Rhododendron & Cherry Laurel Management Plan 2015-2022

For the lands owned by Glenbower Wood & Lake Ltd.

Report produced by:

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Summary

This management plan was drawn up for the part of Glenbower wood (southern end) that is owned by Glenbower wood & Lake Ltd. Glenbower Wood is located within the village of Killeagh in east Cork and is located on the Dissour River valley. The area has been wooded for hundreds of years and was part of the De Cappel estate for generations and mature ornamental trees remain from that era. The woodland still contains remnants of two old semi-natural Oak woodland forms which are of local importance. Coillte obtained the land in 1933 and added stands of non-native conifers. Glenbower Wood and Lake Ltd. acquired 12.5ha of the wood in 1994 and the committee has been maintaining the woodland for passive recreation for the local and surrounding (Inch and Youghal) community ever since. The woods are also home to a number of birds and mammals and is an important feeding ground for Barn Owls and the Dissour River which flows through the woods contains an important salmon population. The woods also contain two notable plant species: the Bird's Nest Orchid and the Tunbridge Filmy-fern which are of county importance. In recent years the problem of Rhododendron and Cherry Laurel has become apparent within the woods; with the two species forming shady thickets in a number of areas.

Rhododendron [*R. ponticum*] and Cherry Laurel are two non-native invasive species which were originally brought to Ireland and Britain as ornamental plants in the 1900s and were planted in estates. Both plants reproduce through seed and vegetative means. Rhododendron produces beautiful purple-lilac flowers along with vast amount of tiny seeds which are easily dispersed. Cherry Laurel produces white flowers and cherry like fruit. Once established these plants out shade other plants and their thick waxy leaves which are poisonous remain un-grazed, building up on the woodland floor where their chemicals build up in the soil and prevent the growth of native species. Eventually diverse native woodland habitat (except for the canopy) is replaced by dense thickets of Rhododendron and/or Cherry Laurel and a thin moist layer of moss replaces ground flora. Even with the existence of a native canopy of trees, seedlings cannot regenerate through the shade and new soil conditions and so the woodland is replaced with a habitat that cannot sustain the same quantity or diversity of plants, insects, birds or mammals.

One of the main goals of the committee is to restore and expand the locally important semi-natural woodland areas within its charge along with the two notable plant species of county importance. To do this a strategic management plan was created for the total removal of Rhododendron and Cherry Laurel. This plan takes into consideration the features and history of the greater woodland, along with the ecology of Rhododendron and Cherry Laurel, their present distribution and grade of infestation as well as the limited budget. Together they dictate the control methods which are appropriate for the 12.5ha site. Treatment is to be carried out according to priority of infested areas and in phases with clearance of flowering species to be achieved within 8 years subsequent to commencement. Works are to be undertaken by trained and competent operators with supervision given throughout each phase. Within Phase 2 (year 2-3) areas that have had severe infestation can be helped in their restoration by the planting of appropriate canopy and understory species and some areas of moss and leaf litter removed and replaced with leaf litter taken from areas upwind and of similar habitats which are free of infestation. Coillte land which adjoins the area for which control is planned currently also contains areas of very severe infestation and if not controlled, after Phase 3 (Year 8) the 12.5ha site will require systematic control of Rhododendron and Cherry Laurel seedlings every 6-8 years to prevent re-establishment of the two invasive species. The management strategy requires record taking of any works and allows for evaluation of work. This information then informs the next phase so that the strategy can be adapted to the general challenge that Rhododendron and Cherry Laurel present in their removal and complete eradication.

Acknowledgement

I would like to thank Paudie Lee (Glenbower Wood & Lake Ltd. Committee) for all the useful information and for assisting me in the mapping and grading of the Rhododendron and Cherry Laurel infested areas throughout the land owned by Glenbower Wood & Lake Ltd.

1 Introduction

1.1 Project Brief

Rhododendron (*R. ponticum*) and Cherry Laurel are both very invasive species and are known to be a problem in native woodlands. They out compete native woodland flora and eventually form tall shady thickets; replacing native understory species and ground flora, leaving only canopy trees and replacing a diverse native habitat with one that is of little diversity and use to fauna. Removal of these species is difficult and requires an adaptable strategy of control (Anon, 2009). This document is an adaptable management plan for the removal of Rhododendron and Cherry Laurel of part of the Glenbower Wood owned by Glenbower Wood and Lake Ltd. The plan takes into account the woodland's features, ecology of the invasive species, the extent of infestation and past management. Infested areas have been prioritised according to their grade of infestation invasive with recommended control and removal carried out in phases according to best practice.

This structure of this management plan and control methods were mainly guided by '*Best Practice Management guidelines: Rhododendron (Rhododendron ponticum) and Cherry Laurel (Prunus laurocerasus)'* (Anon, 2010) and *'Rhododendron ponticum: a guide to management on nature conservation sites*' (Higgins, 2008).

1.2 Glenbower Wood and Lake Ltd. Location

Glenbower wood is located within the village of Killeagh in east Cork, within the Dissour river valley. The management plan will only take into account 12.5ha of a greater woodland which is owned by Coillte (referred to as Glenbower Wood). Land owned by Glenbower Wood and Lake Ltd. (refereed to from this point as 'the woodland') is located on the southern edge of Glenbower Wood at the main entrance to Glenbower Wood.

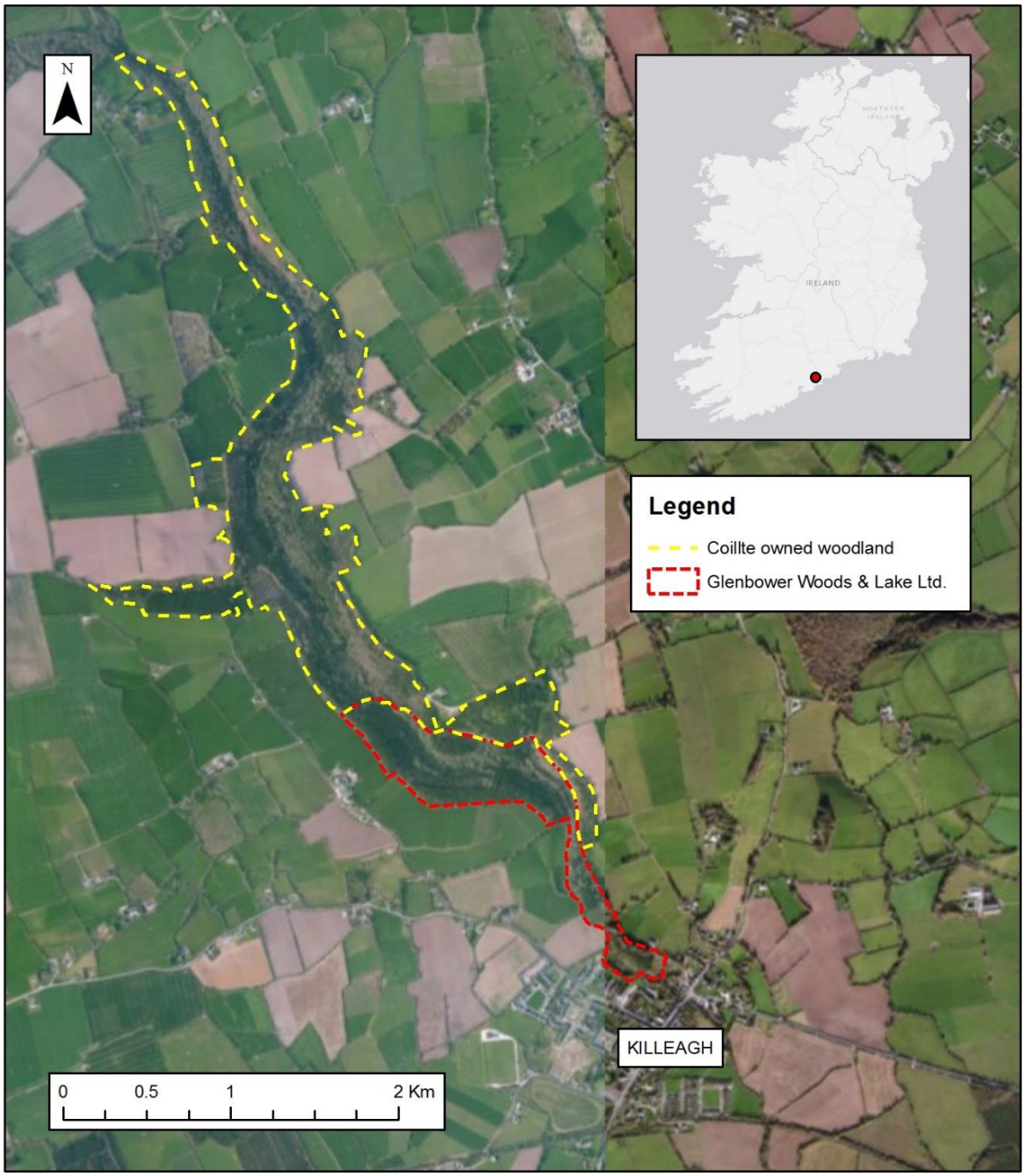


Plate 1. Glenbower Wood location and boundaries

1.3 Woodland Amenity

The site contains two car parks; both located at the very southern edge of the woodland. A playground is also located adjacent to the most southern car park (first car park). An old millrace runs from the first car park into the woodland and is used as a footpath. A main road gives access by car and foot into the woodlands; general car access is not however allowed past the most northerly of the two car parks (second

car park) but offers pedestrian access into the wood. There are a number of existing routes (0.9, 2.3 and 2.2 km in length) and paths run throughout the woodland joining it to the rest of Glenbower wood. One interpretive sign by the second car parks. A number of wooden bridges allow access across the Dissour River and two huts also exist within the woodland (Gittings, 2005).

