Risk Assessment of *Ludwigia* spp. (Water Primroses)

Name of Organism:	*Ludwigia grandiflora* (Michx.) Greuter & Burdet, 1987; *Ludwigia peploides* (Kunth.) P.H. Raven, 1963 *Ludwigia hexapetala* (Hook. & Arn.) G.L. Nesom & Kartesz
Objective:	Assess the risks associated with this species in Ireland
Version:	Final 15/09/2014
Author(s)	Michael Millane and Joe Caffrey
Expert reviewer	Jonathan Newman

Stage 1 - Organism Information

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Section A - Entry
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About the risk assessment

This risk assessment is based on the **N**on-native species **AP**plication based **R**isk **A**nalysis (NAPRA) tool (version 2.66). NAPRA is a computer based tool for undertaking risk assessment of any non-native species. It was developed by the European and Mediterranean Plant Protection Organisation (EPPO) and adapted for Ireland and Northern Ireland by Invasive Species Ireland. It is based on the Computer Aided Pest Risk Analysis (CAPRA) software package which is a similar tool used by EPPO for risk assessment.

Notes: Confidence is rated as low, medium, high or very high.
Likelihood is rated as very unlikely, unlikely, moderately likely, likely or very likely.
The percentage categories are 0% - 10%, 11% - 33%, 34% - 67%, 68% - 90% or 91% - 100%.
N/A = not applicable.

This is a joint project by Inland Fisheries Ireland and the National Biodiversity Data Centre to inform risk assessments of non-native species for the European Communities (Birds and Natural Habitats) Regulations 2011. It is supported by the National Parks and Wildlife Service.

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Stage 1 - Organism Information *The aim of this section is to gather basic information about the organism.*			
N	**QUESTION**	**RESPONSE**	**COMMENT**
1	What is the reason for performing the risk assessment?		A risk assessment is required as this genus is listed as a "Non-native species subject to restrictions under Regulations 49 and 50" in the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011, SI 477/2011. According to Zardini (1991), the genus *Ludwigia* comprises 82 species. This risk assessment will focus on three notable species in the genus *Ludwigia*: *Ludwigia grandiflora* (Michx.) Greuter & Burdet, 1987; *Ludwigia peploides* (Kunth.) P.H. Raven, 1963 *Ludwigia hexapetala* (Hook. & Arn.) G.L. Nesom & Kartesz. Where the term "*Ludwigia* spp." Is used in this risk assessment, it collectively refers to the three non-native species above and not any other species in the genus.
2	Identify the organisms. Are they each clearly a single taxonomic entity and can they be adequately distinguished from other entities of the same rank?	YES and NO	***Ludwigia grandiflora*** (Michx.) Greuter & Burdet, 1987; Synonyms: *Jussiaea grandiflora* Michx., non Ruiz & Pavón *Jussiaea michauxiana* Fernald, nom. illeg. *Jussiaea repens* var. *grandiflora* M. Micheli *Jussiaea uruguayensis* Camb. *Ludwigia grandiflora* (M. Micheli) Greuter & Burdet *Ludwigia hexapetala* (Hook. & Arn.) Zardini, Gu & Raven *Ludwigia uruguayensis* var. *major* (Hassler) Munz *Ludwigia grandiflora* (Michx.) Greuter & Burdet ssp. *hexapetala* (Hook. & Arn.) G.L. Nesom & Kartesz Common names: Water primrose (preferred common name); large flower primrose willow, large-flower primrose-willow, primrose willow, Uruguay waterprimrose, Uruguayan Hampshire-purslane, Uruguayan primrosewillow, and Uruguayan primrose-willow. (CABI 2014a)

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			Ludwigia peploides (Kunth.) P.H. Raven, 1963 Synonyms: *Jussiaea diffusa* auct non Forssk *Jussiaea patibilcensis* Kunth., 1823 *Jussiaea peploides* Kunth., 1823 *Jussiaea polygonoides* Kunth., 1823 *Jussiaea repens* var. *peploides* (Kunth.) Griseb., 1866 *Ludwigia adscendens* var. *peploides* (Kunth.) H. Hara, 1953 *Ludwigia clavellina* var. *peploides* (Kunth.) H. Hara *Jussiaea gomezii* Ram. Goyena, 1909 Common names: Water primrose (preferred common name); California water primrose, creeping water primrose (WSDE undated), floating primrose, floating primrose willow, floating water primrose, and marsh purslane. CABI 2014b) ***Ludwigia hexapetala*** (Hook. & Arn.) G.L. Nesom & Kartesz Synonyms: *Ludwigia urugayensis* (NCSU undated) *Jussiaea uruguayensis* (WSDE undated a) Common names: Creeping waterprimrose (NCSU undated); hairy waterprimrose (NCSU undated), Uruguay marsh-purslane (ASLA undated), Uruguay water-primrose (CAL-IPC undated), and water primrose (WSDE undated). Expert identification may be required to distinguish the various species of *Ludwigia* described above (NCSU undated), especially when not in flower (Dandelot *et al*. 2008). *L. peploides* and *L. hexapetala* are “difficult even for experts to differentiate” (WSDE undated a). Identifying *Ludwigia* can be complicated as leaf shape and appearance can change in response to the environment (WSSA 2014).

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3	If not a single taxonomic entity, can it be redefined? (if necessary use the response box to re-define the organism and carry on)	See comment	There has been some taxonomic confusion in relation to the "*Ludwigia uruguayensis* complex", notably between *Ludwigia grandiflora* and *Ludwigia hexapetala* , which now appear to be considered two discrete species, although hybridisation can occur where both populations are present (Zardini 1991). However, Nesom and Kartesz (2000), while acknowledging that each is a discrete entity, suggest that the morphotypes *L. grandiflora* and *L. hexapetala* should each be treated as a subspecies of *L. grandiflora*. The authors are unsure of the current scientific consensus among taxonomists on this issue.
4	Describe the organism.		***Ludwigia grandiflora*** According to an excerpt from CABI (2014a), "*L. grandiflora* is an emergent, aquatic, herbaceous perennial with two growth forms. During the first growth stage, the plant produces smooth or sparsely pubescent stems that grow horizontally over the soil or water, rooting at nodes and producing white, spongy roots. Leaves are smooth, alternate and have petioles. During the second stage, shoots begin to grow vertically and flower, stems become pubescent and can grow up to 1 m tall (USACE-ERDC 2009). Leaves tend to be more elongate in the second growth form (IPAMS 2009), but can vary widely in shape from lanceolate to elliptic and acute at both ends (USACE-ERDC 2009). Flowers are on solitary stalks that are approximately 2.5 cm long; actinomorphic; sepals 5 (rarely 6), villous or glabrous; petals 5, caducous, obovate, emarginate, bright golden-yellow with a darker spot at the base; stamens in 2 whorls, the epipetalous ones shorter; disc slightly elevated, with a depressed, white-hairy nectary surrounding the base of each epipetalous stamen; style glabrous or hairy in lower two-third. Fruit is a pubescent light-brown capsule, 2.5 cm long containing 40-50 seeds, 1.5 mm long, embedded in a woody endocarp (IPAMS 2009)." ***Ludwigia peploides*** According to an excerpt from CABI (2014b), "*L. peploides* is an emergent and floating herbaceous perennial macrophyte. It has glabrous or pubescent stems 1-30 dm [1 dm = 0.1 m] that can creep horizontally as well as grow vertically. Early growth resembles a rosette of rounded leaves growing on the water's surface. Alternate leaves are polymorphic and less than 10 cm long and oblong to round, often lanceolate at flowering. The species exhibits root dimorphism and has adventitious roots that form at nodes and ensure oxygen uptake. Flowers are 5-merous (pentamerous), grow from leaf axils, are bright yellow, and can be from 7 to 24 mm long. Fruit is in a five-angled reflexed capsule, about 3 cm long that contains 40-50 seeds 1.0-1.5 mm long, embedded in the inner fruit wall (EPPO,

