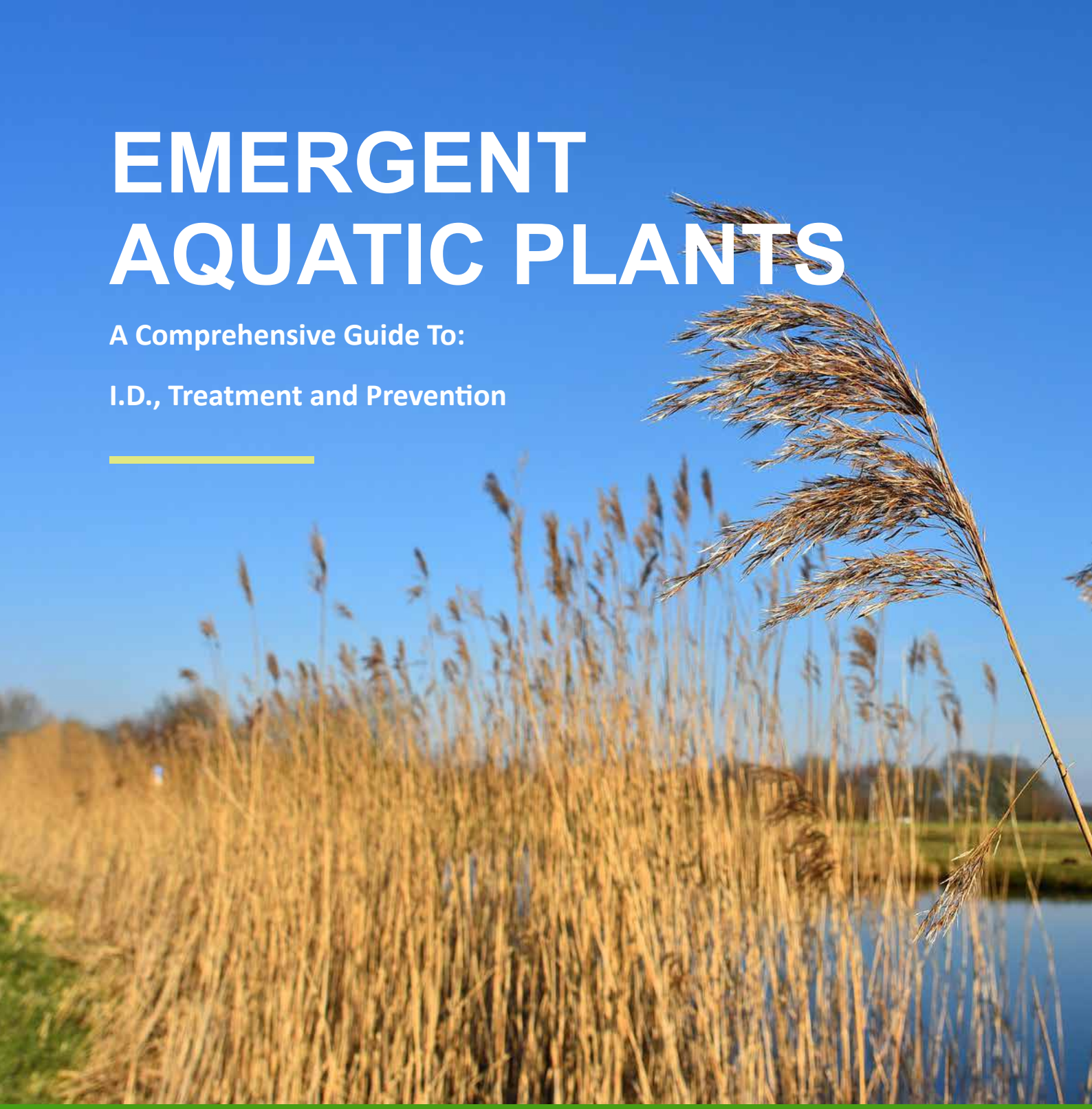

EMERGENT AQUATIC PLANTS

A Comprehensive Guide To:

I.D., Treatment and Prevention

Authored by Isabella Barrow

Aquatic Technologies, 2023

AQUATIC TECHNOLOGIES

The Water Treatment Experts!

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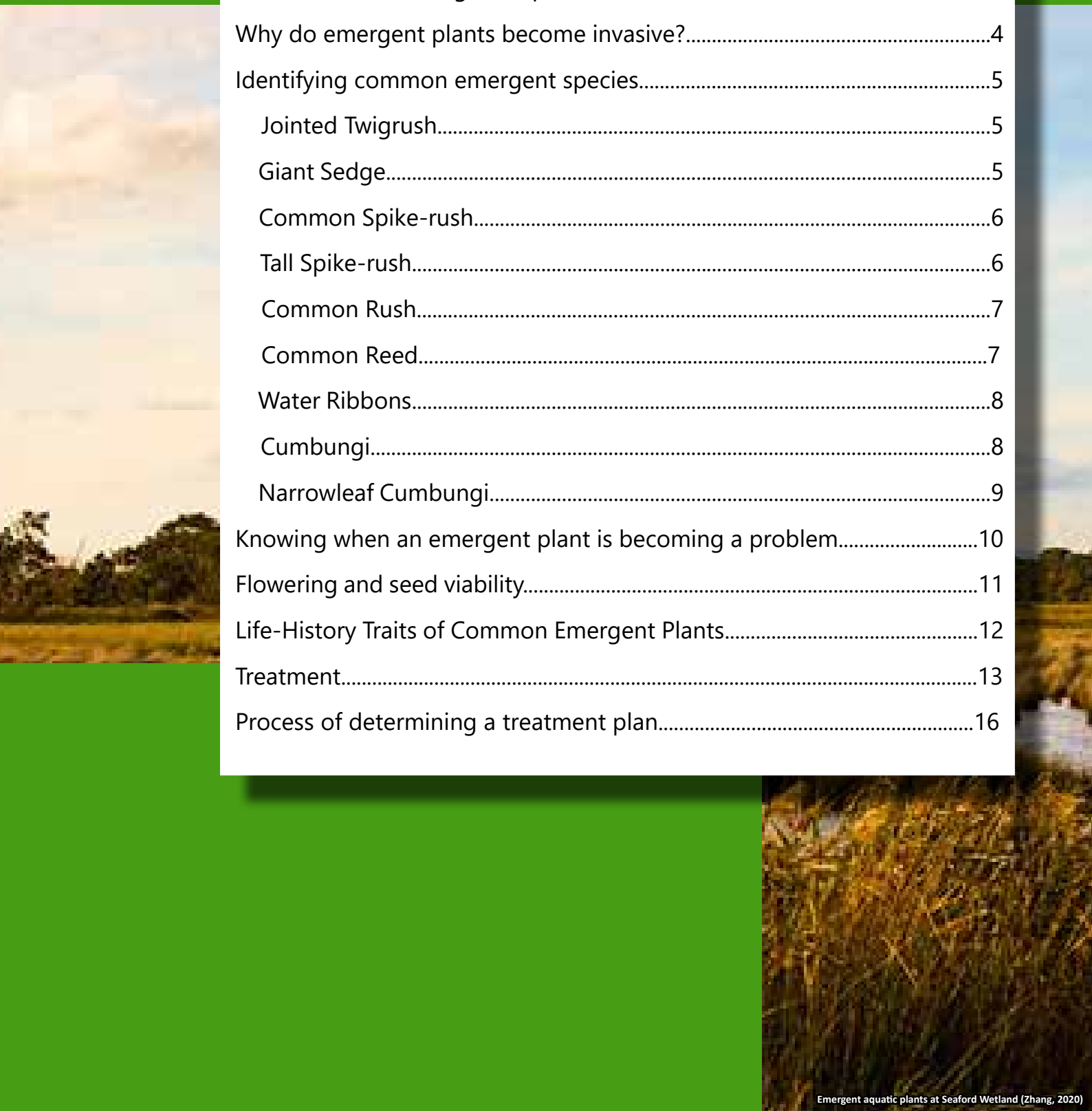

Emergent aquatic plants at Seaford Wetland (Zhang, 2020)

