

***Galeopsis speciosa* (Lamiaceae): an Open Vegetation seed bank community at Worsley in Salford (v.c.59), revealed during construction of the new Royal Horticultural Society Garden at Bridgewater**

Michael J. Crawley
Imperial College London, Silwood Park, Ascot, SL5 7PY

Corresponding author: m.crawley@imperial.ac.uk

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Abstract

This paper provides a baseline flora for the site of the new garden of the Royal Horticultural Society at Worsley New Hall in Salford (v.c.59). During construction, 35,000 m³ of top-soil, sub-soil and spoil were stripped and stored onsite; species recruiting from these seed banks were monitored 2017-2020, leading to the description of a new *Galeopsis speciosa* Open Vegetation plant community. Four commercial wildflower mixes were used during post-construction landscaping in 2019, and their establishment was assessed in 2020. It will be interesting to follow the survival of these introduced species, many of which are not native to the site.

Keywords: landscaping; seed bank; RHS; introduced species; establishment; wildflower seed mix

Introduction

Francis Egerton (1736-1803), 3rd Duke of Bridgewater, made a fortune in the mid-18th century from coal mines at Worsley in Lancashire. Known as a pioneer of canal construction, he is regarded as the father of British inland navigation. He commissioned the Bridgewater Canal to service the coal mines, the first true canal in the modern world, which was built for him by his agent John Gilbert with advice from the engineer James Brindley. It opened in 1761. Subsequently, the Liverpool to Manchester canal was completed by the same team, and these ventures led to Egerton becoming the richest nobleman in England by the end of the 18th century. Worsley Old Hall was built in the late 16th century as the manor house for the Worsley estate, 13 km west of Manchester. The Duke inherited the estate in 1748, and commissioned the construction of the so-called Brick Hall, a classical-style building, which was completed in the 1760s. The Duke did not marry, and the dukedom expired with him. The Brick Hall was demolished between December 1844 and August 1845 (Leigh Road now runs over the site of the former building). The Duke's will placed the canals and estates in a trust which did not expire until 19 October 1903, when the whole property passed to the undivided control of Francis Egerton, 3rd Earl of Ellesmere. The canals had by then been transferred to the Bridgewater Navigation Company in 1872, by whom they were sold in 1887 to the Manchester Ship Canal Company.

Francis Egerton (1800-1857), 1st Earl of Ellesmere was heir to this fortune. He built Worsley New Hall to a design by Edward Blore. The foundations were started in 1839 but the building was not completed until 1846 (Fig. 1). The formal landscaped gardens were set out while the house was being built in the early 1840s, with further developments over the next 50 years. Landscaping included terrace gardens constructed by William Andrews Nesfield (Fig. 1), who started work on the gardens in 1846. By 1857, there were 6 terraces, separated by stone balustrades, and linked with steps and gravel paths. The top two terraces were set out in a *Parterre en Broderie* style. A croquet lawn and tennis court were built close to the terraces. To the south lay landscaped parkland and a boating lake. The lake was enlarged by 1875 and featured an island grotto accessible by a footbridge.

To the west of the terraces, woodland separated the grounds of the New Hall from the gardener's cottage and kitchen gardens. The 11 acre walled kitchen gardens were laid out in the early 1840s to provide vegetables, fruit and flowers to the residents of the New Hall. The perimeter red-brick walls were heated by flues using the Trentham wall case design, to create a warmer micro-climate for the fruit trees grown against them. Glasshouses grew cucumbers, melons, grape vines and peach trees. The head gardener's cottage, built in 1834, was also designed by Edward Blore, while The Bothy was erected in the late 19th century to house unmarried gardeners. A boiler in the cellar of the Bothy provided heating to the kitchen garden glasshouses: its chimney is the most prominent surviving feature of the estate. Queen Victoria visited the hall twice, in October 1851 and June 1857. On her second visit, whilst attending the Art Treasures Exhibition, she planted *Sequoiadendron giganteum* on the lawn of the New Hall in memory of the Duke of Wellington, but the tree did not thrive and was not replaced.

After the New Hall was abandoned by the Earls of Ellesmere in 1914, the gardens fell into disrepair, with the formal gardens becoming overgrown. During World War I, John Egerton, 4th Earl of Ellesmere lent the hall to the British Red Cross, and it was used as a hospital for injured soldiers. The grand rooms of the New Hall were used as wards, with food provided by the kitchen gardens with the terraced gardens and parkland used for recreation. The hospital closed in 1919. In 1920, death duties led the 4th Earl to start auctioning off various items of furniture and fittings from the New Hall: the library, and surplus furniture were sold at auction in April 1921. In 1923, the Worsley estate including the New Hall was sold to Bridgewater Estates Limited, a group of Lancashire businessmen, but their grand plans came to nothing. During World War II, the War Office requisitioned parts of the New Hall and the grounds. The 2nd and 8th Battalions of the Lancashire Fusiliers occupied the site in 1939 and 1940, with around 100 troops based there, using the Hall's basements as air raid shelters, and digging training trenches in the grounds. In 1941 and 1942 the 42nd and 45th County of Lancaster Home Guard Battalions used the site, practising street fighting in the hall, and storehouses for explosives were constructed in the grounds. In September 1943, a fire badly damaged the top floor of the New Hall. The building had suffered during the military occupation, with windows broken and interior furnishings used for firewood. The house was also suffering from dry rot and subsidence due to mining. Calls for tenders to demolish the building were sent out in 1944 and by 1949 the hall had been demolished to ground level, with debris used to fill in the basements.

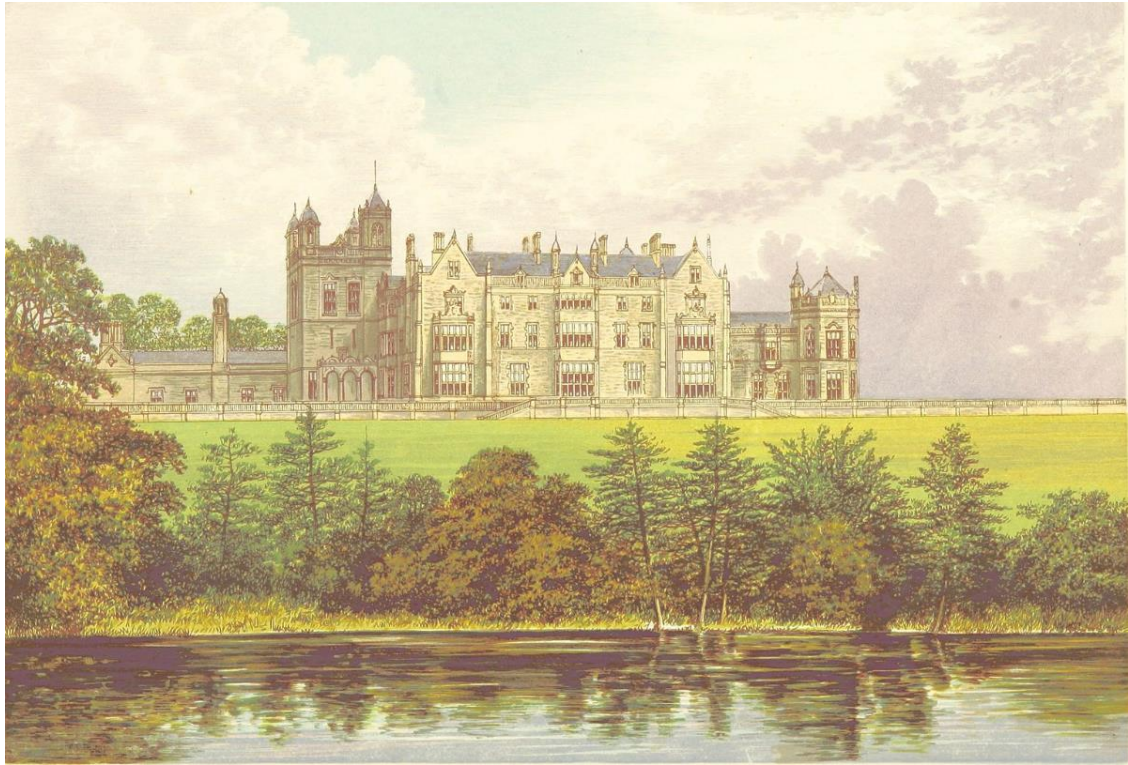


Figure 1. Worsley New Hall (above) was completed in 1846 after 7 years in construction. The formal gardens (below) were designed by Nesfield

Between 1943 and 2016, the woodland was used by generations of boys as an 800-space, 22 acre Scout Camp known as Middlewood. In 1948, the Worsley New Hall Gardens, the Bothy, Garden Cottage and land adjoining comprising 12 acres

were all sold to Messrs Herbert Harris Cunliffe and Richard Cunliffe, for £6,000. At this point Worsley Hall Nurseries and Garden Centre was established.

In 1951, the War Office again requisitioned part of the New Hall site and built a reinforced concrete bunker where the servants' wing had been, along with two anti-aircraft radar masts. In 1956, the War Office purchased the site of the bunker and it was used by the Royal Navy as a food store. In 1961, the bunker was sold to Salford Corporation, and was used by them and Lancashire County Council as a control centre. In 1968, ownership of the bunker passed to Greater Manchester Fire Service; in 1985 they leased it to a local gun club as a shooting range.

The site of the New Hall and gardens remained in the ownership of Bridgewater Estates Ltd until 1984 when the company was acquired by Peel Holdings, now Peel Land and Property. Worsley Hall Nurseries and Garden Centre continued in business until Peel Holdings bought the Kitchen Garden, Garden Cottage and other buildings in 2008. Over the years there had been various ideas about how the site could be regenerated and put to new use, including a racecourse, hotel and spa.

RHS Involvement at the site

The Director General of the Royal Horticultural Society, Sue Biggs, first visited the site in January 2015 to assess its potential as a location for the RHS's fifth garden. After extensive deliberations, the proposal by RHS Council to develop the fifth RHS Garden at Worsley was announced in October 2015, with the intention of calling it RHS Bridgewater. Planning approval for the development was granted in April 2017 and the Secretary of State signed off the development in June 2017. This enabled completion and exchange of lease agreements between Salford City Council, the RHS and Peel Holdings in July 2017.

Phase 1 of the development involved the restoration of the historic 11-acre walled garden, following a master plan drawn up by Tom Stuart-Smith (Fig. 2). A Chinese Streamside Garden winding through Middle Wood will link a new lake (Worsley Water) to the restored original lake (Ellesmere Water). A new Welcome Building, facing east across Worsley Water includes an events space, a learning centre, offices, café, shop and plant centre. Community gardening projects, developed with and for local people and organisations, are an integral part of the plan.

The aim of this paper is to document the vascular plants present on the site before and during the construction of the new garden, as a baseline for understanding future changes in plant biodiversity. Most of these changes will be a consequence of deliberate horticultural introductions, but some will be legacy effects, and others will be unplanned botanical incursions. The description of the flora is presented in three sections: the species that were growing on the site before its purchase by RHS; the plants exposed during the construction phase, concentrating on the species that were present in the soil seed bank; and post-construction landscaping, emphasising those areas that were sown or turfed with commercial wildflower mixtures. The main horticultural planting and the development of the arboretum will be documented in later publications.

