



Functional Buffer Zone

Best practice to protect sensitive sites





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*Marion Profit, Landscape Architect Intern
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Foreword

Scotland's natural environment is still being destroyed at an alarming rate, as in all over the globe. However, increasing amounts of energy and money are being invested to arrest this spiral of degradation.

Today, in the 21st Century, buffer zones have become widely known as an operational approach in nature conservation. They can be one of the key elements of green infrastructure that can protect sensitive sites e.g. woodland. They can minimize negative impacts from human activities and create better sustainable relationships between sensitive sites and communities.

Scientific knowledge exists to help guide the planning and design of buffers. Unfortunately, this information is widely dispersed throughout the vast repositories of research literature and is not easily accessible or usable for most planners, developers and practitioners.

Through the many papers reviewed and people interviewed for this report we found very few examples that quantified the size of buffer required and none that looked at the effectiveness of buffers. Without this type of information it may be difficult to convince developers of the validity of this type of measure. Stakeholders identified the need to put buffers in place. However, in many projects if a buffer zone is implemented, it is often very small with high fences or 5m of grassland, which does not work.

The purpose of this work is to create a short guide for stakeholders who have to create areas along sensitive sites and can be used as a tool during planning process.

Limits of this guidance

a This guide is not a cookbook for design. This guidance is based on limited research (6 months internship research) and reflects a greater degree of extrapolation to generalize them. The planner and other stakeholder must weave these guidelines together with first-hand knowledge of the site, the landscape, and landowner goals to create a design that optimizes benefits and minimizes potential problems.

b This subject could be completed by additional work and more stakeholders should be interviewed including developers.

Introduction

Purpose and status of this guidance

This document is intended as a guide^a regarding best practice 'buffer zone' implementation in Scotland. It aims to explain what a 'buffer zones' is and what it means. To summarize the key concepts associated with proposal designs, outlines the responsibilities and benefits and summaries current approaches to the protection and management of 'buffer zones' in Scotland.

This guide is accompanied by case studies with a short description for each of examples sites investigated during the research.

The guidance is aimed at stakeholders who have to create areas along sensitive sites:

- Developers/professionals considering new projects.
- Communities and interest groups considering the benefits/ disbenefits of development proposals.
- The Regeneration, Planning Service and Local Authority who will assess and determine planning applications for enabling development.

Outline structure of this guidance

Part 1. Research about the 'buffer zone' concept

Discusses the broad scope of the topic, outlines the general context in which 'buffer zone' is undertaken and highlights its importance. The content is designed to help inform a broad audience about what 'buffer zone' is.

Part 2. Local stakeholder interviews^b

Gives a pragmatic approach based on interviews that discussed the impact of new development on sensitive sites e.g. woodland. Why a 'buffer zone' is important? What should it achieve? Why should we invest in 'Functional Buffer Zone'?

Part 3. Fundamental recommendations & case studies

Sets out fundamental principles and technical issues that can be illustrated by successful or unsuccessful case study examples.

Part 4. Applications of the design recommendations

Provides design example ideas to develop the fundamental principles of a 'Functional Buffer Zone' alongside a sensitive site.

Part 1 Research about the 'buffer zone' concept

Policy context

In all of the policy documents reviewed and in the literature relative to the Green Infrastructure and supplementary guidance, there is no shared definition referring to 'buffer zone'. Even if the legislation does not explicitly mention 'buffer zones', they can provide a significant value to following the national policies:



- **Scottish Planning Policy (SPP)**: advises that the planning system should protect, enhance and promote green infrastructure, including open space and green networks.
- **National Planning Framework (NPF3)**: identifies the Central Scotland Green Network (CSGN) as a national development priority with the objective of delivering significant improvements in environmental quality through green infrastructure.
- **Scottish Government's Policy on Control of Woodland Removal**: reinforces that 'Woodlands and forestry are an economic resource, as well as an environmental asset' that the planning system should protect.
- **2020 Challenge for Scotland's Biodiversity** : states that the planning system should 'protect and restore biodiversity on land and in our seas, and to support healthier ecosystems'.
- **Green Infrastructure Design and Place making** : states that the planning system should 'providing new and linking existing habitats or natural features, to allow species movement.
- **Fitting landscapes – securing more sustainable landscapes**: aims that the planning system must use resources wisely to 'Employ natural characteristics and processes in the design of earthworks, drainage and landscape, integrating both habitat and landscape elements.

There is no legislation defining a 'buffer zone' therefore no way to ensure that they are delivered in accordance to the stakeholders' requirements during the planning process. To be a more powerful tool, the concept of 'buffer zone' developed here should be adopted as a supplementary planning guidance.

What does 'buffer zone' mean?

Buffer¹ means lessen or moderate the impact of (something) and zone² means 'an area or stretch of land having a particular characteristic, purpose, or use, or subject to particular restrictions'. The Oxford Dictionary defines a 'buffer zone' as 'an area of land designated for environmental protection'³.

'Buffer zones' are an important part of **Green infrastructure** (GI). GI differs from conventional approaches to open space planning because it offers greater functionality. It can offer an environmentally friendly approach to land development, growth management and built infrastructure planning. Well designed green infrastructure and creatively designed green spaces offer lots of benefits and can support multiple agendas by helping to develop communities and places that are sustainable, attracting residents and business, support healthy lifestyles and encourage the kinds of behaviour that contribute towards the success of places in social, economic and environmental terms⁴.

'**Multifunctionality**' is central to the green infrastructure concept and approach. It refers to the potential for green infrastructure to have a range of functions, to deliver a broad range of **ecosystem services**⁵.

The term 'buffer zone' appeared in 1970's⁶ resulting from increasing pressure on natural resources, although the principle has been in use for a long time. Before the 'buffer zone' concept became widely known in Europe, its principle was already being applied, often in combination with production purposes. For example forest plantations at the fringes of forest or other reserves, e.g. teak plantations around reserves in India or the tea plantations around conservation areas in Kenya were effective buffers. Presently, 'buffer zones' are more often applied to simultaneously minimise human impact on sensitive sites and address the socio-economic needs and wants of the affected population.

The 'buffer zone' is an international use concept;

- "zone tampon" in French,
- "zone de amortiguamiento" in Spanish,
- "zona tampão" in Portuguese,
- "bufferzone" in Dutch.

1 <http://www.oxforddictionaries.com/definition/english/buffer>

2 <http://www.oxforddictionaries.com/definition/english/zone>

3 <http://www.oxforddictionaries.com/definition/english/buffer-zone?q=buffer+zone>

4 <http://www.gov.scot/Resource/Doc/362219/0122541.pdf>

5 <http://publications.naturalengland.org.uk/publication/35033>

6 <http://www.cbd.int/doc/pa/tools/Buffer%20zones%20and%20their%20management%20policies%20and%20best%20practices.pdf>

Is there a shared definition of 'buffer zone' to protect sensitive sites?

