

Sydney Weeds Committees

Sydney Central Regional Weeds Committee • South West Sydney Regional Weeds Committee
Sydney North Regional Weeds Committee • Sydney West–Blue Mountains Regional Weeds Committee

Priorities for the control of Alligator Weed in the Sydney Region

Report prepared by
Sydney Weeds Committees

February 2010



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This report was prepared by Frances Pike, Project Officer for Sydney Weeds Committees in consultation with members controlling Alligator Weed across the Sydney Region. The input of these skilled officers was vital to the process and is gratefully acknowledged.

1. Introduction and Background

This report is a culmination of the efforts of the Sydney Weeds Aquatic Task Force to determine priority areas for control of Alligator Weed in the Sydney Basin. It utilises a methodology developed in a joint initiative between the National Aquatic Weeds Management Group, the Hunter and Central Coast Regional Environmental Strategy Team and the (former) federal Department of Agriculture, Fisheries and Forestry. The method, referred to in the title of that project as a *landscape unit based approach to the prioritisation of Alligator Weed (Alternanthera philoxeroides) management*,¹ involves the division of a region into catchment management units, scoring those units according to agreed criteria, and combining the scores to determine optimum locations and approaches for control of Alligator Weed across the region.

This landscape unit based approach evolved from infestation mapping and analysis of risk of spread throughout the Hunter, Central Coast and Sydney regions (Chandrasena 2008)², post flood spread mapped in the Hunter (Hunter Councils Environment Division, Hunter Central Rivers Catchment Management Authority and the former Department of Primary Industries), and an assessment of significant plant communities at risk from Alligator Weed. It involved a synthesis of this data via a series of expert workshops to determine priority for control and promotes a consistent, objective approach for the allocation of resources to Alligator Weed management.

With less floodplain and more discrete sub-catchments, it was possible to adapt the approach to the conditions in the Sydney Basin, resulting in a different type of assessable management unit. It wasn't necessary to undertake as detailed a hydrological analysis as it was in the Hunter to arrive at assessable catchment management units. In the Sydney Basin it was efficient to use existing sub-catchment mapping and either further divide or group these basic sub-catchment units (according to variation or homogeneity of either infestation and/or terrain) to achieve a practical number of comparable units.

Also, given the fragmented and modified nature of the landscape, information on biological assets at risk from Alligator Weed needed to be coupled with local knowledge of other factors, i.e. other risks threatening these assets and their condition status.

All factors to determine the priorities for control of Alligator Weed were thus considered by teams with expertise in the Sydney Basin infestations, resulting in a list of ranked control areas (with management objectives involving eradication, containment, asset protection or a combination thereof), toward which resources can be directed more efficiently.

¹ A Landscape Unit Based Approach to the Prioritisation of Alligator Weed (*Alternanthera philoxeroides*) Management in the Hunter and Central Coast Region of New South Wales

² Assessment of Risk of Spread for Strategic Management of the Core Alligator Weed Infestations in Australia- 'Taking Stock', 2008, Department of Agriculture, Fisheries and Forestry

2. Study Area

The study area is the Sydney Basin catchment and includes an area managed by members of four Regional Sydney Weeds Committees (Fig.1).

Fig 1. Study area for determining priority Alligator Weed Control locations in the Sydney Basin



River systems by which Alligator Weed could be transported into the Sydney Basin are included and assessed using the project methodology *with the exception* of rivers or catchments with no record of Alligator Weed and/or which monitoring indicates are likely to remain free of the weed. (Monitoring to prevent infestation downstream from these latter, typically upper catchment locations will be required in future). The un-assessed/non-infested areas include:

- Lake Burragorang
- Monkey Creek
- ErskineCreek/Sassafras River
- Kowmung River
- Cox's River
- Grose River
- Bargo River
- Hacking River
- Little River
- Nattai River
- Wingecaribee River
- Wollondilly Rivers

The Cowan/Pittwater and Berowra Creek catchments, potentially able to impact the Hawkesbury River system, are not known to contain infestations and are within the scope of the Hunter/Central Coast Region Study. Neither Middle Harbour nor the Southern Beaches are known to be infested. Assessment has been undertaken for those river systems where infestations exist or recently have existed, i.e. the Botany, Cooks, Duck, Georges, Hawkesbury, Lane Cove, Nepean, Parramatta, Wolgan and Woronora Rivers and for infestations occurring in the following coastal areas: the Northern Beaches and Port Jackson.

Fig 2. River systems included/excluded from assessment based on status of infestation

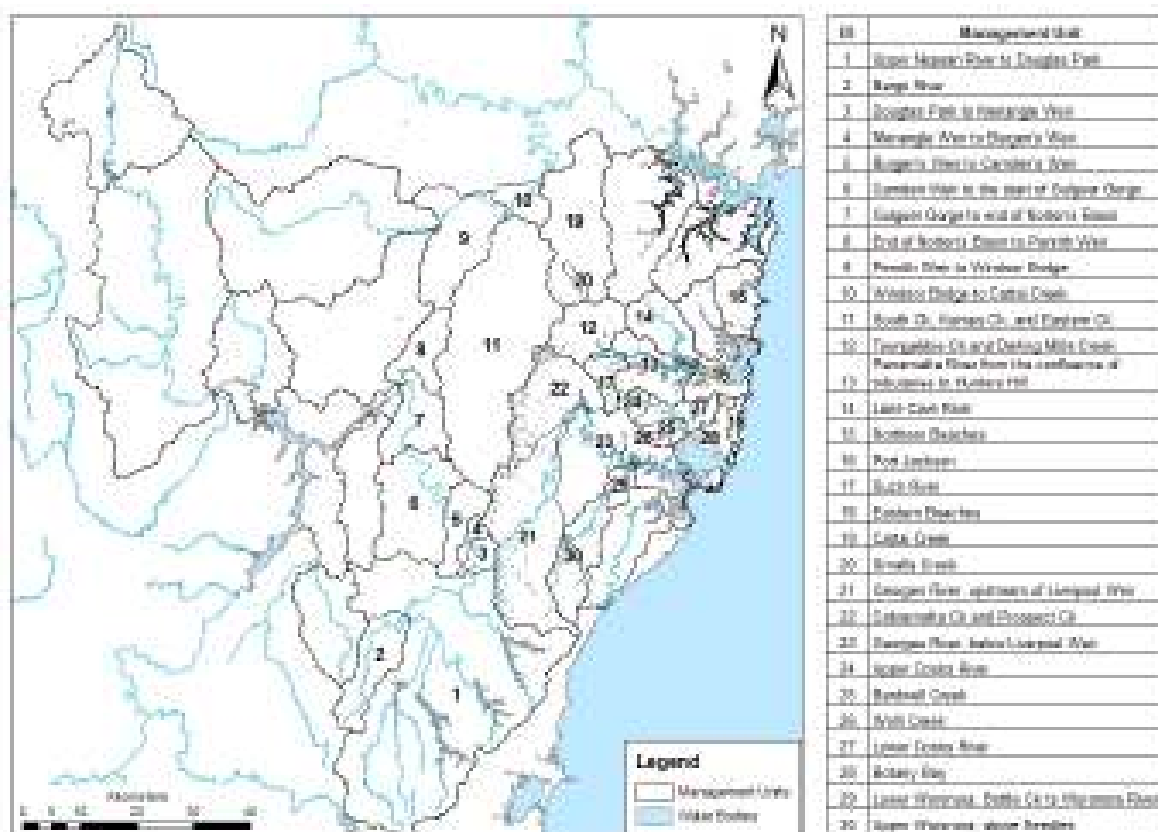


3. Methods

3.1 Units of Assessment

Further subdivisions of the river stretches were made to incorporate the influence of sub catchment units flowing into them and/or the nature of their infestations. In some cases sub catchments were grouped to reflect the logic of managing them as a unit owing to proximity, similarity of terrain and/or infestation level, land use, assets and hydrological interaction. The following assessment units resulted (see Fig 3).

Fig 3. Alligator Weed Management Units for Assessment



The assessment units can be further understood from the following descriptions

NEPEAN HAWKESBURY SYSTEM

- Bargo River
- Nepean Dam to Douglas Park
- Douglas Park to Menangle Weir
- Menangle Weir to Burgen's Weir
- Burgen's Weir to Camden Weir
- Camden Weir to the start of Gulguer Gorge
- Gulguer Gorge to end of Norton's Basin
- End Norton's Basin to Penrith Weir
- Penrith Weir to Windsor Bridge
- Windsor Bridge to Cattai Creek
- Cattai Creek Sub- catchment
- Smalls Creek
- South, Kemps Creek and Eastern Creeks

GEORGES RIVER

- Upper Georges River:*
- Upstream of Liverpool Weir
- Lower Georges River:*
- Downstream of Liverpool Weir
- Cabramatta/Prospect Creeks

PARRAMATTA RIVER

- Upper Parramatta River:*
- Toongabbie Creek and Darling Mills Creek
- Lower Parramatta River:* Confluence of Parramatta River tributaries to Hunters Hill

PORT JACKSON

DUCK RIVER

LANE COVE RIVER

NORTHERN BEACHES

EASTERN BEACHES

COOKS RIVER

- Bardwell Creek
- Wolli Creek Catchment
- Upper Cooks River* - to Punchbowl Road
- Lower Cooks River* – downstream of Punchbowl Road

BOTANY BAY

WORONORA RIVER

- Above the Needles to Heathcote Road
- Bottle Creek to Woronora River

3.2 Method for determining priority ranking

3 principal factors influence assessment of priority of areas for control, these being:

- the potential for further spread within or beyond an area
- the extent of the impact of ongoing infestation
- the feasibility of achieving the desired outcomes for a given management area

Management units are compared according to a relevant set of criteria for each factor which are assigned scores. A combination of (weighted) scores determine ranking.

Provision is made for special attributes of an assessable unit to be considered and recorded to explain the rationale for the assigning of any individual score which might otherwise seem inconsistent given the criteria.