The woodland organises a 'Music in the Wood' event every August bank holiday and a number of groups use the wood; the Spanish College, St Raphael's Mental Hospital, Bishopstown Orienteering Club, Glenbower Athletic Club and the Youghal Athletic Club. The wood is well known and visited by the community of Killeagh and the communities of Inch and Youghal (Gittings, 2005).

1.4 Site History

Glenbower gets its name from the Irish *glean-bodhar* which means deafening glen and refers to the loud noise created by the Dissour River during high flow in winter. Glenbower wood was once part of a larger estate which remained in the De Cappell family from 1182 to 1933. The main access road into the woodland and two bridges (the White Bridge and the Metal Bridge) were built in the 1830s. The Metal Bridge (C-066-048) is the only listed monument within the woodland. A number of other listed monuments can be found adjacent to the woodland[1]

In the 1900s the estate was richly wooded with remnants of very old woodland. In 1933 Glenbower woods was acquired by Coillte (formerly known as Forest and Wildlife Service). This resulted in a number of conifer stands being planted; a number have since been felled and replanted (Anon, 2014). Thickets of Rhododendron and Cherry Laurel are scattered throughout Glenbower wood and are thought to have been introduced as ornamentals sometime around the 1950's. A w deeply shaded Cherry Laurel thicket now runs along what was originally a planted Laurel walkway (Paudie Lee, Glenbower Wood & Lake Committee member, pers. comm.).

[1] Killeagh Mills C-066-05201, a Bullaun Stone C-066-037 and Aghadoe House C- 066-03801; Sheela-na-Gig, C-066-03802 and Country House, C-066-03803 (Duchas, 1998).

Up until 1989 the woodland contained an idyllic 6-7 Acre lake that was originally formed to feed a mill downstream. However, the damn was breached and the lake drained. The remainder of the dam and fish pass are still present. In 1994 Glenbower Wood and Lake Ltd. attained 12.5ha from Coillte and a committee maintains the small southern section of woodland on behalf of the general public and are financed by grants and fund raising (Anon, 2014). Coillte still own the coniferous trees/timber. When Coillte remove conifers from the woodland they replant with native Oak species (Gittings, 2005).

1.5 General Management Objectives for the Woodland

As mentioned the main purpose of the woodland is for amenity use by the community and those further afield. The woodland is currently maintained by two part-time workers supplied by Tús which is a community work placement initiative (Anon, 2013). Present management is based on the following broad objectives:

- maintain and enhance facilities for passive recreation
- restore the lake and improve the condition of the Dissour river
- restore stands of native broadleaved trees

The following action plans goals were drawn up in 2006-2010 Management Plan (Gittings, 2005) which can be divided into amenity and nature conservation:

- Amenity
  - To maintain the use of the site for community activities and events
  - Replace the lake to be used as key amenity feature for angling
  - Maintain and enhance present facilities for passive recreation
  - To improve the interpretive facilities for visitors
  - To promote the woodland outside the local area

- Nature
  - Maintain the existing integrity of native habitats (especially Oak-birch-holly woodland and Wet pedunculate oak-ash woodland) by preventing the spread of Rhododendron and non-native tree regeneration
  - Maintain the population of the Bird's Nest Orchid
  - Maintain the local Otter population
  - Maintain the present role the River Dissour plays in supporting the present Salmon population
  - Maintain feeding habits currently available to the local Barn Owl population

2 Ecology to be Taken into Consideration

2.1 The Woodland's Natural Resources

The woodland's habitats were last surveyed in 2005 and the following brief information is based on the more detailed *2006-2010 Management Plan* (Gittings, 2005). Habitats have been categorised according to the nationally used *A Guide to Habitats in Ireland* (Fossitt, 2007).

2.1.1 **Habitats**

The woodland contains a number of habitat types (*see Appendix 4*). The Dissour River is categorised as *Eroding/upland river* (FW1) and enters the woodland from the north in the centre of the woodland on the valley floor, passing to the western edge of the site as it enters the woodland. Woodland exists on the valley slopes and valley floor. Semi-natural habitats consists of *oak-birch-holly woodland* (WN1), *wet pedunculate oak-ash woodland* (WN4) Scrub (WS1), *dry meadows and grassy verges* (GS2). Non-native habitats consist of *mixed broadleaved woodland* (WD1), *mixed broadleaved/conifer woodland* (WD2) and non-native type *Conifer plantations* (WD4).

2.1.1.1 Nature Conservation Importance of Habitats

The *Eroding/upland river* (FW1) has very little modification but as the habitat is widespread within the county of Cork it is deemed to be of high local importance.

The oak-birch-holly woodland (WN1) is listed (as old sessile oak woods with Ilex and Blechnum in the British Isles) on Annex 1 of the Habitats Directive (92/43/EEC). This habitat on site contains few non-natives and is of high quality. However its small size deems it as high local importance.

Wet pedunculate oak-ash woodland (WN4) is listed (as Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Pandion, Alnion incarnae, Salicion albae)) on Annex 1 of the Habitats Directive (92/43/EEC). However this habitat has been degraded by non-native species which are at present in the understory and canopy. There are however, a number of large Alder trees. This habitat is scarce in the county of Cork, however due to its degradation this habitat is deemed to be of high local interest.

Scrub (WS1) and *dry meadows and grassy verges* (GS2) are not of significant nature conservation importance.

Mixed broadleaved woodland (WD1), *mixed broadleaved/conifer woodland* (WD2) and *conifer plantations* (WD4) are non-native habitats and are not of significant nature conservation importance in relation to intrinsic habitat quality. Parts of these habitats may however be of importance to important plants, mammals and invertebrates.

2.1.2 **Notable Plants**

Glenbower wood contains populations of Bird's-nest Orchid and Tunbridge Filmy-Fern which are of county importance; surveys are required to find the extent of these species within the woodland. Great Horsetail occurs within Glenbower wood and is a scarce species within the county of Cork; however this species is widespread in East Cork (Gittings, 2005). It is likely more notable species are present and surveying is required.

2.1.3 **Invertebrates**

There is little information in relation to invertebrates within Glenbower wood. However due to the age of the woodland it is likely that some important species are present (Gittings, 2005). Surveys are required.

2.1.4 **Vertebrates**

The Dissour river contains a good population of Salmon which is a species listed on Annex 2 of the Habitats Directive (92/43/EEC). Unspecified Lampreys (there are 3 species) have been recorded in the river and are listed on Annex 2 of the Habitats Directive. The Otter which is listed on Annex 2 of the Habitats Directive (92/43/EEC) is thought to be present along the river. Only the population of Salmon are important features of the wood.

A number of bird species have been recorded in Glenbower wood and most are protected via Wildlife Acts 1976 and 2000. The Kingfisher is an occasional visitor to the woods and is listed on Annex 1 of the Birds Directive (79/4/09/EEC). A number of the birds are of conservation concern or are of local significance. The Barn Owl is a nationally scarce breeding species and is red listed due to a decline in its range and breeding population. As Glenbower woods is an important feeding ground for the species the woods is of County importance as a feeding habitat to the species and the species is an important feature of the woods (Gittings, 2005)

The Pine Marten is protected under the Wildlife Acts 1976 and 2000 and once very rare and localised has been making a comeback over the last few years. The Red Squirrel is also protected by the above legislation, while common and widespread nationally is listed as near-threatened at a global scale (IUCN, 2004). The Common Frog, Common Lizard, Hedgehog, Pygmy Shrew, Irish Hare, Stoat, Badger are present in the woodland and are protected under the Wildlife Acts 1976 and 2000 and are common and widespread within Ireland and are not of significant importance.

2.2 Past Management of Rhododendron and Cherry Laurel in the Woodland

The *2005-2010 Management Plan* (Gittings, 2005) suggested the removal of Rhododendron in order to restore the woodlands semi-natural woodland. Until now no strategy for removal was drawn up for Rhododendron and Cherry Laurel. However most infested areas have in the past been cut near to ground level (especially at the southern end entrance), trimmed and/or damaged. Cutting and damage dates between 2015-1987. Cutting back was not followed by chemical treatment and has resulted in a jumble of dense plants that are now a lot less straightforward to access and treat. It is paramount that any further removal/cutting of Rhododendron and Cherry Laurel is undertaken in a phased, priority based system outlined in this document.

