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EXECUTIVE SUMMARY

Orange hawkweed (*Hieracium aurantiacum*) presents a major threat to primary production and biodiversity across south eastern Australia. It is on the ‘National Alert List of Environmental Weeds’. In addition, orange hawkweed is recognised as an ‘Agricultural Sleeper Weed’ in Australia. It is estimated losses to the Australian grazing industries would be in the order of $48 million pa if this weed were allowed to occupy its potential range.

Under the NSW Noxious Weed Act 1993, all hawkweeds (*Hieracium* spp.) are listed as Class 1 noxious weeds – these plants must be eradicated from the land and the land must be kept free of these plants. Currently in New South Wales, orange hawkweed impacts on the environment and is only located in Kosciusko National Park (KNP). However if its spread is not contained, it has the potential to impact greatly on primary production as well as native vegetation. There may also be additional unknown infestations outside of KNP as orange hawkweed was used as a horticultural plant in New South Wales.

The *NSW Orange Hawkweed Strategy* has been developed in consultation with a range of stakeholders to address the above threats. The *NSW Orange Hawkweed Strategy* is aimed at eradication of orange hawkweed from New South Wales and as such to prevent the spread of the weed. It identifies four goals:

• Prevent establishment of new orange hawkweed infestations;
• Eradicate existing orange hawkweed infestations;
• Prevent and reduce the spread of orange hawkweed to new areas through the removal of existing infestations;
• Develop resources and improve capacity to detect and manage orange hawkweed.

These goals deliver specific measurable outcomes and actions that comply with the NSW Invasive Species Plan, specifically, Objective 2.2 – ‘rapid response to eradicate or contain new invasive species’.

The Strategy identifies a number of stakeholders who will implement specific actions. These include NSW National Parks and Wildlife Service (NPWS), Department of Primary Industries, Catchment Management Authorities, Local Control Authorities, Regional Weed Advisory Committees (RWAC) and the Noxious Weeds Advisory Committee (NWAC).
INTRODUCTION

Orange hawkweed (*Hieracium aurantiacum*) is native to Europe and has become a major weed in the USA, Canada, Japan and New Zealand, together with other hawkweeds (*Hieracium* spp.). These species pose a major threat to Australian grasslands and temperate areas and accordingly have been listed as State Prohibited Weeds in New South Wales, Victoria and Tasmania. Although only in the early stages of establishment, orange hawkweed has the potential to seriously degrade Australian ecosystems and be a major cost to the grazing industry.

A perennial species, it spreads by wind-borne seeds which also attach to clothing, animals and vehicles. Once established, individual plants spread locally by producing runners. In New Zealand, *Hieracium* spp. weeds have displaced inter-tussock vegetation in native grasslands dominating more than 500,000 ha in the south island, threatening the viability of the pastoral industry. In Australia some 27,000,000 ha are considered potentially at risk from orange hawkweed invasion.

In New South Wales, 135 infestations, totalling 7.43 ha, are currently confined to an area of some 8,165 ha (the Target Area) within Kosciuszko National Park (KNP). The weed threatens the ecology and biodiversity of this National Heritage Area.

There is an urgent need to prevent further incursions of this weed by controlling and monitoring existing infestations, scouting for additional incursions within the search area and providing information about the weed to those in susceptible areas. The *NSW Orange Hawkweed Strategy* aims to coordinate the management of orange hawkweed across the state.
BACKGROUND

IDENTITY

Orange hawkweed is one of several *Hieracium* species (family Asteraceae) generally known as hawkweeds; they are major weeds in North America and New Zealand. These species may hybridise, potentially producing even better adapted invasive forms in new locations. The orange hawkweed in New South Wales is *Hieracium aurantiacum* subsp. *carpathicola*, it is native to the mountains of northern and central Europe; it has also been known by the name *Pilosella aurantiaca*.

BIOLOGY

Orange hawkweed is a perennial that flowers in summer producing bright orange compound flowerheads of 5–30 flowers. The flowers do not require pollination to produce seeds, although this may still occur. The seeds are black with fine white bristles and a pappus ('parachute'). During summer, up to 40,000 seeds may be produced per square metre of infested areas. Seed dispersal occurs by wind, water and by adhering to animals, shoes, clothing and vehicles, often in mud. The plant grows initially as a rosette and spreads by producing runners (stolons) and rhizomes (underground runners) from which daughter rosettes develop. It is an adaptable species, and as a weed, has occupied a wider range of climatic environments than its distribution in its native range would indicate.