The concept of 'buffer zone' can be approached from various angles. This makes it difficult to give an overall definition. The following are important definitions;

UNESCO 'Buffer zones'¹

Several UNESCO 'buffer zone' definitions have been proposed emphasizing conservation or both conservation and development objectives. One of the most commonly cited definitions of 'buffer zones' is: "an area peripheral to a national park or equivalent reserve, where restrictions are placed upon resource use or special development measures are undertaken to enhance the conservation values of the area". This type of 'buffer zones' is used to protect historical sites, in particular World Heritage sites (Figure 2).



Fig.2 Antonine Wall buffer zone (Natural Heritage)

'Streamside Forest' or 'Riparian Forest Buffer'²

A riparian buffer is an area of vegetation that is maintained along the shore of a water body to protect stream channels and banks. Buffers can reduce the pollutants entering a stream, lake or pond by trapping, filtering and converting sediments, nutrients and other chemicals in runoff from surrounding lands. Forested riparian buffers (Figure 3) are riparian buffers with a functional forest ecosystem. Forested buffers are the most beneficial type of buffer because they provide water quality and ecological benefits, including food, cover and protection from temperature changes for fish and wildlife.



Fig.3 Ripatrian Forest Buffer (Wikipedia)

'Time buffer' or 'species-specific buffer'³

A common method used to prescribe 'buffer zone's for protected birds species involves one or two measures of disturbance distance:

- 'Alert distance' (AD), the distance between the disturbance source and the animal at the point where the animal changes its behaviour in response to the approaching disturbance source;
- 'Flight initiation distance' (FID), the point at which the animal flushes or otherwise moves away from the approaching disturbance source (Figure 3).

Also recommendations on 'safe-working distances' (essentially, 'buffer zones' around breeding sites) have been made for a number of UK breeding bird species.

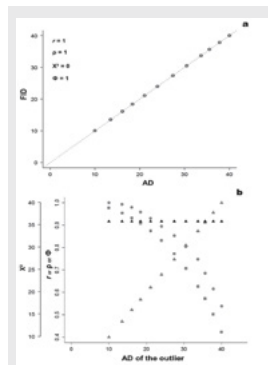


Fig.4 Species-specific buffer (Diogo S.)

1 <http://whc.unesco.org/en/events/473>
 2 http://www.dep.state.pa.us/dep/deputate/watermgmt/wc/Subjects/StreamReleaf/Forestbufftool/tkit_TOC.pdf
 3 <http://www.snh.org.uk/pdfs/strategy/renewables/BIRDSD.pdf>
 4 <http://nac.unl.edu/buffers/index.html>

'Conservation buffer' or 'ecological buffer'⁴

Are strips of vegetation placed in the landscape to influence ecological processes and provide a variety of goods and services to us. They are called by many names, including wildlife corridors, greenways, windbreaks, and filter strips to name just a few.

To protect sensitive sites like Wildlife Reserves, there is no legislation or specific 'buffer zones' definition. So, there is currently not a generally shared understanding of the concept of 'buffer zones' to protect sensitive sites and legislation regarding them. This guidance needs to share the same name and definition for all of the stakeholders who have to create new developments alongside sensitive sites.

The 'buffer zone' we need should be functional ; designed to be practical and useful, rather than just attractive and aims to connect both wildlife and communities.



Part 2 Local stakeholders interviews

Why we did interviews?

We organised interviews to get a better understanding of several stakeholders' perceptions of FBZ and their specific visions. The aim was also to get people interested in the subject for possible further research.

The method consisted of a one hour structured interview of stakeholders with experience relating to specific sites from a questionnaire (see annex 1) made from several documents such as 'What Makes a Successful Place?'¹.

A total of 15 stakeholders were interviewed and delegates at the Scottish Green Infrastructure conference were invited to participate through a poster presentation. Contributors gave us their specific view point and advice; a starting point to write recommendations for developers and stakeholders.

What are the main lessons from interviews?

There is a growing need for FBZ driven by:

- The need to build more housing (population increase) is driving developments closer to sensitive sites.
- Land pressure is decrease in available land for sale.
- Growth of larger scales schemes led by Developers versus private customers who were building these own houses.

The planning decisions require FBZ

All the people who were interviewed have been involved in a number of planning decisions where a 'buffer zone' has been required as part of the conditions of the development during the planning process. When asked 'what percentage of the time do you think the 'buffer zones' are effective?' 100% said they don't know. This explains the difficulty to find successful examples of effective implementation of 'buffer zone' next to a sensitive site.

The delivery process can't guarantee the successful implementation of 'buffer zone'

Currently the status of 'buffer zone' is 'advice'. It's not formally defined in the Scottish planning policy. There is no way to ensure that they are delivered according to the stakeholders' requirements during the planning process.

Construction is the last step to delivering a project. Even if during the planning process a 'buffer zone' had been request it may not be knows if it has been delivered due to lack of resources to monitor planning conditions.

The delivery of buffer zones is often restricted by the capacity of the land managers to establish and maintain the buffer to the required standard.

There is no defined buffer width

All the people who took part to the interview process identified different width buffers. The distance is never the same as it depends on the project issues (e.g. long distances regarding wildlife disturbances, short distance regarding to anti social behavior issues). But the interviewees agreed that 5m between a sensitive site and a new development are rarely enough.

Some participants said that a FBZ is not about a single distance but more about 'implementing the right things in the right place for the right issue'. Therefore there are 2 different approaches to buffer a sensitive site;

- Distance/width, and,
- Zoning.

Shared benefits and functions

Interviews brought to light that, as a part of green infrastructure multifunction is one key of the effectiveness of the FBZ. Achieving a balance/compromise between different requirements is not easy. A FBZ is expected to be a compromise (cf. Diagram page 7).

Conflict between issues can arise

For planners and landscape architects, the FBZ should allow active travel and not a no-man's-land.

In the point of view of wildlife protection e.g. birds, the FBZ may be a place without human activity to limit disturbances.

This conflict is one of the most important issues that can be resolving by the right landscape design in the right place.



Why do we need 'Functional Buffer Zones'?

In many projects if a 'buffer zone' is implemented, stakeholders said that it is often very small with high fences or 5m of grassland. What are the real consequences of a 5m grassland + fences? During this research, we spent time on the Scottish Wildlife Trust's Cumbernauld reserves to understand the need for woodland buffers. The following is a typical story of what happens when a new development is implemented next to a woodland without specific measures.

1 At the beginning of the new development

The family has just bought their dream house and everything is like in the Housing Developer's brochure. This is an attractive place for the family because they have woodland close by. However they are unaware that it is a sensitive site because there is nothing to indicate the entrance point and which attitude/behavior they should adopt (Figures 5, 6 & 7).



