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Outline

Local policy - what do local planning authorities expect?

Factors for plant selection

Maintenance considerations for plant selection

Case studies

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My previous lecture was an overview of living wall systems.
This lecture is about plant selection for living walls,

- How EU and local government policy informs the plant choice
- Considerations for plant selection
- Maintenance

I will examine the complexities of choosing plants for modular living wall systems, as well as vertical microclimates and considerations of climate change (EU policy).

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What do local planning authorities expect?

City of London Open Strategy Supplementary Planning Document Jan 2015

Policy DM 10.2

- encourage the installation of green walls in appropriate locations,
- ensure that they are satisfactorily maintained,
- consideration should be given to the use of plants which are suitable for local conditions, pollution and wind effects as well as climate change,
- management arrangements for the proposed green infrastructure to ensure its long term sustainability and lasting contribution to the urban environment,
- installation of green walls to prevent overheating.

European Union – Environmental Policy
http://europa.eu/pol/env/index_en.htm

Key policies that effect design decisions…

'Zero carbon by 2019'
EU Energy Performance of Buildings Directive (EPBD) 2003 is the root of landscape and building design decisions. It was responsible for the introduction of building energy labelling.

Following this, BREEAM (Building Research Establishment Environmental Assessment Method) was set up to evaluate a broad range of categories from energy to ecology.

Mitigating ecological impact: An ecologist must be appointed and a total number of (native) plant species will be calculated and specified for use in green roofs and living walls.

Mayor's Air Quality Strategy 2010 and
City of London Air Quality Strategy 2011-15
The strategy sets out a framework for improving London's air quality and measures aimed at reducing emissions from transport, homes, offices and new developments, as well as raising awareness of air quality issues.

It will encourage the use of green walls and green roofs in new and existing buildings, particularly in close proximity to pollution hotspots.

The EU Water Framework Directive 2000
There are 12 water topics forming the directive. One of which is about climate change and addressing floods, droughts and aquatic ecosystems.
Rainwater harvesting for use in landscape irrigation and rainwater attenuation initiatives are used as part of green roof and living wall design innovations.

Factors for plant selection

In any planting scheme, vertical or horizontal, the following points are considered:

- Environment (physical and biological)
- Design
- Maintenance
- Health and Safety

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In *any* planting scheme, there are certain factors to consider when choosing plants.

Environment

- Essential requirements for plant growth are met
    - Sunlight & air captured by the leaves
    - Water & minerals captured by the roots
- Will the plant thrive
- Microclimate

Design

- Aesthetics
    - Colour, form texture…
- Size
    - Living wall cell / panel size is small and affects root growth – restricting the size of the plant as it matures
    - Larger plants affect shading of surrounding smaller / shorter plants
    - Larger plants affect wind load on the living wall structure and surrounding plants