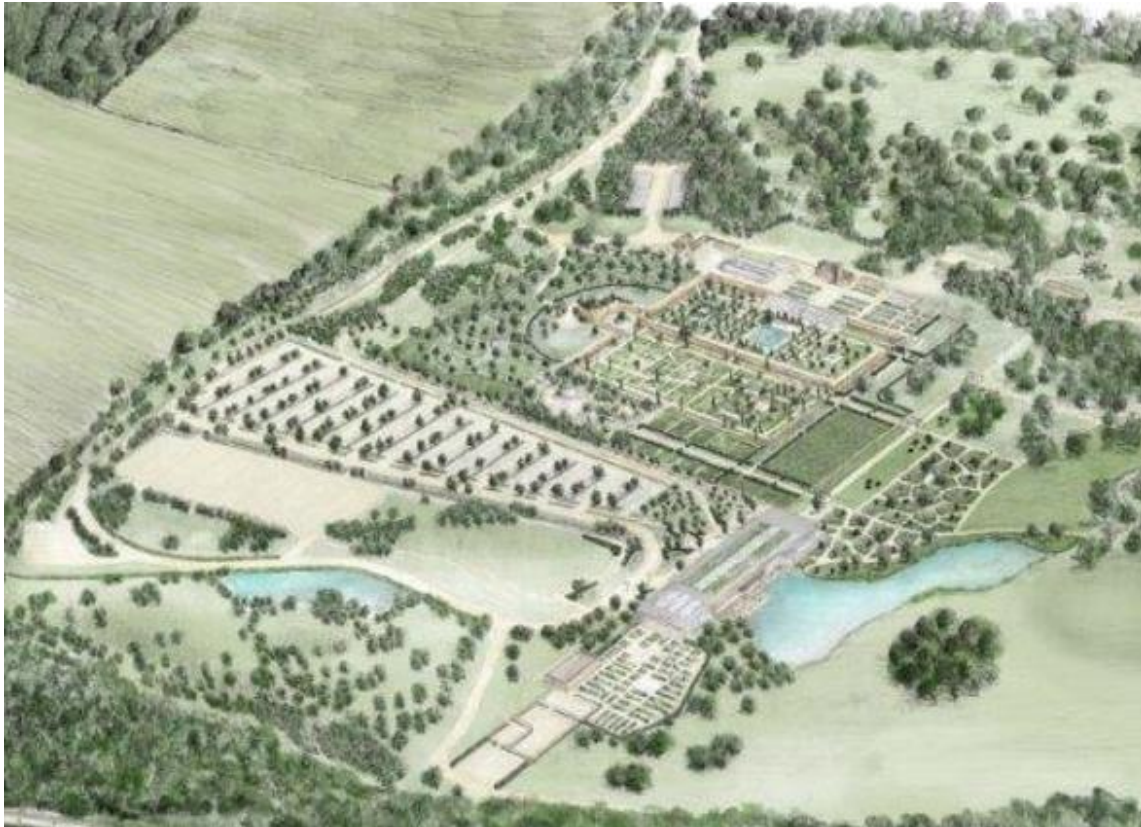


Figure 2. The Walled Garden as planned by Tom Stuart-Smith involves a Paradise Garden with Lily Pond, a Kitchen Garden, with Community Gardens to the south (centre of picture). Trial beds were to be laid out between the north wall and The Bothy (top of picture). Two new lakes were built: Worsley Water (right) with the adjacent Welcome Building and Retail Area and Moss Basin (left)

Methods

The study area comprises 63 ha, as shown in Fig. 3. The boundaries of RHS Bridgewater are defined on the north by Leigh Road and on the south by the Bridgewater Canal. The eastern boundary follows the edge of the slip road of Junction 13 of the M60 motorway, and the western boundary runs from Leigh Road south to the Canal.

The site was surveyed for vascular plants on 9 March and 1 September 2016 (pre-purchase), 1 June 2017 (pre-soil-stripping), 10 September 2018 (topsoil mounds), 15 August and 25 September 2019 (topsoil mounds) and 11 July 2020 (post-construction). Comprehensive species lists were made for each plant community, noting the dominant, abundant, frequent, occasional and rare species (dafor; Tansley, 1911), but detailed assessments of plant cover were not undertaken. Nomenclature follows Stace (2019).

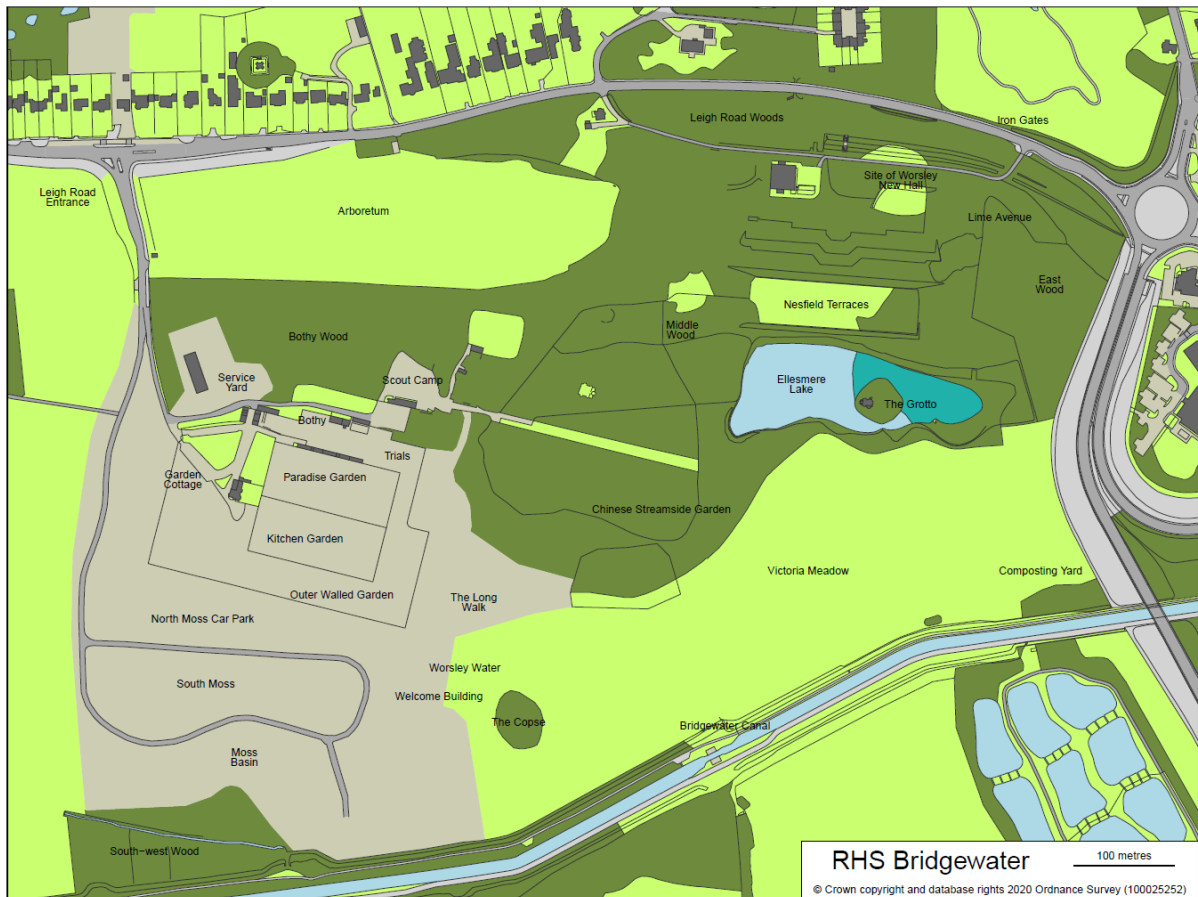


Figure 3. Plan of RHS Bridgewater in 2020. The two principal grasslands, Arboretum and Victoria Meadow are in light green. Existing woodland and scrub are in dark green. The main construction sites (2017-2020) are in grey. A new vehicle entrance onto Leigh Road, controlled by traffic lights, was completed in 2018, funded by Salford Council

Results

The flora when the site was purchased: 1) semi-natural habitats

Woodland - The main block of woodland comprised East Wood, Leigh Road Woods, Middle Wood and Bothy Wood and represents a species-poor remnant of W10 (Rodwell, 1991a), with the canopy dominated by self-sown *Acer pseudoplatanus* and the shrub layer by thickets of *Rhododendron ponticum* naturalised from rootstocks planted in the late 19th century to support choice cultivars as grafts. The dense shade excluded all ground flora from much of the area. The composite species list is shown in Table 1a, where the most conspicuous ground-layer plants were *Dryopteris dilatata* and *D. filix-mas* (Table 1a). For such a grand garden (Brookes, 1857) there is a surprising lack of ornamental conifers and veteran native trees.

Table 1. The flora of (a) woodland, (b) scrub and (c) grassland at RHS Bridgewater at the time of purchase in 2017. Frequency for each community is scored from n = 27 (woodland), n = 19 (scrub) and n = 18 (grassland). Species seen in 2 or more of the samples appear in the table. The footnote lists species recorded from a single sample in each community type

a) woodland			b) scrub			c) grassland		
	dafor	% frequency		dafor	% frequency		dafor	% frequency
<i>Acer pseudoplatanus</i>	d	100	<i>Dactylis glomerata</i>	ld	100	<i>Rumex obtusifolius</i>	a	100
<i>Dryopteris dilatata</i>	f	92	<i>Arrhenatherum elatius</i>	ld	69	<i>Dactylis glomerata</i>	a	83
<i>Quercus robur</i>	o	73	<i>Holcus lanatus</i>	ld	69	<i>Holcus lanatus</i>	a	83
<i>Carex remota</i>	ld	65	<i>Quercus robur</i>	a	69	<i>Lolium multiflorum</i>	d	83
<i>Fagus sylvatica</i>	o	65	<i>Rumex obtusifolius</i>	a	69	<i>Ranunculus acris</i>	a	83
<i>Geum urbanum</i>	f	58	<i>Acer pseudoplatanus</i>	a	63	<i>Ranunculus repens</i>	a	75
<i>Rhododendron ponticum</i>	ld	58	<i>Heracleum sphondylium</i>	a	63	<i>Arrhenatherum elatius</i>	a	67
<i>Fraxinus excelsior</i>	f	54	<i>Lolium multiflorum</i>	ld	63	<i>Lolium perenne</i>	o	67
<i>Tilia x europaea</i>	f	54	<i>Poa trivialis</i>	a	63	<i>Poa trivialis</i>	f	58
<i>Betula pubescens</i>	f	50	<i>Ranunculus acris</i>	a	63	<i>Cirsium arvense</i>	f	50
<i>Crataegus monogyna</i>	o	50	<i>Urtica dioica</i>	ld	63	<i>Alopecurus geniculatus</i>	la	42
<i>Dryopteris filix-mas</i>	f	50	<i>Betula pubescens</i>	a	56	<i>Cerastium fontanum</i>	f	42
<i>Ilex aquifolium</i>	f	50	<i>Galium aparine</i>	a	56	<i>Taraxacum officinale</i> agg.	a	42
<i>Juncus effusus</i>	f	50	<i>Ranunculus repens</i>	a	56	<i>Alopecurus pratensis</i>	f	25
<i>Silene dioica</i>	f	50	<i>Salix cinerea</i> subsp. <i>oleifolia</i>	a	56	<i>Anthoxanthum odoratum</i>	f	25
<i>Ranunculus repens</i>	f	42	<i>Alopecurus pratensis</i>	f	50	<i>Bromus hordeaceus</i>	f	25
<i>Rubus idaeus</i>	f	42	<i>Chamerion angustifolium</i>	la	50	<i>Cirsium vulgare</i>	f	25
<i>Rumex sanguineus</i>	f	42	<i>Lolium perenne</i>	f	50	<i>Cynosurus cristatus</i>	f	25
<i>Sambucus nigra</i>	f	42	<i>Epilobium hirsutum</i>	f	44	<i>Phleum pratense</i>	f	25
<i>Urtica dioica</i>	ld	42	<i>Salix caprea</i> subsp. <i>caprea</i>	f	44	<i>Agrostis stolonifera</i>	la	17
<i>Cardamine flexuosa</i>	f	35	<i>Sambucus nigra</i>	f	44	<i>Cerastium glomeratum</i>	f	17
<i>Circaea lutetiana</i>	la	35	<i>Silene dioica</i>	f	44	<i>Equisetum arvense</i>	o	17
<i>Poa trivialis</i>	f	35	<i>Betula pendula</i>	f	38	<i>Heracleum sphondylium</i>	o	17
<i>Digitalis purpurea</i>	f	31	<i>Cirsium arvense</i>	f	38	<i>Holcus mollis</i>	la	17
<i>Impatiens glandulifera</i>	la	31	<i>Crataegus monogyna</i>	f	38	<i>Juncus effusus</i>	la	17