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			2004; The Jepson Online Interchange, 2009)." ***Ludwigia hexapetala*** According to NCSU (undated), *Ludwigia hexapetala*, "produces light green, floating stems early in the season with rosettes of smooth, shiny, slightly oval leaves. Later in the season, the stems become erect, reddish-brown, very woody, and often may begin to split lengthwise. On the erect stems, the leaves elongate and become strap-shaped and pointed at the tips. Wiry, branched roots form at the nodes giving the root system a feathery appearance. Soft, fleshy, white, roots filled with air spaces form when the plants root in mud or dense vegetative mats. Leaves are arranged alternately along the stems. Emergent leaves and stems usually are slightly to extremely hairy, giving the plant another common name, "hairy waterprimrose". Flowers appear during early summer on stalks attached in the upper leaf axils of emergent stems. They are solitary, up to an inch in diameter, have five to six bright yellow petals, and may be covered with hairs, particularly on the stalks. Flowering occurs from late April through the end of August or early September. Many small, yellowish seeds are produced during the summer in elongated, woody capsules."
5	Does a relevant earlier risk assessment exist? (give details of any previous risk assessment)	YES	Two preliminary risk assessments were previously carried out for Ireland as follows. A stage one and two risk assessment as part of *Ireland's National Plant Conservation Strategy - Target 10 - Managing Invasive Alien Species* (Botanic Gardens 2007); and a prioritisation risk assessment as part of the *Risk Analysis and Prioritisation for Invasive and Non-native Species in Ireland and Northern Ireland* (Kelly *et al*. 2013a). The former assessment designated all three *Ludwigia* spp. as potential high risk invasive plants and the latter assessment designed *L. grandiflora* and *L. peploides* as 'high risk' invasive species for Ireland. In Britain, a risk assessment was undertaken for *Ludwigia* spp. which specifically focused on *L. grandiflora, L. peploides* and *L. hexapetala* (GB Non-Native Species Secretariat 2010). This risk assessment classed the negative impacts of *Ludwigia* spp. on native biodiversity followed by flood risk, angling and other water users as major. The European and Mediterranean Plant Protection Organisation (EPPO), of which Ireland is a member, has conducted risk assessments on *L. grandiflora* and *L. peploides* (EPPO 2011a and EPPO 2011b, respectively) but not *L. hexapetala*. Both risk assessments concluded, "The risk of establishment of *Ludwigia* [*grandiflora* and *peploides*] in aquatic habitats, and negative impacts on their

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			vegetation and use, justifies measures to prevent its further spread in the EPPO region. The pest qualifies as a quarantine pest."
6	If there is an earlier risk assessment is it still entirely valid, or only partly valid?	YES	Only preliminary screening risk assessments were previously conducted in Ireland (refer to Question 5). The GB Non-Native Species Secretariat (2010) risk assessment covers the same three *Ludwigia* species as this risk assessment and is considered very relevant as Britain is a neighboring jurisdiction to Ireland with similar habitat types and abiotic conditions including climate. The EPPO risk assessments are also entirely valid as they consider Europe-wide risks for member countries.
7	Where is the organism native?		***L. grandiflora*** is considered native to Central America (Guatemala), South America, south-east North America and Mexico (CABI 2014a). ***L. peploides*** is considered to be native to North, South and Central America, New Zealand and parts of Australia (CABI 2014b). ***L. hexapetala*** is considered to be native to South America (ASLA undated).
8	What is the current global distribution of the organism (excluding Ireland)?		The current global distribution of ***L. grandiflora*** is North, South and Central America, and Europe (Belgium, France, Germany, Spain, Switzerland and The Netherlands) (reviewed in CABI 2014a). The current global distribution of ***L. peploides*** is North, South and Central America, Australia and New Zealand; Europe (Belgium, France, Germany, Greece, Italy, Portugal, Spain, Switzerland, The Netherlands and the UK); eastern and south-eastern Asia and Turkey, and Africa (Burkina Faso, Madagascar and Mali) (reviewed in CABI 2014b). The current global distribution of ***L. hexapetala*** is South America and California (Nesom and Kartesz 2000; CAL-IPC undated).
9	What is the current distribution of the organism in Ireland?		***Ludwigia grandiflora*** has been recorded at two sites in Ireland to date. Both records are from 2009. The first record is in an artificial pond in Clarecastle, Co. Clare where it was reported to be present along the pond edge amongst creeping bent and rushes (National Biodiversity Data Centre 2009). The second record is from Gleesk Road, Sneem, Co. Kerry where it was present in a number of isolated garden ponds (each <100 square metres in size) (National Biodiversity Data Centre 2009). In the latter case, extensive operations were conducted by IFI staff

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			to eradicate the species and this is believed to have resulted in a high degree of control, if not complete eradication (Inland Fisheries Ireland 2012). Inland Fisheries Ireland staff intend to monitor the ponds in Sneem again this year for any signs of re-establishment and will treat this if required (J. Caffrey, personal communication). ***Ludwigia peploides*** and ***Ludwigia hexapetala*** are not known to be present in Ireland. Neither of the three *Ludwigia* species are present in Northern Ireland. In Britain, *L. grandiflora* is now the subject of control measures in Britain. The plant is only known from a few sites in the UK and it has been eradicated from some of these locations, Water-primrose (*L. peploides*) has often been incorrectly recorded (Kelly and Maguire 2009).
10	Is the organism known to be invasive anywhere in the world?	YES	According to EPPO (2011a), "***L. grandiflora*** is widespread and invasive in the south and west of France but its distribution is still very limited in the north and east of France, as well as in Belgium, Germany, Ireland, Italy, the Netherlands, Spain and the UK where invasion is at an early stage. The species could spread to further EPPO countries and have negative impacts on agriculture and the environment." *L. grandiflora* is also considered invasive in some states bordering the east and west coasts of the USA (reviewed in CABI 2014a). According to EPPO (2011b), "***L. peploides*** is widespread and invasive in the south-east and west of France and its distribution is still very limited in Belgium, Corsica, Greece, Italy, the Netherlands, Spain, Turkey, and the UK where invasions are at an early stage. The species could spread to further EPPO countries and have negative impacts on agriculture and the environment." *L. peploides* is also considered invasive in two states in the USA (New York and Washington) but is not prevalent there (reviewed in CABI 2014b). There is a paucity of information on the invasive status of ***L. hexapetala***. It is documented as invasive in California (e.g. Hansen *et al*. 2010). According to Hansen *et al*. (2010), "*Ludwigia hexapetala* infestations quickly spread throughout shallow water bodies …. with dense mats of underwater stems, adventitious roots, and trapped sediment that clog the entire water column. Every summer, the plant produces large amounts of above-ground biomass. While alive, it traps great quantities of sediment. When it senesces in mid- winter, the stems fold down onto each other in a dense layer. The next summer's growth continues the cycle until eventually *L. hexapetala* transforms a marsh with formerly open-water areas into a

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			saturated peat-like bog within a few years, leaving the new surface firm enough to support the full weight of an adult without getting wet.”