3.3 Method for rating the 3 principal factors contributing to an assigned ranking

A score is derived for each principal factor:

- **Potential for Further Spread (PFS)** - a score of 1-5 derived by averaging (or weighting) the 1-5 scores for terrestrial and aquatic spread both within and to neighbouring management units
- **Consequence of Further Impact (CFI)** - a score of 1-5 for the likely impacts to biodiversity within the management unit
- **Management Feasibility (MF)** - a score of 1-3 representing the likelihood of effectively managing or containing infestations within the management unit

The scores are combined using the following formula;

$$\text{Priority level} = (\text{PFS} + \text{CFI}) \times \text{MF}$$

This results in a score between 1 and 30 which can be aggregated to levels of priority. For the Sydney Region 4 priority level were assigned, (Low, Moderate, High, Very High).

The scores for **spread and impact** are based on both degree and likelihood as shown in the table below. The degree is scored as minor, moderate or major and likelihood as likely, possible or unlikely. Spread and impact are considered in terms of a 'no action' alternative. In the case of spread this process will be undertaken for both terrestrial and aquatic spread.

	Degree		
Likelihood	<i>1. Minor</i>	<i>2. Moderate</i>	<i>3. Major</i>
<i>3. Likely/certain</i>	3	4	5
<i>2. Possible</i>	2	3	4
<i>1. Rare/unlikely</i>	1	2	3

Management feasibility is recorded as a score from 1 to 3 based on the likelihood of effectively managing or containing infestations within the management unit. The levels of likelihood are the same as those for assessing spread and impact.

Key decision points for consideration in allocating each of the degree and likelihood levels for spread, impact and feasibility are provided below.

➤ **Potential for Further Spread - Aquatic & Terrestrial**

Minor - Core or low catchment units with little or no chance of further spread within them and little or no chance of further spread to neighbouring areas or all neighbouring areas already widely infested

Moderate - Marginal or medium catchment order units; core or low catchment order units with some potential for major further infill of unit or spread to less infested units

Major - Outlier or high catchment order units; units with infestations confined to single site; large potential for spread to other units

Likelihood

Aquatic- consideration of the presence in unit and relative to infestations of vectors of aquatic spread, e.g. watercourses, spread related activities (fishing, eel trapping, boating, channel maintenance, dredging), floodplain areas; consideration of infestation types

Terrestrial- consideration of the presence in unit and relative to infestations of vectors of aquatic spread, e.g. turf farms, regular earthmoving; consideration of infestation types

➤ **Consequence of Further Impact**

Minor- little or no significant, at-risk biodiversity assets within AWMU

Moderate- Presence within AWMU of at risk biodiversity assets of state significance (EEC, TS, SEPP, important wetlands etc); direct, current impacts or threats to regionally or locally significant, at risk biodiversity assets (e.g. significant species/communities, river environments, wetlands etc)

Major- Direct and current impacts or threats to state significant, at-risk biodiversity assets; presence in AWMU of nationally significant biodiversity assets (EPBC listed entities, RAMSAR wetlands etc)

Likelihood- vulnerability of type of ecosystem or entity at risk to impacts from AW, including likelihood of AW establishing healthy population and susceptibility of entity to impacts from invasion by AW

➤ **Management Feasibility**

Likelihood- the extent to which management or containment of infestations within the AWMU could be effectively carried out. Need to consider extent and situation of infestations and effectiveness of available control options. Where spread scores are high feasibility of containment should be considered and where impact scores are high feasibility of mitigation of the relevant impacts should be considered.

3.4 Data collection and Mapping

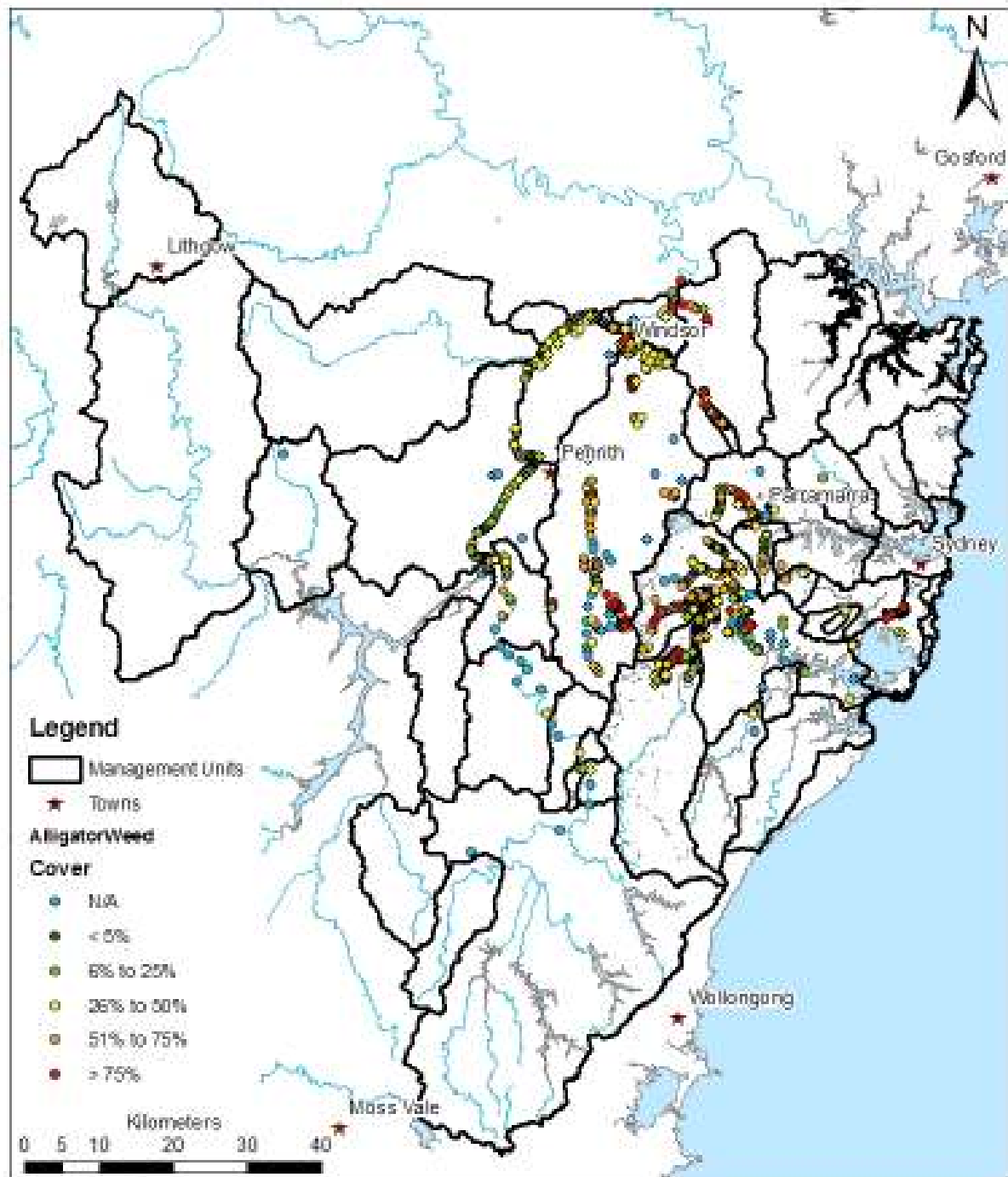
Prior to the assessment of factors relating to the spread and impacts of Alligator Weed, GIS data sets were compiled. These included Alligator Weed infestation data set, Management Unit (MU) data sets and location, spread, impact and management feasibility layers. The source of each data set is listed in Appendix A. The GIS data collated for the assessment process were not intended to be exhaustive as there were no adequate data sets available a variety of important factors.

3.4.1. Alligator Weed Data Set

The data set indicating location and severity of Alligator Weed included information from the final report, *Assessment of Risk of Spread for Strategic Management of the Core Alligator Weed Infestations in Australia - 'Taking Stock', Department of Agriculture, Fisheries and Forestry, October 2008*, additional data collated by Kelly Saunderson, former Project Officer South West and West/Blue Mountains Regional Weeds Committees with assistance from the committee members, and results of 'ground truthing' by noxious weeds officers between October 2008 and October 2009, (with a further late advice of an infestation adjacent to Towra Point December 2009).³ The compiled data set indicates the location and percentage cover of Alligator Weed infestations. Owing to variation in manner of recording infestation, values were allocated to percentage groupings (e.g. < 5%, 6% to 25%) rather than individual percentage scores. Where quantity was not recorded, (earlier data sets) a Not Available (N/A) value applied.

³ As this report was being compiled in December 2009, Craig Shephard, (managing Towra Point Nature Reserve), advised of a contractor having just identified Alligator Weed in close proximity to this Ramsar Wetland.

Fig 4. Alligator Weed Infestation Data Set



3.4.2. Alligator Weed Management Units

For the assessment, catchments within the study area were divided into Management Units (MU) using the ArcMap 9.3 software package (ESRI 2008). The scores for risk of further impact, further spread, management feasibility and the total score were recorded for each MU in ArcMap 9.3 for visual display. The assessment units numbered to correspond with mapped attributes are set out in Figure 3.

3.4.3. Spread Factors

The data sets available to assist in determining the spread of Alligator Weed infestations included natural dispersal factors such as watercourses and 1:100 year flood levels on the Hawkesbury River floodplain. Owing to the topography of the Sydney Basin, detailed fine scale prediction of flood impact is, with the exception of the Hawkesbury, not as relevant as it is for the Hunter. (The Hawkesbury floodplain spread factor was been taken into account with relevant mapping overlay during scoring of this area).

Anthropogenic dispersal vectors such as managed canals and locations of turf farms, which are frequent in the Hunter, did not feature prominently in this study. This is because the number and extent of turf farms and similarly impacting agricultural activities is fewer and less, with managed canals typically at the extreme lower end of the regional catchment, thereby presenting less threat, (with the exception of Rockdale/Botany where significant wetlands can be impacted). Where anthropogenic dispersal vectors appeared to prevail, knowledge from the local Noxious Weeds Officers was sought. For source of data sets see Appendix A.