<i>Asplenium scolopendrium</i>	o	31	<i>Cynosurus cristatus</i>	f	38	<i>Plantago major</i>	o	17
<i>Veronica montana</i>	o	31	<i>Dryopteris filix-mas</i>	f	38	<i>Jacobaea vulgaris</i>	o	17
<i>Athyrium filix-femina</i>	o	27	<i>Impatiens glandulifera</i>	f	38	<i>Trifolium repens</i>	o	17
<i>Heracleum sphondylium</i>	o	27	<i>Rhododendron ponticum</i>	ld	38	<i>Urtica dioica</i>	o	17
<i>Carex pendula</i>	o	23	<i>Salix x reichardtii</i>	f	38	<i>Vicia sepium</i>	o	17
<i>Castanea sativa</i>	o	23	<i>Trifolium repens</i>	f	38			
<i>Dactylis glomerata</i>	o	23	<i>Cerastium glomeratum</i>	f	31			
<i>Epilobium montanum</i>	o	23	<i>Equisetum arvense</i>	f	31			
<i>Galium aparine</i>	o	23	<i>Fagus sylvatica</i>	o	31			
<i>Phalaris arundinacea</i>	o	23	<i>Fraxinus excelsior</i>	o	31			
<i>Jacobaea vulgaris</i>	o	23	<i>Phleum pratense</i>	o	31			
<i>Solanum dulcamara</i>	o	23	<i>Plantago lanceolata</i>	o	31			
<i>Alnus glutinosa</i>	o	19	<i>Pteridium aquilinum</i>	la	31			
<i>Betula pendula</i>	o	19	<i>Jacobaea vulgaris</i>	f	31			
<i>Epilobium hirsutum</i>	o	19	<i>Agrostis stolonifera</i>	f	25			
<i>Hyacinthoides non-scripta</i>	o	19	<i>Alopecurus geniculatus</i>	la	25			
<i>Salix caprea</i> subsp. <i>caprea</i>	la	19	<i>Bromus hordeaceus</i>	o	25			
<i>Scrophularia nodosa</i>	o	19	<i>Plantago major</i>	o	25			
<i>Aesculus hippocastanum</i>	o	15	<i>Trifolium pratense</i>	o	25			
<i>Ajuga reptans</i>	o	15	<i>Vicia cracca</i>	o	25			
<i>Holcus lanatus</i>	o	15	<i>Alliaria petiolata</i>	la	19			
<i>Larix x marschlinii</i>	ld	15	<i>Alnus glutinosa</i>	o	19			
<i>Plantago major</i>	o	15	<i>Anthoxanthum odoratum</i>	f	19			
<i>Pteridium aquilinum</i>	o	15	<i>Anthriscus sylvestris</i>	f	19			
<i>Quercus petraea</i>	r	15	<i>Cerastium fontanum</i>	f	19			
<i>Ranunculus acris</i>	o	15	<i>Juncus effusus</i>	f	19			
<i>Rumex obtusifolius</i>	o	15	<i>Persicaria maculosa</i>	o	19			
<i>Agrostis capillaris</i>	o	12	<i>Phalaris arundinacea</i>	o	19			
<i>Alliaria petiolata</i>	o	12	<i>Poa annua</i>	o	19			
<i>Corylus avellana</i>	o	12	<i>Acer campestre</i>	o	13			
<i>Deschampsia cespitosa</i>	o	12	<i>Acer platanoides</i>	o	13			

<i>Equisetum arvense</i>	o	12	<i>Aesculus hippocastanum</i>	o	13
<i>Glyceria maxima</i>	r	12	<i>Betula x aurata</i>	o	13
<i>Hedera helix</i>	o	12	<i>Buddleja davidii</i>	o	13
<i>Holcus mollis</i>	la	12	<i>Cardamine flexuosa</i>	o	13
<i>Iris pseudacorus</i>	o	12	<i>Castanea sativa</i>	o	13
<i>Prunella vulgaris</i>	o	12	<i>Centaureum erythraea</i>	o	13
<i>Quercus x rosacea</i>	o	12	<i>Cirsium vulgare</i>	o	13
<i>Salix cinerea</i> subsp. <i>oleifolia</i>	la	12	<i>Dryopteris dilatata</i>	o	13
<i>Salix fragilis</i>	o	12	<i>Epilobium ciliatum</i>	o	13
<i>Salix x reichardtii</i>	o	12	<i>Reynoutria sachalinensis</i>	r	13
<i>Stachys sylvatica</i>	o	12	<i>Festuca rubra</i>	o	13
<i>Tussilago farfara</i>	o	12	<i>Glyceria fluitans</i>	o	13
<i>Acer platanoides</i>	r	8	<i>Holcus mollis</i>	la	13
<i>Agrostis stolonifera</i>	o	8	<i>Hypochaeris radicata</i>	o	13
<i>Arrhenatherum elatius</i>	o	8	<i>Ilex aquifolium</i>	o	13
<i>Betula x aurata</i>	o	8	<i>Matricaria discoidea</i>	o	13
<i>Chamerion angustifolium</i>	la	8	<i>Polygonum aviculare</i>	o	13
<i>Cirsium arvense</i>	o	8	<i>Populus x canadensis</i>	o	13
<i>Cornus sericea</i>	o	8	<i>Prunus avium</i>	o	13
<i>Cytisus scoparius</i>	o	8	<i>Prunus laurocerasus</i>	o	13
<i>Dryopteris affinis</i>	r	8	<i>Pulicaria dysenterica</i>	o	13
<i>Dryopteris borrieri</i>	r	8	<i>Rubus idaeus</i>	o	13
<i>Reynoutria japonica</i>	lf	8	<i>Rumex acetosa</i>	o	13
<i>Lapsana communis</i>	o	8	<i>Sagina procumbens</i>	o	13
<i>Lolium perenne</i>	o	8	<i>Salix alba</i>	o	13
<i>Mercurialis perennis</i>	la	8	<i>Salix fragilis</i>	o	13
<i>Phragmites australis</i>	la	8	<i>Salix viminalis</i>	o	13
<i>Picea abies</i>	o	8	<i>Sorbus aucuparia</i>	o	13
<i>Polystichum setiferum</i>	r	8	<i>Tilia x europaea</i>	o	13
<i>Sorbus aucuparia</i>	o	8	<i>Tussilago farfara</i>	o	13
<i>Taxus baccata</i>	la	8	<i>Vicia sepium</i>	o	13

<i>Torilis japonica</i>	r	8
<i>Trifolium repens</i>	o	8

Species recorded in just 1 woodland sample

Acer platanoides 'Crimson King', *Acer saccharinum*, *Acorus calamus*, *Anisantha sterilis*, *Anthriscus sylvestris*, *Aquilegia vulgaris*, *Arctium minus*, *Arctium nemorosum*, *Arum maculatum*, *Astrantia major*, *Baptisia australis* var. *minor*, *Brachypodium sylvaticum*, *Bromus hordeaceus*, *Buddleja davidii*, *Callitriche stagnalis*, *Carex muricata* subsp. *pairae*, *Centaurea debeauxii*, *Centaureum erythraea*, *Cerastium fontanum*, *Chrysosplenium oppositifolium*, *Cirsium palustre*, *Cirsium vulgare*, *Cornus sanguinea*, *Crepis vesicaria* subsp. *taraxacifolia*, *Deschampsia cespitosa* subsp. *cespitosa*, *Epilobium ciliatum*, *Epilobium palustre*, *Epilobium parviflorum*, *Euonymus europaeus*, *Festuca rubra*, *Galanthus nivalis*, *Galium saxatile*, *Geranium dissectum*, *Geranium molle*, *Geranium robertianum*, *Glechoma hederacea*, *Glyceria fluitans*, *Juncus conglomeratus*, *Larix decidua*, *Lemna minor*, *Ligustrum ovalifolium*, *Lotus corniculatus*, *Lysimachia nemorum*, *Mahonia aquifolium*, *Oenothera glazioviana*, *Oxalis acetosella*, *Pentaglottis sempervirens*, *Persicaria maculosa*, *Plantago lanceolata*, *Poa annua*, *Poa nemoralis*, *Polygonatum x hybridum*, *Quercus ilex*, *Quercus rubra*, *Ribes rubrum*, *Rubus fruticosus* agg., *Salix alba*, *Sonchus asper*, *Symphoricarpos x chenaultii*, *Symphytum grandiflorum*, *Tilia cordata*, *Tragopogon pratensis* subsp. *minor*, *Trifolium dubium*, *Typha latifolia*, *Veronica hederifolia* subsp. *hederifolia*, *Veronica serpyllifolia*, *Vicia sepium*

Species recorded in just 1 scrub sample

Acer pseudoplatanus 'Atropurpureum', *Aegopodium podagraria*, *Aesculus carnea*, *Agrostis capillaris*, *Anisantha sterilis*, *Arctium minus*, *Arum maculatum*, *Calystegia sepium*, *Carduus crispus*, *Carex nigra*, *Carex pendula*, *Centaurea debeauxii*, *Chamaecyparis lawsoniana*, *Crepis capillaris*, *Cytisus scoparius*, *Epilobium montanum*, *Epilobium parviflorum*, *Ervilia hirsuta*, *Fagus sylvatica* 'Atropurpurea', *Festuca ovina*, *Fragaria vesca*, *Galium album*, *Hieracium* sect. *Hieracium*, *Humulus lupulus*, *Hyacinthoides non-scripta*, *Juncus inflexus*, *Juncus tenuis*, *Ligustrum* sp., *Lotus corniculatus*, *Luzula campestris*, *Medicago lupulina*, *Picea sitchensis*, *Pilosella aurantiaca* subsp. *carpathicola*, *Potentilla erecta*, *Prunella vulgaris*, *Quercus cerris*, *Rubus fruticosus* agg., *Rumex acetosella*, *Rumex sanguineus*, *Salix x sepulcralis*, *Scrophularia nodosa*, *Stachys sylvatica*, *Torilis japonica*, *Trifolium dubium*, *Ulex europaeus*, *Ulmus glabra*, *Veronica serpyllifolia*, *Vicia sativa* subsp. *segetalis*