Stage 2 - Detailed assessment: Section A - Entry

This section evaluates the probability of entry of an organism into Ireland. For organisms which are already present, only complete the entry section for currently active pathways of entry and potential future pathways. The entry section need not be completed for pathways which have allowed an organism to enter in the past but are no longer active.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
1.01	How many active/future pathways are relevant to the potential entry of this organism (n/a, very few, few, moderate number, many or very many)?	FEW	MEDIUM	Horticultural and aquarium trade. The risk of inadvertent introduction of viable plant material by boaters, anglers, other water users or migrating waterfowl coming from abroad from an infested area is considered very low because of the absence of *Ludwigia* spp. in the wild in Northern Ireland and their very low prevalence in Britain. Therefore, these potential pathways are not considered further in the present risk assessment.
1.02	List significant pathways through which the organism could enter. Where possible give detail about the specific origins and end points of the pathways.	1. Horticultural and aquarium trade	MEDIUM	*Ludwigia* spp. may be occasionally imported into Ireland *via* the horticultural and aquarium sectors for sale to the public in retail outlets such as garden centres and aquarium shops. However, a detailed internet search of plant listings from such outlets on 30/06/2014 did not find any such specimens advertised for sale. A search of direct internet sales found only a single vendor advertising seeds of "water primrose" for sale (USA 25 seeds for €1.31 including P&P to Ireland – Ebay.ie listing 30/06/2014). Seed viability is not good and although seeds are available you may get only a 20 – 30% germination rate (J. Newman, personal communication). *L. grandiflora* is traded as an ornamental aquatic plant for outdoor use, and is not normally used in aquaria (EPPO 2011a). According to EPPO (2011a), in general, *L. grandiflora* is likely to be traded under *Jussiaea*, or other erroneous names. Imports of *L. grandiflora* to Ireland are likely to come directly from south-east Asia (e.g. Indonesia, Malaysia or Thailand) or as a secondary import from a mainland European country (EPPO 2011a). *Ludwigia* spp. are not now officially traded in England as recent legislation (April 2014) there has banned this (The Wildlife and Countryside Act 1981 (Prohibition on Sale etc. of Invasive Non-native Plants) (England) Order 2014 http://www.legislation.gov.uk/uksi/2014/538/made).

Pathway 1 - Horticultural and aquarium trade				
N	**QUESTION**	**RESPONSE**	**CONFIDENCE**	**JUSTIFICATION**
1.03	Is entry along this pathway intentional (e.g. the organism is imported for trade) or accidental (e.g. the organism is a contaminant of imported goods)?	INTENTIONAL	MEDIUM	*Ludwigia* spp. may be occasionally imported into Ireland *via* the horticultural and aquarium sectors for sale. However, the authors can find no information to confirm this.
1.04	How likely is it that large numbers of the organism will travel along this pathway from the point(s) of origin over the course of one year?	VERY UNLIKELY	HIGH	The authors can find no current listing advertising this plant for sale in Ireland.
1.05	How likely is the organism to enter Ireland undetected or without the knowledge of relevant competent authorities?	VERY LIKELY	VERY HIGH	Awareness by the relevant competent authorities at points of entry to recognise and identify this species is limited or non-existent at present.
1.06	How likely is the organism to survive during passage along the pathway?	VERY LIKELY	VERY HIGH	Survival is considered to be very likely if specimens are distributed for trade.
1.07	How likely is the organism to arrive during the months of the year appropriate for establishment?	LIKELY	HIGH	Very likely given that spread can occur both vegetatively and by seed (GB Non-Native Species Secretariat 2010). In Britain, the principal movement of *Ludwigia* spp. is limited to season (spring to late summer) when sales can be made (GB Non-Native Species Secretariat 2010).
1.08	How likely is the organism to be able to transfer from the pathway to a suitable habitat or host?	LIKELY	HIGH	Any transfer would most likely be human-mediated through the dumping of excess growth from a private pond into an aquatic habitat in the wild; *via* deliberate planting in such waters; or planting in a water from which subsequent natural spread can occur to the wild e.g. *via* a pond outflow (GB Non-Native Species Secretariat 2010). Suitable habitat in Ireland is considered to be widespread for *Ludwigia* spp. (Kelly and Maguire 2009). They can colonise static or slow-flowing waters: rivers, shallow ponds and lakes, canals, oxbow lakes, wet margins of ponds and lakes, wetlands, ditch networks, sediment bars on river borders and wet meadows (reviewed in EPPO 2011a and EPPO 2011b; WSSA 2014; WSDE (undated a and b). *L. peploides* can also colonise brackish waters (Mesleard and Perennou 1996 as cited in EPPO 2011b).

Pathway 1 - Horticultural and aquarium trade				
N	**QUESTION**	**RESPONSE**	**CONFIDENCE**	**JUSTIFICATION**
1.09	Estimate the overall likelihood of entry into Ireland based on this pathway?	MODERATELY LIKELY	LOW	Although *Ludwigia* spp. do not appear to be traded in Ireland, there remains some potential that the plant could be imported and sold in Ireland under a different trade name, arrive as an hitch-hiker in other aquatic plant consignments or may brought back from abroad by a private individual for planting in a pond.
1.10	Do other pathways need to be considered?	NO		

Overall likelihood				
N	**QUESTION**	**RESPONSE**	**CONFIDENCE**	**JUSTIFICATION**
1.11	Estimate the overall likelihood of entry into Ireland based on all pathways (comment on the key issues that lead to this conclusion).	MODERATELY LIKELY	MEDIUM	Although *Ludwigia* spp. do not appear to be traded in Ireland, there remains some potential that the plant could be imported and sold in Ireland under a different trade name, arrive as an hitch-hiker in other aquatic plant consignments or may brought back from abroad by a private individual for planting in a pond. The movement of boats, angling gear and other equipment used in water activities from infested areas outside Ireland to the country could also facilitate entry if viable plant material can survive transit *via* these pathways. The potential for this may increase in the coming years if *Ludwigia* spp. populations expand in Britain.