3.4.4. Impacts on Biodiversity

Datasets collated to assist in assessing the potential impacts to biodiversity included vegetation mapping of at risk Endangered Ecological Communities (EECs), and Significant Wetlands layers from the Department of Environment, Climate Change and Water. (Source: Appendix A.

Table 1 lists communities typically at risk and the presence of these within any unit was considered.

Table 1. Vegetation communities specifically at risk from Alligator Weed

Freshwater Wetlands on Coastal Floodplains
Sydney Freshwater Wetlands
Coastal Saltmarsh
River-flat Eucalypt Forest on coastal Floodplains
Swamp Oak Forest on Coastal Floodplains
Swamp Sclerophyll Forest on Coastal Floodplains
Mangroves

3.4.5 Location and Management

The location layers included data sets such as roads, railways, towns, and open space to help orientate assessors. Aerial photographs including Spot5 satellite imagery and 0.5m aerial photographs from the Department of Environment, Climate Change and Water (DECCW) and the Department of Lands (DoL) were also utilised. (Appendix A)

The management feasibility layers covered features in the landscape which might affect management, such as roads and elevation contours.

3.5 Assessment Workshops

Local government weed and environmental officers and environmental managers of other agencies with experience of the Sydney Basin infestations, assessed the areas with which they were most familiar during 3 workshops. The supporting GIS data were displayed to prompt discussion and clarify boundaries of the management units relative to infestation location and spread and impact features. The scores were recorded in an excel spreadsheet during the workshops, which automatically calculated the priority score for each management unit and these were captured to the geo-database for mapping. Where it is considered that scores are problematical or potentially unclear to those less familiar with either the process or an assessment unit, explanations are provided along with the results. A sample management unit appears below, (Figure 5, MU 12, Toongabbie Creek and Darling Mills Creek), with further figures (6,7) illustrating attribute layers used for scoring spread and impact.

Fig 5. Alligator Weed infestation in MU 12 Toongabbie Creek and Darling Mills Creek

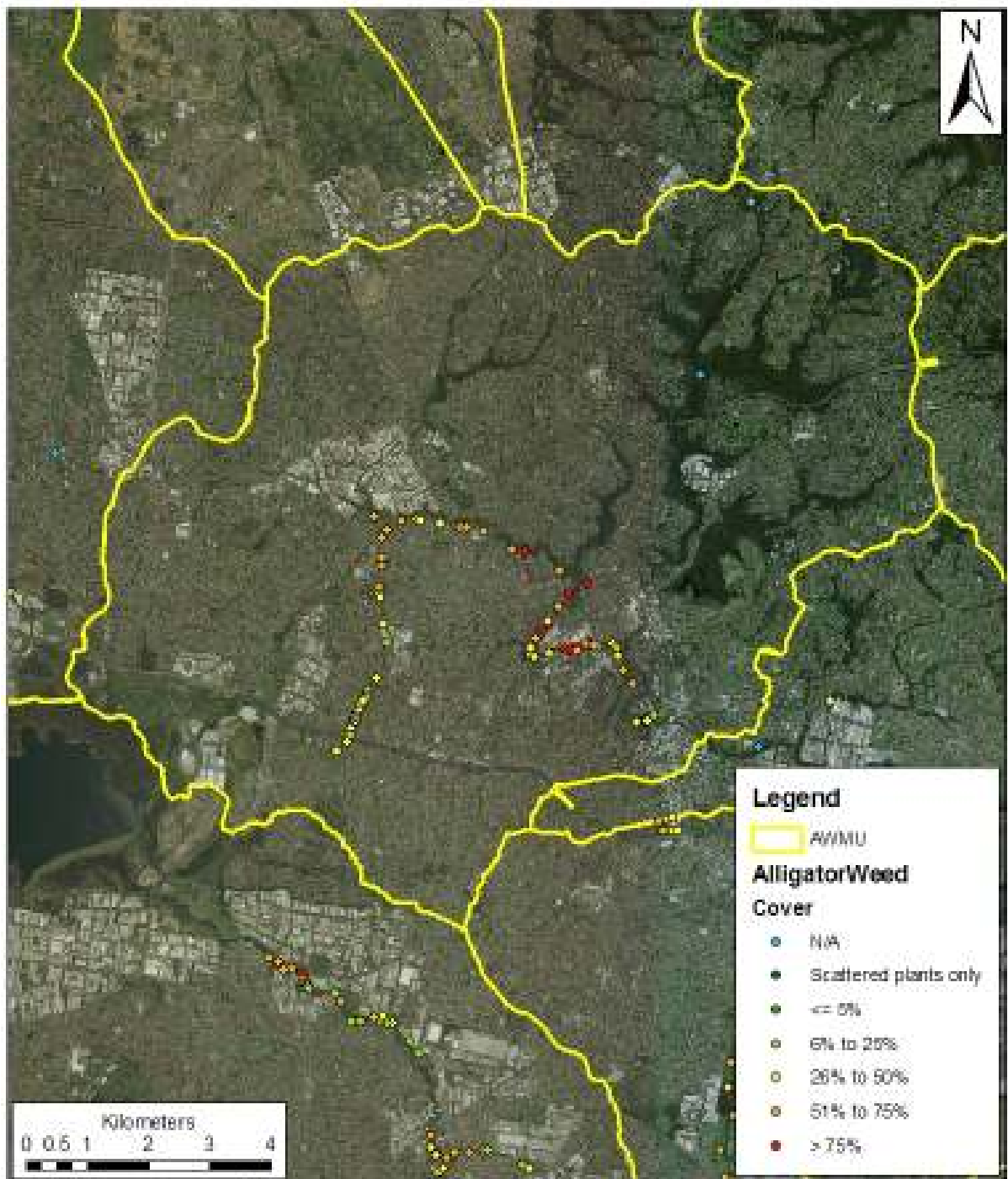


Fig 6. Alligator Weed spread factors in MU 12

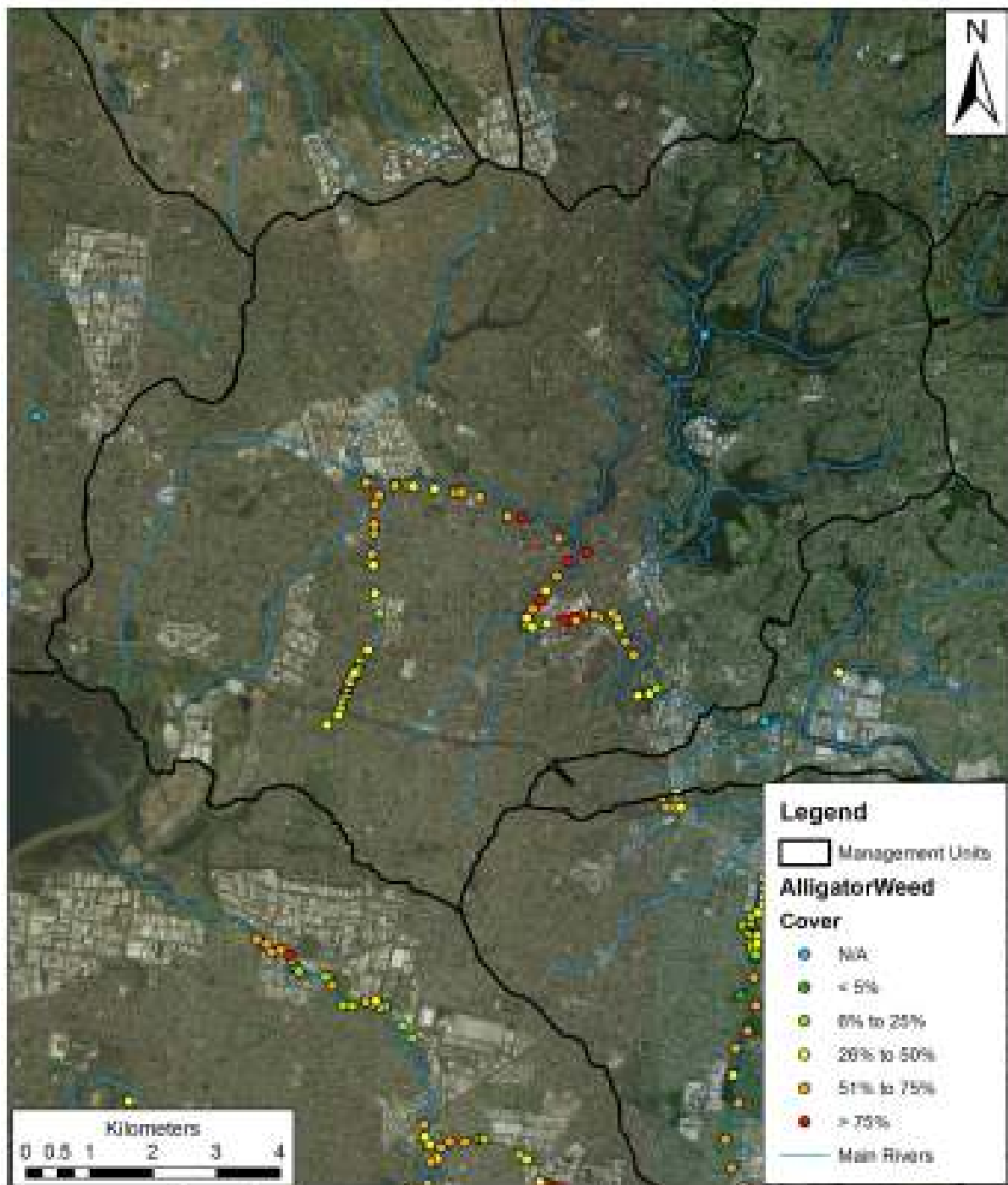
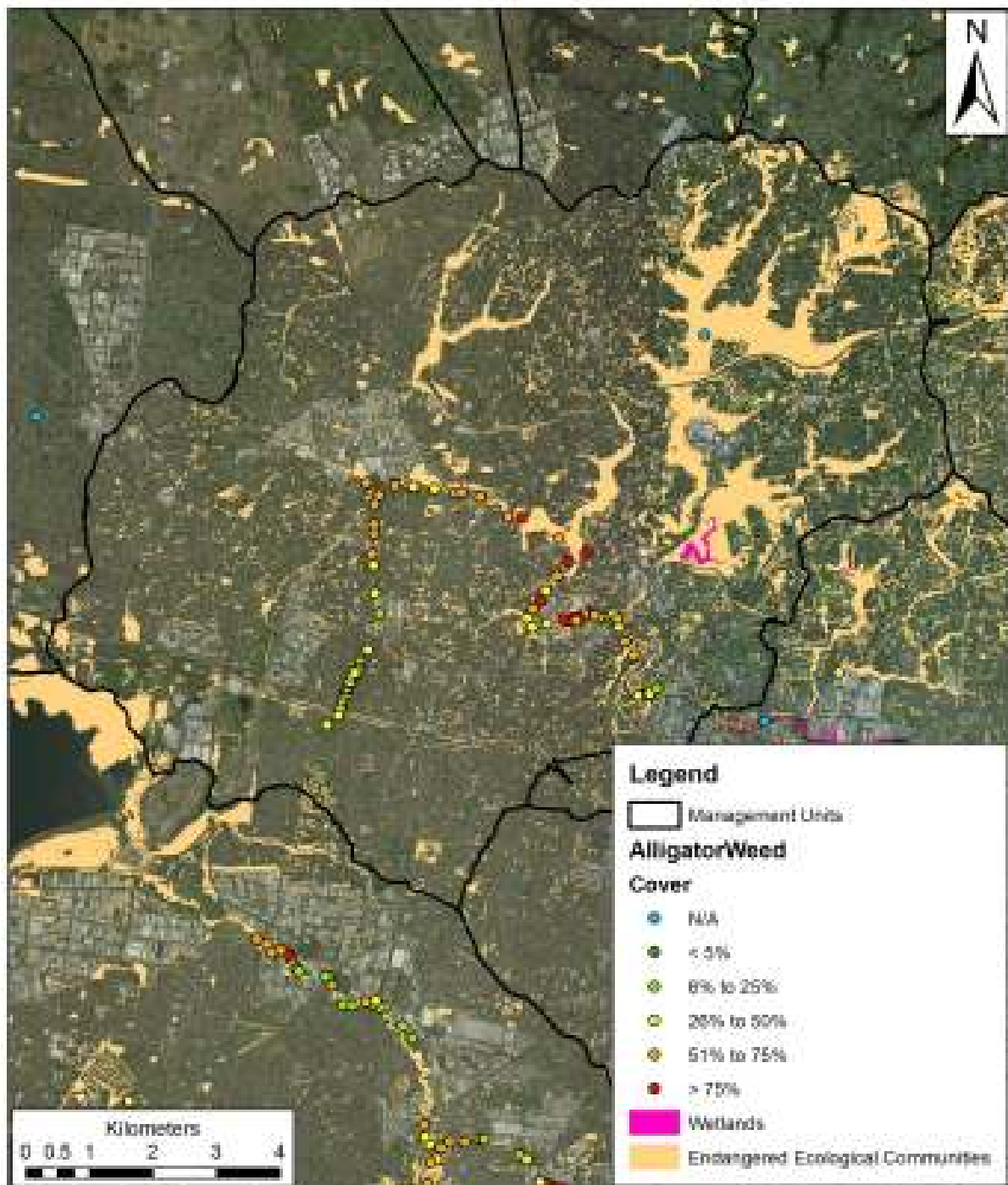


