Vastern Park, Reading

Proof of Evidence

Design and Townscape

Appendix A- Michael Doyle CV

Appendix B- SSE Correspondence

Appendix E- Extracts from 'The Image of the City, Kevin Lynch.

Appendix F- TGN 06/10.

Appendix G- Extract from Global Streets Design Guide (Global Designing Cities Initiative 2016 page 81)

Appeal to the Secretary of State against the decision of Reading Borough Council under section 78 of the Town and Country Planning Act 1990.

LPA Application Reference: 200328/OUT

for
Reading Borough Council

March 2021

DOYLE

86-90 Paul Street
London
EC2A 4NE
T. 020 3305 7476
Number 3,
159 Marine Parade
Brighton

BN2 1EJ
T. 01273 567 777
michaeldoyle.doyle@gmail.com
DOYLE DESIGN LLP
Partnership No. OC3088999

List of Partners available at the above address.

Appendix A- Michael Doyle CV

Michael Doyle BA(Hons) DipUD DipTP MRTPI

1.1.1.1 Michael is an urban designer and town planner with thirty-five-year track record in senior positions in both private practice and local government. He is an affiliate member of the Institute of Historic Building Conservation and a former Arts Council/CABE Space Enabler.

1.1.1.2 Michael led the preparation of a range of masterplans and development frameworks, mixed use town and city centre regeneration strategies, transport and interchange design studies, and large-scale planning applications, negotiations and appeals.

1.1.1.3 He led the preparation of a new public realm policy and strategy for the City of London. He has prepared Design Statements for Reading East MRT and the completion of the Maidenhead ring road. He prepared initial concept design for the new Christchurch footway and cycle bridge in Reading and also drafted the Design and Access Statement. He prepared the Reading Station Area Framework and played a key role in the Reading Station Redevelopment (for Reading Council and Network Rail). He prepared the masterplan for Konza Technology City, Kenya, in association with Pell Frischmann.

1.1.1.4 Michael led the preparation of a series of city-wide and city centre strategies including Manchester City Centre Eastern Gateway Development Study (for Manchester City Council) and Nottingham City Centre Regeneration Framework (for Nottingham Regeneration). He has prepared development frameworks and sub-regional masterplans for areas including Northampton northern growth strategy (for Barratt), Swindon Regeneration Framework (for The New Swindon Company), Wembley Development Framework (for English Partnerships) and Kings Dock (Liverpool) Development Framework (for English Partnerships).

1.1.1.5 Michael has prepared a series of planning, design and development briefs, urban design guidelines and codes for major sites including the planning, design, and development brief for the New English National Stadium at Wembley (for Brent Council) and planned urban extensions for the City of Truro (3500 dwellings) and Bathgate, West Lothian (1,500 dwellings).

1.1.1.6 Michael is an accomplished illustrator and is the Editor of 'Graphics for Urban Design' published by Thomas Telford.

1.1.1.7 Michael previously worked as Managing Partner of Doyle Tym Design; Urban Design Associate Director with David Lock Associates; Principal Urban Designer at the London at Brent, Conservation & Design Team Leader in Hackney and Senior Planner/ Urban Designer with Tibbalds Monro. His first job was with the Royal Docks Team at Newham Council which followed a one-year student placement at the London Borough of Lewisham.

Appendix B- SSE Correspondence

SSE Services plc
One Forbury Place
43 Forbury Road
Reading
Berks, RG1 3JH

Dr Andrea Mageean
The Planning Inspectorate
Temple Quay House
2 The Square
Temple Quay
Bristol
BS1 6PN

Telephone: 07767 850601
E-mail: andy.fraser@sse.com

Our reference:
Your reference:

29 October 2021

Dear Dr Mageean

Re: Electricity Distribution System at 55 Vastern Road, Reading

Further to the attached letter from Mr Richard Gough dated 16th July 2021 regarding the planning application (local authority ref: 200188 and appeal ref 3276463) which is the subject of an inquiry now taking place before you, we understand that evidence has been presented to the inquiry on our representations on the Reading Borough Council (RBC) Local Plan in 2017 and 2018 as evidence of SSE's future intentions regarding the substations and transformers adjacent to the appeal site and we wish to set out our position.