Stage 2 - Detailed assessment: Section B – Establishment

This section evaluates the probability of establishment of an organism within Ireland. For organisms which are already well established in Ireland there is no need to complete this section - move straight to the Spread section.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
2.01	Is the organism well established in Ireland (if there is any uncertainty answer 'unsure')	NO	-	Refer to Question 9.
2.02	How likely is it that the organism will be able to establish in Ireland based on the similarity between local climatic conditions and the organism's current global distribution?	VERY LIKELY	HIGH	*L. grandiflora* has already demonstrated this in two locations in Ireland (National Biodiversity Data Centre 2009). Both, *L.* peploides and *L. hexapetala* occur in the wild in Britain (Kelly and Maguire 2009) which has a similar climate to Ireland, all of which indicate that climatic conditions are suitable for the three *Ludwigia* spp. in Ireland. Furthermore, according to a CLIMEX simulation*, Ireland along with many other EPPO countries in the Atlantic and Mediterranean regions which are characterised by mild winters are suitable for the establishment of both *L. grandiflora* and *L. peploides* (EPPO 2011a and EPPO 2011b, respectively). * *The CLIMEX model is a computer programme aiming at predicting the potential geographical distribution of an organism considering its climatic requirements. It is based on the hypothesis that climate is an essential factor for the establishment of a species in a country* (EPPO 2011a).
2.03	How likely is it that the organism will be able to establish in Ireland based on the similarity between other local abiotic conditions and the organism's current global distribution?	VERY LIKELY	HIGH	There are no over-riding abiotic factors that will inhibit the establishment of the three *Ludwigia* spp. in suitable habitats in Ireland. *L. grandiflora* has already demonstrated this in two locations in Ireland (National Biodiversity Data Centre 2009). According to EPPO (2011b), "Both *L. peploides* and *L. grandiflora* are tolerant to a wide range of conditions in terms of nutrient levels, types of substrate (gravel banks or sediments), pH and water quality (Marat *et al.* 2006). They prefer full light but can tolerate shade (biomass production is reduced under shade); they are limited by flow velocity (greater than 0.25 m/s) (Dandelot 2004) and by salinity (*L. grandiflora* tolerates up to 6g/L). *Ludwigia* spp. prefer high nutrient conditions (Hussner 2010) and become dominant in nutrient-rich conditions (Rejamánková 1992). Compared to *L. grandiflora*, *L. peploides* can grow in brackish waters of the Camargue, with salt concentrations of about 10 g/L (e.g, at the mouth of the Rhône) (Grillas *et al.* 1991; Mesleard and Perennou 1996). These abiotic factors are very common in the EPPO region and completely similar to the ones in the current range of the species".

Stage 2 - Detailed assessment: Section B – Establishment

This section evaluates the probability of establishment of an organism within Ireland. For organisms which are already well established in Ireland there is no need to complete this section - move straight to the Spread section.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
2.04	How likely is the organism to encounter habitats necessary for the survival, development and multiplication of the organism in Ireland?	VERY LIKELY	HIGH	As previously mentioned, suitable habitat in Ireland is considered to be widespread for *Ludwigia* spp. (Kelly and Maguire 2009). They can colonise static or slow-flowing waters: rivers, shallow ponds and lakes, canals, oxbow lakes, wet margins of ponds and lakes, wetlands, ditch networks, sediment bars on river borders and wet meadows (reviewed in EPPO 2011a and EPPO 2011b; WSSA 2014; WSDE (undated a and b). *L. peploides* can also colonise brackish waters (Mesleard and Perennou 1996 as cited in EPPO 2011b).
2.05	How likely is it that establishment will occur despite competition from existing species in Ireland?	VERY LIKELY	MEDIUM	"The propensity of *Ludwigia* species for growing out from the margins of a water body and occupying the water surface with floating mats gives the plant a significant competitive advantage" (Yen and Myerscough 1989 as cited in GB Non-Native Species Secretariat 2010).
2.06	How likely is it that establishment will occur despite predators, parasites or pathogens already present in Ireland?	VERY LIKELY	MEDIUM	According to GB Non-Native Species Secretariat 2010, "Some herbivores have been recorded in France (Cordo and Deloach 1982a and 1982b) but these have not had a marked effect on the plants."
2.07	How likely is it that establishment will occur despite existing management practices?	UNLIKELY	HIGH	In general, the public management of waterways is increasingly undertaken cognisant of ensuring biosecurity measures are in place to mitigate for the spread of aquatic invasive species. An increase in awareness of the threat from aquatic invasive species by some private entities has also reduced this risk. Nevertheless, according to risk assessments by EPPO (2011a) and (2011b), "The EWG (Expert Working Group) considered that there are no management practices that could prevent the establishment of this plant [i.e. *L. grandiflora* or *L. peploides*]. Most water bodies that are at risk of colonisation are not subject to management, and those with management plans in place [would not be able to] prevent the establishment of the species."
2.08	How likely is it that management practices in Ireland will facilitate the establishment of the organism?	UNLIKELY	HIGH	Refer to Question 2.07.

Stage 2 - Detailed assessment: Section B – Establishment

This section evaluates the probability of establishment of an organism within Ireland. For organisms which are already well established in Ireland there is no need to complete this section - move straight to the Spread section.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
2.09	How likely is it that the biological characteristics of the organism would allow it to survive eradication campaigns in Ireland?	LIKELY	MEDIUM	The eradication of *L. grandiflora* and *L. peploides* is considered very difficult or even impossible in water bodies with heavy infestation. Local eradication is possible if it is started early and the water system is reasonably accessible (Grillas 2004 as cited in EPPO 2011b). *Ludwigia* spp. possess inherent characteristics enabling rapid vegetative spread between connected water bodies. Where present, the probability of short distance spread is very high as vegetative spread is very effective for local colonisation (EPPO 2011a and 2011b). Therefore, any eradication campaigns conducted without consideration to the removal of vegetative fragments may further disperse the plant.
2.10	How likely is it that the biological characteristics of the organism will facilitate its establishment?	LIKELY	HIGH	The ability of *Ludwigia* spp. to establish in a range of habitats and under a range of abiotic conditions, coupled with its capacity for both vegetative and sexual reproduction, can facilitate its establishment.
2.11	How likely is it that the organism's capacity to spread will facilitate its establishment?	LIKELY	HIGH	*Ludwigia* spp. possess inherent characteristics enabling rapid vegetative spread between connected water bodies. Where present, the probability of short distance spread is very high as vegetative spread is very effective for local colonisation (EPPO 2011a and 2011b). Anthropogenic-mediated spread is principally responsible for dispersal between systems (EPPO 2011a and EPPO 2011b).
2.12	How likely is it that the organism's adaptability will facilitate its establishment?	LIKELY	MEDIUM	The ability of *Ludwigia* spp. to establish in a range of habitats and under a range of abiotic conditions, coupled with its capacity for both vegetative and sexual reproduction, are adaptable traits that can facilitate its establishment.
2.13	How likely is it that the organism could establish despite low genetic diversity in the founder population?	LIKELY	MEDIUM	Although the main method of propagation of *Ludwigia* spp. is by vegetative fragmentation (EPPO 2011a and 2011b), there is no evidence to suggest low genetic diversity in any founder population will inhibit any future establishment. Indeed, invasive populations of *L. grandiflora* and *L. hexapetala* in California (USA) were found to have an extremely limited genetic diversity with reproduction almost exclusively clonal and *via* the dispersal of vegetative propagules (Okada *et al*. 2009). In general, many other non-native aquatic plants which can only reproduce asexually have established robust populations in Ireland in