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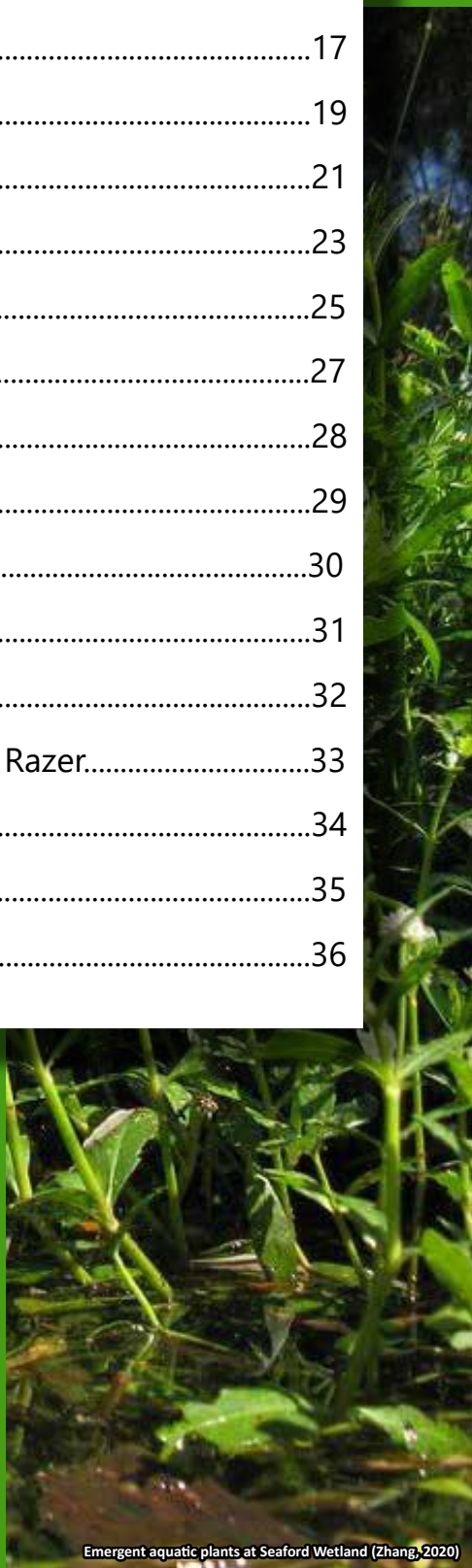


Emergent aquatic plants at Seaford Wetland (Zhang, 2020)

INTRODUCTION TO EMERGENT AQUATIC PLANTS

Emergent plants are characterised by having dense, often rhizomatous roots in shallow soils along the water's edge, with their growth habit emerging from the water. They occur along banks of rivers, streams, creeks, and irrigation channels, and can often tolerate some salinity. Emergent plants can be highly valuable for binding soil and reducing erosion [1]. They can improve water quality by slowing water flow and trapping sediment, soil and run-off from adjacent land by accumulating nutrients in their stems and rhizomes [1]. These species provide essential habitat and food sources for native fauna, and may also help control exotic weed species by outcompeting for nutrients [1].

However, emergent species can be problematic when they become invasive. When a species becomes invasive, they outcompete other native plants, changing the plant community and risking damage to the overall health and functionality of the ecosystem [2]. Furthermore, when an emergent plant becomes invasive, they can obstruct drainage and flow in shallow channels [3]. Freshwater ecosystems play a crucial role in nutrient and water cycling, which provide essential ecosystem services for humans [4]. The health of these ecosystems is reliant on a complex and functioning vegetative community. It remains essential that emergent aquatic species are managed appropriately in a variety of environmental settings.

Cumbungi invading a waterway and obstructing flow (Hardyy, 2021)

Why do emergent plants become invasive?

Emergent plant species become invasive when they grow out of control, displacing native vegetation communities, and obstructing drainage [5].
A range of factors can lead to an emergent aquatic plant becoming invasive:

- Changes in hydrologic regime: the relationship between high and low flows [2]
- Increased nutrient level: increased fertilisation from adjacent run-off [6]
- Changing climatic conditions: increased atmospheric carbon dioxide, warming ocean and coastal currents and increased ambient temperature [7]

Changing climatic conditions have seen species spread to new locations with similar climates as their native range, and become invasive [7]. This can pose challenges for land managers, as species previously not thought of as a weed become invasive when their home range extends. Invasive species have particular traits that make them more likely to become a weed infestation. Many invasive species are pioneer species – they are the first species to colonise an area after disturbance [7]. Their ability to exploit disturbed habitats make them particularly problematic in agricultural settings.

IDENTIFYING COMMON EMERGENT SPECIES


Baumea articulata flower head (Rose, 2008)


Baumea articulata habit (Rose, 2008)

Name:	***Baumea articulata* – Jointed twigrush**
Description:	An emergent, native perennial sedge growing up to 2.5 metres tall. *Baumea articulata* has cylindrical stems with basal, hollow leaves that are as long, or longer, than the stem, and a straw-coloured sheath [8]. Reddish-brown, loose and drooping inflorescence, containing spikelets, and flowers between spring and summer (November – April)[8].
Habitat:	Still water such as lagoons and deeper swamps, as well as slow-moving streams [8].
Distribution:	NSW, VIC, WA, QLD, SA, TAS
Reproduction:	*Baumea articulata* is a monoecious plant, meaning it contains both female and male parts. It reproduces vegetatively via belowground clonal rhizomes, and via seed [9].
Dispersal:	*Baumea articulata* disperses through water (hydrochory), and via the fruit dropping below the parent plant as a result of gravity (barochory) [9].


Cyperus exaltus (Le, 2006)


Cyperus exaltus (Rose, 2008)

Name:	***Cyperus exaltatus* – Giant sedge**
Description:	An emergent, native perennial sedge growing up to 2 metres tall and forming tussocks. Flat, linear, green leaves, as long as or longer than flowering stem, with sheath at base [8]. Large inflorescence with numerous spikelets, yellow to dark yellow/brown [8]. *Cyperus exaltatus* flowers between spring and summer (Sep. – Feb.), and fruits between summer and autumn (Dec.-May) [9].
Habitat:	Shallow water, such as swamps or wetland margins, and banks of streams and lagoons [8].
Distribution:	NSW, VIC, SA, WA, QLD, NT
Reproduction:	*Cyperus exaltatus* is a monoecious plant. Reproduces via seed, and vegetatively, through underground rhizomes. *Cyperus exaltatus* is a geophyte, meaning the rhizome is buried in dry soil, with leaves dying back in winter months [9].
Dispersal:	*Cyperus exaltatus* disperses through water (hydrochory).

IDENTIFYING COMMON EMERGENT SPECIES


Common spike-rush flower head (Disley, 2022)


//Find accurate photo reference please

Eleocharis acuta growth habit (Beckers, 2011)

Name:	***Eleocharis acuta* – Common spikerush**
Description:	A native perennial, growing less than 1 metre tall. Leaves are reduced to basal sheaths, with light to dark green cylindrical to flattened stems. Stems are triangular in cross-section just below the spikelet [8]. Inflorescence at the tip of the spike, composing narrow-cylindrical spikelets, approximately 10-30mm in length, and yellow-brown to brown in colour [10]. Flowers between spring and summer (Sep. – Feb.). *Eleocharis acuta* are non-mycorrhizal, meaning the roots are resistant to mycorrhizal fungi and generally remain uncolonised [9].
Habitat:	Stationary and slow-moving water. Widespread in swamps, lake margins and watercourses throughout the lowlands. Occurs in perennial wetlands and channels.
Distribution:	NSW, VIC, SA, WA, QLD, TAS
Reproduction:	*Eleocharis acuta* is a monoecious plant, It reproduces via seed and vegetatively through clonal spread of rhizomes.
Dispersal:	Seed dispersal by birds (epizoochory) and water (hydrochory).