Fig.5 New houses's model pictures Oakwood Cumbernauld (Millers Homes)

Fig.6 Nothing to indicate the entrance point (© M.Profit, CLL)

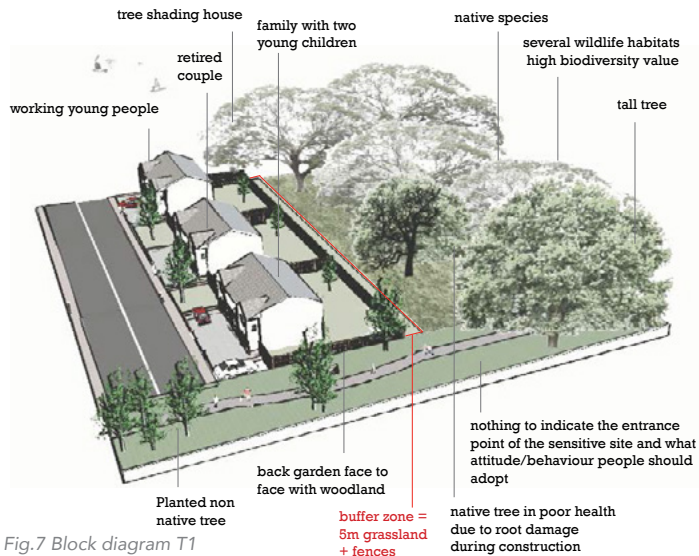


Fig.7 Block diagram T1 (© M.Profit, CLL)

2 After 5 years

Things change. The family may have more children and family needs a biggest house. Like the family the woodland is also growing. People build gates to directly access the woodland as an extension to their gardens (Figures 9 & 10). Teenagers and children play in the wood and create things like tree houses and make fires that damage tree structure. Step-by-step litter increases in the woodland.

The family wants to extend their garden so why not expanded it towards the woodland?



Fig.8 Effects identified (garden extending, damage on tree by children, etc) (© M.Profit, CLL)



Fig.9 Block diagram T2 (© M.Profit, CLL)

3 After 10 years

Almost 10 years after, the woodland condition is suffering. A lot of people who live here are complaining to the woodland manager, especially about shading and safety issues. Litter has built up behind fences and creates a bad image of the sensitive site. Invasive plant species from back gardens are now growing well on the woodland edges and spreading further into the woodland. Gardens expansion is continuing and some families are now taking fuel directly from the woodland (Figures 10 & 11).



Fig.10 Other effects on woodland in Cumbernauld pictures (© M.Profit, CLL)

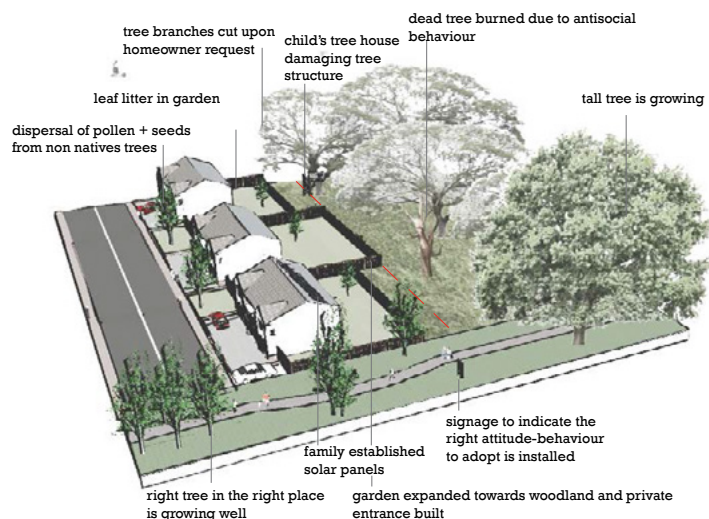


Fig.11 Block diagram T3 (© M.Profit, CLL)

From this story, potential effects were identified (Figure 12). The Woodland Trust also classified in 2012 twelve development types as having the potential to impact ancient woodland. From this, five potential effects were hypothesised to describe the ways in which these types of development may impact on ancient woodland. From the Woodland Trust's report, 3 other potential effects have been found in addition to this research project; chemical effects, fragmentation and cumulative effects.

At the end, woodland reduced in size



Fig.12 Summarize of new developments effects on sensitive sites (© M.Profit, CLL)

Due to safety concerns and complaints about the state of the woodland edges, the site manager will have to:

- Remove and recycle litter / waste, destroy invasive species.
- Fell trees (including mature trees) within approximately 30m to garden fence. That distance corresponding to the mature tree height.
- Replant smallest local species trees to restore woodland edges.

But that restorative measures will not allow the buffer to function and more effects will continue to impact sensitive sites. The cost to do works can vary depending on the woodland context e.g. access.

Every day, mature woodland is disappearing because of lack of measures before new development works. The consequences are economic, social and environmental. Implementing a FBZ during the planning process and ensure it works is the key to delivering a great place for both people and wildlife to live.

Why developers should invest in 'Functional buffer zone'?

The stakeholders we met think that FBZ should achieve:

Environmental benefits	Economic benefits	Social benefits
<ul style="list-style-type: none"> - Protect sensitive wildlife habitats - Reduce wildlife disturbances - Prevent the spread of invasive species - Reduce litter build up - Increase biodiversity - Provide ecosystems services - Improve health of sensitive sites 	<ul style="list-style-type: none"> - Increases inward investment and property values - Reduce propriety maintenance cost - Reduce sensitive site maintenance cost - Reduce cost to repair due to antisocial behavior 	<ul style="list-style-type: none"> - Reduce antisocial behavior to deliver attractive places with positive image - Increase natural surveillance to involve residents in conservation areas - Provide a corridor for movement and enhance recreational experience - Enhance visual interest and beauty the landscape - Make the place and sensitive sites edges safe regarding falling trees

Table 1 FBZ benefits expected

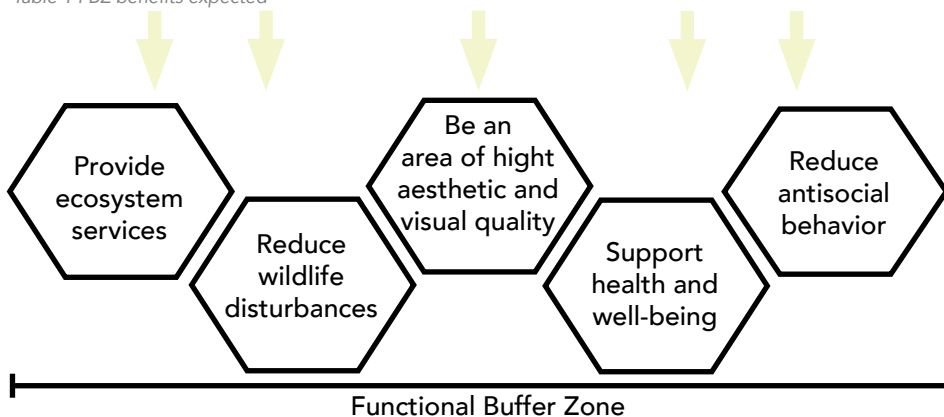


Fig.13 FBZ functions expected (© M.Profit, CLL)

Here is a list of statistics from several studies

15%

Developers would be willing, on average, to pay at least 3% more for land in close proximity to open space, with some putting the premium as high as 15-20%¹

7%

A 1992 study showed that a view of a forest can increase house prices by 7%; a view of water can lead to an increase of 5%¹