Stage 2 - Detailed assessment: Section B – Establishment

This section evaluates the probability of establishment of an organism within Ireland. For organisms which are already well established in Ireland there is no need to complete this section - move straight to the Spread section.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
				spite of apparent low genetic diversity in their founder populations.
2.14	Based on the history of invasion by this organism elsewhere in the world, how likely is it to establish in Ireland? If possible, specify the instances of invasion elsewhere in the justification box	VERY LIKELY	HIGH	*L. grandiflora* has already demonstrated this in two locations in Ireland (National Biodiversity Data Centre 2009). Both, *L.* peploides and *L. hexapetala* occur in the wild in Britain (Kelly and Maguire 2009), a neighbouring landmass which has similar climate and abiotic conditions to Ireland, which strongly indicates their suitability to establish populations in Ireland. With the exception of France, other European countries with *Ludwigia* spp. populations in the wild are considered to be at an early stage of invasion (Robert *et al*. 2013) ***L. grandiflora*** (the following is adapted from Vanderhoeven 2013 and references therein). In **France**, *L. grandiflora* is widespread in the south and west of the country and has recently been observed to spread in northern and central areas under Atlantic climatic condition. Populations have been observed to survive during the winter despite a more continental climate. In **Belgium**, the plant was first recorded in the wild in 1983. It is now widespread in Flanders (61x 1km square records since 1995) and present in in Wallonia (21 x 1km square records since 1984). Population sizes vary from less than 1 m² to 3500 m², with a surface percentage cover ranging from 1 to 100 % in invaded sites. In **The Netherlands**, *L. grandiflora* is at an early stage of invasion. It is reported with varying abundance throughout the country except in the Waddensea Islands. In **Britain**, *L. grandiflora* was reported from three southern locations in 2006 (J. Newman, personal communication). ***L. peploides*** (the following is adapted from Robert *et al*. 2013 and references therein). In **France**, *L. peploides* was introduced from the Americas to Montpellier.

Stage 2 - Detailed assessment: Section B – Establishment

This section evaluates the probability of establishment of an organism within Ireland. For organisms which are already well established in Ireland there is no need to complete this section - move straight to the Spread section.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
				Since then it has become one of the most widespread and detrimental aquatic invasive plants in the country, present at hundreds of sites in southern and western France. More recently spread to some sites in the north and east of France. In **Belgium**, *L. peploides* was first reported in the wild in the mid-nineties. It is now established in the Flandrian and Brabant sector in Belgium. However, only a few populations exist. *L. peploides* was first recorded in **Italy** in 2004. It occurs in Lombardia, Emilia-Romagna and is considered invasive in the provinces of Cremona and Lodi. In **Spain**, the plant is well naturalised at various localities along the El Llobregat river in the province of Barcelona, and it is also present in La Selva del mar in the Province of Gerona. In **Greece**, *L. peploides* was recorded in 2001 in the western part of the country in 3 localities near lake Lysimachia covering 0.7 ha with a population of over 10,000 individuals. In **Holland**, the species was first recorded in 2007, found in four sites located in the south of the country and North Brabant. It disappeared from one of these sites without any intervention and was successfully removed from another site by the water board. In 2007, a third infestation covering several hundred square meters was removed, and regrowth has not been observed since (June 2010). ***L. hexapetala*** There is a paucity of documented accounts on the invasion history of this species.
2.15	If the organism does not establish, then how likely is it that transient populations will continue to occur?	UNLIKELY	LOW	As climatic conditions and abiotic conditions appear to be suitable for the establishment of *Ludwigia* spp. in Ireland, transient populations are un likely to occur in suitable habitats.

Stage 2 - Detailed assessment: Section B – Establishment

This section evaluates the probability of establishment of an organism within Ireland. For organisms which are already well established in Ireland there is no need to complete this section - move straight to the Spread section.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
2.16	Estimate the overall likelihood of establishment. Mention any key issues in the comments box	VERY LIKELY	HIGH	As climatic and abiotic conditions appear to be suitable for all three *Ludwigia* spp.in Ireland, it is considered very likely that these species can establish in suitable habitats throughout the country.

Stage 2 - Detailed assessment: Section C - Spread

This section evaluates the probability of spread of an organism within Ireland. Spread is defined as the expansion of the geographical distribution of an organism within the risk assessment area.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
3.01	What area (given in % or 10km squares) in Ireland could the organism establish (0% - 10%, 11% - 33%, 34% - 67%, 68% - 90% or 91% - 100%)?	34% - 67% (of 10 km squares)	MEDIUM	Suitable habitat in Ireland is considered to be widespread for *Ludwigia* spp. (Kelly and Maguire 2009). These species can colonise static or slow-flowing waters: rivers, shallow ponds and lakes, canals, oxbow lakes, wet margins of ponds and lakes, wetlands, ditch networks, sediment bars on river borders and wet meadows (reviewed in EPPO 2011a and EPPO 2011b; WSSA 2014; WSDE a and b, undated). *L. peploides* can also colonise brackish waters (Mesleard and Perennou 1996 as cited in EPPO 2011b).
3.02	How important is the expected spread of this organism in Ireland by natural means (minimal, minor, moderate, major or massive)?	MINOR	MEDIUM	In general, *Ludwigia* spp. possess inherent characteristics enabling rapid vegetative spread between connected water bodies. Where present, the probability of short distance spread is high as vegetative spread is very effective for local colonisation (EPPO 2011a and 2011b). However, anthropogenic-mediated spread is principally responsible for dispersal between systems (EPPO 2011a and EPPO 2011b). At present, the expected spread of *L. grandiflora* is considered to be minor because the distribution of the species is highly restricted in Ireland (two confined locations - National Biodiversity Data Centre 2009), and eradication operations have already been conducted at one of these locations (Inland Fisheries Ireland 2012).

Stage 2 - Detailed assessment: Section C - Spread

This section evaluates the probability of spread of an organism within Ireland. Spread is defined as the expansion of the geographical distribution of an organism within the risk assessment area.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
3.03	How important is the expected spread of this organism in Ireland by human assistance (minimal, minor, moderate, major or massive)?	MINOR	MEDIUM	In general, anthropogenic-mediated transfer is the principal pathway to facilitate the establishment of the plant from colonised to uncolonised waters (EPPO 2011a and EPPO 2011b). As there appears to be no trade in *Ludwigia* spp. on the island of Ireland, and the occurrence of *L. grandiflora* is currently restricted to confined ponds in only two locations, expected spread by human assistance is considered to be minor.
3.04	Within Ireland, how difficult would it be to contain the organism (minimal, minor, moderate, major or massive)?	MINOR	HIGH	As the occurrence of *L. grandiflora* is currently restricted to confined ponds in only two locations in Ireland (refer to response to Question 9) containment is considered entirely feasible.
3.05	What proportion (%) of the area in Ireland suitable for establishment, if any, has already been colonised by the organism?	0% - 10%	VERY HIGH	Refer to Question 3.04.
3.06	What proportion of the area in Ireland suitable for establishment, if any, do you expect to have been invaded by the organism five years from now (including any current presence)?	0% - 10%	HIGH	It is likely that *L. grandiflora* will not significantly expand its distribution in Ireland in the next five years. *Ludwigia* spp. do not appear to be traded in Ireland at present and are unlikely to be officially traded in the country in the foreseeable future. In addition, the ban on the trade of *Ludwigia* spp. in Britain further reduces the potential that these species will be imported for the horticultural trade here.
3.07	What other timeframe would be appropriate to estimate any significant further spread of the organism (10, 20, 40, 80 or 160 years)? Please comment on why this timeframe is chosen.	20 years	LOW	In the absence of proposed restrictions on sale and import (i.e. Regulation 50 of SI 477/2011) and the implementation of routine biosecurity measures to prevent spread from presently colonised areas, some further spread to uncolonised systems is considered possible.