Eleocharis sphacelata flower head (Rose, 2007)


Eleocharis sphacelata growth habit (Rose, 2007)

Name:	***Eleocharis sphacelata* – Tall spike-rush**
Description:	A native perennial with dark green stems growing 2 metres tall. Stems are cylindrical with inflorescence a continuation of the stem, and purplish sheath at the base [8]. The spikelet is cylindrical and tapering, dark red-brown in colour, flowers are white and stringy in appearance. *Eleocharis sphacelata* flowers between spring and summer [8]. It is a rhizomatous plant, with a bud-bearing root, meaning root buds produce vertical suckers or adventitious roots as a result of fire [9]. It has a non-mycorrhizal root system.
Habitat:	Grows in still or slow-moving fresh water and can grow in water bodies 5 metres deep or more.
Distribution:	Found in all States and Territories
Reproduction:	*Eleocharis sphacelata* is a monoecious plant. Reproduces via seed, and vegetatively through clonal spread of rhizomes [9].
Dispersal:	Disperses via birds (endozoochory). The seed is also dispersed through inadvertently attaching to the outside of an animal (epizoochory) [9].

IDENTIFYING COMMON EMERGENT SPECIES


Juncus usitatus flower head (Tann, 2009)


Juncus usitatus habit (Far South Coast Management Network, 2014)

Name:	***Juncus usitatus* – Common rush**
Description:	A densely tufted, native perennial growing up to 1.2 metres tall, with erect green to yellow-green stems [8]. Red-brown three branched inflorescence with minute seeds [8]. Flowers mostly between November – February, with old flowers remaining on the plant year round. Seeds shed between January – March. *Juncus usitatus* has a non-mycorrhizal root system.
Habitat:	*Juncus usitatus* occurs commonly close to the water's edge and shallow water, along streams, riverbanks, and irrigation supply channels. It grows in mud, sand and sandy soils.
Distribution:	VIC, NSW, SA, WA, TAS, ACT
Reproduction:	*Juncus usitatus* reproduces via seed, as well as vegetatively through clonal spread of rhizomatous roots [9].
Dispersal:	Disperses seeds by wind (Anemochory), through gravity (barochory), and by inadvertently transporting on the outside of animals (epizoochory) [9].


Phragmites australis flower head (Rose, 2004)


Phragnmites australis growth habit (Rose, 2006)

Name:	***Phragmites australis* – Common reed**
Description:	Large, tufted perennial, with stems growing up to 4 metres. Leaf blade is flat, sometimes in-rolled, and green to yellow-green in colour. Inflorescence is a dense, ovoid spikelet, cream to red-brown in colour, and florets contain fine silky hairs [8]. *Phragmites australis* flowers mainly from November to May. *Phragmites australis* has an arbuscular mycorrhizal root structure, meaning the plant has the ability to continue to thrive under stressful conditions i.e. drought, high salinity and extreme temperatures [11].
Habitat:	Occurs in swamps, lowland watercourses, and poorly drained land. *Phragmites australis* is tolerant of brackish water and moderate levels of salinity [9].
Distribution:	Found throughout all states of Australia
Reproduction:	*Phragmites australis* is monoecious and has a highly extensive rhizome system. It mainly reproduces vegetatively through clonal spread of rhizomes [9]. The belowground organs are able to persist for several years [12]. It can also reproduce via seedling recruitment, however, this is far less common possibly due to issues with seed viability [12].
Dispersal:	Seed dispersal by wind (anemochory), water (hydrochory) and inadvertent transportation on animals (epizoochory), with the hairs acting as a dispersal appendage [9].

IDENTIFYING COMMON EMERGENT SPECIES


Cycnogeton procerum flower head (Rose, 2015)


Cycnogeton procerum growth habit (Talbot, 2015)

Name:	***Cycnogeton procerum* (previously *Triglochin procerum*) – Water ribbons**
Description:	A perennial, emergent aquatic herb. Light green leaves, both erect and floating, measuring between 0.5 – 2 metres, which are flat and appear glossy. Inflorescence is a dense, long spike approximately 30cm, white to green in colour. Fruits are globular to ellipsoid in shape. Rhizomatous roots, ending in elongated tubers [9]. *Cycnogeton procerum* is a highly variable species, partly due to environmental factors, but also due to genetic control. Flowers between September – February. Fruits between December- March [9]. Exhibits plasticity – meaning it is able to change its genetic traits under differing nutrient conditions and is proficient at sequestering phosphorus [13].
Habitat:	*Cycnogeton procerum* grows in still to slow moving water, such as swamps, lagoons and streams, and can also withstand dry periods. In East Gippsland, *Cycnogeton procerum* can tolerate saline and acid waters. This variant has adapted narrower leaves.
Distribution:	All states in Australia
Reproduction:	*Cycnogeton procerum* is monoecious, and reproduces via seed and vegetatively.
Dispersal:	Seed dispersal by water (hydrochory), facilitated by buoyant seeds that can float for up to 5 weeks [13].


Typha latifolia flower spike (Cerchiai, 2015)


Typha latifolia (Domeij, 2019)

Name:	***Typha latifolia* – Cat's Tail, Reed-Mace, Cumbungi**
Description:	An introduced, herbaceous, perennial, erect emergent aquatic plant. Leaves are grey-green in colour, flat or slightly rounded on the back and growing up to 3 metres tall. Inflorescence is a dense spike of male flowers above a dense spike of dark brown to dark red-brown female flowers, with prolific seeding – can produce 222,000 seeds per flower spike [14]. Flowers between December – February. Rhizomatous root system.
Habitat:	Grows in fresh to brackish water, up to 2 metres deep, and along slow moving streams, irrigation channels, swamps and lakes.
Distribution:	Naturalised in Vic, NSW and TAS.
Reproduction:	*Typha latifolia* reproduces sexually via seed dispersal, and vegetatively through clonal spread.
Dispersal:	Seed dispersal by wind and water (hydrchory) and wind (anemochory) *major weed of drains and channels of irrigation, displaces native species in wetlands

IDENTIFYING COMMON EMERGENT SPECIES


Typha orientalis growth habit (Rose, 2008)


Typha domingensis growth habit (Rose, 2009)

Name:	***Typha orientalis* – Broadleaf cumbungi *& Typha domingensis* – narrowleaf cumbungi**
Description:	Erect, native perennials, growing up to 4 metres tall. Both species grow in fresh or brackish water, up to 2 metres deep. One spike may produce up to 200,000 seeds, and seeds are highly viable. Inflorescence is a dense spike of male flowers above a dense spike of female flowers, brown in colour. Both species have an arbuscular mycorrhizal and non-mycorrhizal root structure. *Typha orientalis* (Broadleaf cumbungi): Leaves are flat and bluish to grey-green in colour. The leaf blade is approximately up to 200 cm long and 0.5-1.5cm wide [8]. The female part of the inflorescence is 8–30 cm long, and 10–30 mm in diameter [8]. Flowers between July – March. *Typha domingensis* (Narrowleaf cumbungi): Leaves are flat and green to yellow-green in colour. The leaf blade is approximately up to 200 cm long and 0.5-1.5cm wide [8]. The female part of the inflorescence is approximately 12–40 cm long, and 5–20 mm in diameter [8]. Flowers between December – May.
Habitat:	These species grow in still or slow moving water, such as creek margins, and inland and coastal rivers.
Distribution:	Both species occur in every state.
Reproduction:	Both species are monoecious and reproduce via seed, with highly viable seeds. They also reproduce vegetatively via clonal spread of rhizomes.
Dispersal:	Seed dispersal by wind (anemochory). *Can become a major weed in rice crops, irrigation channels and drains

KNOWING WHEN AN EMERGENT PLANT IS BECOMING A PROBLEM

Some emergent aquatic plants are more likely than others to become invasive and cause issues. There are a range of factors to consider when assessing whether a species will become problematic by growing out of control, such as:

- Seed viability
- Dispersal mechanisms
- External influences i.e. increased temperature and increase in nutritional input
- Biological traits i.e. longevity of seed/bud bank, allelopathy.