2.3 Effect of Rhododendron and Cherry Laurel on Semi-natural Habitats

Both Rhododendron and Cherry Laurel are non-native invasive species (Dehnen-Schmutza, 2004). Both species were introduced to the British Isles as Ornamental plants and finally as shelters within estates for Pheasants ((Elliott, 1996) & (Walther & Grundmann, 2001)). Rhododendron and Cherry Laurel are both native to Eastern Europe along the Black Sea. There are also small pockets of Rhododendron in Spain and Portugal where it is in fact an endangered species (Higgins, 2008). Rhododendron was introduced to the British Isles manly from Spain in 1763 ((Milne & Abbott, 2000) & (Curtis, 1803)). This invasive quality of Rhododendron was not realised until 1949 and eradication experiments soon followed (Brown, 1953). Cherry Laurel was introduced sometime in the 1900s (Walther & Grundmann, 2001) and while it is invasive it is not considered to be as invasive as Rhododendron and fewer studies of its control have been undertaken in Ireland. Suggested treatment follows that of the greater studied Rhododendron (Anon, 2010).

Both plants have become naturalised in estates and now threaten semi-natural woodland (Anon, 2010) and Rhododendron is known to impact three important semi-natural acidic habitats in Ireland (Higgins, 2008). These naturalised plants outcompete native species and within woodlands they shade out ground flora and the understory;

changing the habitats composition at first and then finally forming thickets that form deeply shade and drop poisonous leaves that also effect the soil composition. What results is a shady thicket, a native canopy and a habitat that no longer regenerates and offers less to birds, mammals, flora and insects ((Maguire, et al., 2008) & (Higgins, 2008)). Once these species are established it is very difficult to remove them. Control methods generally consist of mechanical and chemical treatment; with treatment required for many years to deal with re-growth and seedling germination. Today both species but especially Rhododendron continue to spread throughout the British Isles creating losses in habitat, forestry production and agricultural production via land encroachment (Dehnen-Schmutza, 2004) with Rhododendron is thought to be one of the top non-native invasive species in the British Isles today (Williamson, 2002).

2.3.1 **Rhododendron Ecology**

Rhododendron is an evergreen shrub that contains thick waxy leaves that can grow to 8 metres in height in woodland conditions. It can survive in a number of soil types and has been found growing in soils with a pH of 3.3 – 6.4 but thrives in well drained acidic soils ((Maguire, et al., 2008) & (Higgins, 2008)). The species is frost tolerant and drought resistant and produces inflorescences made up of 10-20 lilac-magenta flowers which are 6cm in size. The plant generally flowers between May and June however this is affected by altitude, latitude. The plant is known to produce large amounts of pollen and nectar and depends on a number of insects, especially bumblebees to pollinate its flowers. Fertilised flowers then take about 6months to mature and form capsules. The capsules dry and seeds are released from December onwards.

The species is a prolific seed produces but can also spread vegetatively. Thriving plants produce seed yearly. Seeds are tiny (0.5mm x 1.5mm), light and contain a hairy frill on each end which helps with the dispersal of the seed via wind, water and vectors. Wind generally drops seeds 100 metres away but have been known to deposit plants up 1km away. Wind direction is also very important in relation to where seeds are dropped. Seed is known to set more in the open than in deep shade, and will set in breaks in the canopy. The fact that the seeds are so small means that they have no food reserves and once germinated their tiny roots must immediately source water.

Therefore, seedlings generally do not establish on leaf litter or dense vegetation. Low moss carpets, dead logs and bare moist soil are optimum for seed germination and establishment. Once seeds reach a moist environment they generally germinate within the year, however they have been known to survive for longer. Seeds stored within a dry dark environment can survive beyond a year. Seedlings are neither frost nor drought resistant (Higgins, 2008).

The plant is slow to flower; taking 10-12 years when grown from seed. Flowering plants that are cut back produce denser growth and will generally flower within 3-4 years and produce more seed than the plant did prior to cutting. Plants generally if not damaged remain as a single stem until year 10. Dense thickets take 25-30 years to develop. The root system size of Rhododendron varies according to conditions. Plants in dry locations have shallow (30-60cm), compact root balls. Plants located in wetter soils form larger shallower root balls and struggle and will reproduce via layering (Higgins, 2008).

2.3.2 **Cherry Laurel Ecology**

Like Rhododendron, the leaves of Cherry Laurel has thick evergreen leaves. In its native habitats it grows as part of woodland understory or as a subdominant tree growing on moist soil and reaching heights of 6-10metres. In spring the species produces small white flowers which are carried on upright white spikes which do not actually open until early summer. Nectaries can be found on both flowers and the underside of leaves, making them a favourite to insects. In autumn cherry like fruits are produced ((Rushfort, 1999), (Walther & Grundmann, 2001) & (Anon, 2009)). While the plant contains cyanide and is poisonous, the flesh of its fruit is not poisonous but the seed is. This allows birds to eat the flesh of its berries and disperse seeds. The plant also reproduces vegetatively via layering and suckering (Hackney, 2008)

2.3.3 **Related Legislation**

In direct relation to Rhododendron and Cherry Laurel there are no legal provisions. The EU Plant Health Directive 2002 was drawn up to prevent both the introduction and spread of *Phytophthora ramorum.* Rhododendron is a host for the fungal pathogen

Phytophthera ramorum which causes Sudden Oak Death (Maguire, et al., 2008) Rhododendron which is infected by the pathogen "causes a twig and leaf blight with browning/blackening of leaf stalk, bases and tips, stem damage and wilting". The host plant doesn't necessarily die, however after a certain level of infection the pathogen can spread to nearby susceptible trees. Apart from native species of Oak and Ash non-natives Beech, Sycamore, Horse Chestnut and Spanish Chestnut are susceptible to the pathogen also. Infected trees develop bleeding cankers of their trunks which can be fatal (Higgins, 2008). If hosts and/or trees are observed with symptoms, the Forest Service[2] should be immediately contacted.

2.3.4 Land Liable to Infestation

Areas which are suitable to germination are those downwind of flowering Rhododendron plants and those which contain bare soil and thin moss carpets. Areas adjacent to infestation. Seedling establishment also follows stream and ditch edges. Woodlands which have been infested and treated are more likely to become re-infested if the areas contain only a low moss carpet; which can remain for up to 3 years after clearance of the species (Higgins, 2008).

2.4 Factors which make Rhododendron and Cherry Laurel Difficult to Control

As Rhododendron has been studied more than Cherry Laurel (in relation in control) and is known to be more of a problem, difficulties are in relation to Rhododendron but due to the lack of information the information should cover Cherry Laurel too.

2.4.1 Plant Control

Plant kills generally require the combination of mechanical and chemical treatment and generally require a follow up treatment (Higgins, 2008).

[2] Forest Protection & FRM Section, Forest Service, Department of Agriculture, Forestry & Food, Kildare Street, Dublin 2. Tel: 01 6072651 or forestprotection@agriculture.gov.ie

2.4.2 **Leaves**

The thick and waxy leaves of the two species makes uptake of herbicide slow. Therefore when herbicides are used adjuvants must be used to improve usefulness of herbicides (Higgins, 2008).

2.4.3 **Stems**

Due to the biology of plants, foliar application of herbicides must be applied to all leaves. If stems are missed herbicide can only travel down to the root and cannot travel down and then up to other stems, meaning that the plant can still remain alive (Higgins, 2008).

Plants are generally not killed by cutting plants to the stump and require chemical treatment to complete a plant kill (Higgins, 2008).

2.4.4 **Growth**

The cutting back of plants if not followed by herbicide treatment results in plants producing dense growth that if mature will flower within 3-4 years and produce more seeds than the original plant produced. Damaged stems produce multi-stems which are less straightforward to treat (Higgins, 2008).

2.4.5 **Wind**

Plants should be treated with the wind so as to minimise the spread of seeds into clear areas. Even when an area is cleared of flowering plants, an area can be re-infested by flowering plants outside of the treated site (Higgins, 2008).

3 Rhododendron and Cherry Laurel Management Strategy

The main objective of this management plant is to eliminate Rhododendron and Cherry Laurel from the woodland. This is to be carried out on infested areas (survey and map site), in a systematic manner where infested areas are prioritised and treatment follows a combination of chemical and mechanised control methods which have been tried and tested in other Irish semi-natural woodlands habitats. A range of Control methods

were chosen for their ability to tackle the individual conditions of the woodlands, state of infestation and budget. All work will be carried out by trained competent operators under supervision. Brash will be managed appropriately and work will be undertaken in phases and to a timeline. Records are to be kept, work and methods evaluated and changed along with phases extended if required. Also to lower the chances of re-establishment by seed, degraded habitats will be restored and Coillte will be communicated with so that sources of seed outside the woodland may be limited.