Stage 2 - Detailed assessment: Section C - Spread

This section evaluates the probability of spread of an organism within Ireland. Spread is defined as the expansion of the geographical distribution of an organism within the risk assessment area.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
3.08	In this timeframe, what proportion of the endangered area (including any currently occupied areas) is likely to have been invaded by this organism?	0% - 10%	LOW	Refer to Questions 3.06 and 3.07.
3.09	Based on the answers to questions on the potential for establishment and spread in Ireland, define the area endangered by the organism. Be as specific as possible. If available, provide a map showing the area most likely to be endangered.	-	MEDIUM	Suitable habitat in Ireland is considered to be widespread for *Ludwigia* spp. (Kelly and Maguire 2009). These species can colonise static or slow-flowing waters: rivers, shallow ponds and lakes, canals, oxbow lakes, wet margins of ponds and lakes, wetlands, ditch networks, sediment bars on river borders and wet meadows (reviewed in EPPO 2011a and EPPO 2011b; WSSA 2014; WSDE (undated a and b). *L. peploides* can also colonise brackish waters (Mesleard and Perennou 1996 as cited in EPPO 2011b).
3.10	Estimate the overall potential for future spread for this organism in Ireland (very slowly, slowly, moderately, rapidly or very rapidly). Use the justification box to indicate any key issues .	SLOWLY	MEDIUM	The restricted distribution of *L. grandiflora* in Ireland presents an ideal opportunity to eradicate this species before it has the chance to spread to uncolonised waters in the country. In general, future spread will be slow, at best, if the following occurs: - Proposed restrictions on sale and import (i.e. Regulation 50 of SI 477/2011) are enacted and enforced; - There is implementation of routine biosecurity measures to prevent spread from presently colonised areas. This may include informing the landowner of the potential threat of the species to native species and habitats if it should escape from its present confinement. - Further eradication / control measures are undertaken which reduce the available inoculum for further spread.

Stage 2 - Detailed assessment: Section D - Impact *This section evaluates the probability of impact of an organism within Ireland.*				
N	**QUESTION**	**RESPONSE**	**CONFIDENCE**	**JUSTIFICATION**
4.01	How great is the economic loss caused by the organism within its global distribution (excluding Ireland), including the cost of any current management?	MODERATE	HIGH	According to GB Non-Native Species Secretariat 2010, "*Ludwigia* species are problems in irrigation channels, dams/reservoirs and canals and rivers in South America and southern Africa." Globally the economic loss could be considered as 'moderate'. In a local context, this may be 'major'. ***L. grandiflora*** CABI provide an overview of the economic impacts of ***L. grandiflora*** as follows. "In California, USA dense stands of *L. grandiflora* reduce floodwater retention (Okada *et al*. 2009). The plant can also cause hyper-sedimentation and silting (Dandelot *et al*. 2008). *L. grandiflora* has naturalized in France and has cost millions of Euros (RAFTS 2009). *L. grandiflora* is considered by some to cause the most damage of any invasive aquatic macrophyte in water ecosystems across many regions of France. In the northeast of France, it often achieves growth capable of blocking slow-moving waterways, interfering with navigation, impacting irrigation and drainage in lakes, ponds and ditches (Ruaux *et al*. 2009). The species' physical and chemical alteration of the environment can cause severe damage to local ecosystems and biodiversity." EPPO (2011a) have reviewed the financial cost of controlling ***L. grandiflora*** (with some figures for ***L. peploides***) as follows: "*L. grandiflora* interferes with agricultural production, ecosystem services and human use of water bodies (e.g. deterioration of dams and infrastructures, loss of recreation areas, increase in flood risk, etc.). Standard calculation of control costs is extremely difficult as it greatly depends on the characteristics of the sites and of the infestations (Lambert *et al*. 2009). In the west of France, for the period 1990-2003, the cost range of weed pulling techniques, expressed in tonnes of fresh biomass (Million 2004), were as follows for both *L. grandiflora* and *L. peploides*: - Mechanical removal: 51 to 64 € [per tonne of fresh biomass removed from] highly invaded sites with very dense biomass. - Manual removal: 1100 to 1330 € [per tonne of fresh biomass removed from sites with] new infestations, and for removal of small isolated

Stage 2 - Detailed assessment: Section D - Impact *This section evaluates the probability of impact of an organism within Ireland.*				
N	**QUESTION**	**RESPONSE**	**CONFIDENCE**	**JUSTIFICATION**
				patches over larger areas after initial mechanical extraction. In Belgium sums of 140 000 and 126 000 € were respectively spent in 2005 and 2006 to clear 25 ha invaded *with L. grandiflora* (De Bruyn *et al*. 2007). The cost of control in the UK between 1998 and June 2010 for a total of 2.38 ha was 27,320 GBP including method development costs, which is equivalent to 11,467 GBP/ha (Renals 2010). These costs are ongoing until eradication will be achieved." ***L. peploides*** CABI provide an overview of the economic impacts of ***L. peploides*** as follows. "*L. peploides* can double its biomass in 15 to 20 days in slow flowing water (EPPO 2004), and the resulting mats can drastically reduce water flow (Dandelot *et al*. 2008). Along with closely related *Ludwigia grandiflora, L. peploides* is considered by some to cause the most damage in aquatic systems across many regions of France, blocking slow-moving waterways, and impacting irrigation and drainage in lakes, ponds and ditches (Ruaux *et al*. 2009). The plant can also cause hyper-sedimentation and silting (Dandelot *et al*. 2008). In France, the plant can displace native wetland grasses that serve as forage for livestock (CEH 2007). In Chile it is reported as a weed of rice (Ramírez 1991). ***L. hexapetala*** There is a paucity of specific information relating to the global economic cost of *L. hexapetala*.
4.02	How great has the economic cost of the organism been in Ireland from the time of introduction to the present? Exclude any costs associated with managing the organism from your answer.	MINIMAL	VERY HIGH	No such costs have been reported. Only *L. grandiflora* is present in Ireland and it is currently restricted to a small number of ponds in a total of two locations.