The following scale ranks what we consider to be low risk (green) to high risk (red) species, based on the aforementioned factors:

Phragmites australis - Common Reed

Cyperus exaltatus - Giant Sedge

Eleocharis acuta - Common Spikerush

Baumea articulata - Jointed Twigrush

Juncus usitatus - Common Rush

Eleocharis sphacelata - Tall Spikerush

Cycnogeton procerum - Water Ribbons

Typha orientalis and Typha domingensis - BroadLeaf Cumbungi and Narrowleaf Cumbungi

Typha latifolia - Cumbungi

FLOWERING AND SEED VIABILITY

It is important to understand the biological traits of emergent aquatic species in order to best manage problematic plants. The following table (Table 1) establishes life history traits of common emergent plants. This will determine the best management and treatment plan for when these species become invasive. The viability of a seed means whether or not it is alive. The percentage of viable seed in this table refers to the percentage of seeds in a collection that were viable. We classify a species as having highly viable seeds as being over 80% of the seeds collected were viable. Germination requirements are the external factors determining whether or not a seed will germinate. High germination requirements means that a seed requires more external factors, or more complex external factors, to germinate. A plant with highly viable seeds and low germination requirements is more likely to become invasive. Flowering times are important to consider for herbicidal treatment and mechanical removal, as management is more likely to be successful if treatment is applied prior to the plant setting seed.

Rhizome structure of Cyperus laevigatus (Rose, 2018)

Typha orientalis flowerhead going to seed (Rose, 2014)

TABLE 1: LIFE-HISTORY TRAITS OF COMMON EMERGENT PLANTS

Species	Reproduce Vegetatively	Reproduce via Seed	Highly viable seed (above 80%)[15]	Germination Requirements (high/low)	Flowering Time	Root Structure
Baumea articulata Jointed Twig Rush	YES	YES	YES	HIGH (High Dormancy)	VIC, NSW, QLD, TAS: Nov. – Apr. SA: Oct. – Mar. WA: Sep. – Dec. NT: Does not occur	Non mycorrhizal
Cyperus exaltatus Giant Sedge	YES	YES	NO	N/A	VIC, NSW, TAS: Sep. – Feb SA, WA: Jan. – May QLD: Dec. – Jun. NT: Dec. – Jun.	Non mycorrhizal
Eleocharis acuta Common Spike-Rush	YES	YES	YES	High (extended period of contact with water >50 days)[18]	VIC, NSW, TAS: Sep. – Feb. SA, QLD, NT: Sep. – Apr. WA: Sep. – Dec.	Non mycorrhizal
Eleocharis sphacelata Tall spike rush	YES	YES	YES	High (extended period of contact with water >70 days)[18]	VIC, NSW, TAS: Sep. – Feb SA, WA: Nov. – Feb. QLD, NT: Mar. – Aug.	Non mycorrhizal
Juncus usitatus Common rush	YES	YES	N/A	N/A	VIC, NSW, SA: Nov. – Feb QLD: Sept. – Feb WA: Sept. – Nov TAS, NT: Does not occur	Non mycorrhizal
Phragmites australis Common Reed	YES	YES	NO	Low (50% germinate over 1-2 weeks over 10° C)[19]	VIC, NSW, TAS: Nov. – May. SA: Dec. – Aug. WA: Dec. – Feb. QLD: Sep. – Feb. NT: Apr. – Aug. + Nov.	Arbuscular mycorrhizal fungi
Cycnogeton procerum Water Ribbons	YES	YES	YES	N/A	VIC, NSW, TAS, SA: Sep. – Feb WA, QLD, NT: Aug. – Apr.	Non mycorrhizal
Typha latifolia Cumbungi	YES	YES	YES	High (high temperatures above 20° C, low CO2 concentration, long exposure to light)[20] Higher germinate rate in sites with higher nutrients than Typha domingensis. [21]	VIC, NSW, TAS: Dec. – Feb. SA, WA, QLD, NT: Does not occur	Non mycorrhizal
Typha orientalis Broadleaf Cumbungi	YES	YES	YES	Low	VIC, NSW, TAS, SA: Dec. – Mar. WA: Nov. – Jan. QLD: Jan. – May. NT: Aug. – Oct.	Arbuscular mycorrhizal
Typha domingensis Narrowleaf Cumbungi	YES	YES	YES	Low	VIC, NSW, TAS, SA: Dec. – May. QLD: Jan. – May. WA: May. – Sep. NT: All months	Non mycorrhizal

*Root structures with mycorrhizal fungi mean the plant has a symbiotic relationship with the fungus. This means they are both using each other to gain resources they need. Roots that have this symbiotic relationship with mycorrhizae are stronger and can withstand more stress.

*As a consequence of climate change, an increase in soil temperatures will possibly negatively impact the length of seed dormancy and seed viability, which may result in a change in species distribution – Juncus usitatus stops germinating at soil temperatures exceeding 80°C [16].

** Due to Phragmites australis flowering late, it is thought that their ability to produce viable seed before winter die back is low [17]

TREATMENT

When treating emergent aquatic plants, it is important to consider long-term management. These species have extensive underground rhizome systems, and often produce seed as well, meaning that an integrated approach to treatment and management may be necessary.
There are three dominant types of treatment for emergent plants:

Chemical
- AQ200 (Diquat)
- Glyphosate

Physical
- Hand pulling
- Hand cutting
  - Aquatic Weed Razer

Machinery
- Mobitrac Amphibious Harvester

Organic herbicide is typically unsuccessful for these species due to their reproductive traits and habitat. If your waterbody can not have a chemical based herbicide, you will need to consider a combination of physical and mechanical treatment plans over successive seasons.

Why do these species need an integrated treatment approach?

An invasive emergent aquatic plant will often not be eradicated with a one off treatment. The common species listed in this guide contain underground bud banks. These bud banks can serve as an energy source to the parent plant during times of environmental stress, such as drought [21]. Bud banks may also lie dormant below the ground. Therefore, the plant may regenerate if the bud bank has not been fully exhausted [22]. In areas of high erosion, it may be pertinent to treat the aboveground biomass with herbicide, while leaving the root structure in place to hold the bank together [23]. The treatment and management approach will depend on your specific requirements, such as location of the invasive species, and whether full eradication is required.

CHEMICAL TREATMENT

	Mode	Timing of Application	Treatment effect	Restrictions and Precautions	Active in the water body
AQ200 (Diquat)	Contact herbicide that is absorbed by foliage and disrupts photosynthesis [24].	During active growth, before the plant sets seed.	Plant decline is noticed generally within less than 7 days [25]	Ineffective in water with high turbidity levels [24].	Very short exposure time. Not detected in the water body after 10 days [26]
Glyphosate	Contact herbicide that prevents the plant from making specific proteins that are required for plant growth [27].	During active growth, before the plant sets seed.	Plant decline is noticed in 2-7 days post treatment [27].	Many councils have banned or are phasing out the use of glyphosate [28]. Surfactants added to the product can be highly toxic to non-target organisms, particularly frogs [29]. Glyphosate is now classified as a probable human carcinogen [30].	Glyphosate's active ingredient will take between 12 days to 10 weeks to degrade in water [31].

Physical and mechanical treatment

It is important to note that physical and mechanical methods may result in turbid water. If chemical application is part of the integrated treatment plan, it should be done prior to physical/mechanical treatment, or when the water is no longer turbid. There is potential for physical and mechanical control of invasive plants to spread seed and rhizome fragments, leading to the plants growing in areas that were previously untouched by infestations [33]