Species recorded in just 1 grassland sample

Cardamine pratensis, *Chamerion angustifolium*, *Elytrigia repens*, *Epilobium parviflorum*, *Ervilia hirsuta*, *Galium saxatile*, *Glyceria fluitans*, *Juncus bufonius*, *Lotus corniculatus*, *Petasites hybridus*, *Phalaris arundinacea*, *Rumex acetosa*, *Salix cinerea* subsp. *oleifolia*, *Sambucus nigra*, *Stellaria alsine*, *Thymus drucei*, *Vicia cracca*

A second, much smaller fragment of naturally regenerated wet woodland occupies the extreme south-wester corner of the estate, bordering the Bridgewater Canal. It is dominated by *Acer pseudoplatanus*, with *Athyrium filix-femina*, *Crataegus monogyna*, *Digitalis purpurea*, *Dryopteris dilatata*, *Epilobium hirsutum*, *Fagus sylvatica*, *Fraxinus excelsior*, *Geum urbanum*, *Glyceria fluitans*, *Heracleum sphondylium*, *Ilex aquifolium*, *Impatiens glandulifera*, *Lemna minor*, *Persicaria maculosa*, *Poa trivialis*, *Quercus robur*, *Ranunculus acris*, *Ranunculus repens*, *Rhododendron ponticum*, *Rubus idaeus*, *Rumex sanguineus*, *Sambucus nigra*, *Silene dioica*, *Solanum dulcamara*, *Sorbus aucuparia*, *Stachys sylvatica*, *Tilia x europaea* and *Urtica dioica*.

Certainly or probably planted species persisting within the main block of woodland were *Acer platanooides*, *Acer saccharinum*, *Aesculus hippocastanum*, *Aquilegia vulgaris*, *Castanea sativa*, *Fagus sylvatica*, a plantation of *Larix x marschlinsii*, *Ligustrum ovalifolium*, *Picea abies*, *Pinus strobus*, *Polygonatum x hybridum*, *Polystichum setiferum*, *Populus x canadensis*, *Quercus ilex*, *Q. petraea*, *Q. x rosacea*, *Reynoutria japonica*, *Rhododendron* spp., *Symphoricarpos x chenaultii*, *Symphytum grandiflorum* and an avenue of *Tilia x europaea*.

Grassland - There were two extensive grasslands: Victoria Meadow dominates the south-eastern quarter of the estate, and The Arboretum occupies the north-western corner. Both were similar in their botanical composition (MG7; Rodwell, 1992): they represent ultra-species-poor hay meadows, sown to *Lolium multiflorum* and heavily fertilized each year. Other than *Rumex obtusifolius*, *Ranunculus* spp. and a scattering of thistles, there were very few dicots (Table 1c). Damper patches within the meadow were dominated by *Juncus effusus* with *Alopecurus geniculatus*, *Agrostis stolonifera*, *Glyceria fluitans*, *Phalaris arundinacea* and *Stellaria alsine*.

Scrub - A zone of scrub ranging between 5 and 20 m wide surrounded Victoria Meadow and Arboretum Meadow (Fig. 3). The flora (Table 1b) was intermediate between woodland and grassland, and while the woodland component was reduced in species-richness, the grassland component had more species (both of grasses and forbs; MG1, Rodwell 1992) than the adjacent meadow, dominated as this was by *Lolium multiflorum*. In damper areas, willow (*Salix cinerea* subsp. *oleifera* and hybrids) and *Impatiens glandulifera* were conspicuous.

Wetland - There were small patches of wetland all along the southern boundary, next to the Bridgewater canal, with a Reedmace swamp (S12; Rodwell 1995) in the south-eastern corner. The most extensive wetland was at the eastern end of the man-made Ellesmere Lake which had been a focal feature of the original garden, at the foot of the steep terraces, south of the grand house. The eastern half of the lake had long-since silted up, and the former lake bed supported a wet woodland, with *Acer pseudoplatanus*, *Alnus glutinosa*, *Athyrium filix-femina*, *Betula pubescens*, *Carex pendula*, *Crataegus monogyna*, *Dactylis glomerata*, *Dryopteris dilatata*, *Dryopteris filix-mas*, *Fagus sylvatica*, *Impatiens glandulifera*, *Phalaris arundinacea*, *Phragmites australis*, *Quercus robur*, *Ribes rubrum*, *Rumex sanguineus*, *Salix x fragilis*, *Solanum dulcamara* and *Urtica dioica*. The ground layer was dominated by *Carex remota* (as in W2; Rodwell 1991a).

The Moss - Nothing remained of the Sphagnum mires (M18; Rodwell 1991b) that once dominated the lower ground on the south of the site (the grey area in Fig. 3) which would have supported species like *Erica tetralix*, *Andromeda polifolia*, *Drosera intermedia*, *D. anglica*, *Rhynchospora alba*, *Myrica gale* and *Osmunda regalis* (Savidge et al., 1963). These mires were probably drained in the mid 18th century before the canal was built. The ghost of the mire survives in the form of black, peaty soils underlying the improved grasslands that stretch from South Moss to Victoria Meadow.

The Lake - Before it was drained for dredging (2018) and refurbishment of the stonework (2019), the surface of the boating lake (now re-named Ellesmere Lake) was completely dominated by *Nymphoides peltata*. There were isolated patches of *Nuphar lutea* and *Nymphaea alba* and pockets of *Lemna minor*, but there was very little marginal vegetation.

The flora when the site was purchased: 2) Built-up areas

The Walled Garden - In 2016 this was a head-high wilderness of *Pteridium aquilinum*, *Rubus fruticosus* agg. with various species and hybrid *Salix*, set amongst derelict greenhouses and broken-down brick walls. There were scattered individuals of *Acer platanoides*, *Acer platanoides* 'Crimson King', *Aesculus carnea*, *Alnus glutinosa*, *Anemone x hybrida*, *Arrhenatherum elatius*, *Asplenium scolopendrium*, *Betula pendula*, *Buddleja davidii*, *Calystegia sepium*, *Carex pendula*, *Cercis siliquastrum*, *Chamerion angustifolium*, *Cirsium vulgare*, *Crococsmia x crocosmiiflora*, *Dryopteris filix-mas*, *Epilobium hirsutum*, *Equisetum arvense*, *Eupatorium cannabinum*, *Fallopia baldschuanica*, *Geranium robertianum*, *Holcus mollis*, *Hypericum perforatum*, *Hypochaeris radicata*, *Juglans regia*, *Lapsana communis*, *Lobelia erinus*, *Mentha spicata*, *Mentha x piperita*, *Mentha x villosa*, *Oenothera biennis*, *Origanum vulgare*, *Parthenocissus quinquefolia*, *Parthenocissus tricuspidata*, *Phragmites australis*, *Prunella vulgaris*, *Salix caprea* subsp. *caprea*, *S. cinerea* subsp. *oleifolia*, *S. x fragilis*, *S. viminalis*, *S. x reichardtii*, *Senecio vulgaris*, *Sonchus oleraceus*, *Symphytum x uplandicum*, *Thuja plicata*, *Tussilago farfara*, *Vicia sativa* subsp. *segetalis* and *Vinca major*.

The Former Terraced Gardens - This area, once dominated by immaculately manicured terraces of formal bedding, with fountains and ornate stonework was overgrown waste ground. Between 2011 and 2014 Salford University and Peel Holdings carried out a joint project involving an archaeological excavation of the north of the area to expose the foundations and cellars of Worsley New Hall (Fig. 4) The area revegetated over the period 2014-2017 in a typical waste-ground secondary succession and by 2020 was a dense scrub dominated by *Buddleja davidii* and *Salix* spp. and hybrids. Species restricted to this area, or reaching their peak abundance here, were *Carex elata* 'Aurea', *Centaurea debeauxii*, *Centaureum erythraea*, *Cirsium vulgare*, *Cytisus scoparius*, *Epilobium parviflorum*, *Erigeron canadensis*, *E. floribundus*, *Ervilia hirsuta*, *Heracleum sphondylium*, *Hieracium* Sect. *Hieracium*, *Juncus tenuis*, *Prunella vulgaris*, *Pulicaria dysenterica*, *Jacobaea vulgaris*, *Sorbus aucuparia*, *Trifolium repens* and *Tussilago farfara*.



Figure 4. The cellars of Worsley New Hall were excavated during an archaeological dig between 2011-14. After infill, the site was left as open waste ground 2014-2020 to undergo secondary succession to *Buddleja* scrub

The Scout Camp - The Scout Masters maintained open areas for camping, games and camp fires, as well as for woodland adventures. From time to time, they planted trees and ornamental shrubs, and several of these survived and have been preserved (e.g. *Metasequoia glyptostroboides*). The area was a mosaic of woodland, grassy clearings and shrubberies, with *Acer platanoides*, *A. pseudoplatanus*, *Aesculus hippocastanum*, *Agrostis capillaris*, *A. stolonifera*, *Alliaria petiolata*, *Alnus glutinosa*, *Alopecurus geniculatus*, *Anisantha sterilis*, *Anthriscus sylvestris*, *Aquilegia vulgaris*, *Arabidopsis thaliana*, *Arrhenatherum elatius*, *Athyrium filix-femina*, *Bellis perennis*, *Berberis darwinii*, *Betula pendula*, *B. pubescens*, *B. x aurata*, *Cardamine flexuosa*, *C. hirsuta*, *C. pratensis*, *Carex pendula*, *C. remota*, *Cerastium fontanum*, *C. glomeratum*, *Chenopodium album*, *Cirsium arvense*, *Corylus avellana*, *Crataegus monogyna*, *Crepis vesicaria* subsp. *taraxacifolia*, *Crocsmia paniculata*, *Dactylis glomerata*, *Dryopteris dilatata*, *D. filix-mas*, *Epilobium ciliatum*, *E. hirsutum*, *E. montanum*, *E. parviflorum*, *Erigeron canadensis*, *Escallonia macrantha*, *Euonymus europaeus*, *Festuca rubra*, *Fraxinus excelsior*, *Fuchsia magellanica*, *Galium aparine*, *G. saxatile*, *Geranium dissectum*, *G. robertianum*, *Geum urbanum*, *Heracleum sphondylium*, *Holcus lanatus*, *H. mollis*, *Hyacinthoides x massartiana*, *Hypericum 'Hidcote'*, *H. hircinum*, *Ilex aquifolium*, *Juncus bufonius*, *J. effusus*, *Lamium galeobdolon* subsp. *argentatum*, *Lapsana communis*, *Lepidium didymum*, *Leycesteria formosa*, *Lolium perenne*, *Lotus corniculatus*, *Lysimachia nemorum*, *Paeonia officinalis*, *Persicaria maculosa*, *Picea abies*, *Pinus strobus*, *Plantago lanceolata*, *P. major*, *Platanus x hispanica*, *Poa annua*, *P. pratensis*, *P. trivialis*, *Polygonum aviculare*, *Populus nigra* 'Italica', *Prunella vulgaris*, *Prunus avium*, *P. cerasifera* 'Nigra', *P. laurocerasus*, *Pulicaria dysenterica*, *Quercus robur*, *Ranunculus acris*, *R. repens*, *Reynoutria japonica*, *Rhododendron ponticum*, *Ribes uva-crispa*, *Rubus*

idaeus, *Rumex acetosa*, *R. crispus*, *R. obtusifolius*, *R. sanguineus*, *Sagina procumbens*, *Salix caprea* subsp. *caprea*, *S. cinerea* subsp. *oleifolia*, *S. x reichardtii*, *Sambucus nigra*, *Scrophularia nodosa*, *Jacobaea vulgaris*, *Silene dioica*, *Sonchus asper*, *S. oleraceus*, *Sorbus intermedia*, *Stachys sylvatica*, *Stellaria media*, *S. alsine*, *Tellima grandiflora*, *Trifolium dubium*, *Trifolium pratense*, *Trifolium repens*, *Urtica dioica*, *Veronica persica*, *V. serpyllifolia* and *Vinca minor*.