Stage 2 - Detailed assessment: Section D - Impact

This section evaluates the probability of impact of an organism within Ireland.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
4.03	How great is the economic cost of the organism likely to be in the future in Ireland? Exclude any costs associated with managing the organism from your answer.	MODERATE to MAJOR	MEDIUM	This is difficult to quantify and will depend on the future spread of *Ludwigia* spp. in Ireland coupled with an ability to establish abundant populations. Refer to response to Question 4.01 for typical impacts that occur when abundant populations establish.
4.04	How great have the economic costs of managing this organism been in Ireland from the time of introduction to the present?	MINIMAL	VERY HIGH	There is no specific information available on this. However, it is highly likely to be minimal to date. This is principally due to the restricted distribution of the plant in the country. Small costs have been incurred from conducting specific habitat surveys, and the creation of identification and awareness literature by Inland Fisheries Ireland, its predecessors and others. The development of a specific Action Plan for *Ludwigia* spp. by Invasive Species Ireland and their partners has also incurred some minor costs (Kelly and Maguire 2009).
4.05	How great is the economic cost of managing this organism likely to be in the future in Ireland?	MODERATE to MAJOR	MEDIUM	This is difficult to quantify and will depend on the future spread of *Ludwigia* spp. in Ireland coupled with an ability to establish abundant populations. Refer to response to Question 4.01 for typical impacts that occur when abundant populations establish.

Stage 2 - Detailed assessment: Section D - Impact *This section evaluates the probability of impact of an organism within Ireland.*				
N	**QUESTION**	**RESPONSE**	**CONFIDENCE**	**JUSTIFICATION**
4.06	How important is environmental harm caused by the organism within its global distribution?	MODERATE to MAJOR	VERY HIGH	The environmental impacts *of L. grandiflora* and *L. peploides* were reviewed in EPPO (2011a) and (2011b), respectively. Both state that it is difficult to separate the individual impacts of each species as most available information is from France, where populations often co-occur. According to EPPO (2011a and 2011b), "The dominance of *Ludwigia* spp. leads to local loss of floral biodiversity, as well as faunal biodiversity (for macro-invertebrates and fishes) (Dandelot 2004). An analysis of the distribution of *Ludwigia* spp. in France shows that habitats under threat by this species include at least 12 habitats of interest for the European Commission (Habitat Directive 92/43/EEC), and 3 types of wet habitats (aquatic vegetation of the *Nymphaeion albae,* swamp vegetation with tall helophytes, prairial vegetation and flooded forests (Dutartre *et al*. 2007))." "Preliminary observations also show that *L. grandiflora* is not only integrated in the native plant-pollinator network but shows a dominance in terms of frequency of pollinator visits (I. Stiers, pers. obs., 2001)." (EPPO 2011a). "In Greece, *L. peploides* occurs in the lake Lysimachia which constitutes one of the proposed sites of community interest included in the European Ecological network Natura 2000 of Greece (Zotos *et al*. 2006)." EPPO 2011b) *"Ludwigia* spp. cause many significant changes of ecological processes and structures in the following ways : - the high biomass production leads to a slowing of water flow (Dutartre 1988) in channels, ditches and shallow rivers, causing increased sedimentation, which may lead to increased flood risk by reduction of channel carrying capacity, particularly in autumn. This may lead to modifications of flora and fauna communities, fish disappearing in dense beds, etc. In static open waters, the slow rate of litter decomposition can lead to shallowing of the water body and succession to swamp and marsh type vegetation. - reduction in oxygen concentrations: in static waters, dense stands prevent the transfer of oxygen between water and the atmosphere, reduction in light availability for submerged plants

Stage 2 - Detailed assessment: Section D - Impact *This section evaluates the probability of impact of an organism within Ireland.*				
N	**QUESTION**	**RESPONSE**	**CONFIDENCE**	**JUSTIFICATION**
				reduces photosynthetic oxygen production and consumption of oxygen by Ludwigia spp. root respiration results in severe deoxygenation which is harmful to aquatic fauna. Concentrations of oxygen < 1 mg/L have been recorded in waters where Ludwigia spp. are present (Dandelot *et al*. 2005a). - decreases in pH are common due to the suppression of submerged aquatic photosynthetic processes (Dandelot *et al*. 2005b) - change in hydrological regimes of water bodies (Dandelot, 2005b)." (Excerpt from EPPO 2011a and 2011b). There is a paucity of specific information on the environmental harm of *Ludwigia hexapetala* in its global range. .A summary by CAL-IPC (undated). states that the plant "forms dense mats in waterways, reaching above and below the water surface. This dense growth impedes water movement, blocks the growth of native plants, and reduces available habitat for waterbirds and fish."

Stage 2 - Detailed assessment: Section D - Impact

This section evaluates the probability of impact of an organism within Ireland.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
4.07	How important has the impact of the organism on biodiversity* been in Ireland from the time of introduction to the present? *e.g. decline in native species, changes in community structure, hybridisation	MINIMAL	HIGH	No impacts have been reported. Only *L. grandiflora* is present in Ireland and it is currently restricted to a small number of ponds in a total of two locations. No investigations have been conducted on this in these ponds.
4.08	How important is the impact of the organism on biodiversity likely to be in the future in Ireland?	MODERATE to MAJOR	MEDIUM	It is likely based on known impacts from France (refer to response to Question 4.06) that *L. grandiflora* and *L. peploides* could negatively affect biodiversity, particularly where dense infestations establish (i.e. shallow water and marginal habitats; 'major'). This would likely be less severe elsewhere ('moderate') in other habitats where less vigorous populations may occur. There is a paucity of information to assess this for *L. hexapetala* but the species appears to be closely related to, if not a subspecies of, *L. grandiflora* and therefore, similar impacts are considered likely. There may also be implications for the classification of ecological status under the EU Water Framework Directive and the conservation status of certain species and habitats and under the EU Habitats Directive.
4.09	How important has alteration of ecosystem function* caused by the organism been in Ireland from the time of introduction to the present? *e.g. habitat change, nutrient cycling, trophic interactions	MINIMAL	VERY HIGH	No alterations to ecosystem function have been reported. Only *L. grandiflora* is present in Ireland and it is currently restricted to a small number of ponds in a total of two locations. No investigations have been conducted on this in these ponds.
4.10	How important is alteration of ecosystem function caused by the organism likely to be in Ireland in the future?	MODERATE / MAJOR	MEDIUM	It is likely based on known impacts from France (refer to response to Question 4.06) that *L. grandiflora* and *L. peploides* could negatively affect ecosystem function, particularly where dense infestations establish (i.e. shallow water and marginal habitats; 'major'). This would likely be less severe elsewhere ('moderate') in other habitats where less vigorous populations may occur. There is a paucity of information to assess this in for *L. hexapetala* but the species appears to be closely related to, if not a subspecies of, *L. grandiflora* and therefore, similar effects are considered likely.