Function

- Pollution mitigation
- Thermal properties
- Biodiversity
- Aesthetics

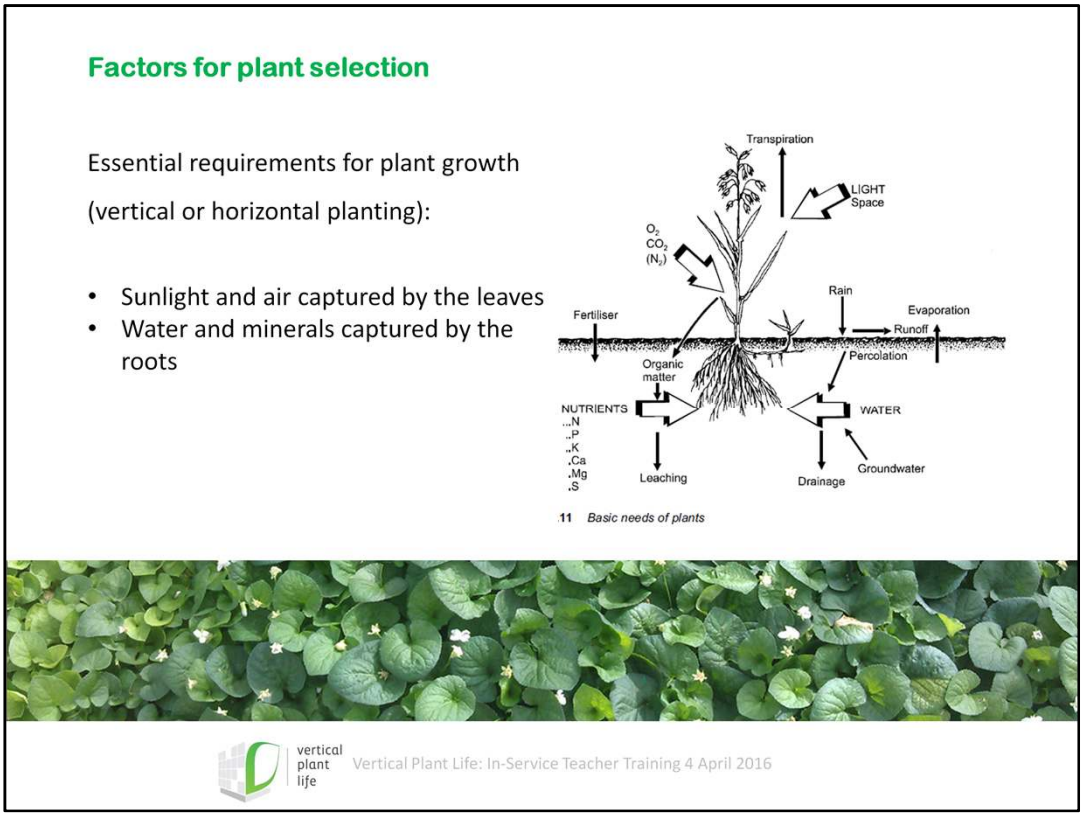
Maintenance

- Maintenance contracts – cost and frequency
- Irrigation and fertigation
- Growth rate
    - Fast growing plants require more water, fertilizer and pruning than slow growing plants
- Seasonality
    - Evergreen vs deciduous
    - Successional flowering and fruiting

- Pests and diseases – constant assessment. Living walls can be hostile environments for plants.

Health and Safety (in both design and maintenance)

- Poisonous plants (digestive) or those known as skin, eye or respiratory irritants/toxins
- Working at height



Essential requirements for plant growth (vertical or horizontal planting):

- Sunlight and air captured by the leaves
- Water and minerals captured by the roots

Image reference:
Use of vegetation in civil engineering
Coppin, N J
CIRIA
First published 1990 as CIRIA publication B10. Reprinted 2007.
CIRIA C708 © CIRIA 2007 ISBN 0-86017-711-4
978-086017-711-1
Page 17 / Figure 2.11

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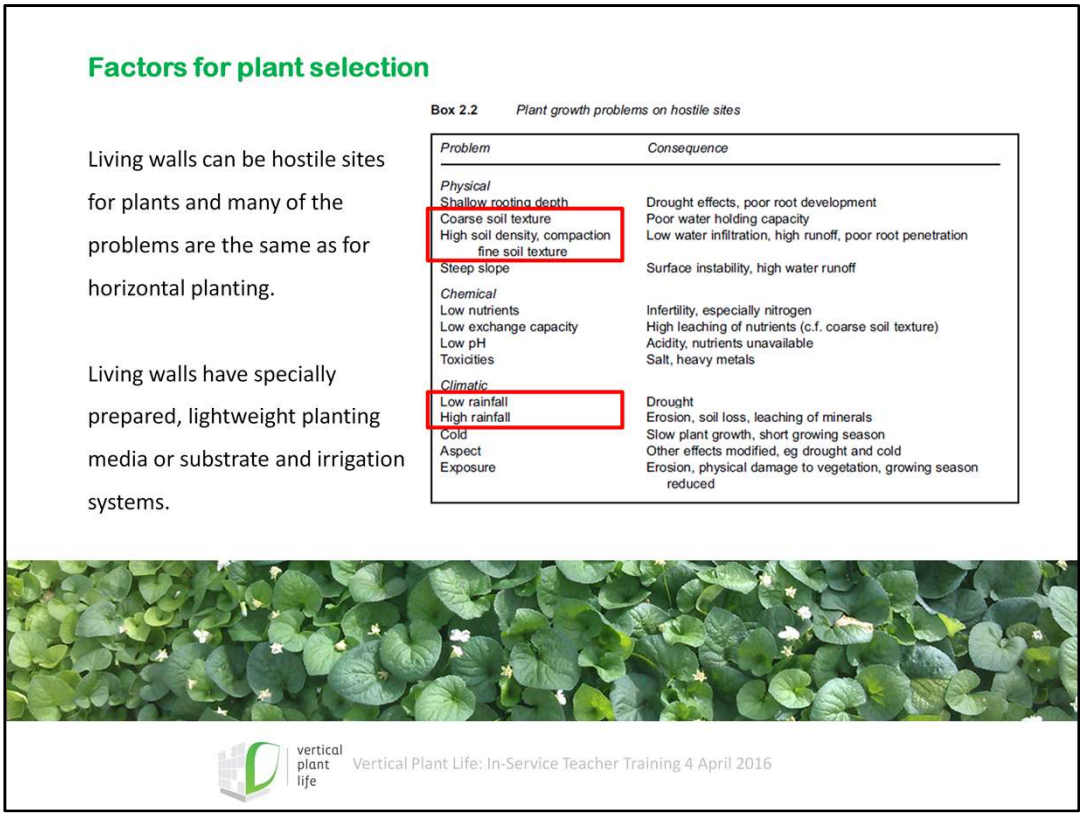

