriage of this area.
    - Check for hollow sections in front axel tubes.
    - Inspect all tool boxes and battery boxes often under the cab steps or in engine bay.
    - Check for void spaces in rear brake assemblies.
    - Hollow sections in drawbars and hollow sections in retractable/extendable type three point linkages.
    - Inspect single counter-weights, multiples may need to be removed to facilitate cleaning of void spaces.
    - Inspect mud guards and wheel flares for hollows and crevices.
    - Inspect roll cages or roll over bars for holes and gaps where attached to the vehicle.
    - If 4WD drive, check for torque tube (front drive shaft guard) for holes or poor attachment.
    - Inspect PTO (Power Take Off) area, PTO shaft, universal joints, shaft covers/PTO tubes.
    - Inspect wiring looms in split protective conduit for trash and dirt residues.

Note: some agricultural tractors will have a rear carry-all mounted on the three point linkages or a forward mounted forklift or bucket/scoop attachment – these should be inspected carefully. Particular attention should be given to the following:

5. **Buckets, blades, scoops**

    - Inspect all areas of the blade for holes or double skins.
    - Inspect and remove cutting teeth, adaptors and wear plates on blades.
    - Inspect hydraulic arms and supports for hollows that may contain soil and trash.

6. **All areas**

    - Check if any sections or channels are hollow and determine if there is a possible entry point for contamination. Check if plates are covering a compartment or space that may have collected dirt/trash.

Mini tractors

The following areas are highlight some of the main areas of concern on mini-tractors:

1. **Tyres and rims** - inspect all parts of tyres and rims, including inner side of rim.

    - Check for gaps in split type rims.
    - Cuts and gashes in tyres.
    - Wheel mounted counterweights.

2. **Chassis** – check inside of chassis rail ledges.

    - Carefully inspect the chassis for hollow areas and cover plates that may conceal void spaces.
    - Void spaces in the area between gearbox and engine (several models have a large void opening accessible from underneath).
    - Void spaces in counter-weights, multiples may need to be removed to facilitate cleaning.
    - Hollow sections in subframe under motor linking the chassis rails.

3. **Engine**

    - Remove grill (usually 2 wing nuts) and clean, inspect and remove wire mesh screen from front of radiator and clean, inspect fan shroud at rear of radiator.
    - Remove and inspect air filter cover, remove dust dish from air filter cover, remove and check air filter/cleaner (if unable to clean satisfactorily, these may require destruction).
    - Check around fuel tank and brackets for dust and trash build ups.
    - Inspect all areas in bonnet and in engine bay for hollows.

4. **Other**

    - External rear brake assemblies and common shaft for brake and clutch pedals
    - Foot plates and mounting brackets.
    - Hollow sections in mudguards, joints between mud flaps and guard, wiring looms under guards.
    - Inspect tool box under seat or under fuel tank, remove contents to allow cleaning.
    - Inspect torn seats and exposed foam at rear of seat (seed and soil can become lodged in the cushioning).
    - Inspect rear axels for track width adjustment pin holes.
    - Inspect the drawbar and mounting.
    - Inspect the three point linkages and operating levers.

Implements – PTO rotary hoe

The following areas highlight some of the main areas of concern on Power Take-Off (PTO) driven rotary hoes:

- Inspect rotary tynes and mounting bolts for soil, tynes may need to be removed or loosened from their adaptors on the horizontal shaft to allow removal of soil from the void.
- Remove or loosen the skid/wear plate from the vertical gear casing (note that this casing is oil filled, thus remove or loosen only those bolts securing the plate).
- Inspect the body of the hoe for double skins or void spaces that could contain soil due to inadequate or incomplete weld joints etc.
- Inspect all areas where mud flaps are attached or plates overlap.
- Check for hollow section reinforcing ribs.
- Inspect the three point linkage attachment points and PTO knuckles and tube, universal joints and shafts.
- Inspect all ground engaging areas of the hoe for signs of wear for the ingress of soil or plant material.
- Rotate the rotary shaft and probe for plant material that may be caught in the bearing housings at the ends or middle if twin shafted.
- Inspect the frame and supports and mounts for the trailing wheels – these are often hollow sections.
- Inspect the trailing wheels for the rotary hoe, these wheels are usually hollow and made from two pieces of metal welded together – with wear the metal and welds crack and the wheels fill with soil.

Remember, the key to a successful cleaning is more than just checking the above areas – you must ensure that your inspection is thorough, systematic and consistent.