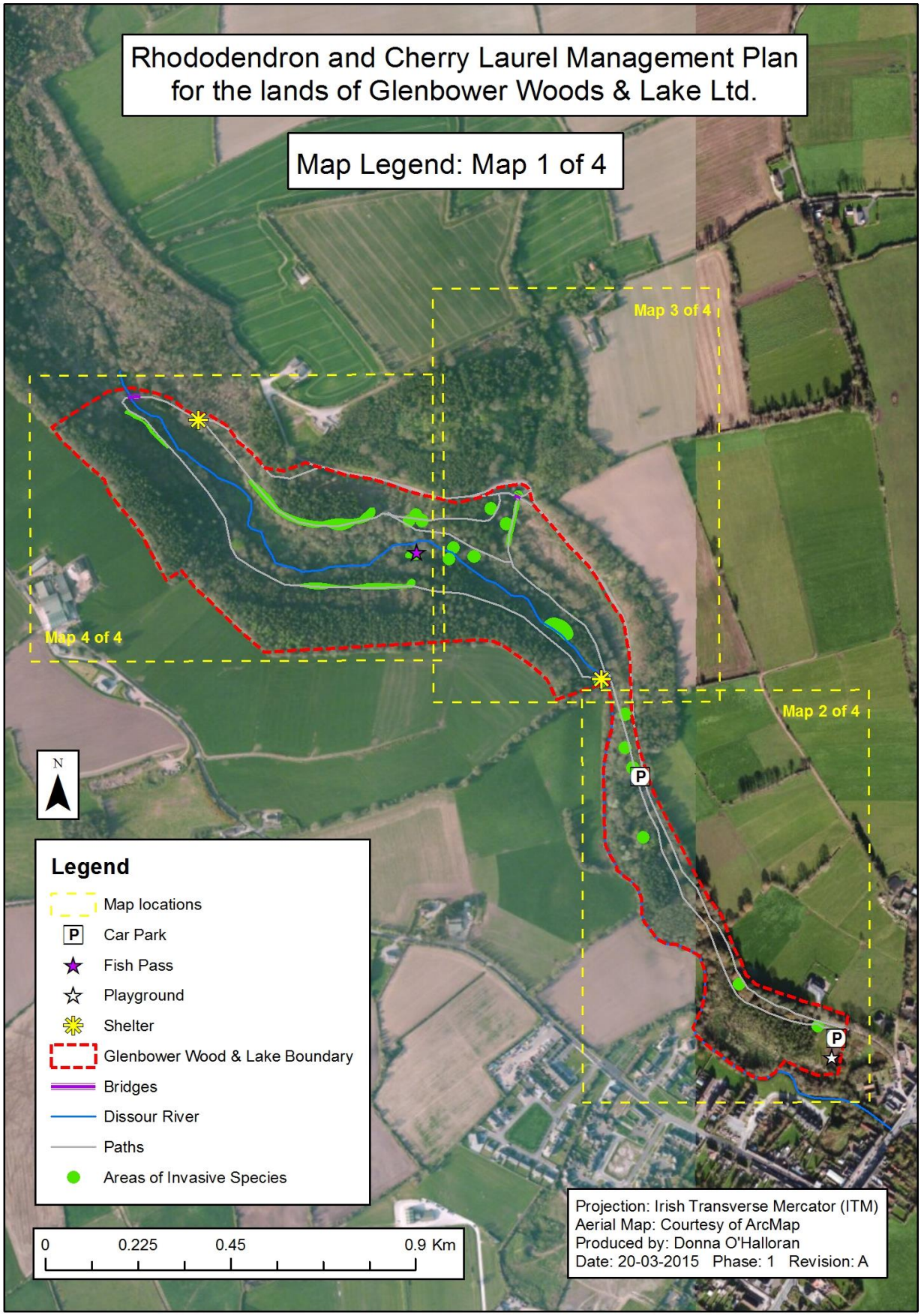
3.1 Mapping and Infestation Grading

In order to understand the full extent and grade of infestation the woodland was surveyed and infestation grades given according to *The Control of Rhododendron in Native Woodlands* (Barron, 2005) which is based on Cross's (1975) recommendations: The grade system used is as follows:

Assessment Criteria:	**Age of Rhododendron:**	**Degree of Infestation**
No Rhododendron present	N/A	1-Absent
Some rhododendron, but plants scattered and mostly small and not flowering.	Up To 12 years	2 Slight
Rhododendron frequent but not clumping. Some flowering, many seedlings present.	Up to 24 years	3 Moderate
Rhododendron abundant, some forming dense clumps, many seedlings.	Up to 30 years	4 Severe
Plants forming dense thickets with almost total absence of ground flora.	More than 30 years	5 Very Severe

During mapping, apart from identifying and categorising infestation, the location of infested areas was noted via a handheld GPS device. The following details were also taken:

- Condition of infested area; height, any past treatment or damage
- Access issues
- Presence of understory if present and condition of ground flora
- Need of restorative planting
- Any presence of ideal germination areas nearby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Car Park
Fish Pass
Playground
Shelter
Glenbower Wood & Lake Boundary
Bridges
Dissour River
Paths
Areas of Invasive Species
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Aerial Map: Courtesy of ArcMap
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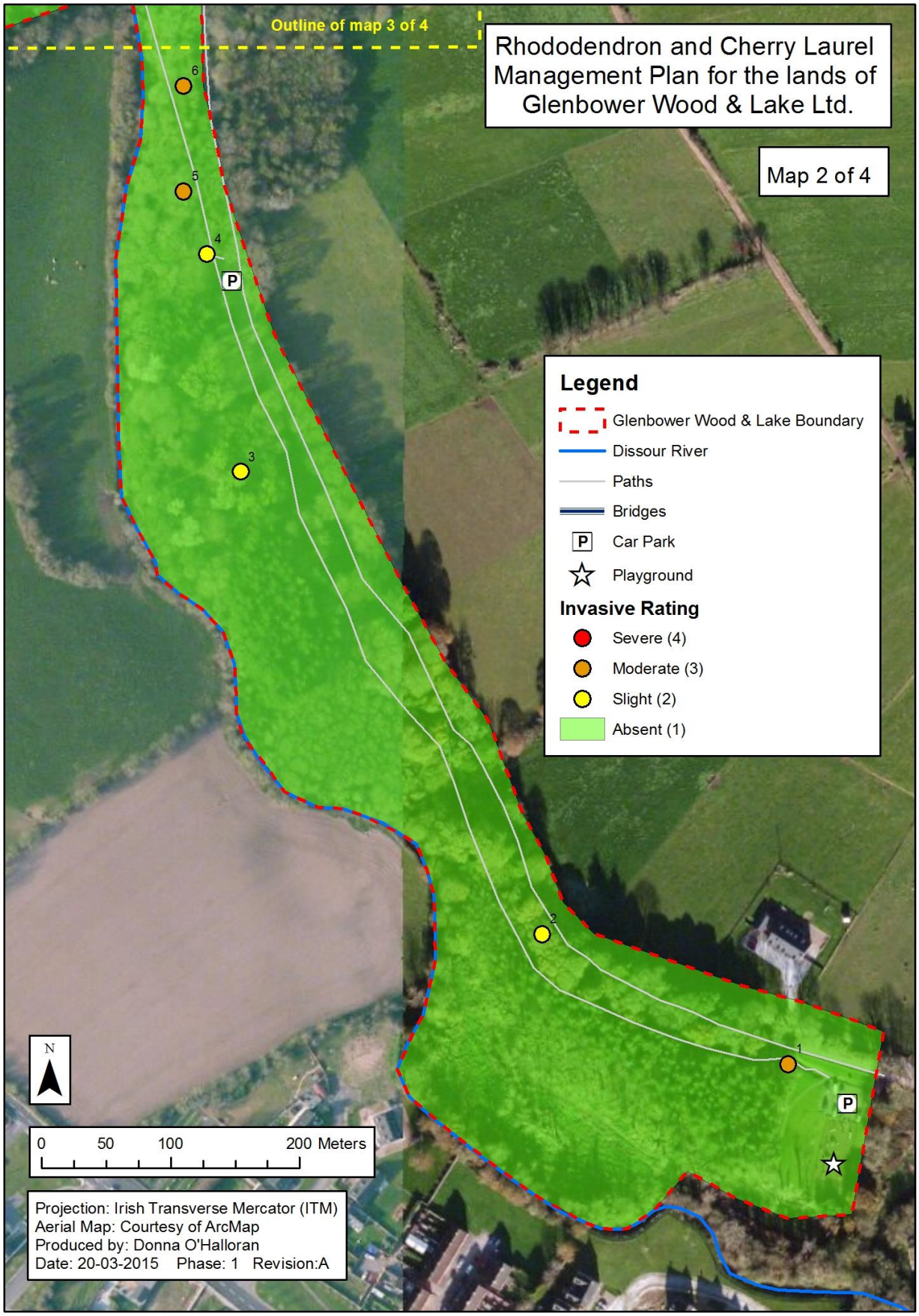
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Glenbower Wood & Lake Boundary
Dissour River
Paths
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Car Park
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Invasive Rating
Severe (4)
Moderate (3)
Slight (2)
Absent (1)
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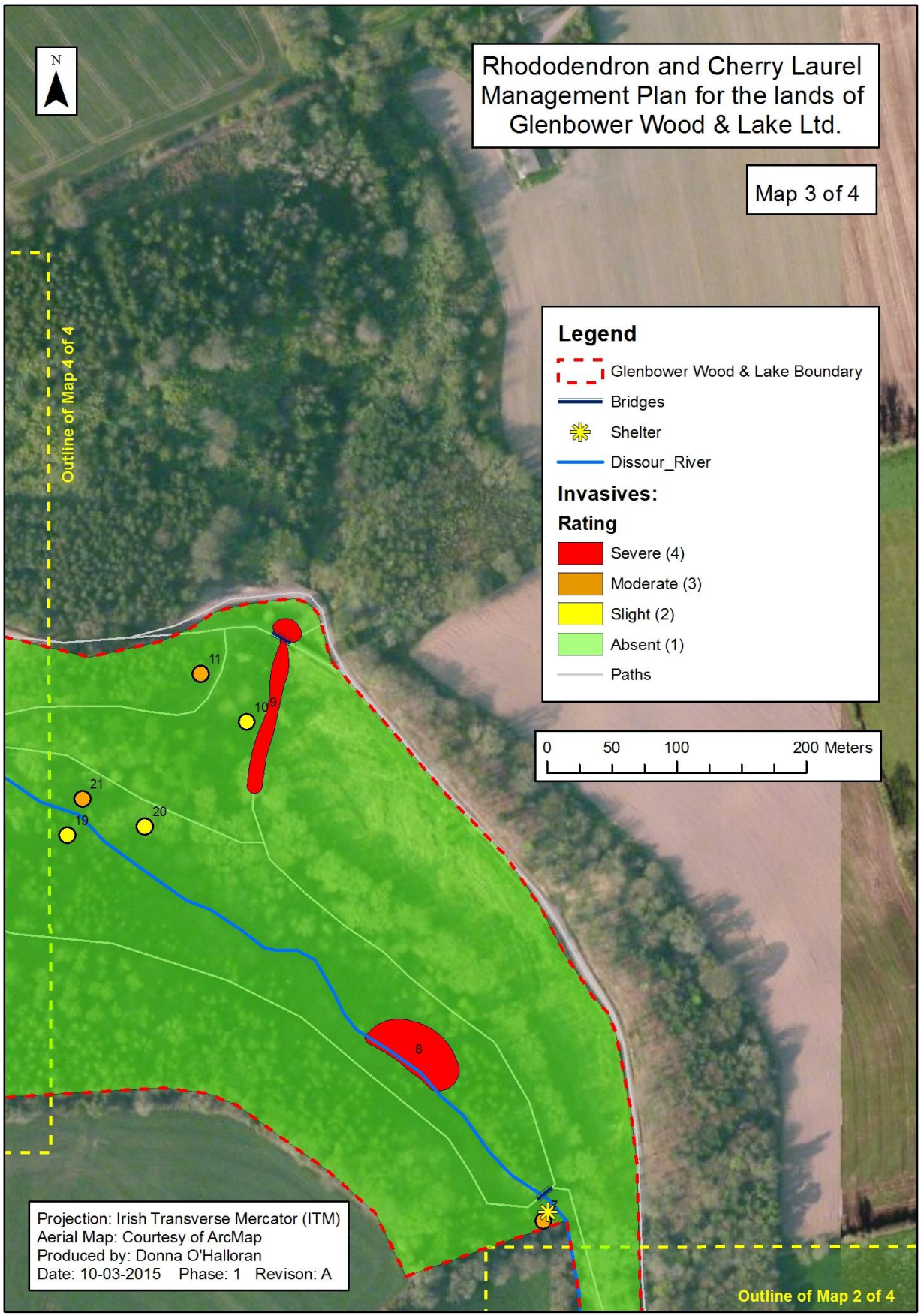
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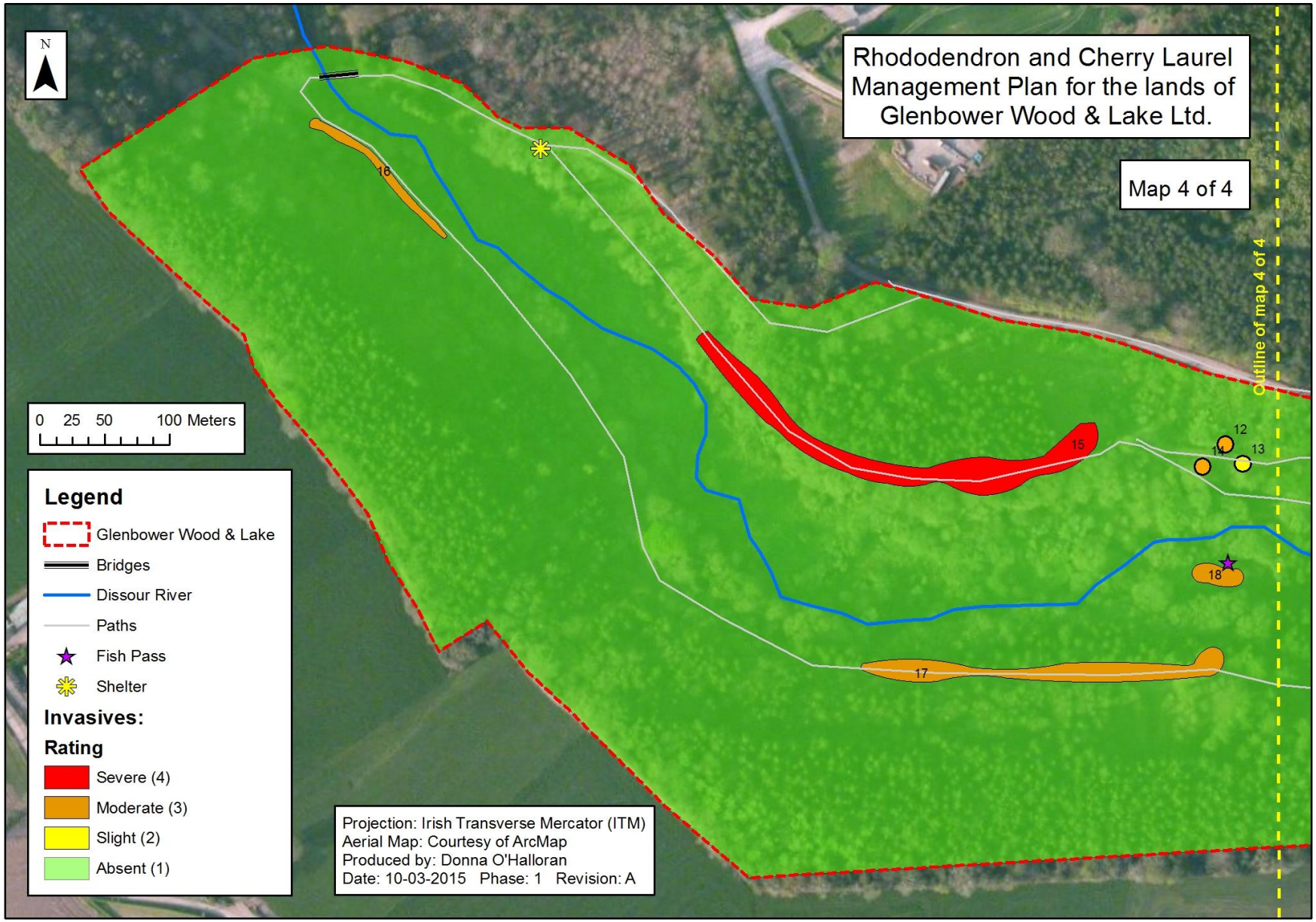
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Date: 10-03-2015 Phase: 1 Revision: A

3.1.1.1 Findings

The past cutting back of the plants made it difficult to categorise infestation. The survey also highlighted that the practice of leaving brash alongside treated areas is not good practice as it has resulted in the growth of seedlings and layering which are difficult to treat and will require the removal of brash before treatment in these areas can begin. The survey also highlighted health and safety issue in relation to accessing infestation on slopes and at the edges of falls. In more severely infested sites it was noted that soil erosion has left trunks holding back eroded soil and this will be taken into consideration when selecting control methods (*see Appendix 1 for individual infested areas details*).

3.2 Control Methods

The control of Rhododendron and to a lesser extent Cherry Laurel are not simple and there are a number of different approaches being tried and tested with a number of different outcomes through Ireland. The correct approach is determined on a site by site basis due to variations in area, funding, level of infestation, past and present management, existence of seed source outside of site, wind direction, topography, habitat type and fragility and weather (Higgins, 2008).