PHYSICAL REMOVAL

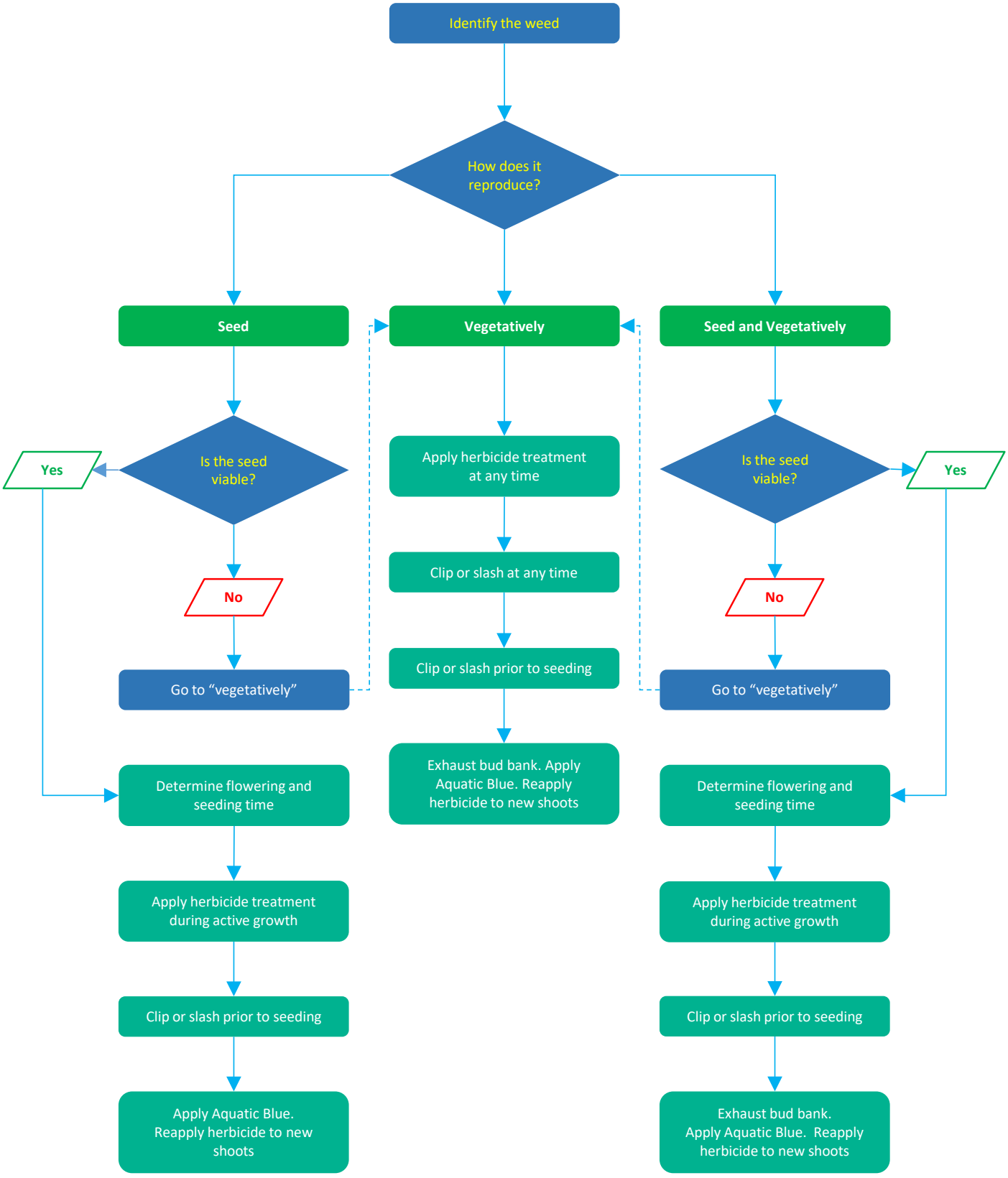
Clipping - Weed Razer	Manual control of emergent aquatic plants using tools such as a weed razor is ideal for very mild infestations. This method can be labour intensive, but is ideal for keeping minor problematic species under control and as an integrated approach for long-term management.
Slashing - Mobitrac	Machinery such as the Mobitrac Amphibious Harvester is used for severe infestations and in large water bodies. It is also ideal for ecologically sensitive areas due to its versatile and powerful mechanism of cutting, harvesting and collecting the weed species.
Flooding	Flooding is used after clipping to eliminate the supply of oxygen to roots [34]. Combining clipping and flooding is an effective method, particularly in areas where chemical control cannot be used. However, flooding is not always possible due to the location of the infestation. If this is the case, the use of Aquatic Blue after clipping may inhibit plant growth by reducing UV light penetration through the water and diminishing photosynthesis capabilities.
Disturbing the bud bank	Many emergent aquatic plants have long lasting, dormant bud banks that will remain in the ground. Exposing the bud bank to light, or disturbance via the use of smoke stimulants may stimulate germination, and aid in exhausting the bud bank [35].

Preventative Measurements

Put in place good land and water management practices to ensure a healthy water body, and prevent aquatic weed infestations:

- Manage fertiliser run-off
  - Use vegetative buffers such as rushes and sedges to minimise excess nutrient input [32]
  - Ensure good management of manure handling
- Remove the topsoil layer from pond/reservoir basin to prevent topsoil erosion [32]
- Control water level and water flow where possible [32]

PROCESS FOR DETERMINING A TREATMENT PLAN



MANAGEMENT PLAN FOR CUMBUNGI

Management plan for Typha latifolia (Introduced Cumbungi) - example

Species:	***Typha latifolia (Cumbungi)***
Location:	Dam
Risk Level: High	**Is the species a high risk invasive plant? This is determined by the species' life history traits.*
Severity of infestation: High (>75% of area), Med. (45-75% of area), Low (<45% of area)	High *It should be noted that Typha latifolia has a seed bank which may remain dormant for up to 100 years [36].
Water Usage:	Main source of irrigation for crops *How the waterbody is utilised will determine if herbicides can be used, and how long the water should not be used for.
Reproduction/Flowering/ Seed viability	Reproduces vegetatively and by seed. Highly viable seed with low germination requirements.

Flowering Calendar:

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
VIC	✓	✓										✓
NSW	✓	✓										✓
TAS	✓	✓										✓

TREATMENT

Herbicide:	Herbicide can be applied at any time. For optimal results it is best to apply during active growth when the plant is photosynthesising and can uptake the herbicide at a greater rate.
Optimum time to apply:	Between male flowers opening and 6 weeks after female flowers open [37].

For example - Apply AQ200 during active growth:

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
VIC	✓	✓							✓	✓	✓	✓
NSW	✓	✓							✓	✓	✓	✓
TAS	✓	✓							✓	✓	✓	✓

Physical/Mechanical:

- Physical and mechanical treatment can be applied at any time. For optimal results it is best to cut aquatic plants prior to the plant setting seed and potentially spreading to new areas.

For example:
- For dense and multiple stands, use mobitrac amphibious harvester to cut stems at least 15 cm below water line prior to **seeds forming** *(see below chart)*.

- Remove and dispose of foliage and flower heads using Aquatic Weed Rake.

- Apply Aquatic Blue to suppress growth.

MANAGEMENT PLAN FOR CUMBUNGI (Cont.)

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
VIC	✓									✓	✓	✓
NSW	✓									✓	✓	✓
TAS	✓									✓	✓	✓

Follow up:

- Cumbungi is highly invasive and will continue to become problematic if it is not managed on an ongoing basis.

- Use the Muck Razer to distress and break up rhizomes.

- If possible, grazing of area will disturb the seed and bud bank, exhausting the seeds and buds.

- Actively treat Cumbungi infestations annually to reduce stands and minimise risk to water quality and infrastructure.

MANAGEMENT PLAN FOR NATIVE NARROW-LEAF CUMBUNGI

Management plan for Typha domingensis (Native Narrow-leaf cumbungi) – example

Species:	***Typha domingensis (Narrow-leaf cumbungi)***
Location:	Dam
Risk Level: High	**Is the species a high risk invasive plant? This is determined by the species' life history traits.*
Severity of infestation: High (>75% of area), Med. (45-75% of area), Low (<45% of area)	High
Water Usage:	Main source of irrigation for crops *How the waterbody is utilised will determine if herbicides can be used, and how long the water should not be used for.
Reproduction/Flowering/ Seed viability	Reproduces vegetatively and by seed. Highly viable seed with low germination requirements.

Flowering Calendar:

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
VIC	✓	✓	✓	✓	✓							✓
NSW	✓	✓	✓	✓	✓							✓
TAS	✓	✓	✓	✓	✓							✓
SA	✓	✓	✓	✓	✓							✓
WA					✓	✓	✓	✓	✓			
QLD	✓	✓	✓	✓	✓							
NT	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

TREATMENT	
Herbicide:	Herbicide can be applied at any time. For optimal results it is best to apply during active growth when the plant is photosynthesising and can uptake the herbicide at a greater rate.
Optimum time to apply:	The optimum time for applying herbicide to Cumbungi is between male flowers opening and 6 weeks after female flowers open, the timing of this is dependent on the population [37].
For example:	Apply AQ200 during active growth:

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
VIC	✓	✓							✓	✓	✓	✓
NSW	✓	✓							✓	✓	✓	✓
TAS	✓	✓							✓	✓	✓	✓
SA	✓	✓							✓	✓	✓	✓
WA		✓	✓	✓	✓	✓						
QLD	✓	✓	✓							✓	✓	✓
NT	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

MANAGEMENT PLAN FOR NATIVE NARROW-LEAF CUMBUNGI (Cont.)