Fig 7. Alligator Weed impact factors in MU 12



4. Results

4.1 Reviewing and recording results of the scoring sessions

Some very minor revisions were made to initial scores when new information was presented during a summary session in December 2009. This included report of an infestation immediately adjacent to Towra Point Nature Reserve, impacting Botany Bay, (MU 28). Also, additional information was sought from local practitioners for the Northern Beaches and the Lane Cove catchments unable to be present at initial scoring sessions.

Appendix B is a record of the scoring sessions with additional notes explaining circumstances influencing some scores. The results of the three separate scoring sessions are set out in Table 2. Descriptions of how results are ranked and depicted in maps follows.

Table 2. Results of scoring sessions

MU	AWMU	Potential for further spread (1-5)	Consequence of further spread (1-5)	Management Feasibility (1-3)	TOTAL
	NEPEAN HAWKESBURY SYSTEM				
2	Bargo River	1	2	1	3
1	Nepean Dam to Douglas Park	2	3	3	15
3	Douglas Park to Menangle Weir	4	2	3	18
4	Menangle Weir to Burgen's Weir	5	2	2	14
5	Burgen's Weir to Camden Weir	3	1	3	12
6	Camden Weir to the start of Gulguer Gorge	4	2	2	12
7	Gulguer Gorge to end of Norton's Basin	5	5	2	20
8	End Norton's Basin to Penrith Weir	3	1	3	12
9	Penrith Weir to Windsor Bridge	4	5	2	18
10	Windsor Bridge to Cattai Creek	2	4	2	12
19	Cattai Creek Sub- catchment	5	5	3	30
20	Smalls Creek	5	2	2	14
11	South, Kemps Creek and Eastern Creek	4	5	2	18
	GEORGES RIVER				
21	Upstream of Liverpool Weir	4	4	2	16
23	Downstream of Liverpool Weir	3	4	3	21
22	Cabramatta/Prospect Creek sub-catch	3	2	2	10
	PARRAMATTA RIVER				
12	Toongabbie Creek and Darling Mills Creek	4	2	2	12
13	Confluence of tributaries to Hunters Hill	1	2	3	9
14	Duck River	3	3	2	12
17	LANE COVE	3	3	3	18
15	NORTHERN BEACHES	2	3	3	15
16	PORT JACKSON	1	1	3	6
18	EASTERN BEACHES	1	1	3	6
	COOKS				
25	Bardwell Creek	3	2	3	15
26	Wolli Creek Catchment	3	3	2	12

MU	AWMU	Potential for further spread (1-5)	Consequence of further spread (1-5)	Management Feasibility (1-3)	TOTAL
24	Upper Cooks River - to Punchbowl Road	3	2	3	15
27	Lower Cooks River – downstream of Punchbowl Road	3	3	3	18
28	BOTANY BAY	3	5	3	24
	WORONORA RIVER				
30	Woronora River (above the Needles to Heathcote Road)	3	4	2	14
29	Woronora River (Bottle Creek to Woronora River)	2	2	2	8

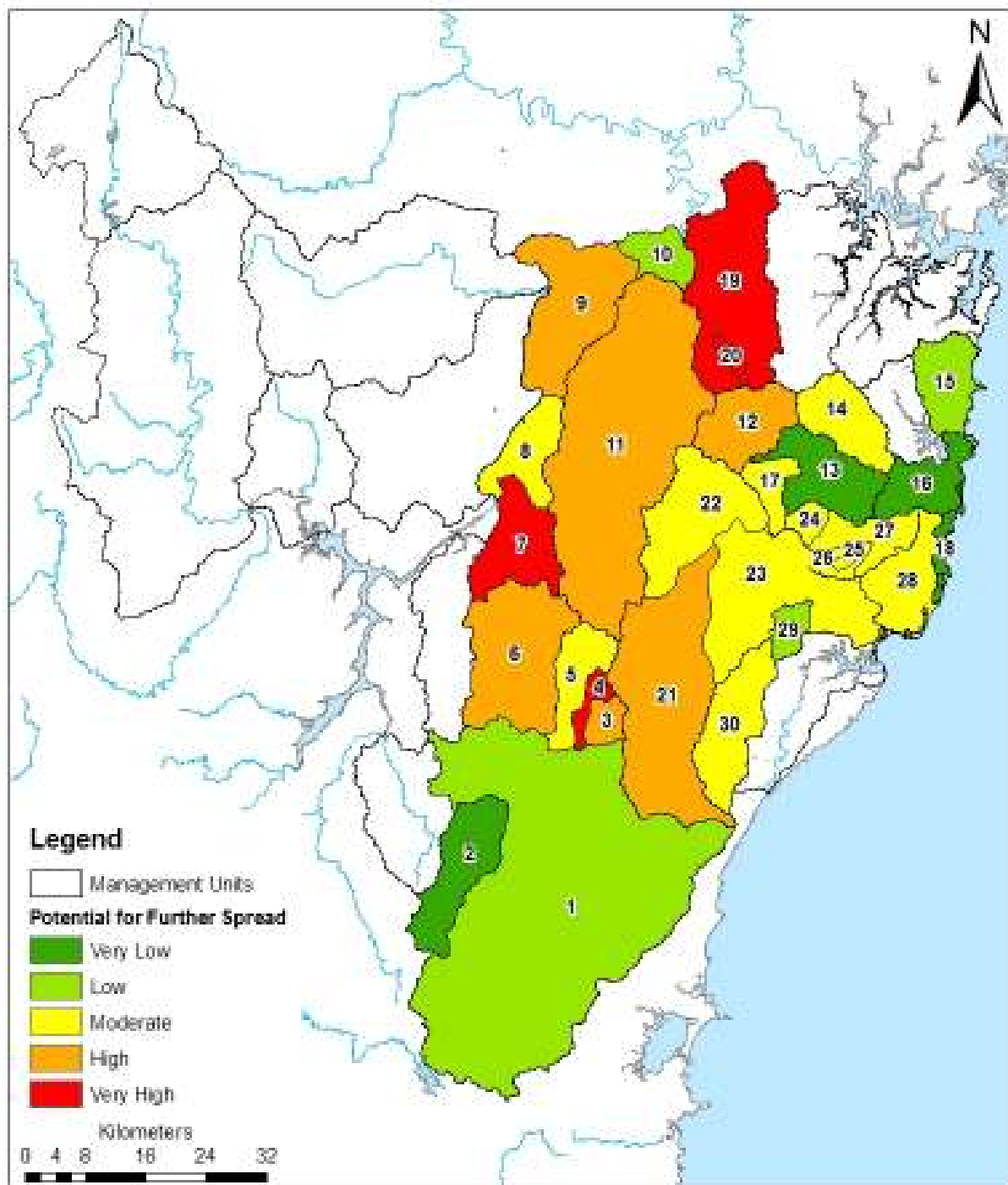
4.2 Recording potential for further spread

The map depicts potential for further spread as:

1. Very Low – dark green
2. Low – light green
3. Moderate - yellow
4. High – orange
5. Very high - red

The scores for the potential for further spread range from 1 - very low potential for further spread, to 5 - very high potential for further spread. Each score has been assigned a colour which ranges from Dark green to Red to indicate the level of potential. For example dark green indicates a very low potential for further spread, while red indicates a very high potential of further spread. The potential for the further spread of Alligator Weed for each Management Unit is shown in Figure 8.