Living walls can be hostile sites for plants and many of the problems are the same as for horizontal planting.

For living walls the planting media is lightweight and specially prepared and they have irrigation systems (can be harvested rainwater) but are not dependant on rainfall.

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Use of vegetation in civil engineering
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CIRIA C708 © CIRIA 2007 ISBN 0-86017-711-4
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This wall at Digby Road, London is about 18m tall and starts about 25m above ground level.
The sloping part of the roof was planted with sedum & sedum matting requiring very little maintenance. The vertical part of the wall was planted with a variety of plants to make a visual impact. I don't know that the same plants would have been chosen in today's design climate.

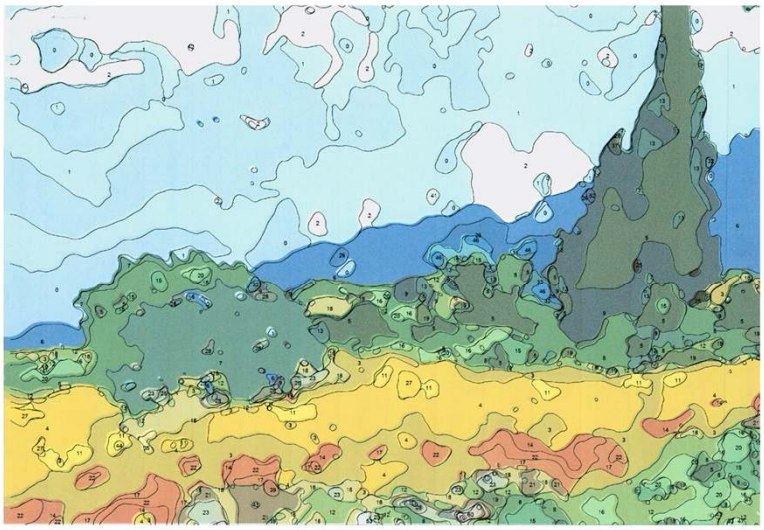
Maintenance considerations:
Starts in the design stage.
Mechanical operations: How will the wall be maintained? Pruning, weeding, watering.
Usually it's at height: cherry picker, scaffolding tower, abseiling
Irrigation – how will it be irrigated. Most have automatic irrigation systems and fertigation. Where will the water come from? Rainwater harvesting – mains, both?

Realisation of Van Gogh's '*A Wheatfield with Cypresses*' into a Living Wall

Over thirty five plant species were chosen with colours relating to the original painting and whose textures complimented the artist's style including the visual effect of light on them from the site's southerly aspect.
Other considerations were the plants suitability to the living wall system, the microclimate, seasonal changes and the public's interaction with the wall. They had to be robust, evergreen, fully hardy, non-hazardous plants.
Once the plants were selected, a photomontage was produced for the initial feasibility study. Finally the plants were mapped over a grid of ANS modules for the nursery to hand plant over eight thousand plants for the finished effect.

Case study: National Gallery, London

2011



A ‘paint by numbers’ was the base for plant choice and placement to achieve the effect of Vincent van Gough’s painting.