Track type dozers

1. **Drivers cab**

   - Check externally under and around driver's cab.
   - Check under mats in cab.
   - Remove/lift seat; remove/lift floor pans to allow checking to top of transmission.
   - Check air conditioner filter (if fitted) – shake/tap filter to check if clean.

2. **Tracks/track frame**

   - Examine tracks carefully.
   - Ensure inspection/cover plates are removed to allow inside track area.
   - Check idler wheels (these support the tracks).

3. **Belly plates** should be removed to allow inspection and cleaning.

4. **Rear plates** at back of dozer should be removed to allow inspection and cleaning.

5. **Hydraulic cover plates** should be removed to allow inspection and cleaning.

6. **Engine**

   - Check radiator core and engine area for residues.
   - Remove and check the air filter/cleaner (these often require destruction where they are clogged with QRM).
   - Check carefully the void space between the oil and radiator cores.

7. **Battery box**

   - Lift/remove the battery to check for contamination (battery box may be at side/rear or under seat).

8. **Fuel cells**

   - Are removable therefore dirt etc can pack between the tank and the frame.

9. **Blade**

   - Ensure that edge of blade top/bottom is not split – this allows soil to be packed very tightly in the hollow.
   - Check cutter points/wear blades.
   - Check trunction arms.
   - Check carefully the pivot points and adaptors at the rear of the front blade – these allow the blade to change height and angle. Sometimes soil has compacted and is difficult to dislodge.
   - Check all hollow sections.

10. **Ripper support frame** is usually hollow.

    - Check carefully i any contaminants have entered this section. The tynes may need to be remove.

11. **Tynes**

    - Tynes need careful inspection. Contamination may often be removed by water blasting, but tynes may need to be removed in some cases.

12. Ripper points

- A pin holds on the ripper points. Dirt can compact under the ripper points.

13. All areas

- Check if any sections or channels are hollow and determine if there is a possible entry point for contamination. Check if plates are covering a compartment or space that may have collected dirt/trash.

Remember, the key to a successful cleaning is more than just checking the above areas – you must ensure that your inspection is thorough, systematic and consistent.

Excavators

Check all areas, with special attention to:

1. **Hollow section chassis channels.**
2. **Turret pivot area.**
3. **Channels for hydraulic hoses from drive motor.**
4. **Counterweight void spaces.**
5. **Engine bay floor.**
6. **Fan shroud and radiator cores.**
7. **Glacier plate** (near radiator).
8. **Air filters** (shake/tap filters to determine if clean).
9. **Removable track adjuster guards and lubrication points.**
10. **Tool box**
11. **Arms/booms – usually the pivot points are the only area of concern.**
12. **Bucket/blade**

- Between teeth of adapters.
- Wear plates.

13. Rear blade (stabiliser)

- Wear plates.
- Hollow section arms.
- Hollow section blade.

14. Mini – excavator

- Hydraulics console.
- False floor.
- Turn table – running gear/tracks – internal gaps.

Wheeled loaders and compactors

Check all areas, with particular attention to the following:

1. **Feet of adaptors on compactors**
2. **Hydraulic points**
3. **Articulation points of hydraulics**
4. **Brake assemblies**
5. **Blade wear plates**
6. **Blade teeth and adaptors**
7. **FOPS and ROPS canopy**
    - Hollow channels.
    - Void space between cab and body (bird's nests have been found here).
8. **Air cleaner and air filters**
9. **Internal of cab, floor and mats**
10. **Air conditioner unit**
11. **Counterweight void spaces**
12. **Under and around removable fuel cells**
13. **Between dual wheels (where applicable)**

Dump trucks

Check all areas, with particular attention to the following:

1. **Internal of cab, floor and mats, behind and under seats.**
2. **Air cleaner**
3. **Air conditioner unit**
4. **Hollow channels in tray frame**
5. **Between dual wheels (where applicable)**

Cars 4WD, trucks and trailers

1. **Ensure that the vehicle is unlocked and you have access to the boot and bonnet.**

2. **Inspect the interior of the vehicle, especially:**

    - Footwells, check carpets and mats for burrs, seeds, mud.
    - Tool boxes

3. **Inspect inside the boot of the vehicle. Remove any contents if required to facilitate the inspection of the following:**

    - Carpet (deposits of hay, weed seeds, burrs and/or soil or water).
    - Spare tyre area.
    - Other recesses in the boot/rear of the vehicle.