25%

Capital costs of traditional drainage are more than double the capital costs of soft, green, sustainable drainage systems (SuDS), and annual maintenance costs are also 20-25% cheaper. Over a 60-year lifespan, SuDS are around half the cost of traditional drainage solutions¹

property value
City parks add 10%, local parks 9% and amenity spaces 2.6% to value of nearby property²

Up to 3
Grass surfacing reduces noise levels by up to 3 decibels compared to concrete paving²

value- for-money
gross lifetime benefits from the buffer zoning project on the upper Bristol Avon are £144,860, representing exceptional value- for-money (...) for the modest investment in fencing of £4,700³

-40% less likely to be overweight or obese if living in a highly green urban area²

council revenue
The improvement of the Glasgow Green landscape and amenities increased the attractiveness of the surrounding area, leading to additional council tax revenue of £800k – £2m²

1 http://www.landscapeinstitute.org/PDF/Contribute/ProfitablePlacesOctober2014_001.pdf
2 <http://www.snh.gov.uk/docs/A1413427.pdf>
3 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/291658/scho0210brxw-e-e.pdf

Part 3. Fundamental recommendations & case studies

Methodology

The lack of information and case studies about size and effectiveness of buffers is a concern. This research needed a tool to make clear the FBZ functions expected and to compare their effectiveness. The following assessment criteria is used to compare examples, design propositions and case studies with transparency, justifiable and achievable criterion through appropriate weightings.

The assessment criteria was created specifically for this research bringing together a number of sources such as the '6 qualities of successful places' written by the Scottish Government¹, 'What Makes a Successful Place?'² and also 'Know what it is that you are assessing: writing assessment criteria'³. This built upon the functions expected by stakeholders during interviews, and literature studied during this 6 months research.

How to use the assessment criteria?

The following guidelines are organized into five key issues and the case studies refer to the assessment criteria bellow.

Use these assessment criteria step-by-step;

Step 1

Take to account Landscape and environmental assessments that have been done on the site where you want to build.

Step 2

Identify key issues of concern you are looking for in the table see bellow (assessment criteria) and go straight to the following recommendations and useful examples;

Step 3

Prepare a preliminary buffer plan or design according to the site context;

Step 4

Come back to the assessment criteria and complete the 'Effectiveness achieved' column with an objective score. If you have very high (for example >80%) that's perfect! If you have less than 50% of effectiveness, the FBZ is not functional. Refine the plan and using other resources as necessary.

¹ <http://www.gov.scot/Topics/Built-Environment/AandP/InspirationalDesigns/6qualities>

² <http://www.pps.org/reference/grplacefeat/> op cit

³ <http://www.reading.ac.uk/engageinassessment/assessment-design/planning/eia-writing-assessment-criteria.aspx>

'Functional buffer zone' assessment criteria

Issues	'Functional Buffer Zone' Functions	Score	
		Effectiveness expected	Effectiveness achieved
Provide Ecosystem services	- Prevent the spread of invasive species	5	
	- Support natural context with native planting	5	
	- Increase biodiversity by creating multiples spaces (grassland, hedge, shrubs, etc.)	5	
	- Provide water regulation (limiting and scale of run-off, flooding, etc.)	5	
Reduce Wildlife disturbances	- Screen undesirable noise from human activities	5	
	- Protect sensitive habitats	5	
	- Limit domestic animals intrusion	5	
	- Limit access to the sensitive site	5	
Reduce antisocial behavior	- Increase natural surveillance	5	
	- Limit the build up litter by enhancing perception of care/maintenance	5	
	- Provide positive image by creating the right entrance point in the right place	5	
	- Build a safe area to reduce risk of branch/tree fall	5	
Support health and well-being	- Provide a corridor for movement and opportunities for exercises	5	
	- Enhance recreational experience	5	
	- Provide places for social interaction	5	
	- Facilities meet appropriate needs	5	
Be an area of high ecological, aesthetic and visual quality	- Use natural features that are important to conserve current landscape	5	
	- Build on distinctive place with quality and character	5	
	- Enhance landscape visual interest to connect people to nature	5	
	- Designed to allow easy management and reduce cost	5	
On a scale of 1 – 5, (1 being very poor, 5 being excellent)		100%	

Table 2 Assessment criteria (© M.Profit, CLL)

Provide ecosystem services

Since the publication of the Millennium Ecosystem Assessment¹ in 2005, interest has grown in the concept of ecosystem services². A great deal of research has been carried out and joint initiatives launched. The Economics of Ecosystems and Biodiversity launched at the G8+5 on Potsdam put forward a new approach: "The buyers and sellers would exchange ecosystem services with the result of no net loss in the quality or quantity of any key ecosystem components – biodiversity, soils, water, etc. Therefore FBZs should contribute to the provision of ecosystem services and result in the no net loss of biodiversity.

Keys design recommendations

- Creating Sustainable Urban Drainage Systems including several successive retention pond, treatment feature, surface water run-off to clean up water, limit flooding, and check dams to slow water movement and increase retention time
- Landscaping areas as a succession of vegetation layers (as a natural Eco tone) to increase biodiversity
- Standoff distance to prevent damage on the tree roots (Figure 14)
- Planting natives species
- Creating multiples spaces (grassland, hedge, shrubs, etc.) to allow diverse range of habitats

Ecosystem services³

Ecosystem services are defined by the Millennium Ecosystem Assessment as "provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient recycling; and cultural services such as recreational spiritual, religious and other non-material benefits".



Fig.14 Standoff distance to prevent damage on the tree roots during works (© M.Profit, CLL)

1 <http://millenniumassessment.org/documents/document.356.aspx.pdf>
 2 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69192/pb12852-eco-valuing-071205.pdf
 3 http://scottishwildlifetrust.org.uk/docs/002_050_publications_Policy_Futures_Series_1_Living_Landscapes_1292841506.pdf
 4 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/291658/scho0210brxw-e-e.pdf

Upper Bristol Avon, Wiltshire

FBZ score = 87%

Case study 4

Date completed // 2008

Location // Immediately upstream of the village of Great Somerford in North Wiltshire alongside the Bristol Avon river

Architect // the Somerfords Fishing Association (SFA), the landowner and the Environment Agency partnership

Design solutions // buffer zone on 330 metres of one bank of the upper Bristol Avon catchment. In this context is a strip of protected habitat between the top of the river bank and the river channel in which natural riparian and wetland habitat can regenerate, supporting wildlife and reducing sediment and potential pollutants running into the river from the surrounding land (capital cost of £4,700).



This study also strengthens the already robust case for the power of ecosystem services as a tool to help identify the breadth of issues and potential beneficiaries. Gross lifetime benefits from the buffer zoning project on the upper Bristol Avon are £144,860 (...) and therefore exceptional value- for-money relative to the small initial investment.

Reduce wildlife disturbances

There are only a few studies about wildlife disturbances next to developments, however they systematically address management options and provide recommendations¹ as follow.