Physical/Mechanical:

Herbicide:

Physical and mechanical treatment can be applied at any time. For optimal results it is best to cut aquatic plants prior to the plant setting seed and potentially spreading to new areas.

For example:
For dense and multiple stands, use mobitrac amphibious harvester to cut stems at least 15cm below water line prior to seeds forming (see below chart).

- Cutting stands 2-3 times per season will effectively reduce growth.

- Remove and dispose of foliage and flower heads using Aquatic Weed Rake.

- Apply Aquatic Blue to suppress growth.

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
VIC	✓	✓	✓									✓
NSW	✓	✓	✓									✓
TAS	✓	✓	✓									✓
SA	✓	✓	✓									✓
WA					✓	✓	✓	✓	✓			
QLD	✓	✓	✓	✓								
NT	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Follow up:

- Cumbungi is highly invasive and will continue to become problematic if it is not managed on an ongoing basis.

- If possible, grazing of area will disturb the seed and bud bank, exhausting the seeds and buds.

- Use the Muck Razer to distress and break up rhizomes.

- Actively treat Cumbungi infestations annually to reduce stands and minimise risk to water quality and infrastructure.

MANAGEMENT PLAN FOR NATIVE BROAD-LEAF CUMBUNGI

Management plan for Typha orientalis (Native Broad-leaf cumbungi) – example

Species:	***Typha orientalis (Broad-leaf cumbungi)***
Location:	Dam
Risk Level: High	**Is the species a high risk invasive plant? This is determined by the species' life history traits.*
Severity of infestation: High (>75% of area), Med. (45-75% of area), Low (<45% of area)	High
Water Usage:	Main source of irrigation for crops *How the waterbody is utilised will determine if herbicides can be used, and how long the water should not be used for.
Reproduction/Flowering/ Seed viability	Reproduces vegetatively and by seed. Highly viable seed with low germination requirements.

Flowering Calendar:

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
VIC	✓	✓	✓									✓
NSW	✓	✓	✓									✓
TAS	✓	✓	✓									✓
SA	✓	✓	✓									✓
WA	✓										✓	✓
QLD	✓	✓	✓	✓	✓							
NT								✓	✓	✓		

TREATMENT	
Herbicide:	Herbicide can be applied at any time. For optimal results it is best to apply during active growth when the plant is photosynthesising and can uptake the herbicide at a greater rate.
Optimum time to apply:	The optimum time for applying herbicide to Cumbungi is between male flowers opening and 6 weeks after female flowers open, the timing of this is dependent on the population [37].
For example:	Apply AQ200 during **active growth:**

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
VIC	✓								✓	✓	✓	✓
NSW	✓								✓	✓	✓	✓
TAS	✓								✓	✓	✓	✓
SA	✓								✓	✓	✓	✓
WA									✓	✓	✓	✓
QLD	✓	✓								✓	✓	✓
NT					✓	✓	✓	✓				

MANAGEMENT PLAN FOR NATIVE BROAD-LEAF CUMBUNGI (Cont.)

Physical/Mechanical:

- Physical and mechanical treatment can be applied at any time. For optimal results it is best to cut aquatic plants prior to the plant setting seed and potentially spreading to new areas.

For example:
- For dense and multiple stands, use mobitrac amphibious harvester to cut stems at least 15 cm below water line prior to seeds forming (see below chart).

- Cutting stands 2-3 times per season will effectively reduce growth.

- Remove and dispose of foliage and flower heads using Aquatic Weed Rake.

- Apply Aquatic Blue to suppress growth.

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
VIC	✓	✓								✓	✓	✓
NSW	✓	✓								✓	✓	✓
TAS	✓	✓								✓	✓	✓
SA	✓	✓								✓	✓	✓
WA								✓	✓	✓	✓	✓
QLD	✓	✓	✓	✓								
NT						✓	✓	✓	✓			

Follow up:

- Cumbungi is highly invasive and will continue to become problematic if it is not managed on an ongoing basis.

- If possible, grazing of area will disturb the seed and bud bank, exhausting the seeds and buds.

- Use the Muck Razer to distress and break up rhizomes.

- Actively treat Cumbungi infestations annually to reduce stands and minimise risk to water quality and infrastructure.

MANAGEMENT PLAN FOR WATER RIBBONS

Management plan for Cycnogeton procerum (Water ribbons) - example

Species:	***Cycnogeton procerum (Water ribbons)***
Location:	Open drain
Risk Level: Medium - High	**Is the species a high risk invasive plant? This is determined by the species' life history traits.*
Severity of infestation: High (>75% of area), Med. (45-75% of area), Low (<45% of area)	Medium
Water Usage:	Excess water, removing water off land *How the waterbody is utilised will determine if herbicides can be used, and how long the water should not be used for.
Reproduction/Flowering/ Seed viability	Reproduces vegetatively and by seed. Highly viable seed, remains buoyant in water for 5 weeks.

Flowering Calendar:

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
VIC	✓	✓							✓	✓	✓	✓
NSW	✓	✓										✓
TAS	✓	✓										✓
SA	✓	✓										✓
WA	✓	✓	✓	✓				✓	✓	✓	✓	✓
QLD	✓	✓	✓	✓				✓	✓	✓	✓	✓
NT	✓	✓	✓	✓				✓	✓	✓	✓	✓

TREATMENT

Herbicide: Herbicide can be applied at any time. For optimal results it is best to apply during active growth when the plant is photosynthesising and can uptake the herbicide at a greater rate.

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
VIC								✓	✓	✓	✓	✓
NSW								✓	✓	✓	✓	✓
TAS								✓	✓	✓	✓	✓
SA								✓	✓	✓	✓	✓
WA	✓	✓						✓	✓	✓	✓	✓
QLD	✓	✓						✓	✓	✓	✓	✓
NT	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓

MANAGEMENT PLAN FOR WATER RIBBONS (Cont.)

Physical/Mechanical:

- Physical and mechanical treatment can be applied at any time. For optimal results it is best to cut aquatic plants prior to the plant setting seed and potentially spreading to new areas.

For example:
- Use Aquatic Weed Razer to cut stems below the water line prior to seeds forming (see below chart).

- Remove and dispose of foliage and flower heads using Aquatic Weed Rake.

- Apply Aquatic Blue to suppress growth.

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
VIC	✓								✓	✓	✓	✓
NSW	✓								✓	✓	✓	✓
TAS	✓								✓	✓	✓	✓
SA	✓								✓	✓	✓	✓
WA	✓	✓						✓	✓	✓	✓	✓
QLD	✓	✓						✓	✓	✓	✓	✓
NT	✓	✓						✓	✓	✓	✓	✓

Follow up:

- Ensure plants are not decomposing in the waterbody to prevent diminished water quality and algal blooms.

- Use the Muck Razer to distress and break up rhizomes.

- Continue management seasonally, if required, to diminish bud banks and minimise risk of recurring blockages.

MANAGEMENT PLAN FOR TALL SPIKE-RUSH

Management plan for Eleocharis sphacelata (Tall spike-rush) - example

Species:	***Eleocharis sphacelata (Tall spike-rush)***
Location:	Natural wetland Reserve
Risk Level: Medium - High	**Is the species a high risk invasive plant? This is determined by the species' life history traits and ability to damage infrastructure.*
Severity of infestation: High (>75% of area), Med. (45-75% of area), Low (<45% of area)	High
Water Usage:	Native habitat for aquatic fauna *How the waterbody is utilised will determine if herbicides can be used, and how long the water should not be used for.
Reproduction/Flowering/ Seed viability	Reproduces vegetatively and by seed. Highly viable seed.

Flowering Calendar:

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
VIC	✓	✓							✓	✓	✓	✓
NSW	✓	✓							✓	✓	✓	✓
TAS	✓	✓							✓	✓	✓	✓
SA	✓	✓								✓	✓	✓
WA	✓	✓								✓	✓	✓
QLD			✓	✓	✓	✓	✓	✓				
NT			✓	✓	✓	✓	✓	✓				

TREATMENT

Herbicide:

- Herbicide can be applied at any time. For optimal results it is best to apply during active growth when the plant is photosynthesising and can uptake the herbicide at a greater rate.