SSE's position remains that the land remains in the ownership of Southern Electric Power Distribution (SEPD) which forms part of SSEN and provides critical infrastructure for Reading and the surrounding areas. The strategic requirement for the substations and transformers located on Vastern Road is highly unlikely to change in the short or long-term.

In June 2017 and January 2018, SSE made representations to the RBC Local Plan in relation to Policy CR10: Tall Buildings, the 10m offset from the River Thames as well as the wider requirements of Policy CR11g.

As we noted in our submissions to RBC dated 13 June 2017, SSE could only secure the viable relocation of the substations and transformers if there was "sufficient value in the scheme". Following the submission of the Draft Local Plan to the Inspector in March 2018, which unfortunately did not include any of our proposed amendments, we concluded that moving the substations and transformers within the site or to another location was financially unviable for the requestor, SSE Services PLC, and the cost of such works couldn't be met by SEPD's customers.

As a result, a decision was made to sell the vacant part of the site no longer required for operations following the submission of the Local Plan in March 2018. Berkeley thereafter

acquired the site in September 2018. The submitted Local Plan policy did not require the allocated site to be brought forward in a single planning application (neither does policy CR11g in its adopted form) therefore a sale to Berkeley was considered the best option.

It was not, and has never been, SSE's intention to fully vacate the site. The on-site substations, transformers and associated equipment as well as the below ground constraints means that moving operations outside or within the site is financially unviable to SSE due to the significant costs which would be incurred, and therefore cannot be justified in the interests of SEPD's customers.

The site at Vastern Road provides critical elements of the electricity infrastructure for Reading, supplying power to thousands of homes and business. With the anticipated future increase in demand across the grid, the strategic requirement for the site is highly unlikely to change in the short or long-term. We therefore have no plans to relocate the substations or their transformers, within the wider site or elsewhere. However, we can say that the Berkeley proposals before the inquiry do not prejudice any development which we might wish to carry out in future. Mr Gough's letter of 16th July 2021 noted that Berkeley's plans have been designed to enable comprehensive development of the whole allocated site. That remains our view.

I trust this information is useful.