Keys design recommendations

- Consider placement of facilities such as benches to minimize noise and build up litter;
- Positioning footpaths alongside housing and consider placement to limit noise;
- Limit human intrusion by creating diverse footpath experiences so that footpath users are less inclined to create footpaths of their own;
- Create physical or natural features that people & domestic animals can't cross (excepted entrance point);
- Create anti-noise barriers by planting native shrub species;
- Use the 'Fight initiation distance' or a 'zoning 'set-back' distances and exclusion' distance principle to implement something new next to a sensitive habitat;
- Maximize the connectivity between habitats;
- Create information or warning signs.

10m wide strip of tree and shrub planting provides an effective noise buffer (reduce by 3-8 decibels)

¹ [http://www.forestry.gov.uk/PDF/FCRP020.pdf/\\$FILE/FCRP020.pdf](http://www.forestry.gov.uk/PDF/FCRP020.pdf/$FILE/FCRP020.pdf)

Black grouse (Tetrao tetrix) Case study

FBZ score = 62%

Date completed // 2015

Location // Across Scotland in case of Wind Farm project close to a sensitive site

Architect // Scottish Wildlife Trust (SWT)

Design solutions // SWT recommend that no construction works should be undertaken (including vehicle movements along tracks) before 9am within 750m of any black grouse lek during April and May. This would be to ensure that the likelihood of causing disturbance to lekking birds during the sensitive breeding season is avoided. In addition (based on a review of recent research in 2015), SWT recommend the requirement for a buffer zone of at least 500m between the lek(s) and the location of any turbine. This would be to minimise the risk of displacement during operation.



Fig.15 Black grouse (wikipedia)

Black grouse are largely dependent upon a mosaic of woodland and scrub and an understory of heather and bilberry.

In Spring, black grouse gather at traditional 'lek' sites where males display competitively and the females select their mates. Males then take no further part in caring for the eggs or young. Females nest on the ground in dense vegetation (higher than 40cm) and lay 6 -11 eggs in late April-early June.

The UK population of black grouse has been declining in range and numbers since the 1900s. Its range declined by 28% between 1968-72 and 1988-9, while the UK population declined dramatically from an estimated 25,000 lekking males in 1990 to just 6,510 in 1996. The 2005 survey revealed a continuing UK decline of 22% since 1995-96.

Reduce antisocial behavior

Antisocial behavior is one of the most damaging impacts on sensitive site in an urban setting. This can be anticipated by the right neighborhood design where the positioning of the development is considered in the wider context of the landscape. Damage also comes from the lack of information around sensitive sites.

Key design recommendations

- Build new developments to consider shading of trees
- Set houses back the equivalent to the mature tree height to guarantee future safety
- Position houses to face woodland (e.g. no back garden alongside woodland) to increase natural surveillance (figure 17)
- Limit garden impacts by separating them from the woodland with a road
- Control people's access by creating a features that channels them to the expected entrance points
- Create a visible entrance points with appropriate signage indicated the behavior to adopt



Fig.16 Back garden alongside woodland (© M.Profit, CLL)



Fig.17 The right set houses alongside sensitive site (© M.Profit, CLL)

Oakwood new development

FBZ score = 31%

Case study

Date completed // 2014

Location // Cumbernauld village - Old Glasgow road in close proximity to a sensitive woodland

Architect // Miller Homes

Design solutions // Brick wall 1.8m height with wood fence 1.5m on top

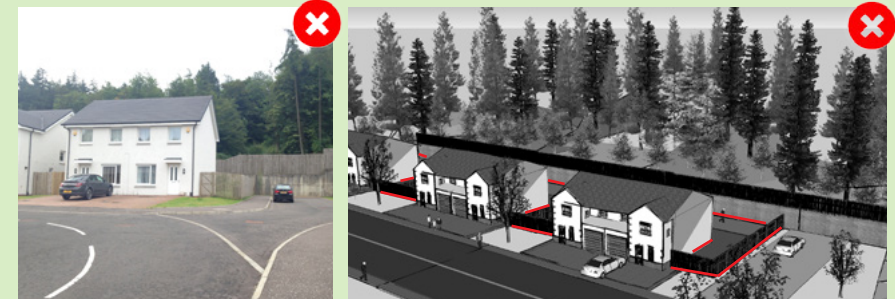


Fig. 18 & 19 Houses build from 15m of mature tree: problem of safety and shading (© M.Profit, CLL)



Fig. 20 Back garden alongside the sensitive woodland (Millers Homes)

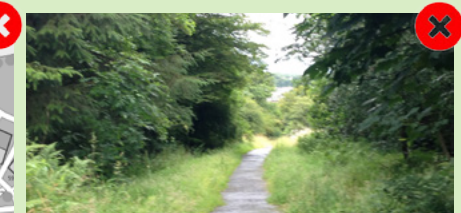


Fig.21 Nothing to indicate the entrance point and the behavior to adopt (© M.Profit, CLL)

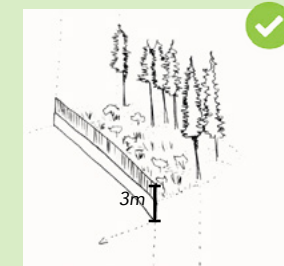


Fig. 22 Design does not allow damage on woodland by antisocial behavior (© M.Profit, CLL)

Be an area of high ecological aesthetic quality

Many people, regardless of background, prefer similar visual elements in the landscape. Naturalistic landscapes providing valuable ecological functions are often viewed as untidy and undesirable, while manicured landscapes with limited ecological functions are perceived as demonstrating stewardship and are visually desirable.

'The challenge is to design buffers that achieve the desired ecological functions while providing landscapes that are visually desirable and that instill long-term commitment'¹.

Keys design recommendations

- Design the area of the buffer visible to the new development to be aesthetically pleasing while the interior can be designed to achieve the more desired ecological functions
- Provide visual frames to contain and provide order e.g. wooden fence or hedge and a singular entrance points
- Use interpretative signage to increase positive image of the sensitive sites
- Enhance visual interest and diversity by increasing seasonal color and by varying plant heights, textures, and forms (figures 23 & 24)
- Use trees where appropriate
- Always planting in clumps and avoid planting in rows
- Use native species
- Keep designs compatible with adjacent landscape
- Use local materials



Fig.23 Visual interest by varying plant textures
(© M.Profit, CLL)



Fig.24 Visual interest and diversity in the path
(© M.Profit, CLL)

Antonine wall case study

FBZ score = 69%

Date completed // in the years following 140 AD

Location // it extends for some 60 kilometres across central Scotland from Bo'ness on the River Forth to Old Kilpatrick on the River Clyde

Architect // Built on the orders of the Emperor Antoninus Pius

Design solutions // The Wall functioned both as a frontier control and military defence. It comprised of a substantial turf rampart built on a solid stone base fronted to the north by a broad, deep ditch and outer mound. Today around one third of the Antonine Wall survives. Around one third lies in urban areas while the remainder lies in open countryside or open spaces within urban areas but survives below the ground and is not visible.

The Wall continues to be subject to considerable development pressures and to protect the important landscape setting of the Antonine Wall a UNESCO 'Buffer Zone' has been designated to the north and south of the monument. The 'Buffer Zone' does not act as an absolute barrier to development but defines a zone where added protection to the immediate setting of the World Heritage Site is given².