HISTORY OF SPREAD

Infestations of orange hawkweed in Australia are limited to New South Wales, Tasmania and Victoria.

In Tasmania, orange hawkweed had been grown as a garden plant since at least 1948 but was first recorded as naturalised in 1963 and it is now widespread in that state. In Victoria it was first recorded as spreading from amenity plantings in the Falls Creek Alpine Village in 1999. Infestations in Victoria are limited and under management.

Although orange hawkweed had been sold in nurseries in New South Wales until relatively recently (2005), it was first recorded as naturalised in 2003, at Toolong Range, KNP. In recent years (2009–2011), surveys have revealed that the weed is found within a Target Area of 8,165 ha. No infestations have yet been recorded outside the Park.

CURRENT STATUS

Orange Hawkweed is on the Alert List for Environmental Weeds, a list of 28 non-native plants that threaten biodiversity and cause other environmental damage. Alert Weeds are weeds in the early stages of establishment that have the potential to become a significant threat to biodiversity if they are not managed. Species were identified for the Alert List based on three criteria:

- posing a high or serious potential threat to the environment;
- having limited distribution within Australia at present; and
- being amenable to successful eradication or containment programmes.
Orange hawkweed was identified in 2006 by the Department of Agriculture, Fisheries and Forestry as a Priority Agricultural Sleeper Weed in Australia. A ‘sleeper weed’ is a weed that is naturalised but has not yet begun an exponential phase of population growth, nor to spread widely.

**POTENTIAL SPREAD**

Modelling suggests that orange hawkweed has the potential to invade large areas of New South Wales, Victoria and Tasmania, even under changing climate scenarios; a total area of 27,000,000 ha is at risk from invasion. In New South Wales, large areas of the Southern and Central Tablelands and parts of the Northern Tablelands are vulnerable to invasion by orange hawkweed. These predictions emphasise the need for on-going monitoring, as well as focused control to minimise the likelihood of orange hawkweed realising its invasive potential in protected areas, grassland and pastures.

**IMPACTS**

**Environment**

Loss of botanical biodiversity is perhaps the greatest potential impact of orange hawkweed. Its ability to quickly establish and spread is evident from experiences in other countries where hawkweed species have become very serious environmental weeds. *Hieracium* species have allelopathic interactions with other plant species. Soil acidity increases underneath established patches of orange hawkweed, modifying the soil environment and potentially inhibiting the growth of other grassland species.

In New Zealand, hawkweeds have displaced inter-tussock vegetation in native grasslands. It is conceivable that orange hawkweed would successfully compete with rare and threatened native herbs that occupy inter-tussock spaces in Australian montane grasslands and subalpine woodlands.

**Primary Production**

Orange hawkweed poses a potential threat to livestock production by displacing nutritious pasture species. The weed aggressively competes with pasture species and is unpalatable to livestock.

In New Zealand, production losses in grazing areas due to *Hieracium* species have been estimated to be as high as 15% on improved land and 5% on unimproved land. For orange hawkweed in Australia, using the lower figure of 5%, potential annual losses to the grazing industries were estimated to be in the order of $48 million in 2002.

**Tourism and Recreation**

Orange hawkweed is an immediate threat to the iconic endemic vegetation and aesthetic beauty of KNP. The weed has the potential to form unsightly monocultures and degrade the intrinsic character of the Park. Moreover this would mean quarantining these areas from public access. The Park is an area highly valued and visited by large numbers of Australians as well as many overseas visitors throughout the year. Tourism in this region is worth some $280 million annually and the presence of abundant invasive plants could devalue and jeopardise this industry.
DISTRIBUTION

In New South Wales, orange hawkweed is restricted to a limited area of KNP. It occurs as 135 discrete infestations totalling 7.43 ha occurring over some 8,165 ha in the vicinity of Round Mountain with some of these infestations in the Jagungal Wilderness Area. This is the Target Area for the weed; it is approximately 1% of the total park area. Spread of the weed from these infestations by wind, water, animals, hikers, mountain bike riders, horse riders and vehicles is possible.

There are also limited infestations in the Victorian Highlands that could be a source of new invasions by vehicles and hikers. The species is more widespread in Tasmania and inter-state travellers could also inadvertently spread the weed to New South Wales.

The distribution of hawkweeds through the nursery trade and by amateur gardeners is also possible. In Victoria, 48 ‘lowland’ sites where the weed is present have been found. These all originated from plants sold in the nursery trade. The possibility of similar sites in New South Wales must also be considered (see p.6).