The Garden Centre - The buildings to the north and west of the Walled Garden were used as a Garden Centre, and supported an essentially urban flora, with tarmac, concrete, lawns, brickwork and waste ground with *Acer pseudoplatanus*, *Agrostis capillaris*, *Alliaria petiolata*, *Amaranthus caudatus*, *Anisantha sterilis*, *Antirrhinum majus*, *Arabidopsis thaliana*, *Arum maculatum*, *Asplenium ruta-muraria*, *A. scolopendrium*, *A. trichomanes* subsp. *quadrivalens*, *Bellis perennis*, *Betula pendula*, *Buddleja davidii*, *Calendula officinalis*, *Calystegia sepium*, *Capsella bursa-pastoris*, *Cardamine hirsuta*, *Cerastium fontanum*, *Chenopodium album*, *C. rubrum*, *Cirsium arvense*, *Cirsium vulgare*, *Cornus kousa* 'China Girl', *Crataegus arnoldiana*, *C. monogyna*, *Crepis vesicaria* subsp. *taraxacifolia*, *Cytisus scoparius*, *Descurainia sophia*, *Dryopteris filix-mas*, *Epilobium ciliatum*, *E. hirsutum*, *E. montanum*, *E. parviflorum*, *Equisetum arvense*, *Erigeron canadensis*, *Erophila verna*, *Ervilia hirsuta*, *Eupatorium cannabinum*, *Euphorbia characias* 'Wilcott', *Fallopia baldschuanica*, *Festuca rubra*, *Foeniculum vulgare*, *Galium aparine*, *G. odoratum*, *Geranium robertianum*, *G. robertianum*, *G. rotundifolium*, *G. x magnificum*, *G. x oxonianum*, *Geum urbanum*, *Griselinia littoralis* 'Variegata', *Hedera colchica*, *H. helix*, *Heracleum sphondylium*, *Holcus lanatus*, *Ilex aquifolium*, *Lapsana communis*, *Lepidium didymum*, *Lolium multiflorum*, *Lolium perenne*, *Lonicera x purpusii*, *Lysimachia nummularia*, *Magnolia x soulangiana*, *Malus domestica*, *Nerine bowdenii*, *Osteospermum jucundum*, *Papaver cambricum*, *Parthenocissus tricuspidata*, *Persicaria maculosa*, *Phuopsis stylosa*, *Plantago lanceolata*, *Plantago major*, *Poa annua*, *Polygonum aviculare*, *Polypodium vulgare*, *Polypogon viridis*, *Potentilla anserina*, *Prunella vulgaris*, *Pyrus communis* 'Maiden', *Ranunculus acris*, *Ranunculus repens*, *Reynoutria japonica*, *Sagina procumbens*, *Sambucus nigra*, *Jacobaea vulgaris*, *Senecio vulgaris*, *Sisymbrium officinale*, *Sonchus asper*, *Sonchus oleraceus*, *Sorbus hybrida* 'Gibbsii', *Sorbus aucuparia* 'Edulis', *Stachys sylvatica*, *Stipa tenuissima*, *Thymus vulgaris*, *Tripleurospermum inodorum*, *Triticum aestivum*, *Tropaeolum majus*, *Urtica dioica*, *Veronica arvensis* and *Veronica serpyllifolia*.

The flora during construction

Work for the new garden involved stripping 35,000 m³ of topsoil, sub-soil and spoil, with most of the top-soil coming from the south-western corner of the estate, during construction of North and South Moss Car Parks, the Welcome Building and Worsley Water. Removing the topsoil and storing it in the Arboretum and at the eastern end of Victoria Meadow began in spring 2018. The flora of the soil piles was first investigated on 10 September 2018, with follow-up surveys on 25 September 2019 and 11 July 2020.

The seed bank of the black peaty soils of The Moss was sufficiently consistent and distinctive to merit description as a new category of Open Vegetation (*Galeopsis speciosa* community; Table 2). The early country floras of Cheshire (Warren 1899) and Lancashire (Wheldon & Wilson, 1907) as well as the metropolitan floras of

Liverpool (Dickinson 1851) and Manchester (Wood, 1840, Grindon 1859) agree that *Galeopsis speciosa* was a locally abundant component of the seed bank of root crops on black, peaty soils. Curtis (1777-98) considered it to be "One of the most splendid of our native wild flowers". An early description of this seed bank was by Price Evans (1923) from Carrington Moss, just south of the River Mersey in Cheshire. Prior to 1886 this had been a well-stocked grouse-moor, over 600 acres in extent, forming part of the estates of the Earl of Stamford. In 1886 the Moss was purchased by the Manchester Corporation to be used primarily as a dumping-ground for town refuse. It was then systematically drained as the first step towards creating valuable agricultural land. Hundreds of thousands of tons of night-soil, with cinders, were dumped on the virgin moss, but after the introduction of modern methods of sanitation this practice was discontinued. Subsequently, street-sweepings were supplemented by sulphate of potash, sulphate of ammonia and super-phosphate. This created a soil that could be worked and tilled in all weathers; it never got too wet and, on the other hand, never too dry (Price Evans, 1923). He described the seed bank as follows: abundant *Achillea millefolium*, *Atriplex patula*, *Chenopodium album*, *Elymus repens*, *Galeopsis speciosa*, *Persicaria maculosa*, *Rumex acetosella*, *Stellaria media*, *Tussilago farfara*, *Veronica hederifolia*; frequent *Capsella bursa-pastoris*, *Fallopia convolvulus*, *Holcus mollis*, *Mentha arvensis*, *Myosotis arvensis*, *Papaver dubium*, *Plantago major*, *Poa annua*, *Poa trivialis*, *Rorippa palustris*, *Senecio vulgaris*, *Sinapis arvensis*, *Spergula arvensis*, *Stachys palustris*, *Symphytum officinale*, *Trifolium* spp., *Veronica arvensis*; 29 further species were listed as occasional or rare. He observed that "*Galeopsis speciosa* is perhaps the most conspicuous weed on the arable ground on the Moss, and it can only be held in check by a vigorous or 'smothering' crop" like potato.

Table 2. *Galeopsis speciosa* seed bank community: a new Open Vegetation (OV) community

Constant species

Galeopsis speciosa, *Sonchus asper*, *Galium aparine*, *Rumex obtusifolius*, *Persicaria maculosa*, *Cirsium vulgare*.

Physiognomy

A spring-germinating ruderal community with a diverse, long-lived seed bank producing a dense cover of species-rich vegetation by late summer. *Galeopsis speciosa* has a strong dormancy that is sufficiently alleviated during the winter to allow germination of only part of a seed batch each spring; hence a stepwise germination pattern occurs over a period of several years (Karlsson et al., 2006).

Habitat

Peaty soils, of the kind developed during the 18th and 19th centuries on lowland 'mosses' in the north-west of England. Driven by the fashion for agricultural improvement, the bog was drained, then copious quantities of night soil were applied to surface of the peat each year. Today these habitats have black peaty loam soils with a pH around 6.2.

Zonation and Succession

The community appears following disturbance of the perennial vegetation by ploughing or during construction work. It disappears after 2-4 years of secondary succession, replaced by rank grassland, then scrub.

Distribution

Not yet documented, but necessarily restricted to the distribution of the nominate species on lowland peaty soils in western Wales, north-west and eastern England, lowland Scotland and Northern Ireland (Fig 5).

Affinities

Closest to OV13 with *Stellaria media*, *Capsella bursa-pastoris*, *Chenopodium album*, *Polygonum aviculare* and *Senecio vulgaris*, but with much higher cover of *Persicaria maculosa*. Substantial overlap with OV33 but with much lower cover of *Poa annua*, and *Persicaria lapathifolia* occasional rather than constant. There is an interesting damp element to this new seed bank with *Agrostis stolonifera*, *Alopecurus geniculatus*, *Cardamine flexuosa*, *Epilobium hirsutum*, *Gnaphalium uliginosum*, *Impatiens glandulifera*, *Juncus effusus*, *Ranunculus sceleratus*, *Rorippa palustris*, *Salix cinerea* subsp. *oleifolia*, *Stachys palustris* and *Typha latifolia*.