4. **Inspect the engine bay, especially:**

    - Radiator
    - Grill
    - Top of transmission gearbox
    - Recess under windscreen wipers

5. **Inspect the underside of the vehicle, especially:**

    - Wheel arches, wheel trims, flares, step treads, bumpers
    - Mud flaps
    - Tyre rims (particularly the rear side)
    - Axels and diffs
    - Spare tyres on 4WD's and station wagons are often suspended underneath. **Note:** these are potentially a high risk area as contaminants collect inside the horizontally-positioned rim.

6. Inspect boxes and/or cartons present in the vehicle if you cannot ascertain their contents.

7. For utes and trucks, inspect the floor of the tray and channels of tai gates, side guards and under chassis rails. Gaps in the floor welds or boards and bolt holes.

8. Inspect trailers – check wheels, guards, trays, channels of draw bar and under body.

Checklist

Cotton pickers	Pass	Fail
The following areas are provided as an initial guide:		
1. Row units		
• Examine the picking heads externally for cotton trash/plant residues/soil • Open all picking head inspection doors to expose moisture racks, doffers, spindle bars and rotor assemblies • Manually rotate and inspect the rotor assemblies • Open rear inspection doors on air ducts located at rear of picking heads • Raise picking heads to inspect underside. ***Note:*** *the picking heads are held up by hydraulics – DO NOT climb underneath unless heads are safely blocked in the raised position.*		
2. Drivers cab		
• Check externally under and around drivers cab, check under mats in cab, check the air conditioning system (where fitted) including ducts and filters.		
3. Horizontal air ducts		
• Remove/open all cover inspection panels (these ducts convey cotton from the front picking section to the basket).		
4. Basket		
• Inspect basket roof. • Access the internal parts of the basket through hinged door on the roof (ladder required to climb into the basket). • Tip or elevate basket (depending on model) to inspect underside, drive shaft assemblies, blower fan, and hollow basket support frames located on the LHS of some models. ***Note:*** • *The meshed surface area of the basket will NOT support a person's weight – walk on the perforated metal walkways ONLY which run from back to front of the machine.* • *The basket is lifted by hydraulics – DO NOT climb under basket unless it is properly and safely secured in its raised position.*		
5. Inspect air ducts from the top		
6. Undercarriage/chassis		
7. Engine		
• Remove cover panel to expose top of radiator (this can be done when basket is in raised position). • Remove or open all screens on the engine, radiator and fuel bays.		
8. Tyres		
• Check for any soil or other contaminants.		

Wheeled tractors

Pass	Fail

The following areas are provided as an initial guide:

1. Tyres and rims – inspect all parts of tyres and rims, including inner side of rim

- Between dual wheels (if fitted).
- Check for wheel mounted counter – weights.
- Gashes or cuts in tyres.

2. Engine

- Check radiator core and grill for residues.
- Check for void between oil cooler and radiator (oil cooler may be hinged or on slide).
- Remove and check air filters/cleaners, pre-cleaners and cyclone style dust separators (if unable to clean satisfactorily, these may require destruction).
- Inspect sound deadening foams and heat shields for soil and trash (foams become impregnated with dust).

3. Drivers cab (where present)

- Check externally under and around drivers cab.
- Check under mats in cab and void space and skirt under suspended seats.
- Check air conditioner filters (if fitted), (most large tractors will have a false cabin roof housing the air-con unit, remove or open false roof).
- Check integrity of rubber door and window seals, if torn, trash and dirt will be sucked into them and trapped.
- Check void space behind consoles and dash for trash and dirt residues.

4. Chassis and vehicle body

- Check inside of chassis rail ledges and back axle -beam and undercarriage of this area.
- Check for hollow sections in front axel tubes.
- Inspect all tool boxes and battery boxes often under the cab steps or in engine bay.
- Check for void spaces in rear brake assemblies.
- Hollow sections in drawbars and hollow sections in retractable/extendable type three point linkages.
- Inspect single counter-weights, multiples may need to be removed to facilitate cleaning of void spaces.
- Inspect mud guards and wheel flares for hollows and crevices.
- Inspect roll cages or roll over bars for holes and gaps where attached to the vehicle.
- If 4WD drive, check for torque tube (front drive shaft guard) for holes or poor attachment.
- Inspect PTO (Power Take Off) area, PTO shaft, universal joints, shaft covers/PTO tubes.
- Inspect wiring looms in split protective conduit for trash and dirt residues.