Yours sincerely,

Andy Fraser || Property Manager – South

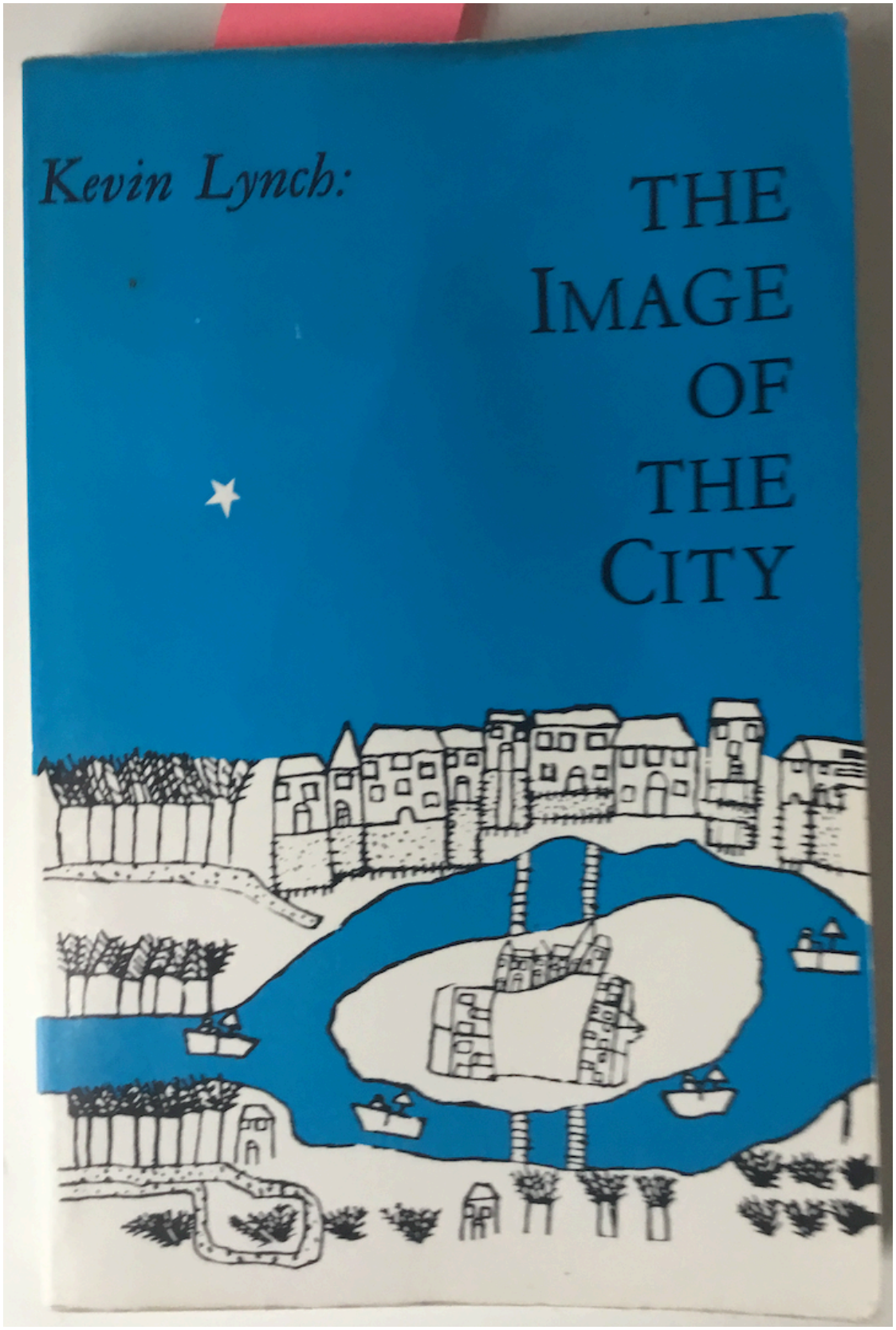
One Forbury Place
Forbury Road
Reading, RG1 3JH