Floristic Table

Species	Frequency	Sites (details below)														Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
<i>Galeopsis speciosa</i>	V	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
<i>Persicaria maculosa</i>	V	1	1	1	1	1	1	1	1	1	1	1	1		1	13
<i>Lolium multiflorum</i>	IV		1	1	1	1	1		1	1		1	1	1	1	11
<i>Urtica dioica</i>	IV	1	1	1	1	1	1	1	1				1		1	10
<i>Fallopia convolvulus</i>	IV	1				1	1	1	1	1	1	1	1		1	10
<i>Lamium purpureum</i>	IV	1			1		1	1	1	1	1	1	1		1	10
<i>Tripleurospermum inodorum</i>	IV		1	1	1	1	1	1	1	1	1			1		10
<i>Viola arvensis</i>	IV		1	1	1		1	1	1	1		1		1	1	10
<i>Chenopodium album</i>	IV	1			1	1	2	1		1		1			1	9
<i>Cirsium vulgare</i>	IV	1	1	1	1	1	1	1	1			1				9
<i>Rorippa palustris</i>	IV	1		1	1			1	1	1	1			1	1	9
<i>Rumex obtusifolius</i>	IV	1		1	1	1	1		1		1	1			1	9
<i>Sinapis arvensis</i>	IV	1			1	1		1	1	1	1			1	1	9
<i>Sonchus asper</i>	IV	1	1	1	1	1			1		1		1	1		9
<i>Stellaria media</i>	IV	1			1	1	1	1	1	1	1				1	9
<i>Agrostis stolonifera</i>	III			1			1	1	1	1	1		1		1	8
<i>Capsella bursa-pastoris</i>	III	1	1			1	1	1		1			1		1	8
<i>Cirsium arvense</i>	III	1		1	1		1	1	1		1			1		8
<i>Plantago major</i>	III		1	1	1	1	1		1			1			1	8
<i>Polygonum aviculare</i>	III			1	1	1	2				1		1	1		8
<i>Galeopsis tetrahit</i>	III		1		1			1	1		1			1	1	7
<i>Matricaria discoidea</i>	III			1	1	1		1	1		1				1	7
<i>Cerastium glomeratum</i>	III			1	1				1	1	1				1	6
<i>Holcus lanatus</i>	III		1	1		1			1		1				1	6
<i>Ervilia hirsuta</i>	III				1		1		1		1			1	1	6
<i>Ranunculus repens</i>	III			1	1	1		1						1	1	6

<i>Ranunculus sceleratus</i>	III		1		1	1			1		1	1	6
<i>Alopecurus geniculatus</i>	III					1	1		1		1	1	5
<i>Arrhenatherum elatius</i>	III		1		1		1				1	1	5
<i>Cerastium fontanum</i>	III		1					1	1		1	1	5
<i>Elytrigia repens</i>	III		1	1	1				1		1		5
<i>Epilobium ciliatum</i>	III		1				1	1	1			1	5
<i>Epilobium hirsutum</i>	III		1		1	1			1			1	5
<i>Galium aparine</i>	III	1	1		1			1			1		5
<i>Matricaria recutita</i>	III				1	1		1		1			5
<i>Persicaria lapathifolia</i>	III	1					1	1		1			5
<i>Phleum pratense</i>	III			1	1			1	1			1	5
<i>Raphanus raphanistrum</i>	III	1	1		1	1		1					5
<i>Senecio vulgaris</i>	III		1		1	1	1				1		5
<i>Veronica persica</i>	III	1			1	1	1				1		5
<i>Atriplex patula</i>	II				1	1					1	1	4
<i>Atriplex prostrata</i>	II				1	1				1		1	4
<i>Brassica rapa</i>	II							1	1	1	1		4
<i>Lepidium didymum</i>	II			1	1					1		1	4
<i>Impatiens glandulifera</i>	II			1				1			1	1	4
<i>Sisymbrium officinale</i>	II			1				1				1	4
<i>Stachys palustris</i>	II					1	1				1	1	4
<i>Vicia cracca</i>	II			1	1						1	1	4
<i>Alliaria petiolata</i>	II	1				1						1	3
<i>Chamerion angustifolium</i>	II				1	1					1		3
<i>Chenopodium rubrum</i>	II	1				1						1	3
<i>Dactylis glomerata</i>	II			1		1					1		3
<i>Epilobium parviflorum</i>	II						1	1		1			3
<i>Equisetum arvense</i>	II			1		1						1	3
<i>Medicago lupulina</i>	II			1		1						1	3
<i>Myosotis arvensis</i>	II				1	1						1	3
<i>Papaver rhoeas</i>	II				1	1			1				3

<i>Ranunculus acris</i>	II		1	1				1	3	
<i>Spergula arvensis</i>	II		1	1				1	3	
<i>Trifolium repens</i>	II	1	1					1	3	
<i>Tussilago farfara</i>	II				1		1	1	3	
<i>Arabidopsis thaliana</i>	I			1		1			2	
<i>Cardamine flexuosa</i>	I					1		1	2	
<i>Galeopsis bifida</i>	I			1				1	2	
<i>Gnaphalium uliginosum</i>	I				1			1	2	
<i>Holcus mollis</i>	I		1			1			2	
<i>Juncus effusus</i>	I	1						1	2	
<i>Lapsana communis</i>	I			1				1	2	
<i>Odontites vernus</i>	I					1		1	2	
<i>Oenothera biennis</i>	I						1	1	2	
<i>Phleum bertolonii</i>	I	1	1						2	
<i>Plantago lanceolata</i>	I			1		1			2	
<i>Rumex crispus</i>	I						1	1	2	
<i>Salix cinerea</i> subsp. <i>oleifolia</i>	I	1						1	2	
<i>Jacobaea vulgaris</i>	I	1		1					2	
<i>Solanum nigrum</i>	I				1			1	2	
<i>Stachys sylvatica</i>	I	1	1						2	
<i>Trifolium dubium</i>	I	1		1					2	
<i>Trifolium hybridum</i>	I	1						1	2	
<i>Typha latifolia</i>	I							1	1	2
<i>Veronica arvensis</i>	I					1	1		2	
<i>Vicia sepium</i>	I	1						1	2	

The following additional species were found in just 1 of the 13 samples with *Galeopsis speciosa*: *Acer pseudoplatanus*, *Achillea millefolium*, *Agrostis gigantea*, *Alopecurus pratensis*, *Anthemis austriaca*, *Anthriscus sylvestris*, *Arctium nemorosum*, *Artemisia vulgaris*, *Brassica rapa* subsp. *rapa*, *Buddleja davidii*, *Calystegia sepium*, *Cardamine hirsuta*, *Chenopodium ficifolium*, *Crococsmia x crocosmiiflora*, *Cymbalaria muralis*, *Datura stramonium*, *Digitalis purpurea*, *Epilobium montanum*, *Erigeron canadensis*, *E.*

floribunda, *E. sumatrensis*, *Eschscholzia californica*, *Euphorbia helioscopia*, *E. peplus*, *Schedononorus arundinacea*, *Geranium dissectum*, *G. robertianum*, *Geum urbanum*, *Glyceria fluitans*, *Heracleum sphondylium*, *Juncus inflexus*, *Lepidium coronopus*, *Leucanthemum vulgare*, *Linaria vulgaris*, *Lolium perenne*, *Lotus pedunculatus*, *Medicago sativa* subsp. *sativa*, *Mentha spicata*, *Origanum vulgare*, *Papaver dubium* subsp. *dubium*, *Phalaris arundinacea*, *Poa annua*, *Polygonum arenastrum*, *Pulicaria dysenterica*, *Reseda luteola*, *Rumex acetosa*, *Rumex sanguineus*, *Salix viminalis*, *Scrophularia auriculata*, *S. nodosa*, *Scutellaria galericulata*, *Silene dioica*, *S. latifolia* subsp. *alba*, *S. x hampeana*, *Sonchus arvensis*, *S. oleraceus*, *Sorbus aucuparia*, *Stellaria pallida*, *Triticum aestivum*, *Typha angustifolia*, *Veronica serpyllifolia*, *Vicia sativa* subsp. *nigra*, *Vicia sativa* subsp. *segetalis*. The low frequency of *Poa annua* and the absence of *Sagina procumbens* are remarkable.

The samples 1-14 were as follows: 1 Arboretum Meadow soil piles (September 2018), 2 Welcome Building (July 2020), 3 E end of Victoria Meadow soil piles (September 2019), 4 last active soil pile Arboretum Meadow (September 2019), 5 N boundary fence by Main Entrance (July 2020), 6 W boundary fence (July 2020), 7 E bank of Worsley Water (July 2020), 8 E boundary soil pile (July 2020), 9 E of The Copse (July 2020), 10 Worsley Water soil pile (July 2020), 11 Chinese Streamside Garden below Ellesmere Lake (July 2020), 12 SW soil pile Moss Basin (July 2020), 13 summit of SW soil pile (July 2020), 14 flanks of SW soil pile (July 2020)

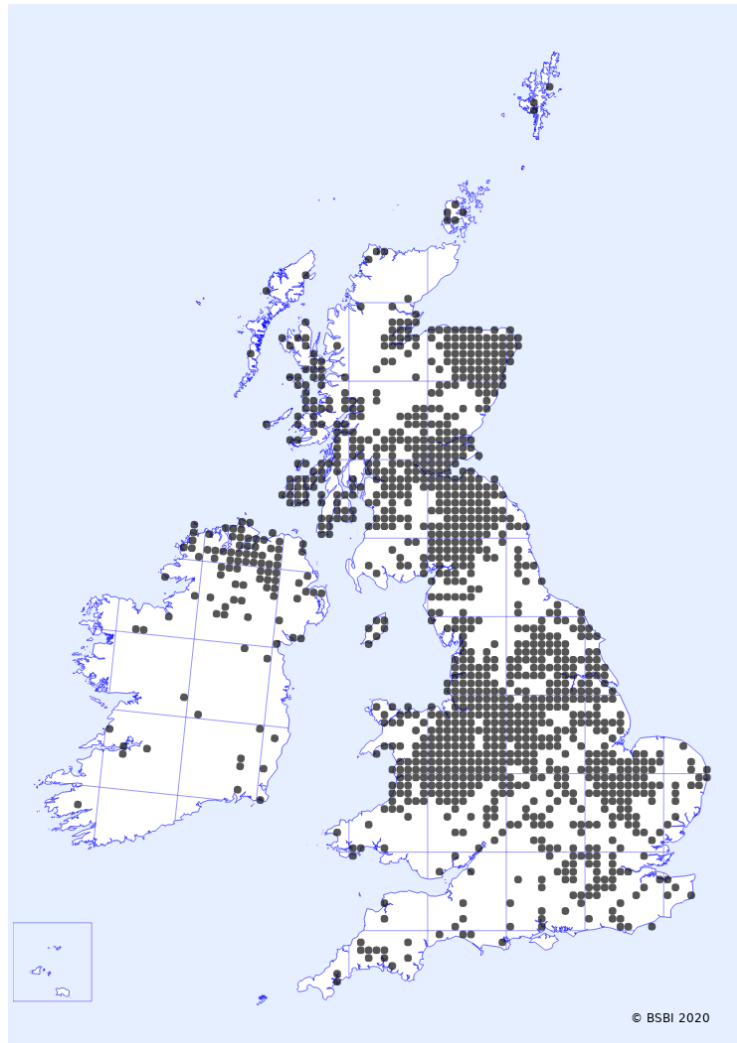


Figure 5. The spatial distribution of *Galeopsis speciosa* in Britain and Ireland. BSBI database 2020 (<https://database.bsbi.org/>)