For example:
- Check herbicide regulations with land management.
- Apply AQ200 during active growth:

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
VIC								✓	✓	✓	✓	✓
NSW								✓	✓	✓	✓	✓
TAS								✓	✓	✓	✓	✓
SA								✓	✓	✓	✓	✓
WA								✓	✓	✓	✓	✓
QLD	✓	✓									✓	✓
NT	✓	✓									✓	✓

MANAGEMENT PLAN FOR TALL SPIKE-RUSH (Cont.)

Physical/Mechanical:

- Physical and mechanical treatment can be applied at any time. For optimal results it is best to cut aquatic plants prior to the plant setting seed and potentially spreading to new areas.

For example:
- Use Mobitrac amphibious harvester to cut 15 cm below water line (suitable for use in sensitive ecosystems) prior to seeds forming (see below chart).
- Remove and dispose of foliage and flower heads using Aquatic Weed Rake.

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
VIC	✓								✓	✓	✓	✓
NSW	✓								✓	✓	✓	✓
TAS	✓								✓	✓	✓	✓
SA	✓								✓	✓	✓	✓
WA	✓	✓						✓	✓	✓	✓	✓
QLD	✓	✓	✓	✓	✓	✓						
NT	✓	✓	✓	✓	✓	✓						

Follow up:

- Ensure plants are not decomposing in the waterbody to prevent diminished water quality and algal blooms.

- Use the Muck Razer to distress and break up rhizomes.

- Continue management seasonally, if required, to diminish bud bank.

MANAGEMENT PLAN FOR COMMON REED

Management plan for Phragmites australis (Common reed) - example

Species:	***Phragmites australis (Common reed)***
Location:	Dam
Risk Level: Low	**Is the species a high risk invasive plant? This is determined by the species' life history traits and ability to damage infrastructure.*
Severity of infestation: High (>75% of area), Med. (45-75% of area), Low (<45% of area)	Medium
Water Usage:	Farm water storage for livestock *How the waterbody is utilised will determine if herbicides can be used, and how long the water should not be used for.
Reproduction/Flowering/ Seed viability	Reproduces vegetatively and by seed. Low viability to not viable seed.

Flowering Calendar:

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
VIC	✓	✓	✓	✓	✓						✓	✓
NSW	✓	✓	✓	✓	✓						✓	✓
TAS	✓	✓	✓	✓	✓						✓	✓
SA	✓	✓	✓	✓	✓	✓	✓	✓				✓
WA	✓	✓										✓
QLD	✓	✓							✓	✓	✓	✓
NT				✓	✓	✓	✓	✓			✓	

TREATMENT	Generally, Phragmites australis will not become problematic and is best to leave in place. If an infestation is restricting access to the dam, then the following treatment may be used to reduce stands and biomass.
Herbicide:	- Herbicide can be applied at any time. For optimal results it is best to apply during active growth when the plant is photosynthesising and can uptake the herbicide at a greater rate. For example: - Select stands to apply herbicide. Keep in mind, emergent aquatic plants stabilise banks and reduce erosion. - Apply AQ200 to selected stands at any time.
Physical/Mechanical:	- Physical and mechanical treatment can be applied at any time. For optimal results it is best to cut aquatic plants prior to the plant setting seed and potentially spreading to new areas. For example: - Use Aquatic Weed Razor Pro to cut stems 15cm below the water line at any time during the season. - Remove and dispose of foliage and flower heads using Aquatic Weed Rake. - Apply Aquatic Blue to suppress growth
Follow up:	- Use the Muck Razer to distress and break up rhizomes. - Manage stands annually if required.

MANAGEMENT PLAN FOR COMMON SPIKE-RUSH

Management plan for Eleocharis acuta (Common spike-rush) - example

Species:	***Eleocharis acuta (Common spike-rush)***
Location:	Open drain
Risk Level: Medium	**Is the species a high risk invasive plant? This is determined by the species' life history traits and ability to damage infrastructure.*
Severity of infestation: High (>75% of area), Med. (45-75% of area), Low (<45% of area)	Medium
Water Usage:	Removing rain water *How the waterbody is utilised will determine if herbicides can be used, and how long the water should not be used for.
Reproduction/Flowering/ Seed viability	Reproduces vegetatively and by seed. Highly viable seed.

Flowering Calendar:

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
VIC	✓	✓							✓	✓	✓	✓
NSW	✓	✓							✓	✓	✓	✓
TAS	✓	✓							✓	✓	✓	✓
SA	✓	✓	✓	✓					✓	✓	✓	✓
WA									✓	✓	✓	✓
QLD	✓	✓	✓	✓					✓	✓	✓	✓
NT	✓	✓	✓	✓					✓	✓	✓	✓

TREATMENT	
Herbicide:	- Herbicide can be applied at any time. For optimal results it is best to apply during active growth when the plant is photosynthesising and can uptake the herbicide at a greater rate. For example: Apply AQ200 during active growth: Aug. – Dec. in VIC, NSW, TAS Aug. – Nov. in WA Sep. – Feb. in SA, NT
Physical/Mechanical:	- Physical and mechanical treatment can be applied at any time. For optimal results it is best to cut aquatic plants prior to the plant setting seed and potentially spreading to new areas. For example: - Use Aquatic Weed Razer pro to cut stems below water line prior to seeds forming: Sep. - Jan. in VIC, NSW, TAS Jun. – Sep. in WA Aug. – Dec. in SA, NT - Remove and dispose of foliage and flower heads using Aquatic Weed Rake. - Apply Aquatic Blue to suppress growth
Follow up:	- Ensure plants are not decomposing in the waterbody to prevent diminished water quality and algal blooms. - Use the Muck Razer to distress and break up rhizomes.

MANAGEMENT PLAN FOR COMMON GIANT SEDGE

Management plan for Cyperus exaltatus (Giant sedge) - example

Species:	***Cyperus exaltatus (Giant sedge)***
Location:	Constructed wetland
Risk Level: Low	**Is the species a high risk invasive plant? This is determined by the species' life history traits and ability to damage infrastructure.*
Severity of infestation: High (>75% of area), Med. (45-75% of area), Low (<45% of area)	Low
Water Usage:	Habitat for aquatic fauna. *How the waterbody is utilised will determine if herbicides can be used, and how long the water should not be used for.
Reproduction/Flowering/ Seed viability	Reproduces vegetatively and by seed. Flowers between: Sep. - Feb. in VIC, NSW, TAS Dec. – Jun. in NT, QLD Jan. – May. In SA, WA
Treatment:	Cyperus exaltatus is a colonising species, and does not tend to persist for more than a few years. Generally, this species will not become problematic. It is also a useful plant for erosion control.
Herbicide:	- Herbicide can be applied at any time. For optimal results it is best to apply during active growth when the plant is photosynthesising and can uptake the herbicide at a greater rate. For example: - Check herbicide regulations with land management. - Select stands to apply AQ200 at any time.
Physical/Mechanical:	Physical and mechanical treatment can be applied at any time. For optimal results it is best to cut aquatic plants prior to the plant setting seed and potentially spreading to new areas. For example: - Use Aquatic Weed Razer to cut plants below the water level at any time. - Remove and dispose of foliage and flower heads using Aquatic Weed Rake.
Follow up:	- Ensure plants are not decomposing in the waterbody to prevent diminished water quality and algal blooms. - Use the Muck Razer to distress and break up rhizomes.