3.2.1.1 Herbicide use

Recent results on the use of herbicides to control Rhododendron in Irish semi-natural woodland found that 100% kills could be achieved by using systematic herbicides alongside mechanical control methods. 10% Glyphosate (Roundup ™) was found to outperform other herbicides in its effectiveness when used alongside mechanical control methods and is chosen for use within the woodland. Glyphosate works by interrupting the plants' production of proteins which results in the plants rapid halt in growth, before the plant gradually turns yellow followed by destruction and death of plant tissue and necrosis of the plants root system. Glyphosate is harmless to animals as they do not contain the same enzymes as plants do. However, Glyphosate is poisonous if ingested by humans or animals. When glyphosate lands on soil it becomes locked to soil particles and cannot be absorbed by plants and therefore not damage them ((Higgins, 2008) & (Henderson, et al., 2010)).

Foliar application of thick waxy leaves requires an adjuvant; Roundup™ Bioactive contains this so no need to add anything. All leaves require thorough coverage to the point of 'run off'. Herbicide can also be applied directly onto cut stumps where less herbicide is required and higher kill rates can be expected. Herbicide requires approximately 6 hours for uptake by leaves therefore it is important that it does not rain as this will wash off the herbicide before it is taken up. At high or very low temperatures, drought or excess moisture plants are stressed and uptake of herbicide is impaired and therefore to minimise waste of time and money herbicide should not be applied. Glyphosate will damage any green leaved plants so it is important to be careful with application. It should also not be applied on windy days as target plants will not receive adequate coverage and surrounding plants which are not targets may be killed. If the herbicide is made stronger than recommended then 'burning off' of treated foliage occurs and this actually prevents the uptake of herbicide and will only damage the plant and not kill it (Higgins, 2008).

3.2.1.2 Mechanical and Chemical Control Methods Using 10% Roundup™ Bioactive

3.2.1.2.1 Pull up

This method consists of pulling plants up with an intact root, removing the soil from roots and carefully disposing of plant. The main advantages to this method are that it can be carried out during any season or weather except when the ground is frozen or dry. Also surrounding native plants are left in place allowing habitats to recover fast. For this method to work effectively the root must come up with the stem and works best for plants between 10cm and 1metre in height (4-8 years old). The use of this method is limited by the age of the plant and soil conditions (Higgins, 2008).

3.2.1.2.2 Foliar Spot Spray

Foliar spraying can be used for plants up to 1.3metres in height. Treated plants require at least 6 hours to be taken up. The downside of this method is that treated plants remain in place after death, application is limited by weather and there is a chance of killing surrounding native plants leaving the area susceptible to invasive species germination. Therefore this method should only be used when the base of a plant cannot be safely accessed (Higgins, 2008).

3.2.1.2.3 Stump Treatment

This is the preferred treatment of invasive plants within the woodland. It involves cutting plants close to the ground (2-4 cm) and immediately brushing the wound with the herbicide. This method can be used on all plant diameters. Treated stumps are more likely to be killed by one treatment and therefore less follow up treatments are required, less herbicide is required than that of foliar application and the operator has less of a load to carry and as the plant is physically removed, surrounding native plants with greater light levels can immediately infringe and begin to recover. Adding a plant based dye helps to keep check of completed treated stumps. Stumps need to be checked 15-18 months after treatment to see if a kill was achieved. Follow up should consist of the snip and treat method for a full kill. The possible requirement of a follow up treatment means that record keeping is essential. As herbicide should not be used in sub-optimal conditions, it is possible to make a high cut (approximately 40cm), wait until the weather is dry, and then cut the remaining stump to ground level and apply herbicide (Higgins, 2008).

3.2.1.2.4 Snip and Treat

This method is essentially the same as the stump treatment method except that it is carried out on smaller plants or on the re-growth of stumps that were treated 15 months prior. Stems are cut back to ground level/old stump and spot treated with 10% gyphosate (Higgins, 2008).

3.2.1.2.5 Stem Injecting

Injecting herbicide directly into the stem of Rhododendron or Cherry Laurel results in the immediate halt of plant growth and flowering. A whole is drilled as vertical as possible, low in the stem and 0.26ml of 10% Gyphosate is injected and can result in 100% kill. This method is recommended where access/health and safety does not allow for the plant to be cut down to ground level. The main downside is dead standing plants remain and can take a very long time to decay (Higgins, 2008).

3.3 Treatments Required According to Infestation Grade and/or Age

3.3.1 Young single stemmed plants up to 1metre in height (Slight Infestation)

- Plants that can be pulled up with their root system should be pulled up by hand.
- Larger single stemmed plants should be snipped and treated.
- Where a plant's base is difficult to access, herbicide can be applied via foliar application.

3.3.2 Isolated flowering plants (Moderate Infestation):

- Where a plant is accessible, it should be cut down to near ground level and the stump treated.
- Where a plant has been previously cut to the stump but has growth should be snipped and treated.
- Plants that cannot be cut to stump level due to issues with access and/or health and safety should be treated via stem injection.

3.3.3 Mature Stands (Severe/Very Severe infestation):

- Where a plant is accessible, it should be cut down to near ground level and the stump treated.
- Plants that cannot be cut to stump level due to issues with access and/or health and safety should be treated via stem injection.
- Where weather conditions do not allow for herbicide treatment and work is impeded plants should be cut to 40cm above ground and when weather conditions are preferable for herbicide uptake, operators should return to these plants, cut to the stump and glyphosate applied.

3.4 Time of the Year for Carrying out Control Methods

According to research carried out in Killarney National Park, plants that are actively growing can be treated throughout the year. Results showed that 10% glyphosate using the control treatment methods described above could achieve 100% kill when used from January through to December. However, it is important to be aware that 100% kill will only be achieved when applied during optimal weather conditions (Higgins, 2008).

3.5 Restoration of Degraded Habitat

The woodland contains two semi-natural woodlands: *oak-birch-holly woodland* (WN1) and *wet pedunculate Oak-ash woodland* (WN4). Both species due to areas of severe infestation caused by Rhododendron and Cherry Laurel contain degraded areas of habitat. Once Rhododendron and Cherry Laurel have been removed re-colonisation will not be immediate due to the years of poisonous leaf litter build up. Often degraded areas are covered in a low moist carpet of moss which are perfect for Rhododendron seedling re-establishment (Higgins, 2008). It is recommended that Oak species[3] (sourced from Irish stock) are planted in 2.5m x 2.5m spacing and understory species are planted at 7m x 7m spacing and the humus layer is removed and covered in leaf mulch collected up wind from similar habitat areas free from Rhododendron invasion. Work should be carried out between autumn and winter (Little, et al., 2011).

3.6 Prioritisation of Infested Areas

Following the categorising of infested areas it was felt that prioritising areas would make systematic treatment more straightforward. Wind flows through the site from a south/south-western direction therefore it is vital that clearance should start along the southern edge and work north towards Coillte owned woodland which contains in areas of severe Rhododendron and very severe Cherry Laurel infestation.

3.6.1 **Highest Priority/ Infestation Absent (1)**

Areas free of infestation are of upmost priority and any observed seedlings should be immediately removed.

3.6.2 **High priority/ Infestation Slight (2)**

Areas with only a slight infestation; that is plants that are not presently flowering but may due to past cutting back be close to flowering age (3-4 years) and have not yet developed a low moss carpet. These areas are located mainly at the southern end of the site.

[3] Replacement canopy and understory plants should be appropriate for the habitat type. *The Classification of Native Woodlands in Ireland and its Application to Native Woodland Management* (Cross, et al., 2010) should be used as a guide.

3.6.3 **Moderate Priority/Infestation Moderate (3)**

Areas which have been cut back or damaged with some flowering and have not yet developed a low moss carpet. These areas are located mainly at the southern end of the site.

3.6.4 **Low Priority/Infestation Severe (4)**

Areas consisting of flowering dense clumps and thickets with no understory and a moss carpet. These areas are mainly located north and east, adjacent to Coillte owned woodland which contain severe to very severe infestations and along the river. These areas will require restoration of their understory and ground flora.

3.7 Management Timeline

The management strategy is flexible to the outcomes of each phase. Therefore it is important that at the beginning of each phase that the site is systematically surveyed during winter/early spring when evergreens are highly visible and the mapped areas updated (this is not required for Phase 1). It is also very important that a record of works is kept so that at the end of each phase areas that are yet to be treated are noted and work can be evaluated and the strategy updated (*see Appendix 2 for phase work sheets*).

3.7.1 **Phase 1 (Preliminary Clearance/) [Year 1]**

Preliminary clearance consists of the removal and treatment of Rhododendron and Cherry Laurel and should begin with the highest priority areas and work towards the lowest priority areas in a south to north direction. Depending on the speed of the work, lower prioritised areas may not be treated. If this is the case Phase 1 may need to be extended. Where possible, young seedlings should be pulled from the ground by hand (ensuring the root is attached). Young single stemmed seedlings should be snipped and treated, if for some reason the stem base cannot be accessed then foliar application is acceptable. Plants which have been treated or damaged in the past and are multi-stemmed should be cut to stump level and treated. Where plants are difficult to cut back or there are health and safety issue stem injection is acceptable.