Case study: National Gallery, London

2011

Colour Region	Indicative Plants
2	Artemisia schmidtiana 'Silver Brocade'
15	Bergenia 'Bressingham White'
31	Bergenia 'Bressingham White'
4	Carex hachijoensis 'Evergold'
35	Carex hachijoensis 'Evergold'
1	Cerastium tomentosum
32	Dianthus gratianopolitanus
46	Dianthus gratianopolitanus
7	Euonymus fortuniei 'Emerald Gaiety'
3	Euonymus fortuniei 'Emerald n' Gold'
0	Festuca glauca 'Elijah Blue'
12	Gerranium macrorrhizum
47	Gerranium macrorrhizum
19	Hebe pinguifolia 'Pagei'
28	Hebe topiaria
9	Hedera helix 'Minima'
52	Hedera helix 'Minima'
39	Heuchera 'Chocolate Ruffles'
60	Heuchera 'Chocolate Ruffles'
27	Heuchera 'Electric Lime'
14	Heuchera 'Marmalade'
22	Heuchera 'Marmalade'
17	Heucherella 'Brass Lantern'
20	Heucherella 'Paris'
21	Lonicera nitida 'Baggesen's Gold'
11	Luzula sylvatica 'Aurea'
18	Lysimachia nummularia 'Aurea'
5	Microbiota decussata
13	Ophiopogon japonicus 'Nana'
25	Ophiopogon japonicus 'Nana'
37	Ophiopogon japonicus 'Nana'
23	Pachysandra 'Variegata'
6	Ruta graveolens 'Jackman's Blue'
7	Sarcococca humilis
8	Thymus vulgaris
16	Waldsteinia ternata

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On installation 35 plant species were used in the design of National Gallery living wall.

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Case study: National Gallery, London

https://www.youtube.com/watch?v=541_ke_ADl0

Video showing the design considerations and the planting in the nursery.
https://www.youtube.com/watch?v=541_ke_ADl0

Design Strategy

A curvilinear and informal / random pattern has been used to provide a verdant, eye-catching installation.

Plants have been chosen primarily for their ecological biodiversity and wildlife value as well as their suitability to sheltered site conditions and its southerly aspect. The plants are either indigenous to the UK, or 'wildlife friendly', defined as not native plants but are noted for their benefit to local wildlife.
Guidance has also been taken from the document 'NA43 Midlands Plateau' regarding the Urban/Suburban Land profile.

The design patterns and plant colours are lead by the practise for planting for bee and butterfly populations in particular. This requires a selection of plants with year round flowering succession (and seasonal variation), planted in large clumps and using their preferred colours of blue, purple, pink, white and yellow.

The plants are mainly evergreen to ensure there are no areas of exposed bare patches. However the deciduous species Snowdrops (Galanthus nivalis), Wild Strawberry (Fragaria vesca) and Sweet Woodruff (Galium odoratum) have been used for their wildlife value and will appear growing through the evergreen plants from late winter to mid summer, providing additional seasonal variation.

Case study: Birmingham New Street Station

2013

Indicative Plants for Living Wall

Plant Name	Colour: Flower / Foliage	Evergreen / Semi-evergreen	Season of Interest: Winter/Spring Summer/Autumn	Native / Naturalised / Wildlife Friendly/ Introduced	Ecological Value
Alyssum spinosum	Pink/ Grey-green, Blue	e	s	W	Wildlife friendly - source of nectar.
Armeria maritima	pink / green	e	sp, s	W	Wildlife friendly - source of nectar.
Blechnum spicant	/ green	se	sp, s, a, w	N	Native plant
Buxus sempervirens	green-yellow/green	e	sp	N	Provides good nesting, cover and winter roosting,cover for birds
Euphorbia amygdaloides	green-yellow / dark green- red	e	sp,s,w	N	Native plant. Nectar for bees and Ichneumon wasps.
Fragaria vesca	white/green	d	sp	N	Leaves are important for Pyrgus malvae eggs and larvae, Flat-backed millipede, Honey bee.
Galanthus nivalis	white/green	d	sp,w	Na	Naturalised plant in England. The flowers are pollinated by the first honey bees to emerge on warm days. Naturalised.
Galium odoratum	white / emerald green	d	sp, s	N	Attracts bees.
Geranium macrorrhizum	pale pink / green, bronze	se	s	Na	Naturalised in Britain. Sought out by bumble bees. Buff-tailed bumble bee, Common carder bumble bee, Red mason bee, White-tailed bumble bee.
Hebe albicans	white/green	e	s	W	Nectar for bees and butterflies
Hebe salicifolia	white/green	e	s,a	I	Nectar for bees and butterflies
Hyssopus officinalis	blue/green	se	s	W	Attractive for some butterflies
Luzula nivea	white / green	e	s	W	Wildlife friendly plant. Source of nectar for insects and nesting material for birds.
Lysimachia nummularia 'Aurea'	yellow/lime yellow	e	s	W	Wildlife friendly plant - source of nectar.
Phyllitis scolopendrium (syn Asplenium scolopendrium)	green	e	sp, s, a, w	N	Native plant
Primula chungensis	orange/ green	e	sp,w	W	Wildlife friendly. Provides a valuable early nectar source for honey bees.
Primula veris	yellow/green	se	sp	N	Provide a valuable early nectar source for honey bees.
Thymus vulgaris	purple/green glaucous	e	s	Na	Naturalised plant. Source of nectar for butterflies and bees, Common carder bumble bee, Honey bee, Red mason bee, White-tailed bumble bee.