Fig 8. Potential for the further spread of Alligator Weed within MU



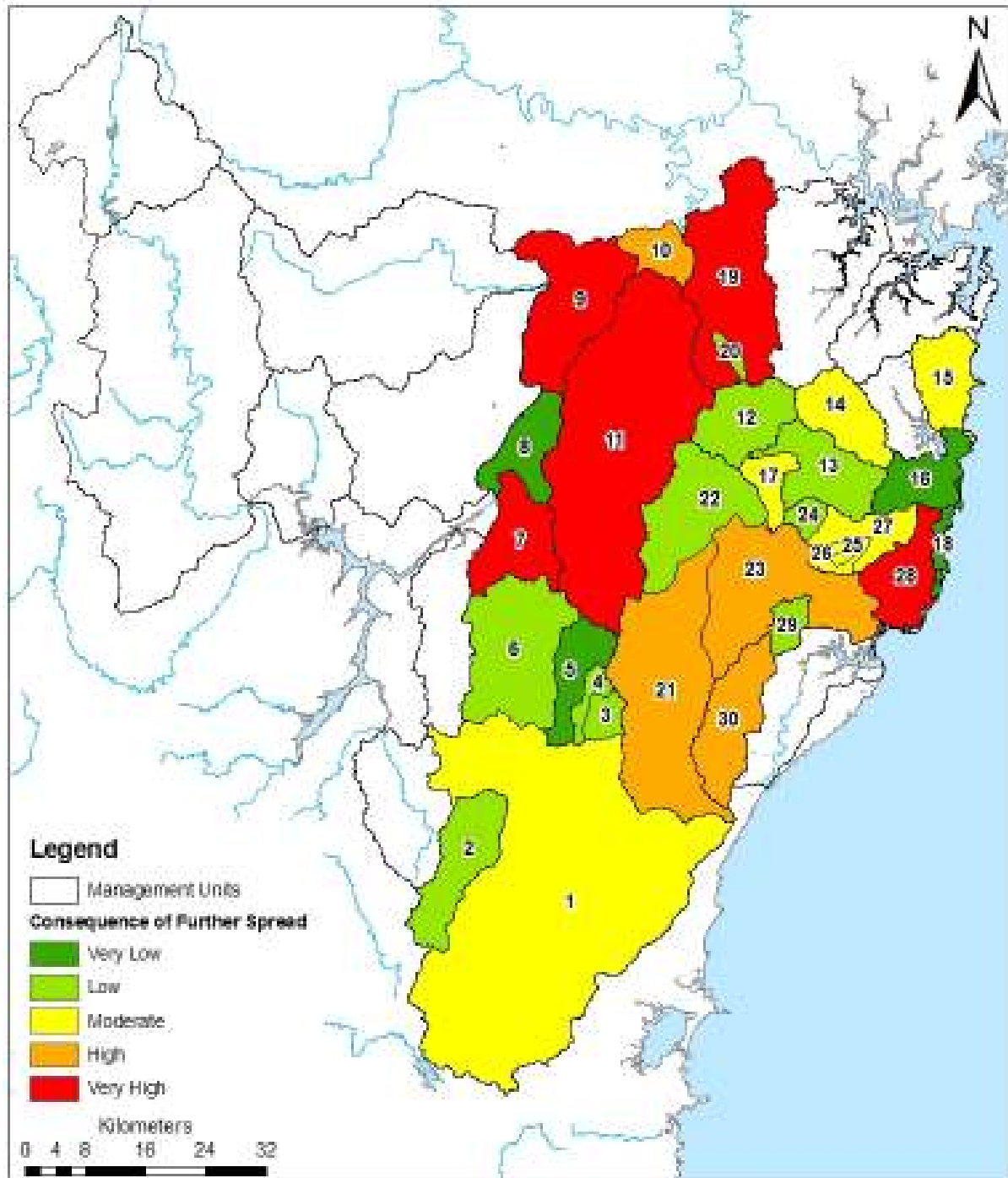
4.3 Recording consequence of further spread

The map depicts consequence of further spread as:

- 1- Very Low – dark green
- 2- Low – light green
- 3- Moderate - yellow
- 4- High – orange
- 5- Very high - red

The final scores for the consequence of further spread within each management unit range from 1 to 5. Each score corresponds with a level of impact, that is, 1 = very low, 5 = very high. Each level of impact is assigned a colour which ranges from Dark green (for very low impact) to Red (for very high impact). The score for impact of spread on each management unit is shown in Figure 9.

Fig 9. Consequence of the further spread of Alligator Weed in MU



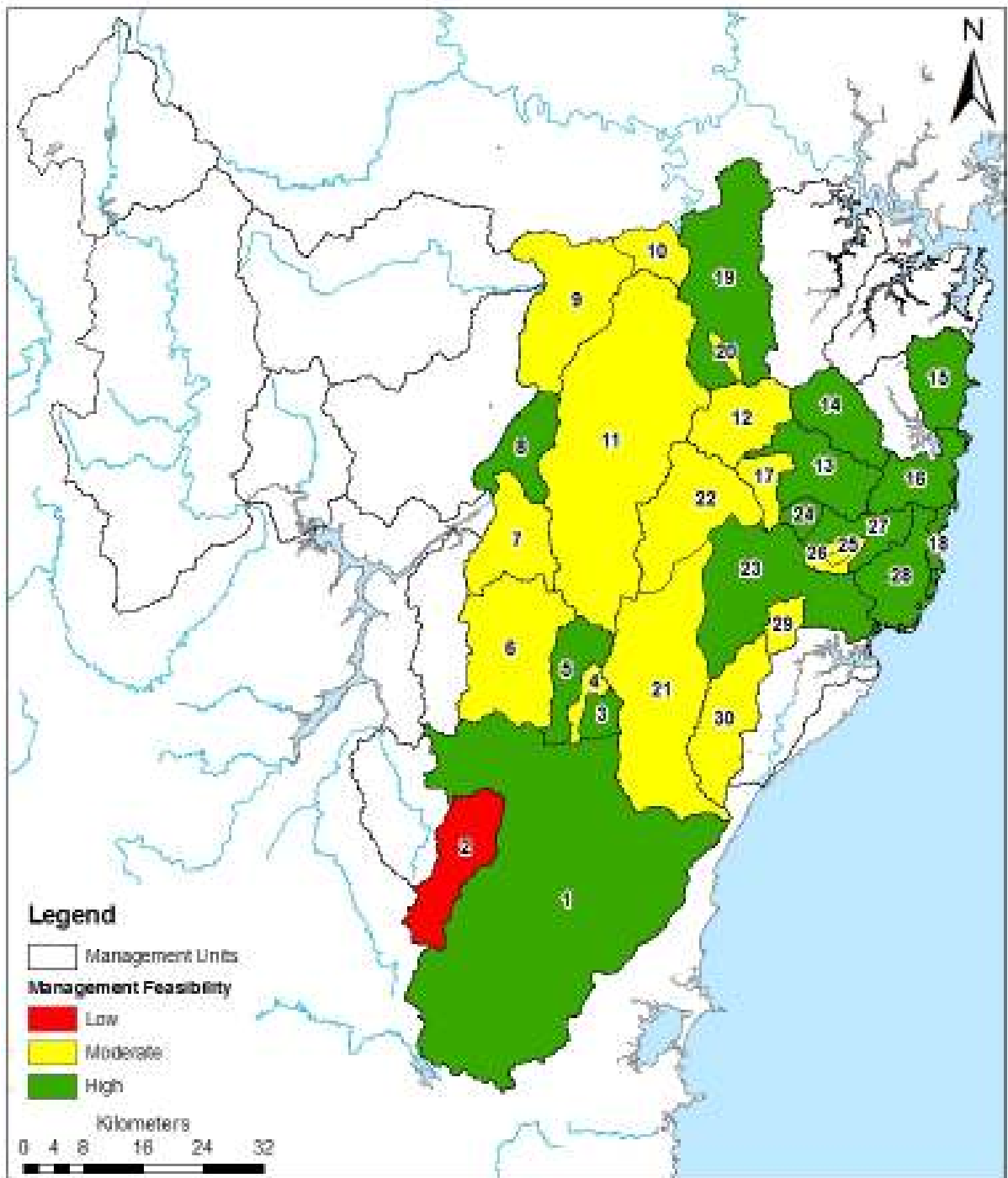
4.4 Recording management feasibility

The map depicts management feasibility as:

- 1- Low – Red
- 2- Moderate – Yellow
- 3- High – Green

The ability to successfully manage the alligator weed infestation was given a rating between 1 and 3. One indicates that there was a low potential for the alligator weed to be successfully managed, while 3 indicated that there was a high potential for the Alligator Weed to be managed and in some cases, potentially eradicated. The scores assigned to the management units in the study area are displayed in Figure 10.