WEED MANAGEMENT CATEGORIES

The following diagram demonstrates where orange hawkweed management (red line) falls on a graph representing a typical weed invasion history. Containment of the current infestations within KNP and their control is the immediate issue. Prevention of spread by early detection and eradication of new infestations will be on-going.
Location of orange hawkweed infestations (within orange shaded area) in Kosciuszko National Park and park location (inset).
The categories are generally defined as follows:

**Prevention** – weed management aimed at preventing new species from arriving.

**Eradication** – weed management aimed at removing newly arrived weeds including all plant material.

**Containment** – weed management aimed at reducing the spread and/or severity of established weed infestations using defined geographical boundaries.

**Asset protection** – weed management aimed at protecting assets from the impact of established weeds. Assets may be environmental, primary production or community in nature.

**CONTROL STRATEGIES**

There are two main control strategies for the orange hawkweed infestations:

- immediate eradication
- suppression leading to eradication

Infestations need to be controlled with the aim of eradication in the shortest possible time frame. As such, there are two approaches to eradication: immediate eradication and suppression leading to eradication. For small, new or isolated infestations that have not yet spread beyond the point of introduction there may be a high possibility of immediate eradication.

*Immediate eradication* aims to eradicate small, new or isolated infestations with herbicide. It is unlikely that immediate eradication will be achieved with a single application of herbicide unless the plants are very young, so treated areas will need to be revisited to check for regrowth from rhizomes and seedling emergence.

Infestations that are too extensive for immediate eradication are subject to suppression leading to eradication. This approach aims to gradually deplete the population of the weed to zero, using herbicides. These infestations and surrounding areas will need to be monitored over the long-term to ensure that the weed has not spread and that suppression has led to eradication.

Information on the control of orange hawkweed is available in the NSW DPI publication Agfact P7.6.58, March 2005 Hawkweeds (*Hieracium* spp.).
LINKS TO OTHER STRATEGIES

This strategy links to the National Weeds Strategy and State Weed Strategies in Victoria and Tasmania.

In New South Wales, this strategy links to the NSW State Plan, the NSW Invasive Species Plan and the NSW DPI Corporate Plan.

At a regional level this strategy links with the draft Southern Ranges NPWS Regional Pest Management Strategy, Murray Catchment Regional Weed Strategy, the Murrumbidgee Catchment Regional Weed Management Strategy and the Southern Rivers Catchment Draft Regional Weed Strategy.

LEGISLATIVE CONTROLS

Management of orange hawkweed falls under the NSW Noxious Weed Act 1993. The Objects of this Act are:

- to reduce the negative impact of weeds on the economy, community and environment of this State by establishing control mechanisms to:
  (i) prevent the establishment in this State of significant new weeds, and
  (ii) restrict the spread in this State of existing significant weeds, and
  (iii) reduce the area in this State of existing significant weeds,
- to provide for the monitoring of and reporting on the effectiveness of the management of weeds in this State.

Under the NSW Noxious Weed Act 1993, all hawkweeds are listed as Class 1 (State Prohibited) noxious weeds – these plants must be eradicated from the land and the land must be kept free of these plants.
GOAL 1: EXCLUDE

PREVENT ESTABLISHMENT OF NEW ORANGE HAWKWEED INFESTATIONS

Challenge
The most effective way to minimise the impacts of invasive species is to prevent their initial incursion. The challenge is to identify species, thoroughly assess potential invasiveness and implement effective barriers to prevent their establishment. NSW Invasive Species Plan 2008

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<tr>
<th>ACTION</th>
<th>OUTPUT / PERFORMANCE INDICATOR</th>
<th>RESPONSIBILITY*</th>
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<tbody>
<tr>
<td>1.1 Establish an orange hawkweed reference group, led by a state coordinator, to give advice and direction on management, extension and research</td>
<td>Orange hawkweed reference group established for the life of this plan with key stakeholders represented</td>
<td>NPWS, LCAs, RWAC, CMAs, NSW DPI (lead agency)</td>
</tr>
<tr>
<td>1.2 Promote orange hawkweed early detection guidelines in LCAs inspection and community monitoring programs</td>
<td>Early detection survey guidelines promoted for inclusion in LCAs inspection programs and community group programs by 2014</td>
<td>LCAs, RWAC, CMAs, NSW DPI (lead agency)</td>
</tr>
<tr>
<td>1.3 Develop cross-border protocols for information exchange and preventing new incursions</td>
<td>Protocols developed with Australian, ACT, Victorian and Tasmanian Government agencies by 2012 that detail a national approach to the management and/or eradication of orange hawkweed</td>
<td>AWC (lead agency), NSW DPI as well as state agencies from Tasmania and Victoria</td>
</tr>
<tr>
<td>1.4 Liaise with the nursery industry and gardening organisations regarding the status of the weed</td>
<td>Advice on orange hawkweed prepared for inclusion in trade and popular publications and websites</td>
<td>NSW DPI</td>
</tr>
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</table>