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Unusually for a living wall in the UK, there are several deciduous plant species at Birmingham New Street for reasons of biodiversity. This affects the maintenance regime and the visual appearance at certain times of the year.

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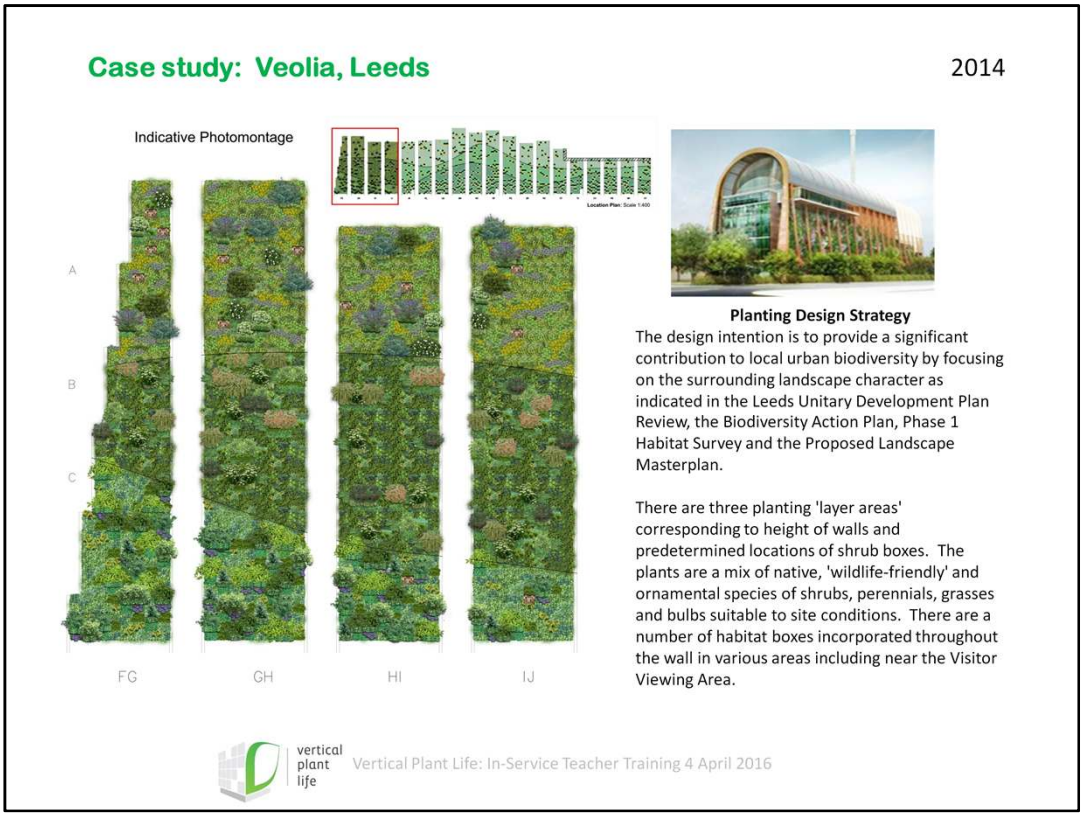

Designed in 2014 – completion spring 2016
The south-facing living wall is believed to be the largest in Europe at 1,800m2.
The living wall will enhance biodiversity in the area creating a 'vertical woodland' and consists of a mix of evergreen and deciduous shrubs in bespoke planters which relate to the surrounding area.

Harvested rainwater is used to maintain the living wall.