Fig.25 Visual interest in a singular entrance point
(© M.Profit, CLL)



Fig.26 Interpretative signage using local materials
(© M.Profit, CLL)



Fig.27 Buffer aesthetically pleasant
(© M.Profit, CLL)



Fig.28 Design compatibility / landscape
(© M.Profit, CLL)

1 <http://nac.unl.edu/buffers/index.html>

2 <http://www.antoninewall.org/system/files/documents/Antonine%20Wall%20SPGr2c-Final-combined.pdf>

Support health and well-being

For many people, footpath and recreational activities are often viewed as not compatible with wildlife protection. There sometimes exists a conflict between access and the protection of sensitive sites.

The challenge here is to design buffers that achieve the desired active travel function while providing landscapes that are desirable for wildlife too. Footpaths can be designed to minimize human disturbance and negative impacts to wildlife. But some factors influencing short-term impacts include: type of species and flushing distance, type and intensity of human activity, time of year and time of day, and type of wildlife activity.

Keys design recommendations

Create footpaths that encourages people to use them:

- Built it in areas around and close to the buildings,
- Provide footpaths that are connected, accessible and encourage multiple uses,
- Make sure that the area feels safe and well used,
- Limit the feeling of insecurity by reducing the opportunity for antisocial behavior (e.g. using vandal resistant materials and appropriate lighting),
- Concentrate activity rather than disperse it alongside the footpath (e.g. playground area),
- Incorporate waterscapes and historical or cultural elements where possible (e.g. old stone walls, SuDS ponds),
- Create vantage points where users can view wildlife or interesting features.

Commonwealth Games Athletes' Village Case study

FBZ score = 89%

Date completed // 2015

Location // Dalmarnock, Glasgow alongside the River Clyde

Architect // RMJM / AECOM, Turleys and Brindley Associates

Design solutions // Buffer with variable size containing; playground areas, footpath, grass-land, native tree hedge.



Fig.29 Footpath close to the housing (© M.Profit, CLL)



Fig.30 & 31 Concentrate playgrounds & activities along the path to connect the community (© M.Profit, CLL)



Fig.32 Various buffer size alongside the River Clyde (© Tom Manley)

Part 4. Applications of the design recommendations

The Cumbernauld Community Growth Area

Cumbernauld's history stretches to Roman times, with a settlement near the Antonine Wall. The security that the wall gave from possibly hostile tribes to the north probably allowed the foundation of a settlement. A rural population grew in the area especially in nearby Cumbernauld Village.

The new town grew^a in the 1950's and 1960's as one of five new towns developed across Scotland to cope with overcrowding in the large cities and slum clearances in Glasgow. The mega-structure town center¹ created a negative image overshadowing award-winning residential neighborhoods. However that changed in 2010 when Cumbernauld won the most improved town in Scotland award. The 2011 Census reported that 52.5% of Cumbernauld residents declared themselves to be in « very good » health² – 5.8% and 5.5% above the UK New Towns and averages, respectively¹.

Cumbernauld is composed of a wide range of natural sites^b, which were present before the construction of the new town. This means that there are a large number of protected areas owned and managed by a wide range of stakeholders (Scottish Wildlife Trust, North Lanarkshire Council, Forestry Commission and RSPB).

A large area has been earmarked for approximately 2,000 new homes via major urban expansion to the South of the town (figure 35). This Community Growth Area (CGA) is at heart of the Cumbernauld Living Landscape project. It is located next to a sensitive site and therefore must be a successful example of best practice regarding FBZ implementation. Also, the need to implement FBZ between the Forest Wood Wildlife Reserve and the new development had been identified in the developers' ecological reports² and the Cumbernauld Living Landscapes vision for the CGA³.

The following are two examples of how a FBZ could be implemented in the Mid Forest Community Growth Area.

1 http://www.tcpa.org.uk/data/files/TCPA_New_Towns_Study_Stage_1_An_Introduction_EMBARGOED.pdf
 2 Echoes Ecology Ltd (September 2015) The Protected Species Survey of the Forest Wood Reserve
 3 <http://cumbernauldlivinglandscape.org.uk/news/article/growing-cumbernauld039s-green-network/>

Did you know?

a Cumbernauld took the lead in adopting a "utopian" approach to planning much in vogue at the time. The result was the construction, on the highest and windiest location for miles in any direction, and over a mile away from the existing village from which it took its name, of a town Centre that at the time was seen as one of the architectural wonders of the world, a modernist concrete "mega-structure" intended to exemplify everything that was good about the new post-war era.



Fig.33 City centre Mega Structure (Marion Profit)

b Separation of people and cars was a major element of the first town master plan and this was carried through for much of the development of the town to improve health. Cumbernauld pioneered designs for underpasses and pedestrian footbridges as well as segregated footpaths.



Fig.34 Community garden Peace (Marion Profit)

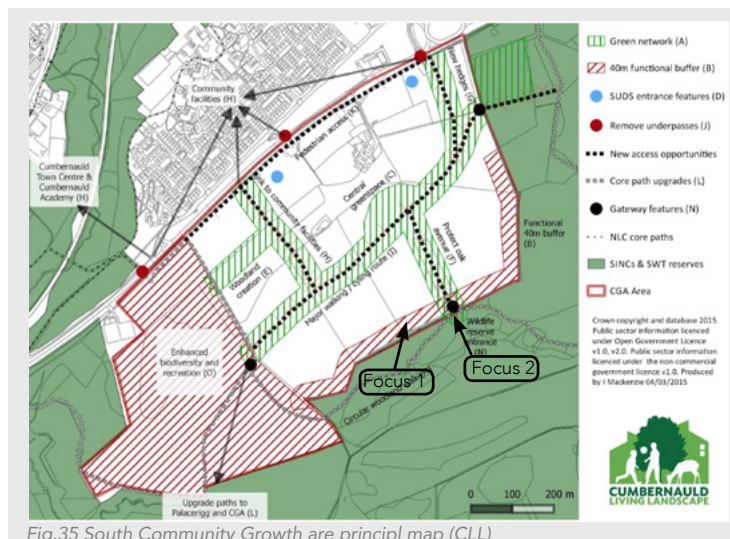


Fig.35 South Community Growth area principle map (CLL)

Focus 1. A FBZ alongside the road

In this context FBZ has minimum distances of 40m due to the mature trees at the edge of the sensitive site. To be more powerful, the FBZ, as a part of green infrastructure should be a succession of spaces, sometimes accessible, sometimes not.

The path

The variety of expected users of the path will influence path design. Needs and aspirations of the potential residents should be clarified through consultation and interpreted in advance of the planning process and the master plan. The path that we imagined to fit in FBZ could be used by foot or cycle.