Note: *some agricultural tractors will have a rear carry-all mounted on the three point linkages or a forward mounted forklift or bucket/scoop attachment – these should be inspected carefully. Particular attention should be given to the following:*

5. Buckets, blades, scoops, carry-all, forklift

- Inspect all areas of the blade for holes or double skins.
- Inspect and remove cutting teeth, adaptors and wear plates on blades.
- Inspect hydraulic arms and supports for hollows that may contain soil and trash.

6. All areas

- Check if any sections or channels are hollow and determine if there is a possible entry point for contamination. Check if plates are covering a compartment or space that may have collected dirt/trash.

Mini tractors

	Pass	Fail

The following areas are highlight some of the main areas of concern on mini-tractors:

1. Tyres and rims - inspect all parts of tyres and rims, including inner side of rim.

- Check for gaps in split type rims.
- Cuts and gashes in tyres.
- Wheel mounted counterweights.

2. Chassis - check inside of chassis rail ledges.

- Carefully inspect the chassis for hollow areas and cover plates that may conceal void spaces.
- Void spaces in the area between gearbox and engine (several models have a large void opening accessible from underneath).
- Void spaces in counter-weights, multiples may need to be removed to facilitate cleaning.
- Hollow sections in subframe under motor linking the chassis rails.

3. Engine

- Remove grill (usually 2 wing nuts) and clean, inspect and remove wire mesh screen from front of radiator and clean, inspect fan shroud at rear of radiator.
- Remove and inspect air filter cover, remove dust dish from air filter cover, remove and check air filter/cleaner (if unable to clean satisfactorily, these may require destruction).
- Check around fuel tank and brackets for dust and trash build ups.
- Inspect all areas in bonnet and in engine bay for hollows.

4. Other

- External rear brake assemblies and common shaft for brake and clutch pedals
- Foot plates and mounting brackets.
- Hollow sections in mudguards, joints between mud flaps and guard, wiring looms under guards.
- Inspect tool box under seat or under fuel tank, remove contents to allow cleaning.
- Inspect torn seats and exposed foam at rear of seat (seed and soil can become lodged in the cushioning).
- Inspect rear axels for track width adjustment pin holes.
- Inspect the drawbar and mounting.
- Inspect the three point linkages and operating levers.

Implements – PTO rotary hoe	Pass	Fail
The following areas highlight some of the main areas of concern on Power Take-Off (PTO) driven rotary hoes:		
• Inspect rotary tynes and mounting bolts for soil, tynes may need to be removed or loosened from their adaptors on the horizontal shaft to allow removal of soil from the void.		
• Remove or loosen the skid/wear plate from the vertical gear casing (note that this casing is oil filled, thus remove or loosen only those bolts securing the plate).		
• Inspect the body of the hoe for double skins or void spaces that could contain soil due to inadequate or incomplete weld joints etc.		
• Inspect all areas where mud flaps are attached or plates overlap.		
• Check for hollow section reinforcing ribs.		
• Inspect the three point linkage attachment points and PTO knuckles and tube, universal joints and shafts.		
• Inspect all ground engaging areas of the hoe for signs of wear for the ingress o soil or plant material.		
• Rotate the rotary shaft and probe for plant material that may be caught in the bearing housings at the ends or middle if twin shafted.		
• Inspect the frame and supports and mounts for the trailing wheels – these are often hollow sections.		
• Inspect the trailing wheels for the rotary hoe, these wheels are usually hollow and made from two pieces of metal welded together – with wear the metal and welds crack and the wheels fill with soil.		
Remember, the key to a successful cleaning is more than just checking the above areas – you must ensure that your inspection is thorough, systematic and consistent.		

Track type dozers

	Pass	Fail
1. Drivers cab		
• Check externally under and around driver's cab. • Check under mats in cab. • Remove/lift seat; remove/lift floor pans to allow checking to top of transmission. • Check air conditioner filter (if fitted) – shake/tap filter to check if clean		
2. Tracks/track frame		
• Examine tracks carefully. • Ensure inspection/cover plates are removed to allow inside track area. • Check idler wheels (these support the tracks).		
3. Belly plates should be removed to allow inspection and cleaning		
4. Rear plates at back of dozer should be removed to allow inspection and cleaning.		
5. Hydraulic cover plates should be removed to allow inspection and cleaning.		
6. Engine		
• Check radiator core and engine area for residues. • Remove and check the air filter/cleaner (these often require destruction where they are clogged with QRM). • Check carefully the void space between the oil and radiator cores.		
7. Battery box		
• Lift/remove the battery to check for contamination (battery box may be at side/rear or under seat).		
8. Fuel cells		
• Are removable therefore dirt etc can pack between the tank and the frame.		
9. Blade		
• Ensure that edge of blade top/bottom is not split – this allows soil to be packed very tightly in the hollow. • Check cutter points/wear blades. • Check trunction arms. • Check carefully the pivot points and adaptors at the rear of the front blade – these allow the blade to change height and angle. Sometimes soil has compacted and is difficult to dislodge. • Check all hollow sections.		
10. Ripper support frame is usually hollow		
• Check carefully if any contaminants have entered this section. The tynes may need to be remove.		
11. Tynes		
• Tynes need careful inspection. Contamination may often be removed by water blasting, but tynes may need to be removed in some cases.		
12. Ripper points		
• A pin holds on the ripper points. Dirt can compact under the ripper points.		