MANAGEMENT PLAN FOR COMMON RUSH

Management plan for Juncus usitatus (Common rush) - example

Species:	***Juncus usitatus (Common rush)***
Location:	Drainage channel
Risk Level: Low	**Is the species a high risk invasive plant? This is determined by the species' life history traits and ability to damage infrastructure.*
Severity of infestation: High (>75% of area), Med. (45-75% of area), Low (<45% of area)	Medium. *Is the species a high risk invasive plant? This is determined by the species' life history traits and ability to damage infrastructure.
Water Usage:	Excess water, removing water off land. *How the waterbody is utilised will determine if herbicides can be used, and how long the water should not be used for.
Reproduction/Flowering/ Seed viability	Reproduces vegetatively and by seed. Flowers between: Nov. - Feb. in VIC, NSW, SA Sep. – Feb. in QLD Sep. – Nov. in WA Does not occur in TAS or NT Seed viability data unavailable.
TREATMENT	
Herbicide:	Herbicide can be applied at any time. For optimal results it is best to apply during active growth when the plant is photosynthesising and can uptake the herbicide at a greater rate. For example: Apply AQ200 during active growth: Sep. – Dec. in VIC, NSW, SA Jul. – Nov. in QLD Jun – Oct. in WA
Physical/Mechanical:	Physical and mechanical treatment can be applied at any time. For optimal results it is best to cut aquatic plants prior to the plant setting seed and potentially spreading to new areas. For example: - If water level is high enough, use Aquatic Weed Razer to cut stems below the water line prior to seeds forming Sep. - Jan. in VIC, NSW, SA Jul. – Jan. in QLD Jun. – Oct. in WA - If the water level is not high enough for slashing, wait until the water level has risen for physical removal or continue herbicide treatment. - Remove and dispose of foliage and flower heads using Aquatic Week Rake.
Follow up:	- Ensure plants are not decomposing in the waterbody to prevent diminished water quality and algal blooms. - Use the Muck Razer to distress and break up rhizomes.

MANAGEMENT PLAN FOR JOINTED TWIG-RUSH

Management plan for Baumea articulata (Jointed twig-rush) - example

Species:	***Baumea articulata (Jointed twig-rush)***
Location:	Constructed wetland
Risk Level: Medium	**Is the species a high risk invasive plant? This is determined by the species' life history traits and ability to damage infrastructure.*
Severity of infestation: High (>75% of area), Med. (45-75% of area), Low (<45% of area)	Medium
Water Usage:	Stormwater runoff management *How the waterbody is utilised will determine if herbicides can be used, and how long the water should not be used for.
Reproduction/Flowering/ Seed viability	Reproduces vegetatively and by seed. Flowers between: Sep. – Feb. in VIC, NSW, TAS Sep. – Dec. in WA Oct. – Mar. in SA Nov. – Apr. in QLD Does not occur in NT Highly viable seed.
TREATMENT	
Herbicide:	- Herbicide can be applied at any time. For optimal results it is best to apply during active growth when the plant is photosynthesising and can uptake the herbicide at a greater rate. For example: - Apply AQ200 during active growth: Sep. – Dec. in VIC, NSW, TAS, SA Sep. – Feb. in QLD Aug. – Nov. in WA
Physical/Mechanical:	- Physical and mechanical treatment can be applied at any time. For optimal results it is best to cut aquatic plants prior to the plant setting seed and potentially spreading to new areas. For example: - Use Aquatic Weed Razer to cut plants below the water level prior to seeds forming: Sep. – Jan. in VIC, NSW, TAS Sep. – Feb in SA Oct. – Mar. in QLD Sep. – Nov. in WA - Remove and dispose of foliage and flower heads using Aquatic Weed Rake.
Follow up:	- Ensure plants are not decomposing in the waterbody to prevent diminished water quality and algal blooms. - Use the Muck Razer to distress and break up rhizomes.

HOW TO APPLY HERBICIDE TREATMENT

AQ200 Aquatic Herbicide and Wetting Agent

Prepare:	Application:	Notes
Apply at a rate of 400ml of AQ200 combined with 150ml Wetting Agent and dilute in 100L of town/ tank water. Put 80% of required water into your clean sprayer before adding the chemicals, then slowly add the other 20% of the water. This avoids frothing of the spray mix.	Spray diluted mixture directly onto exposed foliage of emergent plant. Use a shower spray (not a mist) to fully drench the plant, ensuring all visible foliage is covered. It is best to do one solid application as opposed to many smaller applications.	- Always use PPE when handling AQ200: gloves, goggles, mask, protective clothing - DO NOT use treated water for human consumption, livestock watering or irrigation purposes for 10 days after application. - Use a shower spray (not a mist) - Limit overspray to avoid affecting non-target terrestrial and aquatic plants. - AQ200 can be applied to cut aquatic plants using the wick method to paint the mixture on the stem that is above the water line.

1L of AQ200 mixed with 500ml of Wetting Agent, diluted with 250L of town/tank water covers approx. 250m² - 500m² of surface area.

5L of AQ200 mixed with 2L of Wetting Agent, diluted with 1245L of town/tank water covers approx. 1250m² - 2500m² of surface area.

1L of AQ200 mixed with 500ml of Wetting Agent, diluted with 250L of town/tank water covers approx. 250m² - 500m² of surface area.

USING THE AQUATIC WEED RAZER, AQUATIC WEED RAZER PRO AND MUCK RAZER

	When to use:
Aquatic Weed Razer	Best used for submerged aquatic plants, or small infestations of emergent plants.
Aquatic Weed Razer Pro	- Use for emergent aquatic plants. The adjustable V shaped blade allows dense stands to be removed using the narrow blade setting, moving to the wider setting as the stands become less dense. - Folds for easy storage.
Muck Razer	- Use as a follow up to the Weed Razer or cutting methods. - Use in the water, or along shoreline to damage rhizomes of aquatic plants, hindering their ability to grow.

	How to use:
Aquatic Weed Razer	1. Throw it in the water 2. Let it sink 3. Pull it back in using a repeated, sharp upwards tug motion. 4. Repeat
Aquatic Weed Razer Pro	1. Adjust the blade to a narrow setting to begin with. Widen the blade as the stands become easier to cut. 2. Throw it in the water 3. Pull it back in using a repeated, sharp upwards tug motion. 4. Repeat
Muck Razer	1. Stand in a stable location and roll the muck razer head into the water. The head will fill with water to keep it firmly on the bottom of the pond, dam or lake. 2. Roll the drum back and forth over the targeted area, either by walking with the handle in and out of the water, or by pushing and pulling the drum back and forth with the handle. 3. Start with a smaller area and apply a downward pressure. 4. The process may need to be repeated numerous times over a number of weeks to gradually reduce the muck layers and damage the rhizomes.

Notes:
The Aquatic Weed Razer is to be operated by hand only. **Do not pull it behind a boat, or any other machine-driven equipment.**

- Do not use with children in the immediate area
- Do not use when humans and/or animals are present in the water
- Use protective gloves (thick leather gloves recommended) while handling
- Do not place or use near electrical wires or cords
- Never touch the sharp edges of the blades with bare hands, at any time
- Leave blade covers on the cutting edges when not in use
- Check all bolts, connections and rope before use
- Avoid areas with underwater structures
- When not in use, store in a safe location out of the reach of children

MOBITRAC AMPHIBIOUS HARVESTER

For extensive areas, aquatic plant and weed harvesting services may be necessary.
The Mobitrac amphibious harvester is suitable for all water ways and sensitive ecosystems, and can reach hard to access areas. It is one-manned operated and does not require cranes for lifting or shore convoys. For best results, the Mobitrac should be used to remove smaller infestations of weeds more frequently, as a bulk harvest once every few years can result in algal blooms.

AQUATIC BLUE

Aquatic Blue is a highly concentrated colourant. It is easy and safe to use as a non-herbicidal alternative. It is safe for swimming, and the dye will not stain skin, hair, clothes, rock or sand. The dye reduces light penetration in the water, which restricts aquatic plants' ability to photosynthesise. Aquatic Blue is also useful for controlling algae, and giving your water body a blue hue.
The dye reflects the light, meaning water temperatures remain lower. Colder water holds more oxygen which is beneficial for fish and good bacteria, as well as reducing phytoplankton blooms and limiting PH level fluctuations.

For controlling emergent aquatic plants, use in dams, lakes and ponds after cutting stems below the water level.

How to use:

Where To Use	Quantity	How To Apply	Application Rates
Ponds with a maximum depth of 1m	Use 7.5ml of Aquatic Blue per 1,000L of water	Quick application: Pour directly into the water. For best results: Dilute 1 part Aquatic Blue to 10 parts water and spray evenly around the water surface.	Apply every 4-6 months
Dams and Lakes	5L of Aquatic Blue per 2ML of water		

REFERENCES

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