Fig 10. Feasibility of managing Alligator Weed in MU



4.5 Recording total scores

- 0 – 10 = Low – Green
- 11 – 17 = Moderate – Yellow
- 18 – 23 = High – Orange
- 24 – 30 = Very High – Red

According to the final score, management units were assigned to groups ranging from low to very high. Low included management units with final scores between (and including) 0 to 10. Moderate were those between 11 and 17. High was between 18 and 23. Those with scores between 24 and 30 were assigned to the Very High group. Hence:

VERY HIGH:

Cattai
Botany

HIGH:

Douglas Park to Menangle Weir
Downstream of Liverpool Weir
Gulguer Gorge end Norton's Basin
Penrith Weir to Windsor Bridge
South, Kemps and Eastern Creek
Lane Cove
Lower Cooks River – downstream of Punchbowl Road
Upstream Liverpool Weir

MODERATE:

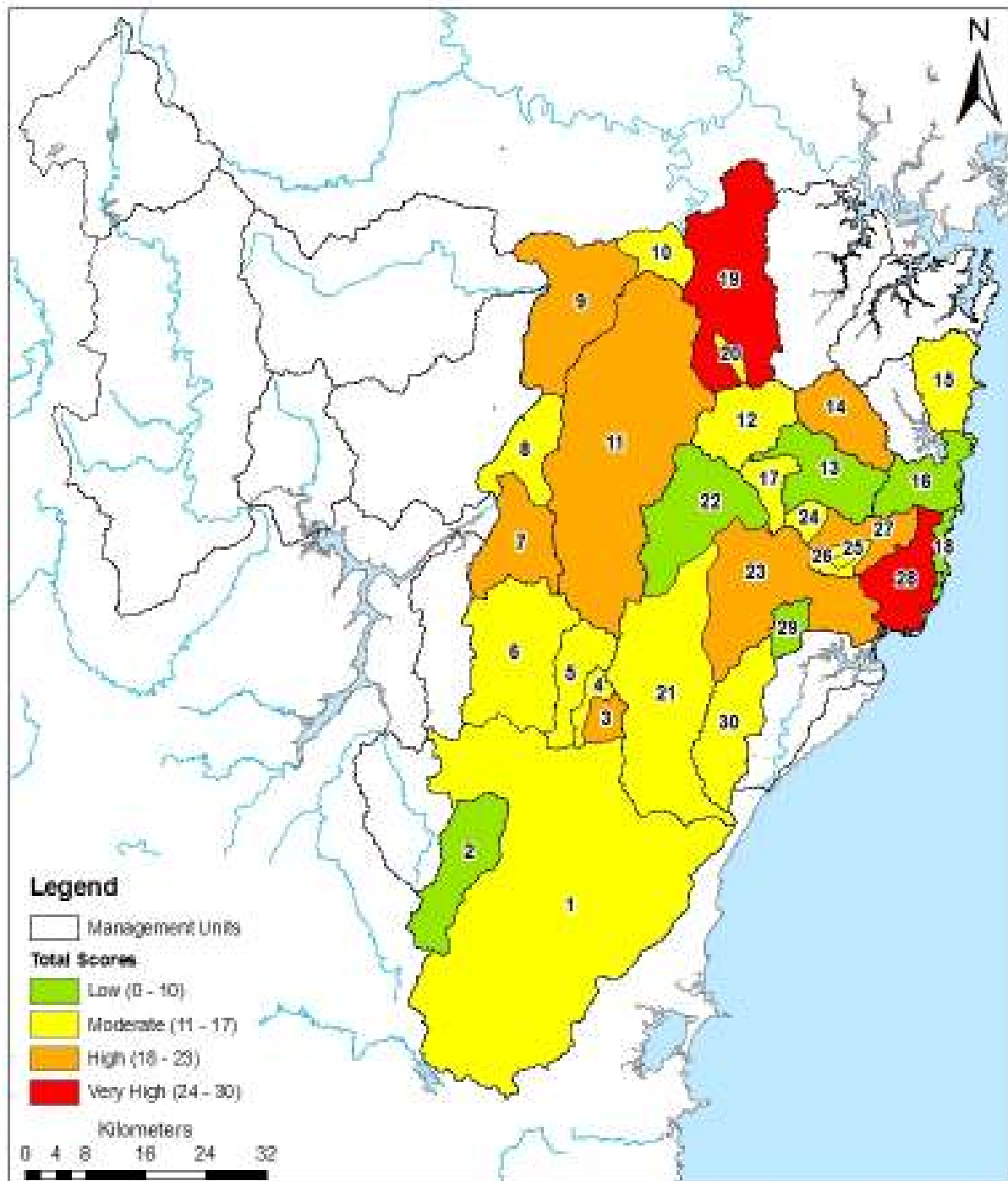
Northern Beaches
Nepean Dam to Douglas Park
Menangle Weir to Burgen's Weir
Burgen's Weir to Camden Weir
Camden Weir to Gulguer
End Norton's Basin to Penrith Weir
Windsor Bridge to Cattai Creek
Smalls Creek
Duck River
Upper Cooks River to Punchbowl Road
Woronora River - Above the Needles to Heathcote Road
Wolli Creek
Bardwell Creek
Upper Parramatta River – Toongabbie and Darling Mills Creeks

LOW:

Port Jackson
Bargo River
Eastern Beaches
Cabramatta/Prospect Creeks
Lower Parramatta River – from confluence of tributaries to Hunters Hill
Woronora River - Bottle Creek to Woronora River

The scores assigned to the management units in the study area are displayed in Figure 11.

Fig 11. Total scores obtained by MU in scoring sessions, grouped

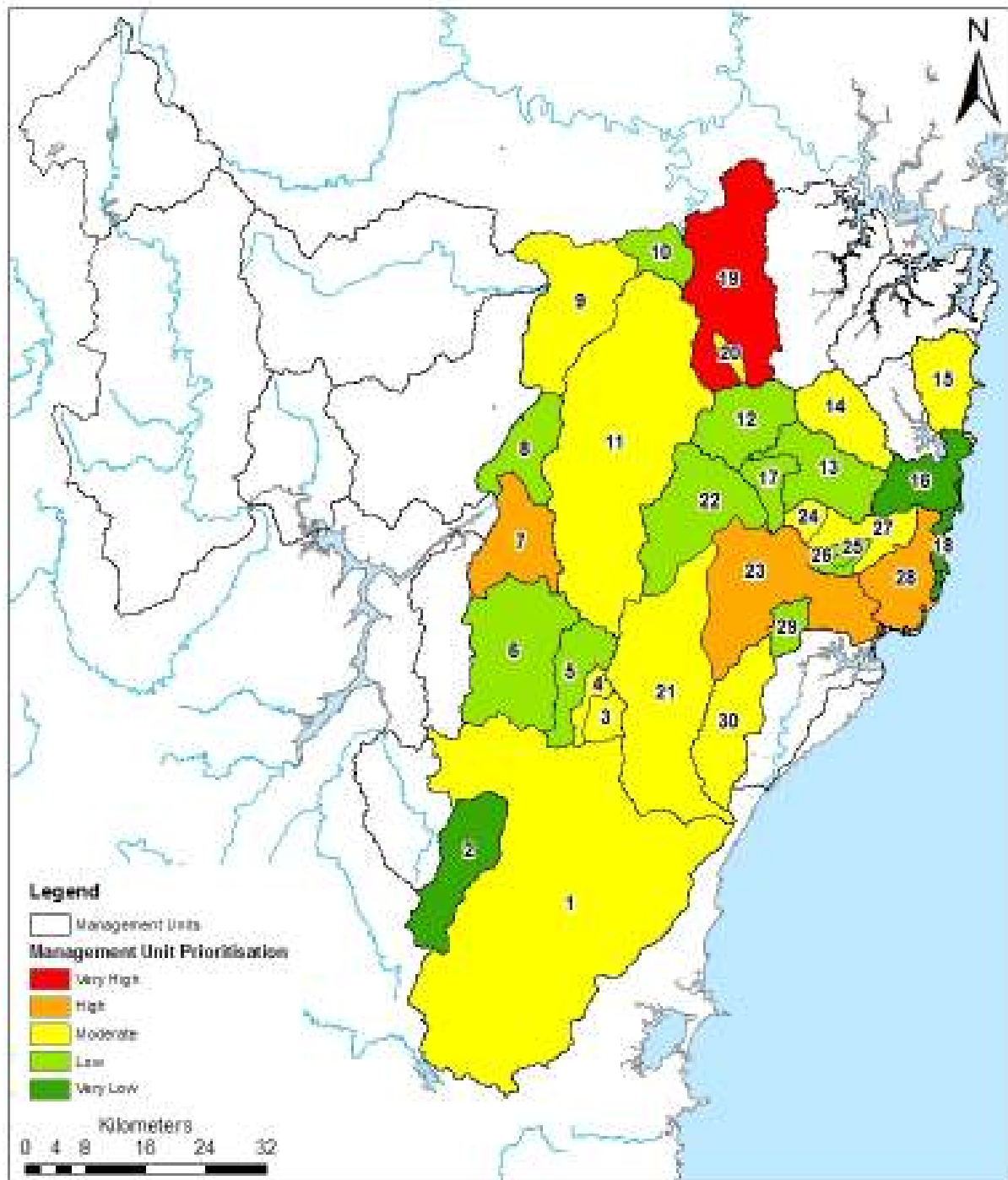


4.6 Assigning a priority rating to total scores

- 1- Very High – red
- 2- High – orange
- 3- Moderate – yellow
- 4- Low – light green
- 5- Very Low – dark green

These ratings were assigned according to the total score of the management unit. Management units which obtained a final score 25 or greater were given a very high priority rating (indicated by red). Management units with a final score between 19 and 24 were assigned a high priority rating (indicated by orange). Units with final scores from 13 to 18 were given a moderate priority rating (shown by yellow). Management units which had scores between 7 and 12 were allocated a low priority rating (light green) and units with final scores between 0 and 6 were rated very low (dark green). The priority ratings assigned to the management units are shown in Figure 12.