Soil piles using material from the northern half of the site were distinctly different in the composition of their seed banks from the black, moss-peat-derived soils in Table 2. For example, the new Service Yard is surrounded by a high mound of material (topsoil and subsoil) that was excavated for the foundations of the tractor shed and its concrete forecourt. This was intermediate between OV12 and OV13 (Rodwell, 2000) where the dominant annual plants were *Brassica rapa* subsp. *rapa*, *Capsella bursa-pastoris*, *Cardamine flexuosa*, *C. hirsuta*, *Cerastium glomeratum*, *Chenopodium album*, *C. rubrum*, *Cirsium vulgare*, *Digitalis purpurea*, *Erigeron canadensis*, *Euphorbia helioscopia*, *E. peplus*, *Galium aparine*, *Geranium molle*, *G. robertianum*, *Gnaphalium uliginosum*, *Helminthotheca echioides*, *Juncus bufonius*, *Lapsana communis*, *Lepidium didymum*, *Matricaria chamomilla*, *M. discoidea*, *Medicago lupulina*, *Melilotus officinalis*, *Myosotis arvensis*, *Persicaria maculosa*, *Polygonum aviculare*, *P. rurivagum*, *Reseda luteola*, *Senecio vulgaris*, *Sisymbrium officinale*, *Solanum nigrum*, *Sonchus asper*, *S. oleraceus*, *Tripleurospermum inodorum* and *Vicia sativa* subsp. *segetalis*. The community also included many more perennial species than did the moss-peat (presumably regenerated from vegetative fragments as well as from seed), including *Agrostis*

capillaris, *A. stolonifera*, *Alliaria petiolata*, *Alopecurus geniculatus*, *Arrhenatherum elatius*, *Asplenium scolopendrium*, *Centranthus ruber*, *Chamaenerion angustifolium*, *Cirsium arvense*, *Crococsmia x crocosmiiflora*, *Cyclamen hederifolium*, *Dactylis glomerata*, *Epilobium ciliatum*, *E. hirsutum*, *E. parviflorum*, *Equisetum arvense*, *Geranium macrorrhizum*, *Geum urbanum*, *Hedera helix*, *Holcus lanatus*, *Hypericum perforatum*, *Juncus bulbosus*, *J. conglomeratus*, *J. effusus*, *Lamium galeobdolon* subsp. *montanum*, *Lolium perenne*, *Lotus corniculatus*, *Lysimachia punctata*, *Mentha spicata*, *Phuopsis stylosa*, *Plantago major*, *Polypogon viridis*, *Potentilla anserina*, *Pteridium aquilinum*, *Ranunculus repens*, *Reynoutria japonica*, *Rumex crispus*, *R. obtusifolius*, *Sagina procumbens*, *Scrophularia nodosa*, *Thymus drucei*, *Trifolium dubium*, *T. repens*, *Tussilago farfara*, *Urtica dioica* and *Vicia sepium*.

Post-construction Landscaping

Four different wildflower mixes were employed (2 seed mixtures and 2 as turves): their botanical compositions are described in Table 3. The plant communities that developed where these mixtures were planted, indicate which of the sown species showed themselves in 2020, plus the local seed bank and unintentionally introduced species that recruited along with them (Table 4). The strip along the northern boundary to the east of the new entrance was sown with seeds of Emorsgate EM3 Meadow Mixture in 2018. Wildflower turf was laid in all the swales (e.g. down the western edge of the main drive, and through the main car park), around Moss Basin and as a strip along the southern wall of the walled garden in 2019. The western end of Victoria Meadow was sown with DLF Seeds Wildflower Seed Mix for Acidic Soil in late 2020 (but after the survey; it will be monitored for the first time in 2021).

Green manures, including *Phacelia tanacetifolia* and *Sinapis alba* were sown as weed suppressors in beds that were destined to lie fallow for one or more growing seasons (e.g. The Outer Walled Garden).

Details of the planting of the Paradise Garden, Kitchen Garden, New Orchard, Chinese Streamside Garden and the Arboretum will be published elsewhere.

Table 3. Wildflower mixtures used at RHS Bridgewater in 2019 and 2020. Emorsgate and DFL mixtures were directly sown as seeds and are ranked by the rate of application (% of total seed sown) for each species. Tillers Turf mixtures were laid as turves, with each individual slab measuring 1200mm x 600mm and weighing on average 15-20kg. For these, only the total seed rates for herbs and grasses are given. The turves were grown on moisture retentive, degradable, recycled fibre matting which acts as a barrier to suppress any indigenous and problematic broad leaved weeds and grasses

Emorsgate EM3 Meadow Mixture	rate (%)	DLF Seeds: Wildflower Seed Mix for Acidic Soil	rate (%)	Tillers Turf Meadow	rate (%)	Tillers Turf Aqua	rate (%)
<i>Galium verum</i>	2	<i>Galium verum</i>	2.2	<i>Achillea millefolium</i>		<i>Achillea millefolium</i>	
<i>Daucus carota</i>	1.8	<i>Ranunculus acris</i>	2.2	<i>Anagallis arvensis</i>		<i>Betonica officinalis</i>	
<i>Malva moschata</i>	1.7	<i>Centaurea debeauxii</i>	1.8	<i>Anthemis arvensis</i>		<i>Centaurea debeauxii</i>	
<i>Poterium sanguisorba</i>	1.6	<i>Agrimonia procera</i>	1.8	<i>Anthyllis vulneraria</i>		<i>Daucus carota</i>	
<i>Silene dioica</i>	1.5	<i>Vicia cracca</i>	1.4	<i>Betonica officinalis</i>		<i>Filipendula ulmaria</i>	
<i>Centaurea debeauxii</i>	1.3	<i>Rhinanthus minor</i>	1.4	<i>Centaurea cyanus</i>		<i>Galium verum</i>	
<i>Leucanthemum vulgare</i>	1.2	<i>Leucanthemum vulgare</i>	1.2	<i>Centaurea debeauxii</i>		<i>Leucanthemum vulgare</i>	
<i>Rumex acetosa</i>	1	<i>Silene flos-cuculi</i>	1.2	<i>Daucus carota</i>		<i>Linaria vulgaris</i>	
<i>Centaurea scabiosa</i>	0.8	<i>Rumex acetosa</i>	1.2	<i>Echium vulgare</i>		<i>Lotus corniculatus</i>	
<i>Galium album</i>	0.8	<i>Achillea millefolium</i>	1.2	<i>Galium verum</i>		<i>Lotus pedunculatus</i>	
<i>Plantago media</i>	0.8	<i>Lotus pedunculatus</i>	1	<i>Geranium pratense</i>		<i>Silene flos-cuculi</i>	
<i>Primula veris</i>	0.8	<i>Achillea ptarmica</i>	0.8	<i>Hypericum perforatum</i>		<i>Lythrum salicaria</i>	
<i>Betonica officinalis</i>	0.5	<i>Hypochaeris radicata</i>	0.4	<i>Hypochaeris radicata</i>		<i>Malva moschata</i>	
<i>Leontodon hispidus</i>	0.5	<i>Erodium cicutarium</i>	0.4	<i>Knautia arvensis</i>		<i>Plantago lanceolata</i>	
<i>Ranunculus acris</i>	0.5	<i>Digitalis purpurea</i>	0.4	<i>Leucanthemum vulgare</i>		<i>Poterium sanguisorba</i>	
<i>Rhinanthus minor</i>	0.5	<i>Galium saxatile</i>	0.4	<i>Malva moschata</i>		<i>Prunella vulgaris</i>	
<i>Achillea millefolium</i>	0.4	<i>Rumex acetosella</i>	0.4	<i>Medicago lupulina</i>		<i>Ranunculus acris</i>	
<i>Silene flos-cuculi</i>	0.4	<i>Betonica officinalis</i>	0.2	<i>Papaver rhoeas</i>		<i>Ranunculus repens</i>	
<i>Agrimonia eupatoria</i>	0.3	<i>Lotus corniculatus</i>	0.2	<i>Poterium sanguisorba</i>		<i>Rumex acetosa</i>	
<i>Knautia arvensis</i>	0.3	<i>Succisa pratensis</i>	0.2	<i>Primula veris</i>		<i>Silene latifolia</i> subsp. <i>alba</i>	
<i>Origanum vulgare</i>	0.3			<i>Prunella vulgaris</i>		<i>Succisa pratensis</i>	
<i>Prunella vulgaris</i>	0.3			<i>Ranunculus acris</i>		<i>Trifolium pratense</i>	
<i>Ranunculus bulbosus</i>	0.2			<i>Reseda luteola</i>			

<i>Silene latifolia</i> subsp. <i>alba</i>	0.2			<i>Rhinanthus minor</i>		
<i>Geranium pratense</i>	0.1			<i>Silene dioica</i>		
<i>Taraxacum officinale</i> agg.	0.1			<i>Silene vulgaris</i>		
<i>Vicia sativa</i> subsp. <i>segetalis</i>	0.1			<i>Trifolium pratense</i>		
				<i>Vicia cracca</i>		
				<i>Viola tricolor</i>		
total herbs	20		20		80	85
Grasses						
<i>Cynosurus cristatus</i>	28	<i>Festuca rubra</i> subsp. <i>commutata</i>	40	<i>Cynosurus cristatus</i>		<i>Agrostis stolonifera</i>
<i>Festuca rubra</i>	24	<i>Cynosurus cristatus</i>	38	<i>Festuca ovina</i>		<i>Alopecurus pratensis</i>
<i>Poa pratensis</i>	16	<i>Festuca ovina</i>	10	<i>Festuca rubra</i>		<i>Anthoxanthum odoratum</i>
<i>Agrostis capillaris</i>	8	<i>Agrostis capillaris</i>	5	<i>Briza media</i>		<i>Cynosurus cristatus</i>
<i>Phleum bertolonii</i>	4	<i>Deschampsia flexuosa</i>	4			<i>Festuca rubra</i>
		<i>Anthoxanthum odoratum</i>	3			<i>Poa pratensis</i>
total grasses	80		80		20	15

Table 4. The flora in July 2020 of areas sown to wildflower mix (Leigh Road in 2019) or laid with wildflower turf (Western and Car Park Swales in 2020) comprises a mix of sown and resident seed-bank species. The species sown or laid in turf are listed in Table 3

Leigh Road S side (Emorsgate EM3)	dafor	Western boundary (Tillers Aqua)	dafor	Car Park (Tillers Meadow)	dafor
<i>Agrostis capillaris</i>	f	<i>Achillea millefolium</i>	f	<i>Achillea millefolium</i>	f
<i>Arrhenatherum elatius</i>	f	<i>Agrostis stolonifera</i>	f	<i>Centaurea debeauxii</i>	f
<i>Centaurea debeauxii</i>	f	<i>Centaurea debeauxii</i>	f	<i>Daucus carota</i>	f
<i>Cynosurus cristatus</i>	f	<i>Cynosurus cristatus</i>	f	<i>Holcus lanatus</i>	f
<i>Daucus carota</i>	f	<i>Galium album</i>	f	<i>Leucanthemum vulgare</i>	f
<i>Galium album</i>	f	<i>Leucanthemum vulgare</i>	f	<i>Linaria vulgaris</i>	f
<i>Galium verum</i>	f	<i>Lotus corniculatus</i> var. <i>sativus</i>	f	<i>Lotus corniculatus</i> var. <i>sativus</i>	f
<i>Leucanthemum vulgare</i>	f	<i>Silene flos-cuculi</i>	f	<i>Silene flos-cuculi</i>	f
<i>Lolium perenne</i>	f	<i>Lythrum salicaria</i>	f	<i>Lythrum salicaria</i>	f
<i>Lotus corniculatus</i> var. <i>sativus</i>	f	<i>Persicaria maculosa</i>	f	<i>Persicaria maculosa</i>	f
<i>Plantago major</i>	f	<i>Rumex obtusifolius</i>	f	<i>Prunella vulgaris</i>	f
<i>Polygonum aviculare</i>	f	<i>Silene dioica</i>	f	<i>Ranunculus acris</i>	f
<i>Prunella vulgaris</i>	f	<i>Silene latifolia</i> subsp. <i>alba</i>	f	<i>Ranunculus repens</i>	f
<i>Ranunculus acris</i>	f	<i>Stellaria media</i>	f	<i>Ranunculus sceleratus</i>	f
<i>Ranunculus repens</i>	f	<i>Atriplex patula</i>	o	<i>Rumex obtusifolius</i>	f
<i>Rumex obtusifolius</i>	f	<i>Atriplex prostrata</i>	o	<i>Silene dioica</i>	f
<i>Stellaria media</i>	f	<i>Capsella bursa-pastoris</i>	o	<i>Silene latifolia</i> subsp. <i>alba</i>	f
<i>Trifolium repens</i>	f	<i>Cerastium glomeratum</i>	o	<i>Anthoxanthum odoratum</i>	o
<i>Alliaria petiolata</i>	o	<i>Chenopodium album</i>	o	<i>Capsella bursa-pastoris</i>	o
<i>Arctium nemorosum</i>	o	<i>Cirsium vulgare</i>	o	<i>Cerastium fontanum</i>	o
<i>Artemisia vulgaris</i>	o	<i>Lepidium didymus</i>	o	<i>Cerastium glomeratum</i>	o
<i>Atriplex patula</i>	o	<i>Fallopia convolvulus</i>	o	<i>Chamerion angustifolium</i>	o
<i>Calystegia sepium</i>	o	<i>Fumaria officinalis</i> subsp. <i>officinalis</i>	o	<i>Chenopodium album</i>	o
<i>Cerastium fontanum</i>	o	<i>Galeopsis speciosa</i>	o	<i>Cirsium arvense</i>	o
<i>Chenopodium album</i>	o	<i>Lamium purpureum</i>	o	<i>Cirsium vulgare</i>	o