OUTCOME – The likelihood of locating new incursions of orange hawkweed is increased.
GOAL 2: ERADICATE

ERADICATE EXISTING ORANGE HAWKWEED INFESTATIONS

Challenge

Invasive species have the ability to establish in new areas rapidly and successful control often corresponds directly with timely and rapid response. The challenge is to develop and deploy effective and efficient ways to eradicate or contain an introduced species before it becomes widespread. NSW Invasive Species Plan 2008

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<tr>
<td>2.1 Implement appropriate and timely control strategies at all known infestations</td>
<td>Control strategies applied at all known infestations</td>
<td>NPWS, LCAs, RWAC</td>
</tr>
<tr>
<td>2.2 Implement hygiene protocols to limit the spread of seed in KNP</td>
<td>Signage and wash down areas established</td>
<td>NPWS (lead agency), NSW DPI</td>
</tr>
<tr>
<td>2.3 Utilise trained community members and stakeholders to survey potential locations in KNP</td>
<td>Record the number and location of new outlier infestations; report to state coordinator</td>
<td>NPWS</td>
</tr>
<tr>
<td>2.4 Source funding for the management of known infestations</td>
<td>Assist in funding applications and provide in-kind support for eradication programs as required</td>
<td>NPWS, CMAs, NWAC, NSW DPI (state coordinator)</td>
</tr>
</tbody>
</table>

OUTCOME – Orange hawkweed infestations are identified and managed promptly

*Acronyms listed in Appendix 1

GOAL 3: CONTAIN

PREVENT AND REDUCE THE SPREAD OF ORANGE HAWKWEED TO NEW AREAS THROUGH THE REMOVAL OF EXISTING INFESTATIONS

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<tr>
<td>3.1 Record locations of existing and new infestations and send to state coordinator</td>
<td>Database maintained including, location of infestations, treatments received and NSW map produced by 2014</td>
<td>NPWS, NSW DPI (joint lead with state coordinator) and LCAs</td>
</tr>
<tr>
<td>3.2 Produce orange hawkweed control fact sheet (including identification of high risk sites and pathways, reporting procedure); update as necessary (see 4.3)</td>
<td>Fact sheet produced and distributed to stakeholders by 2013</td>
<td>NSW DPI (lead agency), NPWS</td>
</tr>
<tr>
<td>3.3 Apply current best practice control techniques at all orange hawkweed sites</td>
<td>Site specific best practice techniques applied at all sites. Number of sites and size of infestations is reduced</td>
<td>NPWS, LCAs</td>
</tr>
<tr>
<td>3.4 Monitor and adopt new management techniques where necessary (see 4.3)</td>
<td>Regional annual report submitted to state coordinator detailing management responses at orange hawkweed infestation sites</td>
<td>NPWS (lead agency), LCAs, NSW DPI, NWAC</td>
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</table>