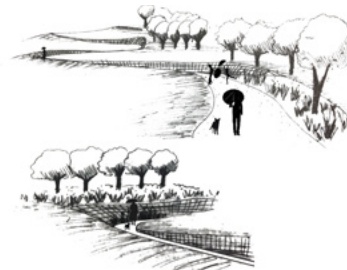


Fig. 36 Footpath layout principle
(© M.Profit, CLL)

Fit and alignment (figure 36)

- Go around the side of hills rather than cutting straight through them;
- Avoid long straights or else use landscaping to draw attention away from them;
- Use landscaping to prevent users shortcutting loops or zigzags;
- Try to follow existing desire lines. If it's not possible, make the new path route more attractive so that supersede the desire line;
- Try to integrate views and if possible sites of interest;
- Try to provide cohesive linear landscape.

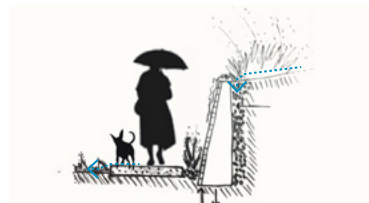


Fig. 37 Drainage principle for both footpath and retaining wall
(© M.Profit, CLL)

Drainage

Keeping water off and away from the path is the single most important factor to maximize longevity and usability (figure 37);

- Create a cross-fall goes into slope or a camber;
- Create drainage ditch to intercept water flowing down slope and surface water from path;
- Create drainage ditch between the path and the wall where plants can grow.

The mound & the ditch

The layout of the FBZ is one of the keys of his effectiveness. This layout is created for several purposes in the case of flat terrain and for a long distance;

- Creating anti-noise barriers from development by planting native small trees;
- Creating barriers that people can't cross;
- Integrating movement by avoiding long straights;
- Starts excavation of natural soil 5m from reserve limits to not damage the tree roots.

To be effective, the layout of the mound should respect;

- An irregular layout as possible to avoid monotony;
- Use the soil from excavation to create the upcast mound in situ;
- A minimum of 45% slope to minimize human intrusion;
- A minimum of 3 m height to transform the landscape.



Fig. 38 Actual site to create a FBZ in the South Cumbernauld CGA (© M.Profit, CLL)

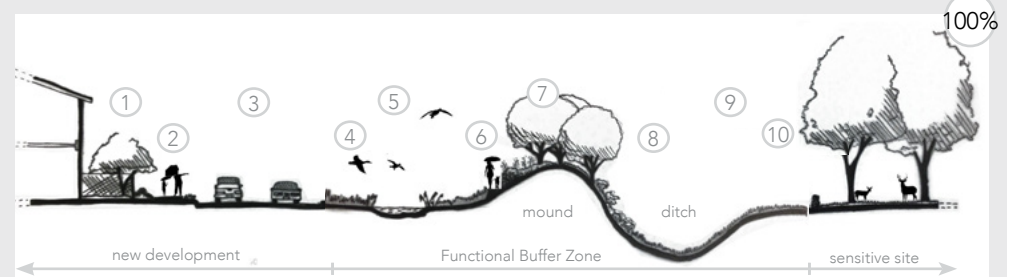


Fig. 39 A FBZ proposal design profile (© M.Profit, CLL)



Fig. 40 A FBZ proposal design picture (© M.Profit, CLL)

- | | |
|--|--|
| ① Front garden face to face with woodland | ⑥ Footpath with a wall that people can't cross |
| ② Natural surveillance | ⑦ Up cast mound creating anti-noise barriers |
| ③ Road to create distance with the FBZ | ⑧ Wildlife friendly plants |
| ④ Native species to contain litter | ⑨ Natural soil excavation starts 5m from the reserve |
| ⑤ Successive ponds to clean up water from road | ⑩ Existing wall and fence kept |

Focus 2. An entrance point to connect the new development

“Creating the right entrance point in the right place”

- Create a singular and visible entrance point that encourages people to use it;
- Create a place that makes a good first impression;
- Set up signage indicating the behavior to adopt using a vandal-resistant material; and
- Create an area, which gives safe and well used felling.

BEFORE



Fig. 41 Actual site where create an entrance point (© M.Profit, CLL)

AFTER



Fig. 42 A proposal for that entrance point in the Cumbernauld CGA (© M.Profit, CLL)

- ① Creating signage incorporate to the path material to prevent anti social behavior that increase well used felling
- ② Using the same material as in Cumbernauld
- ③ Creating grassland areas where people can see from a long distance to give them safety felling
- ④ Planting shrubs with various heights, textures, and forms on the mound
- ⑤ Using the wall to implement interpretive panel & controlling acces by creating a unique entrance that enhance curiosity while give a safety felling

Other ‘Functional Buffer Zone’ profile principles

Profile 1

78%



Fig. 43 profil 1 (© M.Profit, CLL)

- ① Back garden
- ② Shrubs to limit garden extension
- ③ Footpath to enhance passive surveillance
- ④ Shrubs to stop litter build up
- ⑤ Ha-ha to avoid intrusion into the reserve
- ⑥ Ecotone to limit noise disturbances

Profile 2

66%

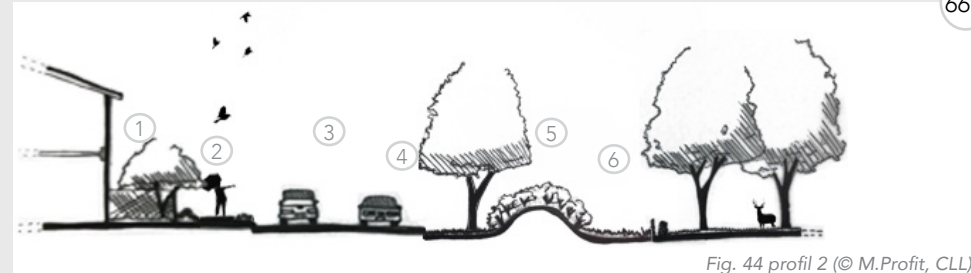


Fig. 44 profil 2 (© M.Profit, CLL)

- ① Front garden
- ② Passive surveillance
- ③ Road
- ④ Small tree as a visual limit
- ⑤ Mound that can be planted
- ⑥ Grassland

Profile 3

53%

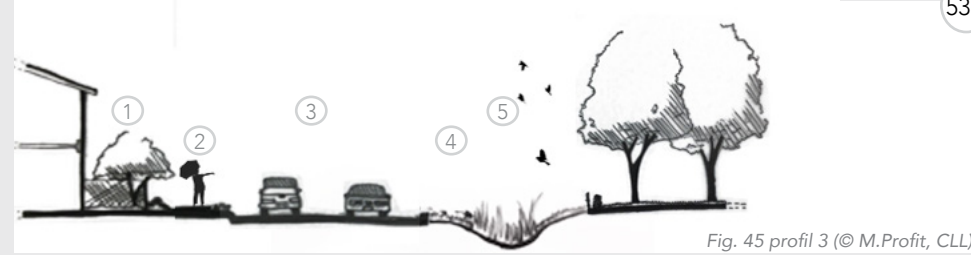


Fig. 45 profil 3 (© M.Profit, CLL)