Fig 12. Final priority ratings for resource allocation to control Alligator Weed in MUs



5. Determination of management actions based on results of assessment scores, individual and combined.

Management actions derive from the scores for each of the three factors assessed and address optimum potential results for the management unit relating to containment of spread and the mitigation of impacts respectively. Based on a list of actions resulting from assessments of the Hunter infestations⁴ and adapted for Sydney conditions they are as follows:

Table 3. Generic management actions for the Sydney Region

VERY HIGH:	
<i>Spread:</i>	<i>Contain all spread within unit and to neighbouring units</i>
<i>Impact:</i>	<i>Mitigate impacts to all biodiversity and manage buffers and establish further buffers around management unit</i>
<i>Management:</i>	<i>Containment and buffers</i>
HIGH:	
<i>Spread:</i>	<i>Reduce spread within the management unit and contain all spread to neighbouring units</i>
<i>Impact:</i>	<i>Mitigate impacts to all biodiversity assets with managed buffers</i>
<i>Management:</i>	<i>Reduce all infestations: manage infestations at priority sites</i>
MODERATE:	
<i>Spread:</i>	<i>Contain spread to priority areas</i>
<i>Impact:</i>	<i>Mitigate impacts to priority biodiversity assets with managed buffers</i>
<i>Management:</i>	<i>Reduce infestations at priority sites</i>
LOW:	
<i>Spread:</i>	<i>Monitor spread</i>
<i>Impact:</i>	<i>Monitor impacts</i>
<i>Management:</i>	<i>Monitor/manage infestations</i>

Hence the following proposed management of the assessed Sydney Management Units which combines the generic actions above for each ranked priority group with specific recommendations from officers with knowledge of the units present at the summary session.

VERY HIGH:

Cattai Creek

Contain all spread within unit and to neighbouring units

Mitigate impacts to all biodiversity and manage buffers and establish further buffers around management unit

Containment and buffers

Cattai Creek requires further subdivisions of its tributaries to determine internal management priorities. Locate and treat most upstream sources. Minimise spread from likely vectors. Institute vehicle hygiene protocols. Encourage council to apply weed control conditions for DA approval. Continually suppress infestations; reduce or eradicate to prevent spread and to protect downstream assets.

⁴ Generic management priorities: A Landscape Unit Based Approach to the Prioritisation of Alligator Weed (*Alternanthera philoxeroides*) Management in the Hunter and Central Coast Region of New South Wales, June 2009. (Table 6 of that report.)

Botany Bay

Contain all spread within unit and to neighbouring units

Mitigate impacts to all biodiversity and manage buffers and establish further buffers around management unit

Containment and buffers

Eradicate or reduce infestations to protect key ecological assets, especially the largest patch of extant saltmarsh. Manage infestations in close proximity to the Towra Point saltmarsh.

HIGH:

Douglas Park to Menangle Weir

Reduce spread within the management unit and contain all spread to neighbouring units

Mitigate impacts to all biodiversity assets with managed buffers

Reduce all infestations; Manage infestations at priority sites.

Reduce with view to eradication; monitor and re-treat where necessary.

Downstream of Liverpool Weir

Reduce spread within the management unit and contain all spread to neighbouring units

Mitigate impacts to all biodiversity assets with managed buffers

Reduce all infestations; Manage infestations at priority sites.

Mitigate impacts to salt marsh areas in Bankstown and important assets in Liverpool Council area, e.g. Voyager Wetlands.

Monitor any freshwater inflows for re-infestations sources.

Monitor infestations with the potential to affect Alford Point, Beauty Point and Mickey's Point

Gulguer Gorge to the end of Norton's Basin

Reduce spread within the management unit and contain all spread to neighbouring units

Mitigate impacts to all biodiversity assets with managed buffers

Reduce all infestations; Manage infestations at priority sites.

Penrith Weir to Windsor Bridge

Reduce spread within the management unit and contain all spread to neighbouring units

Mitigate impacts to all biodiversity assets with managed buffers

Reduce all infestations; Manage infestations at priority sites.

Contain spread by control around high volume recreational areas.

Area is characterised by highly modified multi-channelled stream bed and high nutrient availability with poor access from Penrith to Yarramundi, then single channel. Reduce all infestations wherever possible and maintain annual control actions and monitoring. Ensure containment to existing sites and ensure no further terrestrial spread. Do not rely on bio-control action. Note presence of mega-sized plants due to nutrients.

South, Kemps and Eastern Creek

Reduce spread within the management unit and contain all spread to neighbouring units

Mitigate impacts to all biodiversity assets with managed buffers

Reduce all infestations; Manage infestations at priority sites.

Ensure that there is no spread to the floodplain. Manage spread vectors such as earth moving associated with development and agriculture.

Development applications greater than 1 ha should contain conditions to ensure control and prevent spread. Protect Kemps Creek Nature Reserve, ecological assets.

Lane Cove

Reduce spread within the management unit and contain all spread to neighbouring units

Mitigate impacts to all biodiversity assets with managed buffers

Reduce all infestations with view to eradication; *Protect EECs, freshwater wetlands.*

Lower Cooks River – downstream of Punchbowl Road

Reduce spread within the management unit and contain all spread to neighbouring units
Mitigate impacts to all biodiversity assets with managed buffers
Reduce all infestations; Manage infestations at priority sites.
Mitigate impacts to downstream salt marsh. Monitor freshwater inflows for re-infestation.

MODERATE:

Upstream Liverpool Weir

Contain spread to priority areas
Mitigate impacts to priority biodiversity assets with managed buffers
Reduce infestations at priority sites
*Contain spread to waterways. Reduce infestations. Protect Cumberland Plain woodland.
Dispose of Gross Pollutant Trap sediment appropriately.*

Northern Beaches

Contain spread to priority areas
Mitigate impacts to priority biodiversity assets with managed buffers
Reduce infestations at priority sites
*Narrabeen Creek: Continually suppress infestation. Periodic inspections of downstream areas and nearby wetland to check for spread. Ensure appropriate hygiene procedures are followed for any works conducted in creek.
Dress Circle Rd. Avalon terrestrial infestation: Aim for eradication and continually suppress. Contain infestation and ensure area is not mown.*

Nepean Dam to Douglas Park

Contain spread to priority areas
Mitigate impacts to priority biodiversity assets with managed buffers
Reduce infestations at priority sites
*Monitor the river for re-occurrence. Contain infestations of urban properties.
Aim for eradication of existing infestations.*

Menangle Weir to Burgen's Weir

Contain spread to priority areas
Mitigate impacts to priority biodiversity assets with managed buffers
Reduce infestations at priority sites
Contain and reduce spread to downstream areas.

Burgen's Weir to Camden Weir

Contain spread to priority areas
Mitigate impacts to priority biodiversity assets with managed buffers
Reduce infestations at priority sites
Contain and reduce spread to downstream areas.

Camden Weir to Gulguer

Contain spread to priority areas
Mitigate impacts to priority biodiversity assets with managed buffers
Reduce infestations at priority sites
Contain and reduce spread to downstream areas.

End Norton's Basin to Penrith Weir

Contain spread to priority areas
Mitigate impacts to priority biodiversity assets with managed buffers
Reduce infestations at priority sites
Contain and reduce spread to downstream areas.

Windsor Bridge to Cattai Creek

Contain spread to priority areas

Mitigate impacts to priority biodiversity assets with managed buffers

Reduce infestations at priority sites

Contain and reduce spread to downstream areas.

Smalls Creek

Contain spread to priority areas

Mitigate impacts to priority biodiversity assets with managed buffers

Reduce infestations at priority sites

Contain and reduce spread to downstream areas.

Duck River

Contain spread to priority areas

Mitigate impacts to priority biodiversity assets with managed buffers

Reduce infestations at priority sites

Contain and reduce spread to downstream areas.

Upper Cooks River to Punchbowl Road

Contain spread to priority areas

Mitigate impacts to priority biodiversity assets with managed buffers

Reduce infestations at priority sites

Contain and reduce spread to downstream areas.

Woronora River - Above the Needles to Heathcote Road

Contain spread to priority areas

Mitigate impacts to priority biodiversity assets with managed buffers

Reduce infestations at priority sites

Contain and reduce spread to downstream areas.

Wolli Creek

Contain spread to priority areas

Mitigate impacts to priority biodiversity assets with managed buffers

Reduce infestations at priority sites

Contain and reduce spread to downstream areas.

Bardwell Creek

Contain spread to priority areas

Mitigate impacts to priority biodiversity assets with managed buffers

Reduce infestations at priority sites

Contain and reduce spread to downstream areas.

Upper Parramatta River – Toongabbie and Darling Mills Creeks

Contain spread to priority areas

Mitigate impacts to priority biodiversity assets with managed buffers

Reduce infestations at priority sites

Contain and reduce spread to downstream areas.

LOW:**Port Jackson**

Monitor spread

Monitor impacts

Monitor/manage infestations

Bargo River

Monitor spread
Monitor impacts
Monitor/manage infestations

Eastern Beaches

Monitor spread
Monitor impacts
Monitor/manage infestations

Cabramatta/Prospect Creeks

Monitor spread
Monitor impacts
Monitor/manage infestations

Lower Parramatta River – from confluence of tributaries to Hunters Hill

Monitor spread
Monitor impacts
Monitor/manage infestations

Woronora River - Bottle Creek to Woronora River

Monitor spread
Monitor impacts
Monitor/manage infestations

An additional management tool is to apply conditions on development applications so that any Alligator Weed infestations need to be controlled/eradicated as a consent condition. (Appendix D)

6. Evaluating the landscape unit based approach to the prioritisation of Alligator Weed and implementing outcomes in the Sydney Basin

6.1 Limitations of Approach

The Sydney teams agreed that the landscape unit based approach to the prioritisation of Alligator Weed management is extremely helpful for determining a strategic allocation of resources and is a sound basis upon which to develop management plans/regimes. Its immediate applicability to other aquatic species was noted and some observed that it could perhaps be adapted to some non aquatic weed species. As with the Hunter process the team agreed that the assessment of potential for spread 'is difficult in areas where human activities may result in sudden movements over large areas (including outside of the study area), in terms of keeping scores in proportion to those for areas dominated by natural dispersal vectors'.⁵ As in the Hunter, Sydney teams lacked precise knowledge of the (efficacy of) hygiene practices of contractors involved in managed canals and other activities likely to cause spread. Again, 'to address these issues it may be necessary over time to develop a separate assessment and management strategy for highly managed areas'.⁶

⁵ A Landscape Unit Based Approach to the Prioritisation of Alligator Weed (*Alternanthera philoxeroides*) Management in the Hunter and Central Coast Region of New South Wales

⁶ Ibid.