Stage 2 - Detailed assessment: Section D - Impact

This section evaluates the probability of impact of an organism within Ireland.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
4.11	How important has decline in conservation status* caused by the organism been in Ireland from the time of introduction to the present? *e.g. sites of nature conservation value, WFD classification, etc.	MINIMAL	HIGH	There has been no official decline in conservation status caused by *L. grandiflora* in Ireland to date and no potential for such a decline at present due to its restricted occurrence to a small number of confined ponds in a total of two locations.
4.12	How important is decline in conservation status caused by the organism likely to be in the <u>future</u> in Ireland?	MODERATE to MAJOR	MEDIUM	It is likely based on known impacts from France (refer to response to Question 4.06) that *L. grandiflora* and *L. peploides* could cause detrimental impacts to native habitats and species in Ireland. This may result in the downgrading of ecological status under the Water Framework Directive and have implications for Natura 2000 sites. Impacts are likely to be 'major' where dense infestations establish (i.e. shallow water and marginal habitats) and less severe elsewhere. There is a paucity of information to assess in detail the potential threat to conservation status of *L. hexapetala* in Ireland but the species appears to be closely related to, if not a subspecies of, *L. grandiflora* and therefore, similar impacts are considered likely.
4.13	How important is social or human health harm (not directly included in economic and environmental categories) caused by the organism within its global distribution?	MODERATE	HIGH	According to EPPO (2011a), "Stands of *Ludwigia* spp. can be very dense, with highly branched and very solid stems of several metres long, preventing passage for fish and users of the water (Dutartre *et al.* 2007). In some agricultural ditch networks in the West of France, dense stands of *L. grandiflora* cause damage to irrigation and drainage use of the water bodies, it is for example the case in the wet part of the Marais Poitevin (Nicolas Pipet, Interdepartmental Institution of Sèvre Niortaise watershed, pers. comm., 2011). Flood risks may be increased by the reduction of channel carrying capacity, particularly in autumn (Dandelot 2004). Floating mats of this plant can increase mosquito populations by making the larvae inaccessible to mosquito-eating fish (Pillsbury 2005 in DEFRA 2006) and creating static water beneficial to mosquito development."
4.14	How important is social or human health harm (not directly included in economic and environmental categories) caused by the organism within Ireland?	MINIMIAL	VERY HIGH	No impacts have been reported. Only *L. grandiflora* is present in Ireland and its current distribution is limited to a small number of ponds in a total of two locations.

Stage 2 - Detailed assessment: Section D - Impact

This section evaluates the probability of impact of an organism within Ireland.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
4.15	How important is it that genetic traits of the organism could be carried to other organisms / species, modifying their genetic nature and making their economic, environmental or social effects more serious?	MINIMAL	MEDIUM	Unlikely - there is no evidence for this.
4.16	How important is the impact of the organism as food, a host, a symbiont or a vector for other damaging organisms (e.g. diseases)?	MINIMAL	MEDIUM	None has been reported (GB Non-Native Species Secretariat 2010)
4.17	How important might other impacts not already covered by previous questions be resulting from introduction of the organism? Specify in the justification box.	MINIMAL	HIGH	All known potential impacts have been covered elsewhere is this assessment.
4.18	How important are the expected impacts of the organism despite any natural control by other organisms, such as predators, parasites or pathogens that may already be present in Ireland?	MINIMAL	MEDIUM	*Ludwigia* spp.are not likely to be naturally controlled by any predator, parasite or pathogen in Ireland.
4.19	Indicate any parts of Ireland where economic, environmental and social impacts are particularly likely to occur. Provide as much detail as possible, where possible include a map showing vulnerable areas.		HIGH	As stated previously, suitable habitat in Ireland is considered to be widespread for *Ludwigia* spp. (Kelly and Maguire 2009). These species can colonise static or slow-flowing waters: rivers, shallow ponds and lakes, canals, oxbow lakes, wet margins of ponds and lakes, wetlands, ditch networks, sediment bars on river borders and wet meadows (reviewed in EPPO 2011a and EPPO 2011b; WSSA 2014; WSDE (undated a and b). *L. peploides* can also colonise brackish waters (Mesleard and Perennou 1996 as cited in EPPO 2011b). Impacts are likely to occur in any of these locations where dense populations of *Ludwigia* spp. establish.
4.20	Estimate the overall potential impact of this organism in Ireland. Use the justification box to indicate any key issues.	MAJOR	MEDIUM to HIGH	Experience from abroad, (notably France) clearly indicates that. *L. grandiflora* and *L. peploides* have the potential to cause significant ecological, environmental and socio-economic impacts should they become widely established in the wild here. There is a paucity of information to assess in detail the potential impact of *L. hexapetala* in Ireland but the species appears to be closely related to, if not a subspecies of, *L. grandiflora* and therefore, similar impacts are considered likely.

Stage 2 - Detailed assessment: Section E – Conclusion

This section requires the assessor to provide a score for the overall risk posed by an organism, taking into account previous answers to entry, establishment, spread and impact questions.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
5.01	Estimate the overall risk of this organism in Ireland (noting answers given in 1.11, 2.16, 3.10 & 4.20).	MAJOR	HIGH	The three *Ludwigia* spp. assessed appear to pose a major risk to native biodiversity, native ecosystems and conservation goals as well as having the potential to cause negative socio-economic impacts in slow-flowing or still waters due to their capacity to spread rapidly and establish dense infestations. The Irish climate appears to be very suitable for the establishment of *L. peploides* and *L. hexapetala* and it has already been demonstrated that it is suitable for the establishment of *L. grandiflora*.

Stage 2 - Detailed assessment: Section F – Additional questions

This section is used to gather information about the potential effects of climate change on the risk posed by an organism. It is also an opportunity for the risk assessor to highlight high priority research that could help improve the risk assessment.

N	QUESTION	RESPONSE	CONFIDENCE	JUSTIFICATION
6.01	What aspects of climate change, if any, are most likely to affect the risk assessment for this organism?		LOW	Climate change is expected to increase water temperatures over time in Ireland, with increased periods of drought in summer and higher rainfall in winter leading to more flooding events (Desmond *et al*. 2008). Global climate niche modelling (based on the International Panel on Climate Change low and high emissions climate change scenarios) project that there will be a progressive increase in the suitable climatic range for *Ludwigia grandiflora* in the island of Ireland from around the year 2040 (Kelly *et al*. 2014). Climatic modelling also suggests that global warming is also expected facilitate an increase the future spread of *L. peploides* and *L. hexapetala* in Europe (Thouvenot and Haury 2013).
6.02	What is the likely timeframe for such changes (5, 10, 15 , 20, 50 or 100 years)?	20-50 YEARS	LOW	This response is based on global climate niche modelling (Kelly *et al*. 2014) as outlined above.
6.03	What aspects of the risk assessment are most likely to change as a result of climate change		MEDIUM	Refer to response to Question 6.01.
6.04	If there is any research that would significantly strengthen confidence in the risk assessment, please note this here. If more than one research area is provided, please list in order of priority.	YES		At present, it makes sense to conduct a single risk assessment for the potentially problematic non-native aquatic species in this genus (GB Non-Native Species Secretariat 2010). However, in future, further species-specific risk assessments of *Ludwigia* spp. may be necessary as more is understood about the different species and the taxonomy becomes clearer (GB Non-Native Species Secretariat 2010). The paucity of information on *L. hexapetala* in the literature which has made it somewhat difficult to comment on this species in more detail. Finally, it would be useful to assess the current status of *L. grandiflora* in in Clarecastle, Co. Clare to further information this risk assessment.

9.0 References

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