<i>Lepidium didymus</i>	o	<i>Linaria vulgaris</i>	o	<i>Lepidium didymus</i>	o
<i>Epilobium hirsutum</i>	o	<i>Lolium multiflorum</i>	o	<i>Cynosurus cristatus</i>	o
<i>Galium aparine</i>	o	<i>Lolium perenne</i>	o	<i>Elytrigia repens</i>	o
<i>Phleum bertolonii</i>	o	<i>Matricaria discoidea</i>	o	<i>Epilobium hirsutum</i>	o
<i>Phleum pratense</i>	o	<i>Matricaria recutita</i>	o	<i>Filipendula ulmaria</i>	o
<i>Helminthotheca echioides</i>	o	<i>Polygonum aviculare</i>	o	<i>Holcus mollis</i>	o
<i>Silene dioica</i>	o	<i>Prunella vulgaris</i>	o	<i>Juncus bufonius</i>	o
<i>Silene latifolia</i> subsp. <i>alba</i>	o	<i>Ranunculus sceleratus</i>	o	<i>Lapsana communis</i>	o
<i>Sonchus arvensis</i>	o	<i>Rorippa palustris</i>	o	<i>Medicago lupulina</i>	o
<i>Stachys sylvatica</i>	o	<i>Salix caprea</i> subsp. <i>caprea</i>	o	<i>Papaver rhoeas</i>	o
<i>Urtica dioica</i>	o	<i>Senecio vulgaris</i>	o	<i>Persicaria lapathifolia</i>	o
<i>Ervum tetraspermum</i>	o	<i>Sisymbrium officinale</i>	o	<i>Poa trivialis</i>	o
<i>Achillea ptarmica</i>	r	<i>Trifolium pratense</i>	o	<i>Rorippa palustris</i>	o
<i>Deschampsia cespitosa</i>	r	<i>Barbarea vulgaris</i>	r	<i>Sisymbrium officinale</i>	o
<i>Heracleum mantegazzianum</i>	r	<i>Deschampsia cespitosa</i>	r	<i>Trifolium pratense</i>	o
<i>Primula vulgaris</i>	r	<i>Thymus drucei</i>	r	<i>Trifolium repens</i>	o
<i>Rumex longifolius</i>	r	<i>Tripleurospermum inodorum</i>	r	<i>Vicia cracca</i>	o
<i>Senecio jacobaea</i>	r	<i>Ervilia hirsuta</i>	r	<i>Atriplex patula</i>	r
<i>Thymus drucei</i>	r	<i>Vicia sativa</i> subsp. <i>segetalis</i>	r	<i>Atriplex prostrata</i>	r
<i>Trifolium pratense</i>	r	<i>Viola arvensis</i>	r	<i>Epilobium ciliatum</i>	r
				<i>Epilobium montanum</i>	r
				<i>Epilobium palustre</i>	r
				<i>Galeopsis tetrahit</i>	r
				<i>Matricaria discoidea</i>	r
				<i>Salix viminalis</i>	r
				<i>Stachys sylvatica</i>	r
				<i>Thymus drucei</i>	r
				<i>Tripleurospermum inodorum</i>	r
				<i>Tussilago farfara</i>	r
				<i>Viola arvensis</i>	r

Discussion

Rather little has survived of the Victorian planting of Worsley New Hall, and the flora is depauperate in species like *Cedrus* spp., *Pseudotsuga menziesii*, *Abies* spp., and *Sequoiadendron giganteum* that we might expect to find on a typical estate of this date and splendour. Where there are horticultural survivors, they are clearly of much more recent origin (e.g. *Metasequoia glyptostroboides*). One of the few ornamental conifers that survived at the time of purchase in 2017 was an individual of *Pinus contorta* subsp. *latifolia* that grew by the wall of Garden Cottage: it was knocked down unintentionally during pipe-laying in 2020.

As to the legacy of invasive alien plants, Bothy Wood and the adjacent Service Yard Swamp had a substantial population of *Reynoutria japonica* which was herbicide injected in 2019. The other problem plant was *Impatiens glandulifera* which was frequent and locally abundant throughout Leigh Road Woods and East Wood, on the motorway embankment, and in the scrub along the southern boundary beneath the Bridgewater Canal. The gigantic *Reynoutria sachalinensis* grew just outside the eastern boundary fence on the embankment of the M60 slip road.

The construction work associated with building the new RHS garden involved the movement and temporary storage of vast quantities of topsoil and this provided an opportunity to study the seed banks beneath contrasting habitats within the Warley New Hall estate. The black, peaty soils from The Moss in the south-west corner of the site proved to have a highly distinctive seed bank with *Galeopsis speciosa* as a major component. This is described here as a new Open Vegetation community (not in Rodwell, 2000; see Table 2). It will be interesting to see from the results of future work, over what part of the geographic range of *G. speciosa* (Fig. 5) the community occurs. A notable feature of this seed bank was the co-occurrence of closely related taxa: *Persicaria lapathifolia* along with *P. maculosa* and *Galeopsis bifida* with *G. tetrahit*. *Persicaria amphibia* was reported by as a pernicious weed on some of the arable soils on Carrington Moss (Price Evans, 1923), and was locally frequent on the soil piles in the south-western corner of RHS Bridgewater.

This fertile soil was used to fill many of the beds in the Paradise Garden and all the beds in the Kitchen Garden. It was also used in landscaping the ground at the newly-constructed Welcome Building and around the adjacent new lake (Worsley Water). These works will have spread the seed of *Galeopsis speciosa* over most of the non-wooded parts of the estate.

In assessing the flora of soil piles, there is inevitably a degree of uncertainty about the origin of the seed of the species that appear (e.g. did they come from the seed bank or by contemporary inward dispersal). Some of the more obvious non-seed-bank species were the alien fleabanes (the recently arrived *Erigeron sumatrensis* and *E. floribunda* and the longer-established *E. canadensis*). These typically peaked in abundance in the first year after topsoil dumping, germinating in an essentially competition-free substrate, but declined dramatically in abundance in the 2nd and 3rd years as competition from perennial grasses increased. Their likely origin was the embankment of the M60 motorway slip-road. Other species recorded from the soil piles had clearly come from spilled seed used in the wildflower mixtures (e.g. *Anthemis austriaca*, *Eschscholzia californica*, *Leucanthemum vulgare*, *Linaria*

vulgaris, *Lotus pedunculatus*, *Medicago sativa* subsp. *sativa*, *Mentha spicata*, *Origanum vulgare*, *Papaver dubium* subsp. *dubium*).

The use of wildflower mixtures in semi-natural habitats outside a horticultural setting has become controversial in recent decades (May, 1994), especially where it has been shown that species being sold as native wildflowers were actually alien species (e.g. *Cota austriaca* instead of *Anthemis arvensis*), alien subspecies (e.g. *Poterium sanguisorba* subsp. *balearicum*) or alien varieties (e.g. *Lotus corniculatus* var. *sativus*) purchased cheaply overseas from agricultural suppliers and sold at considerable profit in Britain. The extensive use of well-documented seed mixtures in landscaping at RHS Bridgewater affords an opportunity to follow the establishment and subsequent survival of a set of British native species that were not previously part of the flora of the estate. It will be particularly interesting to follow the fate of any of these introduced species that become naturalised and increase in abundance, indicating that previously their recruitment had been seed-limited (Turnbull et al., 2000). None of the sown species has any reputation for invasiveness (see Stace & Crawley, 2015).

The plan is to record and publish details of the horticultural planting as the garden develops over the years, so that we can tease apart the origins of the botanical changes that are bound to occur: planned introductions, legacy effects and unintended arrivals. This will form a unique archive on the interaction between horticulture and ecology.

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Appendix A

The time-line for the building work was as follows. Clearance of the scrub from the Walled Garden began in February 2017. Engineering work for the entrance drive and the road-widening associated with construction of the new junction onto Leigh Road was in full swing in May 2018. Removing the topsoil from North Moss, South Moss and the site of the Welcome Building, and storing it in the Arboretum and at the eastern end of Victoria Meadow, began in spring 2018. Work to restore the brickwork of the Walled Garden began in June 2018, restoring over 1.4 km of walls: 100,000 original bricks were removed, 80,000 individually cleaned by hand and re-used. In September 2018 heavy plant machinery was back in the Walled Garden to deal with the legacy of the Victorian practice of using arsenic as a weed killer; the contaminated soil had to be dug out and removed. Big machinery was also brought in to desilt the historic Ellesmere Lake in October 2018, after the long hot summer had allowed it to dry out: 3000 m³ of silt was removed in preparation for restoring the walls, refilling and replanting the lake. Pile-driving through the peat for the foundations of the Welcome Building began on 14 Feb 2019, at which time excavating the storm-water detention lake at Moss Basin and creating the south-western soil mounds were under way. February 2019 also saw the excavation of the new Service Yard and creation of the surrounding bund. The hard surface of North Moss car park was laid between February and May 2019. Excavating the new lake at Worsley Water began in June 2019. Between May and September 2019, 8,000 m³ of topsoil was carted back from the storage piles in Arboretum and Victoria Meadow to fill the newly constructed beds in the Paradise Garden and Kitchen Garden. New paths through the woodland, to follow the course of the proposed Chinese Streamside Garden were begun in September 2019. Topping-out of the Welcome Centre was in November 2019. Creation of the rocky stream-bed for the Chinese Streamside Garden began in January 2020. Landscape planting involving sowing and turfing with wildflower mixtures began in February 2020. The Retail area was completed in October 2020. The ground around the Welcome Building and the new Worsley Water was scheduled for sowing with wildflower seed in late 2020 (this was not surveyed as part of the present study).