Perhaps because of the more modified landscape across the Sydney Basin Region and/or topographical differences (less floodplain and therefore less potential to spread to certain assets), in contrast with the Hunter, the issue of potential impacts to infrastructure as opposed to the natural assets of waterways and biodiversity was not considered.

6.2 Implementing outcomes to date

As soon as possible detailed management plans for each management unit (derived from initial generic recommendations) should be developed, and appended to this report (as a document for regular review to guide regional best practice).

Councils should develop consent conditions pertaining to Alligator Weed infestations and submit these with detailed management plans to funding bodies/programmes.

As far as possible funding should be allocated to the highest priority locations (where it is demonstrated that control can be implemented to appropriate standards). Where this is not possible, (for reasons of personnel shortage or other), funds should be allocated to the next highest priority area.

The regional weeds committee should attempt to review this report annually so that condition change is taken into account when funding is allocated.

Where this is deemed not detrimental to control outcomes (i.e. diverted from control measures deemed vital), funding should be allocated to facilitate this process.

Appendix A - List of Data Sets

Data Set	Description	Source
Management Units	Division of study area into smaller units based on sub catchments and suggestions made by Noxious Weeds Officers (2009)	Sydney Weeds Committee
Alligator Weed	Location and percentage cover of Alligator Weed within the study area in 2009	Layer produced from the merge of Alligator Weed data sets (Chandrasena, 2008, 2007), and Noxious Weeds Officers (2009).
Watercourses	Rivers, Streams, Drainage lines, and water bodies	Layer produced from the combination of drainage, major water bodies and ocean layers from the Department of Environment, Climate Change and Water
10m Contours	Elevation contours at 10m intervals	Department of Environment, Climate Change and Water
1:100 Flood	1:100 year flood levels for the Hawkesbury River	Department of Environment, Climate Change and Water
SMCMA Wetlands	Location of RAMSAR listed wetlands in the SMCMA	Sydney Metropolitan Catchment Management Authority
HNCMA Wetlands	Location of RAMSAR listed wetlands in the HNCMA	Hawkesbury Nepean Catchment Management Authority
The Native Vegetation of the SMCMA.	Endangered Ecological Communities and Native Vegetation in the SMCMA (2009)	Department of Environment, Climate Change and Water
HNCMA Endangered Ecological Communities	Endangered Ecological Communities in the HNCMA	Hawkesbury Nepean Catchment Management Authority
Roads	Road infrastructure in NSW	Department of Environment, Climate Change and Water
NSW Towns	Town locations in NSW	Department of Environment, Climate Change and Water
Rail	Rail infrastructure in NSW	Department of Environment, Climate Change and Water
Open Space Inventory	Parks and Reserves	National Parks and Wildlife Service
0.5cm Aerial photographs (2008)	Aerials photographs from 2008	Department of Lands
Spot5 Satellite Imagery	Satellite Imagery	Department of Environment, Climate Change and Water

Appendix B: Records of scoring sessions and explanatory notes

SESSION 1

Present:

Rebecca Coventry	Office of the Hawkesbury Nepean
Joel Daniels	Liverpool Council
James Redgrave	Camden Council
Keith Rossiter	Hawkesbury River County Council
Alex Burgess-Buxton	Wollondilly Council
Frances Pike	Sydney Weeds project officer
Jane Bailey	GIS officer via SMCMA

Bargo River – *No infestation is recorded in Bargo and though most other catchment where this is the case were left out, it's proximity to others meant its inclusion – (therefore monitoring).*

Nepean Dam to Douglas Park – *In this area terrestrial infestations in only four backyards with a combined area of 50 square metres are treated with Metsulfuron and there is ongoing education of the occupiers. The infestation can be eradicated. There would be a significant impact were the infestation permitted to spread.*

Douglas Park to Menangle Weir – *This is an area were treatment is likely to be very successful as there is no terrestrial infestation and the topography allows for effective treatment. It is cliffs with deep water and EEC's are not readily affected. Treatment occurs by boat. The old weir over which water flow is high meaning that there is not trapping of the weed.*

SESSION 2

Present:

Frances Pike
David Kuhle Parramatta
Matt Springall DECC Sydney North

Toongabbie Creek and Darling Mills Creek - *From David Kuhle: he is certain of infestation data here as the in-stream aquatic vegetation survey was consulted and no incidence of Alligator Weed in the Middle Harbour Catchment (as this project included Parramatta River within that study), except in Toongabbie creek.*

Although the principal infestation is in Toongabbie Creek, similarity of terrain makes it useful to link these two tributaries.

David Kuhle observed that even these lower scored areas require ongoing minor control, even with staged eradication as an objective.

Confluence of tributaries to Hunters Hill

This section is infested almost all along the Parramatta River with scattered infestations and is unlikely to spread upstream into any tributaries entering the river, even with high tides. Although mangroves are present the infestations tend to be aquatic.

Duck River – *more potential for spread and will impact the adjacent vegetation if it does so.*

Lane Cove – *There is still an infestation upstream in Macquarie Dam and reports of infestation in Shrimpton's Creek. Should the infestation be upstream of ELS Hall Reserve (i.e. Kent Road) then the score will need to be revised (up).*

Management feasibility needs to be revised when funds arrive. If there is no-one to undertake control or to manage funds then resources need to be directed elsewhere.

Northern Beaches – *from Lavinia Schofield not present: from time to time the Narrabeen Creek where the only known Northern Beaches infestations exists, there is occasionally a need to remove shopping trolleys and/or other objects from the creek and hence there is a chance of spread to other areas and in particular the Warriewood Wetlands which are regionally significant wetlands immediately adjacent and also which are used by the international migratory birds shared with Japan. Also, as bush regeneration occurs there is potential for a volunteer to remove it and spread it along the riparian zones.*

SESSION 3:

Present:

Frances Pike	Project Officer
Jeanie Muspratt	Strathfield Council
Peter Goss	Canterbury Council
Assad Baheer	Sydney Water Stormwater Manager

Upper Cooks River – *Upstream of Muirs Road in Sydney Water land Assad advised that Garry Blashke (community monitor) insists there is no infestation at this point. Downstream of Muirs Road Sydney Water has lots of Alligator Weed – 60% coverage not 2 or 3%*

Lower Cooks River – *Ongoing monitoring of manually removed infestation occur. Both Canterbury Council and Sydney Water ensure that it is not currently present.*

SUMMARY SESSION DECEMBER 2009:

Present:

Rebecca Coventry	Office of the Hawkesbury Nepean
Alex Burgess-Buxton	Wollondilly Council
Matthew Springall	NPWS, DECC
Marshall Thurlow	Campbelltown Council
Joel Daniels	Liverpool Council
James Redgrave	Camden Council
Frances Pike	Sydney Weeds project officer
Craig Shepherd	NPWS, DECC
Andrew Petroeschovsky	National Aquatic Weed Co-ordinator

Additional scoring occurred during summary session for the Upper and Lower Georges River Areas given the immediate threat to Towra Point Nature Reserve with information provided by Craig shepherd. This resulted in a revised score which placed both these units into higher priority groups.

Appendix C: Records of notes from meeting of Alligator Weed Task Force January 2009. (Note: Information was only available from those present and in some cases could be obsolete, i.e. recommended actions could have occurred)

WOLLONDILLY: Most upstream locations: Council aware of Douglas Park infestations but have been informed by fishing club of further upstream scattered infestation.

Mapping required: extensive mapping required along 6 km upstream of Maldon Weir. Private land: dams are present upstream. Landholders will require Chem. Cert III certification. Can this be contribution of private landholders and they participate in DPI training courses?

Problematic features to be addressed: Alligator Weed gets caught in the rocks at overflows and the side of weirs. Community participation can involve monitoring by Bass Fishing club which ventures to extreme upstream locations and which are willing to spot for weeds. Wollondilly has a healthy catchment committee and the membership includes: members of the Greens, Sydney Catchment Authority, BHP Billiton, community members, Southern Coal Fields, Bass Fishing Club

Required: intensive control between Maldon Weir (very steep) and Wallacia Weir. Upstream of Bargo River is o.k. Bents Basin is the lower end and DECC control there.

CAMDEN: Most upstream locations: Alligator not yet seen upstream Bringelly Rd to upper head of catchment at St Gregorys. The top end of south Creek is Oran Park.

Mapping required: South and Kemps Creek (\$3,000)

Current agency funded control: Between Upper South Creek and Bringelly Road.

Current control DPI: \$8,000 DPI for the above is administered by Wollondilly as part of the \$30,000 annual expenditure quoted.

LIVERPOOL: Problematic features to be addressed: Sydney University Farms need to be engaged to control weeds on their land.

Required: Gap between Bringelly Road and Kemps Creek Nature Reserve

CAMPBELLTOWN: Most upstream locations: Are all already mapped and provided to Sydney Weeds

Mapping required: Campbelltown need to continue current treatment which is 3 treatments per year

D.E.C.C: ROUSE HILL AREA - \$10,000 is the estimate for control of this area and needs to be detailed after consultation with Baulkham Hills Council and Sydney Water

LANE COVE: Potential field best practice site with collaboration with Macquarie University – (subsequently by Ryde Council which has controlled almost to eradication on their waterways)

BOTANY – Contributions to both the council and other stakeholders to be determined but estimate \$10,000

Private land: Need to engage the Golf Clubs in the area

BLUE MOUNTAINS: Check that Alligator Weed is controlled at this location where an old Sydney Water Tower existed. Estimate \$5,000 p.a.

References:

- Sommerville, Michael. (2009). *A Landscape Unit Based Approach to the Prioritisation of Alligator Weed (Alternanthera philoxeroides) Management in the Hunter and Central Coast Region of New South Wales*, June 2009 (Final Report of a joint initiative undertaken by the Hunter & Central Coast Regional Environmental Management Strategy Team & the Commonwealth Government Department of Agriculture, Fisheries and Forestry, National Aquatic Weeds Management Group)
- Chandrasena, Nimal. (2008). *Assessment of Risk of Spread for Strategic Management of the Core Alligator Weed Infestations in Australia - 'Taking Stock'*, Department of Agriculture, Fisheries and Forestry, October 2008