3.7.2 **Phase 2 (Advanced Clearance and Final Clearance) [Year 2-3]**

Areas treated in phase 1 must be surveyed on year 2 and year 3 to check the effectiveness of treatment. Standing dead seedling (killed via foliar application) can be pulled. New seedlings can also be pulled and treated stumps which have not been killed and have sprouted can be snipped and treated. Final clearance is reached when all plants over the age of 5 years are dead. If this is the case then it is safe to proceed to Phase 3. During this phase, once all areas have been treated restoration of degraded low priority areas with a low moss carpet should begin. This is important as these areas are liable to invasive seed establishment and restoration will limit soil erosion

3.7.3 **Phase 3 (Initial Maintenance) [Year 6-8]**

For Rhododendron and Cherry Laurel extermination to succeed it is paramount that this phase is undertaken otherwise missed seedlings from Phase 2 and seeds blown in from outside the site are likely to re-establish and flower in 10-12 years.

3.7.4 **Phase 3 Repeated (Ongoing Maintenance) [Every 6-8 years after Year 8]**

At present an external seed source for Rhododendron and Cherry Laurel exists on Coillte owned woodland. If this source remains then systematic sweeps of the site will need to continue every 6-8 years to prevent these species becoming re-established on site.

3.8 Equipment Required

Control Methods	
Method:	**Required Equipment:**
Hand Pull	• Gloves
Basics for: Foliar Application Stump Treatment Cut and treat Stem Injection	• Gloves • Mask • Eye wear • 10% Roundup™Bioactive • Vegetable die • Measuring Jug • Knapsack sprayer
Excess required:	
Stump Treatment	• Chainsaw/loppers • Appropriate chainsaw gear • Brush
Cut and treat	• Loppers/secateurs • Brush
Inject	• Drill and drill bit • Basic syringe

Seed Removal and Brash Management:	
Method:	**Required Equipment:**
Seed disposal	• Secateurs • A large container that can be sealed • Shovel
Brash Management basics	• Wheelbarrow/cart • Chainsaw/loppers • Safe Area for storage
Brash Management: Mulch	• Mulcher

3.9 Standards of Work

3.9.1 Training and Operative Competency

It is paramount that all operators involved have a good understanding of methods and are competent in carrying out control treatments to a very high standard. They should also be aware of any health and safety issues related to areas being treated and a health and safety statement should be drawn up before works commence. Finally before work begins warning signs making the general public aware of works should be put in place (Higgins, 2008). It is a good idea that the Safety, Health and Welfare at Work Act, 2005 as well as the Safety, Health and Welfare at Work (General Application) Regulations, 2007; 6) are adhered to.

3.9.1.1 Herbicide Preparation and Use

While Glyphosate does not absorb easily through the skin, it is good practice to use gloves, protective eye wear and appropriate water resistant work clothing when using it. To prevent accidental ingestion Gyphosate should be stored in its original labelled container and when not in use should be stored under lock and key under conditions specified by the manufacturer. Hands should always be thoroughly washed before eating or smoking to prevent ingestion. As it takes approximately 6 hours for Glyphosate to be taken up by plants, children and animals can touch and accidentally ingest Glyphosate. While using Glyphosate it is paramount that clearly visible signs stating the use of pesticide and its risk to children and dogs are in place until treated plants are dry. Symptoms of ingestion by humans and animals consist of: burns to the mouth and throat, salivating, nausea, vomiting and diarrhoea. Animals may also go off food and appear sleepy. If pesticide ingestion is suspected medical treatment should be sought immediately (Henderson, et al., 2010).

Glyphosate has a low known toxic effect on aquatic life but research is still ongoing and no risks should be taken. Water for 10% solution should be sourced from a private tap (permission has been given). The herbicide should never be mixed up near the river. Only snip and treat, stump treatment or stem injection should be used within 20 metres of water bodies. No foliar application of Glyphosate are to be carried out within 20 metres to rivers and streams. It is very important that the Safety, Health and Welfare at Work (Chemical Agents) Regulations, 2001 as well as the European Communities

(Authorisation, Placing on the Market, Use and Control of Plant Protection Products) Regulations, 2003 are consulted. Those that fail to follow the latter legislation may be found guilty of an offence and liable to pay a maximum of €3,000 and/or a maximum of 6 months imprisonment.

3.9.2 **Chainsaw Use**

Chainsaws should only be used by those with appropriate training and skill. The use of chainsaws should adhere to the '*Guide to Safe Working with Timber and Chainsaws'*. Chainsaws and equipment should be maintained and correct protective equipment should be used at all times (HSA, 2010).

3.9.3 **Heights and Slopes**

Due to the sloped nature of the sites, control measures will be required on slopes and over drops. In such circumstances trained operators will be required to wear harnesses to prevent falls and slips while cutting and/or application of herbicide. Work should be carried out according to the *Guide to the Safety, Health and Welfare at Work (General Application) Regulations 2007 Part 4: Work at Height* (HSA, 2007).

3.9.4 **Supervision of works**

Especially at the beginning of works a supervisor is required along with operatives to answer any questions and ensure a high standard of work is carried out. A supervisor should also visit treated areas on a regular basis during treatment to ensure that work continues to be carried out to a high standard.

3.9.5 **Systematic Approach to Treated Area**

Treatment of areas should be carried out in a systematic manner as should the treatment of each area so that a sweep is done from one area to the next and throughout each area, treating/removing any Rhododendron and Cherry Laurel plants.

3.9.6 **Zero Tolerance**

Once treatment begins within an area, all invasive plant must be removed before the next area requiring treatment is moved onto. This includes any visible seedlings as this will minimise further treatment required in the follow up treatments.

3.9.7 **Tidy Work Practice**

The fact that the public use the site makes tidy practice even more important that any tools and chemicals should not be left around as tripping hazards for children to hurt/poison themselves with. Also during treatment large amounts of stems and trunks (brash) along with seeds will need appropriate disposal and should not be left as trip hazards or in infected areas as seedlings can germinate under brash and stems can root and grow and are difficult to access for treatment. In areas of the site where brash has been left and contains invasive growth, brash must be removed before treatment of the area begins. Where brash exists in Phase 1, it must be removed before that area can be treated.

3.9.7.1 Brash Management

3.9.7.1.1 Mulch

Small stems and unwanted larger stems and trunks should be mulched in a safe area (off the path in a gravelled space) where the mulch can be stored. The mulch can be used for paths within the woodland.

3.9.7.1.2 Wood Piles

A small amount brash should be stored in a safe place and during Phase 2 placed back as piles into treated areas that are free from flowering Rhododendron and Cherry Laurel and have a degraded ground flora. These Piles will provide shelter for re-establishing plants, bring insects and other wildlife back into the area (Higgins, 2008).

3.9.7.1.3 Fire wood

Most of the created brash can be used as firewood. Due to the amount created it is likely that from time to time an amount of logs will need to be stored in a safe place within the woodland. The Committee of Glenbower Wood and Lake Ltd. can decide how to fairly distribute firewood.

3.9.7.2 Seed Management

As brash is produced and placed in a wheelbarrow/cart, any seeds should be carefully removed with secateurs and seed placed in a sealable container. At the end of each phase a 50cm deep hole should be dug and a thin layer of seeds carefully placed into hole and the hole should be refilled and a record kept of its location. The site should be left intact for at least two years.

3.9.8 Treatment Quality

All work should be carried out to a high standard and Glyphosate should only be used during optimum conditions which allow foliar applications to be taken up by plants within 6 hours.

3.9.9 Threat of Re-infestation of woodland by Rhododendron and Cherry Laurel

It is of upmost importance that the adjacent woodland owner (Coillte) are contacted and begin their own invasive species control plan by the end of Phase 2 so as to remove the seed source from the greater Glenbower wood area and therefore limit the need for repeated Phase 3 Ongoing Maintenance (every 6-8 years).