- ① Front garden
- ② Passive surveillance
- ③ Road
- ④ Grassland
- ⑤ SUDS

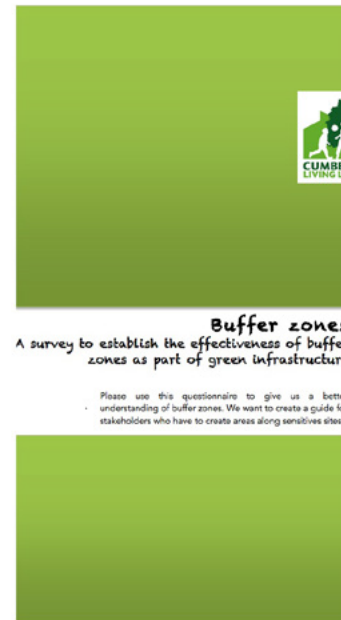
Conclusions and next steps

There is a growing need for 'Functional Buffer Zone' across Scotland to protect sensitive sites. Landscape design solutions exist to build a suitable relationship between sensitive sites and new developments. If used correctly buffers can be of great value for both people and wildlife. While there is no defined distance for buffers recommendations can be made based on the site's sensitivities. For example a distance equivalent to the high of the mature trees (often > 25m) is justified to prevent the removal of a woodland edge due to concerns from falling trees. The lack of good examples of buffers and design guides to implement them is a concern, and is an area that requires further research. If the need of FBZ is not clearly specified in the planning condition it is very unlikely to be delivered.

The design plays a key role in the efficiency of the FBZ. Good design can achieve the desired ecological functions while providing landscapes that are contextually visually desirable. Multifunctionality is also a key to the FBZ. The design we proposed in this guidance should achieve a range of functions such as ecosystem services, reduce wildlife disturbances and antisocial behavior while support health and well-being with a high ecological aesthetic and visual quality. To achieve this, the main recommendations are first, to implement the right neighborhood design where the positioning of the development is considered in the wider context of the landscape. Secondly, to consider promoting responsible use to reduce anti social behavior which is one of the most damaging impacts on sensitive site in an urban setting.

There is a great deal of interest in this topic in Scotland therefore the subject should be investigated further. With additional resources this topic could be researched in greater depth and more stakeholders should be interviewed including developers and commercial stakeholders. This document is a first step towards a more comprehensive guidance. The concept of FBZ and their associated recommendations should be adopted as a supplementary planning guidance by locale authorities to ensure they are delivered according to the need.

Appendix 1. Questionnaire



PART A: YOUR EXPERIENCE ABOUT BUFFER ZONES

- Who are you?
 Planner Architect Landscape Architect Designer Forest Manager
 Wildlife Manager Developer Other.....
- In your job, how often do you need to consider buffer zones and for which type of project or issue?

- What percentage of the time do you think the buffer zones are effective?
 0% 20% 40% 60% 80% 100%
- Could you give examples of successful and unsuccessful buffer zones and briefly explain why they did or did not work?

Successful buffer zone	Unsuccessful buffer zone

Introduction

WHAT IS A BUFFER ZONE?
 Buffer zones are a part of Green Infrastructure. They are multifunctional: can be applied to protect soil, improve air and water quality, enhance wildlife habitat, produce economic products, provide recreation opportunities, create microclimate, active travel routes (cycling/walking), create shelterbelts, give ecosystem services or beautify the landscape as a features.
 There are many different definitions of the term "buffer zones" depending on the background and project objectives. For this specific project of guidance, a buffer zone is:
An area, often peripheral to a sensitive site, in which activities are landscaped or the area managed with the aim of enhancing the positive and reducing the negative impacts of conservation on neighbouring communities, of neighbouring communities on conservation and reconnect both.

WHY THIS GUIDANCE NEEDED?
 Because of the design of the New Town of Cumbernauld, many developments (industrial, activity, housing zones) are in close proximity to sensitive sites and Wildlife Reserves. Buffer zones are one of the key elements of green infrastructure that protect the sites in this context. They can minimize negative impacts and create better sustainable relationship between sensitive sites and communities.

WHAT IS THIS QUESTIONNAIRE FOR?
 The purpose of this first questionnaire is to get a better understanding of respondents perceptions of buffer zones and their functionality. It is to understand where the guidance leads to successful buffers, where this does not work and why.

WHICH METHODOLOGY FOR THIS QUESTIONNAIRE?
 The method consist of a structured interview of stakeholders with experience relating to specific sites. Section A covers the general effectiveness of buffer zones and B investigates issues at a specific site.

PART B: SITE INVESTIGATION

- Now, please think about one example of buffer zone you know in Scotland, United Kingdom or abroad.
- SECTION 1: CONTEXT OF THE CASE STUDY**
- Was the buffer zone successful?
 yes no
 - What is the name and location of the site?

 - Can you give a very brief background to the site (inception date, who is the designer, history of development, planning conditions, etc.)?

 - What kind of spaces are around the buffer zone?

Sensitive site description	Buffer description	Development description
 - What do you know about inhabitants and users of the development?

10. Is the buffer natural or has it been landscaped?
 natural landscaped
 If landscaped, do you know how much the buffer zone cost?

11. Who is responsible for maintenance? What do they do? When?

12. Can you describe the area or make a sketch?

- ◆ SECTION 2: ACCESSIBILITY
13. Is the buffer zone accessible or is access restricted?
 accessible not accessible
 If not accessible, please go straight to section 4 and 5.
14. Are there entrance features to the sensitive site? Is the entrance clearly visible? Can you see the space from a distance?

15. Is there an entrance threshold sign?
 yes no
 If yes, is it vandalized?
 yes no
 If yes, what material is it and what kind of damage?

16. Are there fences? Which type (height, material, etc.)?

17. Are people used another access point and why?
 yes no

- ◆ SECTION 3: USES & ACTIVITIES
18. Within the buffer zone what types of spaces are?
 footpath cycling path grass other
19. Are people using the space?

20. How many different types of activities are occurring?
 people walking eating playing games relaxing reading
 other.....

21. Which parts of the space are used and which are not?

31. Does the buffer zone (or its entrance feature) give the impression of proximity to the sensitive site?
 yes no
32. What were the causes of the success or the failure of this buffer zone?

33. What improvements could be made?

- ◆ SECTION 4: SOCIABILITY
22. Is this a place where you would choose to meet your friends?
 yes no
23. Are people in groups? Are they talking with one another?

24. Are people smiling? Do people make eye contact with each other?

25. Do people tend to pick up litter when they see it?
 yes no
26. Is the place vandalized?
 yes no
27. Are people taking pictures? Are there many photo opportunities available?

Do you wish to add anything else (about this questionnaire, the guide, someone interesting you know we should meet about this subject, another case studies, etc.)?

YOUR CONTACT DETAILS:

- ◆ SECTION 5: COMFORT & IMAGE
28. Does the place make a good first impression?
 yes no
29. Does the area feel safe and well used?
 yes no
30. Is it accessible as a place people are encouraged to use?

Name:
 Organisation:
 Position:
 Phone:
 E-mail:

We plan to showcase the buffer zones guide in November 2015. We will keep you informed.

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