- **Area A - Vertical Field Meadow**;
- **Area B - Vertical Shrub Mosaic**;
- **Area C - Vertical Woodland Edge**;

Image References:
Green Graphite Ltd (indicative photomontage)

Artists Impression
http://www.leeds.gov.uk/PublishingImages/Content%20pages%20images/REFR%20Picture335x165.jpg

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Case study: Veolia, Leeds

2014

Planting Area A: Vertical Field Meadow

AREA - A	NAME
Shrub 1	Buddleja davidii (E)
Shrub 2	Corylus avellana (F)
Shrub 3	Cotoneaster dammeri (F)
Shrub 4	Olearia haastii (E)
Shrub 5	Rosa canina (F)
Front	Armeria maritima
Front	Carex oshimensis 'Evergold'
Side	Carex morrowii
Side	Iris foetidissima
Below	Vinca minor 'Bowles Purple'
Below	Vinca minor 'Gertrude Jekyll'
Matrix	Hedera helix
Matrix	Lonicera nitida 'Baggesen's Gold'
Matrix	Luzula nivea
Matrix	Lysimachia nummularia 'Aurea'
Matrix	Thymus vulgaris

Located at the top section of the Green Wall, where likely wind exposure is greatest. The distribution of shrub boxes is discontinuous and numbers are lowest, with an understory of low growing perennials and grasses. There is a higher concentration of evergreen species near the air intake zone.

Planting Area B: Vertical Shrub Mosaic

AREA - B	NAME
Shrub 1	Berberis thunbergii (C)
Shrub 2	Cotoneaster conspicuus 'Decorus' (D)
Shrub 3	Ilex aquifolium (C)
Shrub 4	Rosa rubiginosa (D)
Shrub 5	Viburnum opulus 'Compactum' (C)
Front	Carex oshimensis 'Evergold'
Front	Phyllitis scolopendrium
Side	Iris foetidissima
Below	Lithodora diffusa 'Heavenly Blue'
Side	Polystichum setiferum
Below	Vinca minor 'Bowles Purple'
Matrix	Euphorbia amygdaloides
Matrix	Hedera helix
Matrix	Hyacinthoides non-scripta
Matrix	Lonicera nitida 'Maigrun'
Matrix	Primula veris
Matrix	Viola odorata

Located in the mid section of the Green Wall, this area is a transition between the Field Meadow and Woodland Edge planting. The distribution of the shrub boxes is rather open and the planting is a mix of shrubs, perennials and bulbs with year round visual interest.

Planting Area C: Vertical Woodland Edge

AREA C	NAME
Shrub 1	Cornus sanginea (A)
Shrub 2	Cornus alba 'Sibirica' (A)
Shrub 3	Cornus sericea 'Flaviramea' (A)
Shrub 4	Euonymus europaeus (B)
Shrub 5	Ligustrum vulgare (B)
Front	Bergenia 'Eroica'
Front	Pachysandra terminalis
Below	Campanula portenschlagiana
Side	Phyllitis scolopendrium
Below	Soleirolia soleirolii
Matrix	Euphorbia amygdaloides
Matrix	Hedera helix
Matrix	Persicaria bistorta
Matrix	Primula veris
Matrix	Viola odorata

Located on the lower section of the Green Wall, this is an area with the greatest number of shrub boxes, having a diverse mixture of evergreen and deciduous shrubs with a range of seasonal highlights from spring and summer flowering through autumn fruiting and leaf colour, to the mix of deciduous and evergreen effects over winter.

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·Area A - Vertical Field Meadow; Located at the top section of the Green Wall, where likely wind exposure is greatest. The distribution of shrub boxes is discontinuous and numbers are lowest, with an understory of low growing perennials and grasses. There is a higher concentration of evergreen species near the air intake zone.

·Area B - Vertical Shrub Mosaic; Located in the mid section of the Green Wall, this area is a transition between the Field Meadow and Woodland Edge planting. The distribution of the shrub boxes is rather open and the planting is a mix of shrubs, perennials and bulbs with year round visual interest.

·Area C - Vertical Woodland Edge; Located on the lower section of the Green Wall, this is an area with the greatest number of shrub boxes, having a diverse mixture of evergreen and deciduous shrubs with a range of seasonal highlights from spring and summer flowering through autumn fruiting and leaf colour, to the mix of deciduous and evergreen effects over winter.

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After construction of the building, installation of the living wall began on site in December 2015 – completion is due spring 2016.

The bespoke shrub boxes and plants were trialled at the nursery first to demonstrate durability.

Image Reference:
Photo of installation – Biotecture Ltd
http://www.veolia.co.uk/leeds/sites/g/files/dvc491/f/styles/asset_image_full/public/assets/images/2015/11/Green_wall_sample__2.jpg?itok=ccHKyxhR

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