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5 Appendix 1: Individual Infested Areas Details

Site No.:	Species	Height	Past Treat-ment	Seeds or flowers present	Status	Notes:
1	CL	>1.5m	Y	Y	Mod(3)	
2	CL	<1.5m	Y	N	Slight (2)	Scattered,
3	CL	<1.5m	N	N	Slight (2)	
4	CL	<1.5m	Y	N	Slight (2)	1 plant
5	Rhod	>1.5m	Y	Y	Mod (3)	
6	Rhod	>1.5m	Y	Y	Mod (3)	
7	CL	>1.5m	Y	Y	Mod (3)	
8	CL	>1.5m	N	Y	Sev (4)	Thickets, adjacent to river
9	CL	>1.5m	Y	Y	Sev (4)	Both side of path
10	Rhod	>1.5m	Y	Y	Mod (2)	Besides stream, access problem- strim brambles
11	Both	>1.5m	Y	Y	Mod (3)	
12	Both	>1.5m	Y	Y	Mod (3)	
13	Both	>1.5m	Y	N	Slight (2)	
14	CL	>1.5m	Y	Y	Sev (3)	Forming trees 8m high
15	Rhod	>1.5m	Y	Y	Sev (4)	Both sides of path, , on slope, trunks holding back eroded soil, in need of restoration
16	CL	>1.5m	Y	N	Slight (3)	Scattered

17	Rhod	>1.5m	Y	Y	Mod (3)	Both sides of path, sloped-health and safety issue
18	CL	>1.5m	Y	Y	Sev (4)	Fish pass, treated in 1987. Neat. Will requires restoration
19	Rhod	>1.5m	Y	N	Slight (2)	
20	CL	>1.5m	Y	N	Slight (2)	
21	CL	>1.5m	Y	Y	Mod (3)	Damaged by fallen tree; regrowth messy

Key:

CL= Cherry Laurel Rhod=Rhododendron Both= Both species present

6 Appendix 2: Control Work Sheets

Phase 1 (Year 1) Control:				
Area No.:	**Date:**	**Control method (s)**	**Weather**	**Treatment completed**
Highest Priority/ Infestation Absent (1)				
High priority/ Infestation Slight to Moderate (2-3)				
Moderate Priority/ Infestation Slight to Moderate (2-3)				
Low Priority/Infestation Severe to Very Severe (4-5)				
Areas left untreated at Phase 1 end:				

Phase 2 Advanced Clearance (Year 2 of 3):				
Areas left untreated at Phase 1 end				
Winter/Spring Survey			**Date:**	
Areas Requiring treatment:		Area Priority :		Map updated?
Phase 2 Advanced Clearance (Year 2 of 3) Control:				
Area No.:	**Date:**	**Control method (s)**	**Weather**	**Treatment completed**
Highest Priority/ Infestation Absent (1)				
High priority/ Infestation Slight to Moderate (2-3)				
Moderate Priority/ Infestation Slight to Moderate (2-3)				

Low Priority/Infestation Severe to Very Severe (4-5)				
Areas left untreated at Phase 2 (Year 2 of 3) end:				

Phase 2 Final Clearance (Year 3 of 3):				
Areas left untreated at Phase 2 (Year 2 of 3) end				
Winter/Spring Survey			**Date:**	
Areas Requiring treatment:		Area Priority :		Map updated?
Phase 2 Final Clearance (Year 3 of 3) Control:				
Area No.:	**Date:**	**Control method (s)**	**Weather**	**Treatment completed**
Highest Priority/ Infestation Absent (1)				
High priority/ Infestation Slight to Moderate (2-3)				
Moderate Priority/ Infestation Slight to Moderate (2-3)				

Low Priority/Infestation Severe to Very Severe (4-5)				
Areas left untreated at Phase 2 (Year 3 of 3) end:				

Phase 3 (Initial Maintenance) [Year 8]				
Winter/Spring Control of Seedlings (travelling south-west across site*)				
GPS coordinates	**Date:**	**Control method (s)**	**Weather**	**Species**
***It is imperative that the site is systematically covered from a south/south-western direction and all seedlings removed/treated. Zero tolerance for Rhododendron and Cherry Laurel!**				

Phase 3 Repeated (Ongoing Maintenance) [Year 14]				
Winter/Spring Control of Seedlings (travelling south-west across site*)				
GPS coordinates	**Date:**	**Control method (s)**	**Weather**	**Species**
***It is imperative that the site is systematically covered from a south/south-western direction and all seedlings removed/treated. Zero tolerance for Rhododendron and Cherry Laurel!**				

7 Appendix 3: Scientific Names of Flora and Fauna Mentioned in the Main Text

Plants:	
Alder	*Alnus glutinosa*
Ash	*Fraxinus excelsior*
Beech	*Fagus sylvatica*
Billberry	*Vaccinium myrtillus*
Bird's-nest Orchid	*Neottia nidus-avis*
Cherry Laurel	*Prunus laurocerasus*
Great Woodrush	*Luzula sylvatica*
Hazel	*Corylus avellana*
Horse Chestnut	*Aesculus hippocastanum*
Holly	*Ilex aquifolium*
Oak	*Quercus sp*
Rhododendron	*Rhododendron ponticum*
Rusty Willow	*Salix cinerea*
Scots Pine	*Pinus sylvestris*
Sitka Spruce	*Picea sitchensis*
Spanish Chestnut	*Castanea sativa*
Sycamore	*Acer pseudoplatanus*
Tunbridge Filmy Fern	*Hymenophyllum tunbrigense*
Western Hemlock	*Tsuga heterophylla*
Wood Sorrel	*Oxalis acetosella*

Fish:	*Salmo salar*
Salmon	*Salmo trutta*
Trout	
Birds:	
Barn Owl	Tyto alba
King fisher	*Alcedo atthis*
Mammals:	
Badger	*Meles meles*
Hedgehog	*Erinaceus europaeus*
Irish Hare	*Lepus timidus*
Otter	*Lutra lutra*
Pine Marten	*Martes martes*
Pygmy Shrew	*Sorex minutus*
Red Squirrel	*Sciurus vulgaris*
Stoat	*Mustela erminea*

8 Appendix 4: Habitat Map sourced from the 2005-2010 Management Plan (Gittings, 2005)

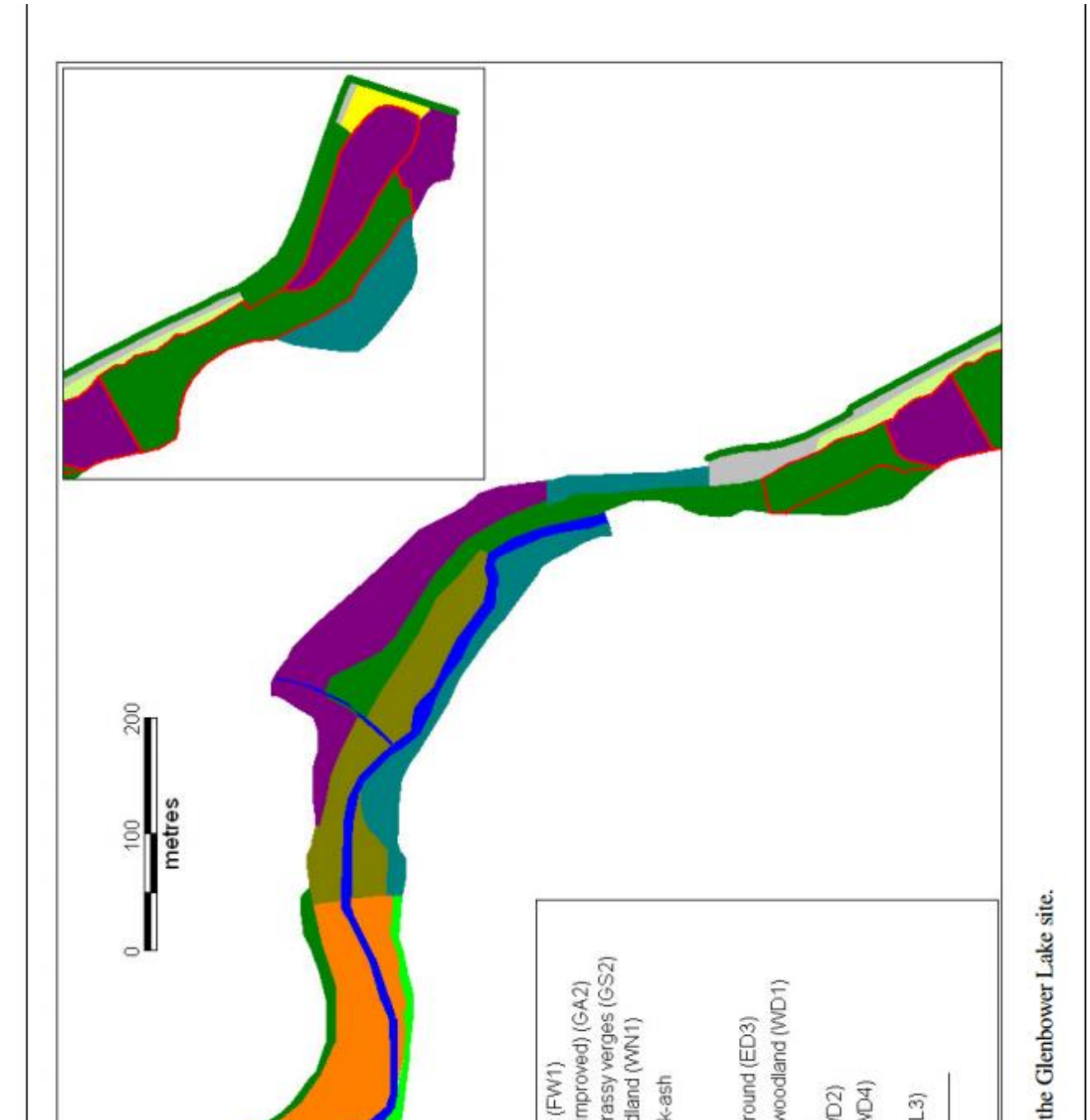

Figure 5. Habitat map of the Glenbower Lake site.