OUTCOME – Orange hawkweed management coordination is improved

*Acronyms listed in Appendix 1
GOAL 4: CAPACITY BUILDING

DEVELOP RESOURCES AND IMPROVE CAPACITY TO DETECT AND MANAGE ORANGE HAWKWEED

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<tr>
<td>4.1 Engage stakeholders to commit to achieving strategy outcomes</td>
<td>Presentation and publication of strategy at NWAC, weed forums and on NSW DPI and NPWS internet pages Conduct targeted consultation with key park (KNP) user groups</td>
<td>NSW DPI, NPWS</td>
</tr>
<tr>
<td>4.2 Develop improved search techniques</td>
<td>Surveys that have increased efficiency via identifying most probable infestation sites</td>
<td>Research organisations (with assistance from NSW DPI and NPWS)</td>
</tr>
<tr>
<td>4.3 Investigate new management techniques including alternative herbicides in field experiments</td>
<td>Other control options available</td>
<td>Research organisations, NSW DPI, NPWS</td>
</tr>
<tr>
<td>4.4 Coordinate and support submission of minor use permits</td>
<td>Minor use permits obtained as required</td>
<td>NSW DPI, NPWS</td>
</tr>
<tr>
<td>4.5 Investigate biology of orange hawkweed, including seed longevity, dispersal and rhizome physiology</td>
<td>Strategic management of orange hawkweed improved</td>
<td>Research organisations (with assistance from NSW DPI and NPWS)</td>
</tr>
<tr>
<td>4.6 Source funding and support to research and field experiments</td>
<td>Assist with applications for orange hawkweed research projects</td>
<td>NSW DPI, NPWS, CMAs</td>
</tr>
<tr>
<td>4.7 Collate and produce annual orange hawkweed strategy report</td>
<td>Annual report on implementation of the NSW orange hawkweed strategy prepared and distributed to NWAC and stakeholders</td>
<td>NSW DPI (state coordinator) and NPWS</td>
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</table>

OUTCOME – Orange hawkweed workforce is aware of, and has the capacity to implement management

*Acronyms listed in Appendix 1

MONITORING, EVALUATION AND REPORTING

Monitoring and evaluation are essential to the continued development of the strategy to gain efficiencies and to obtain best results. Evaluation would include assessing changes in the distribution of the weed (current versus previous and potential), frequency of locating new infestations, and assessments of the costs and benefits of the strategies.

The NSW government has adopted a state-wide strategy for monitoring NSW natural resource management targets. The Natural Resources Monitoring, Evaluation, Reporting and Improvement (MERI) framework seeks to measure long-term trends in NSW’s natural resources and the effectiveness of specific management actions to sustain them.
MILESTONES

Milestones are a way of showing achievements in the life of a plan or strategy. The following milestones are synonymous to the outcomes in this document and attempt to show how we will make progress to achieve the goals in the strategy. This strategy is subject to a five year cycle of review and its implementation will be monitored by the NSW orange hawkweed reference group. Annual reports will be made available to stakeholders.

<table>
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<tr>
<th>GENERAL</th>
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<tr>
<td>M1 Report yearly on the implementation of the NSW Orange Hawkweed Weed Strategy</td>
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<tr>
<th>GOAL 1</th>
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<tr>
<td>M2 Establishment of new orange hawkweed infestations prevented</td>
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<tr>
<th>GOAL 2</th>
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<tr>
<td>M3 Existing infestations of orange hawkweed eradicated</td>
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<th>GOAL 3</th>
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<tr>
<td>M4 Orange hawkweed management is coordinated and fact sheet produced and updated as necessary</td>
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<th>GOAL 4</th>
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<td>M5 Orange hawkweed workforce is aware of, and has the capacity to implement orange hawkweed management</td>
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<tr>
<td>M6 Community awareness of orange hawkweed is increased</td>
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</tbody>
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APPENDIX 1: ABBREVIATIONS

AWC: Australian Weeds Committee
CMA: Catchment Management Authority
KNP: Kosciuszko National Park
LCA: Local Control Authority
NPWS: National Parks and Wildlife Service
NSW DPI: NSW Department of Primary Industries
NWAC: Noxious Weeds Advisory Committee
RWAC: Regional Weed Advisory Committees

APPENDIX 2: GLOSSARY OF TERMS

**Biodiversity**: The variety of life forms, the different plants, animals, microorganisms, the genes they contain and the ecosystems they form.

**Containment**: Restricting the spread of an invasive species incursion.

**Eradication**: The removal of the entire population of a species in a managed area: eliminating that species completely including reproductive propagules.

**Establishment**: The point at which a species can reproduce at a sufficient level ensuring survival in a new habitat without new genetic input from outside the system.

**Evaluation**: The process or results of an assessment or appraisal in relation to stated objectives, standards, or criteria.

**Impacts**: The (usually negative) economic, environmental and/or social effects of invasive species.

**Incursion**: An isolated population of an invasive species recently detected in an area where it has not been previously established.

**Native species**: A species within its natural range (past and present).

**Native range**: Including the area which a species can reach and occupy through wind/ water-borne or other dispersal systems, even if it is seldom found there.

**Pathways**: The means by which invasive species move e.g. air, surface water, groundwater, plants, animals and by human agents.

**Protocol**: A procedure or set of rules.

**Stakeholders**: Those people and organisations who may affect, be affected by, or perceive themselves to be affected by a decision, activity or risk.

**Threat**: Potential impact of an invasive species.

**Weed**: Plants that are unwanted in a given situation and which usually have detectable negative economic, environmental and/or social effects.