13. All areas		

- Check if any sections or channels are hollow and determine if there is a possible entry point for contamination. Check if plates are covering a compartment or space that may have collected dirt/trash.

Remember, the key to a successful cleaning is more than just checking the above areas – you must ensure that your inspection is thorough, systematic and consistent .

Excavators	Pass	Fail
Check all areas, with special attention to:		
1. Hollow section chassis channels		
2. Turret pivot area		
3. Channels for hydraulic hoses from driver motor		
4. Counterweight void spaces		
5. Engine bay floor		
6. Fan shroud and radiator cores		
7. Glacier plate (near radiator)		
8. Air filters (shake/tap filters to determine if clean)		
9. Removable track adjuster guards and lubrication points		
10. Tool box		
11. Arms/booms – usually the pivot points are the only area of concern		
12. Bucket/blade		

- Between teeth of adapters
- Wear plates

13. Rear blade (stabiliser)		

- Wear plates
- Hollow section arms
- Hollow section blade

14. Mini – excavator		

- Hydraulics console
- False floor
- Turn table – running gear/tracks – internal gaps

Wheeled loaders and compactors	Pass	Fail
Check all areas, with particular attention to the following:		
1. Feet of adaptors on compactors		
2. Hydraulic points		
3. Articulation points of hydraulics		
4. Brake assemblies		
5. Blade wear plates		
6. Blade teeth and adaptors		
7. Canopy • Hollow channels • Void space between cab and body (bird's nests have been found here)		
8. Air cleaner and air filters		
9. Internal of cab, floor and mats		
10. Air conditioner unit		
11. Counterweight void spaces		
12. Under and around removable fuel cells		
13. Between dual wheels (where applicable)		

Dump trucks	Pass	Fail
Check all areas, with particular attention to the following:		
1. Internal of cab, floor and mats, behind and under seats		
2. Air cleaner		
3. Air conditioner unit		
4. Hollow channels in tray frame		
5. Between dual wheels (where applicable)		

Cars, 4WD, trucks and trailers	Pass	Fail
1. Ensure that the vehicle is unlocked and you have access to the boot and bonnet.		
2. Inspect the interior of the vehicle, especially:		
• Footwells, check carpets and mats for burrs, seeds, mud. • Tool boxes		
3. Inspect inside the boot of the vehicle. Remove any contents if required to facilitate the inspection of the following:		
• Carpet (deposits of hay, weed seeds, burrs and/or soil or water). • Spare tyre area. • Other recesses in the boot/rear of the vehicle.		
4. Inspect the engine bay, especially:		
• Radiator • Grill • Top of transmission gearbox • Recess under windscreen wipers		
5. Inspect the underside of the vehicle, especially:		
• Wheel arches, wheel trims, flares, step treads, bumpers • Mud flaps • Tyre rims (particularly the rear side) • Axels and diffs • Spare tyres on 4WD's and station wagons are often suspended underneath. **Note:** these are potentially a high risk area as contaminants collect inside the horizontally-positioned rim.		
6. Inspect boxes and/or cartons present in the vehicle if you cannot ascertain their contents		
7. For utes and trucks, inspect the floor of the tray and channels of tai gates, side guards and under chassis rails. Gaps in the floor welds or boards and bolt holes.		
8. Inspect trailers – check wheels, guards, trays, channels of draw bar and under body.		

Appendix D

Vehicle Wash Down Register

Vehicle Wash Down Register

Date	Time	Location	Vehicle registration	Wash down details/method (e.g. high pressure water, hand brush)	Name	Signature	Inspected

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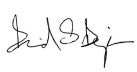
Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	R. Stewart	D Dique		P Bradley		01-03-2011
0	R. Stewart	D Dique		P Bradley		18-03-2011