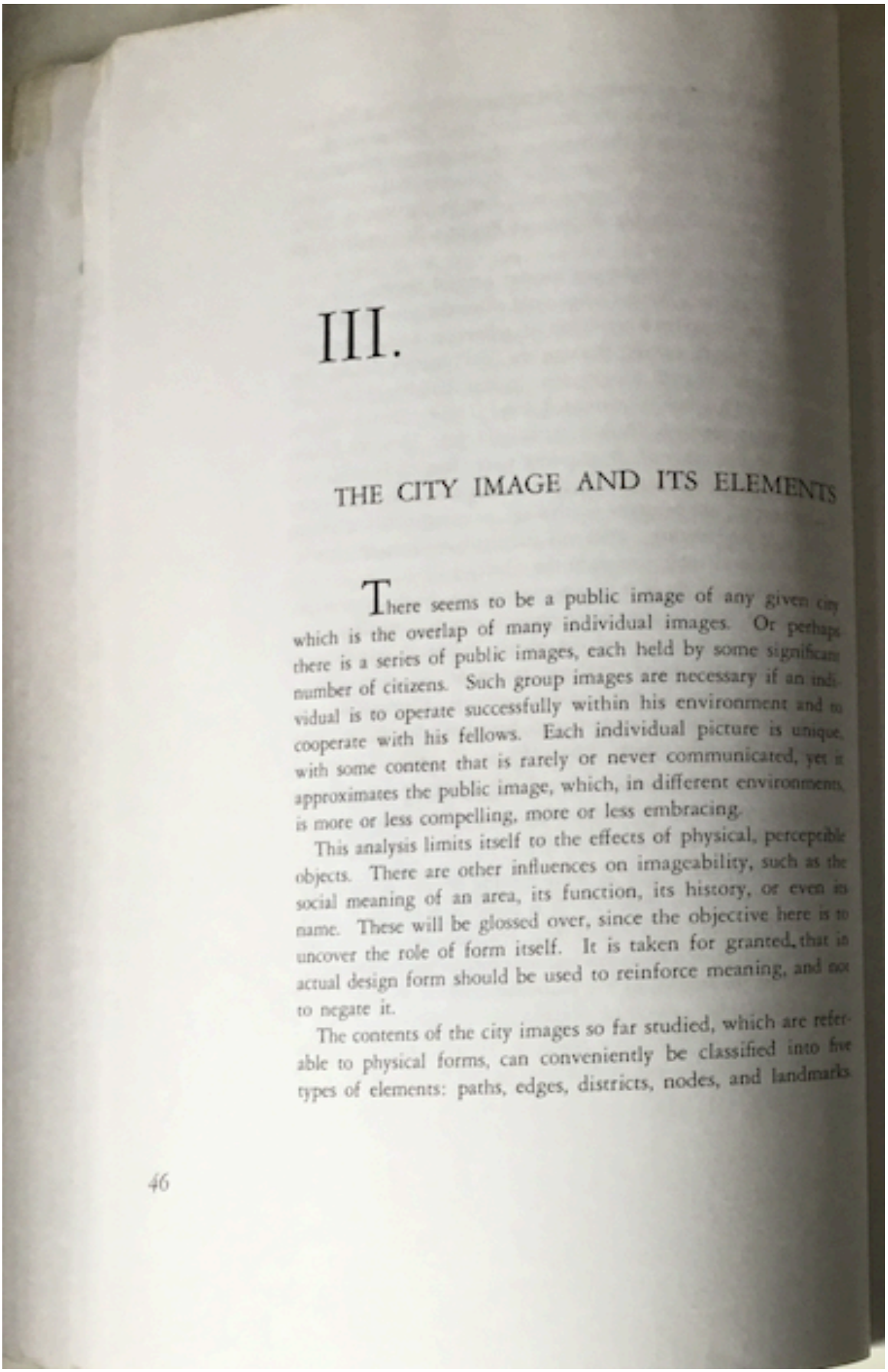
T: +44 (0)7767 850601

sse.com

cc. J. Markwell – Principal Planning Officer, Reading Borough Council
R. Gough – Director of System Operations SSEN
C. McHardy – Land Director, Berkeley Homes

Appendix E- Extracts from 'The Image of the City, Kevin Lynch.





III.

THE CITY IMAGE AND ITS ELEMENTS

There seems to be a public image of any given city which is the overlap of many individual images. Or perhaps there is a series of public images, each held by some significant number of citizens. Such group images are necessary if an individual is to operate successfully within his environment and to cooperate with his fellows. Each individual picture is unique, with some content that is rarely or never communicated, yet it approximates the public image, which, in different environments, is more or less compelling, more or less embracing.

This analysis limits itself to the effects of physical, perceptible objects. There are other influences on imageability, such as the social meaning of an area, its function, its history, or even its name. These will be glossed over, since the objective here is to uncover the role of form itself. It is taken for granted that an actual design form should be used to reinforce meaning, and not to negate it.

The contents of the city images so far studied, which are referable to physical forms, can conveniently be classified into five types of elements: paths, edges, districts, nodes, and landmarks.

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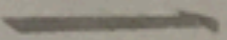
Indeed, these elements may be of more general application, since they seem to reappear in many types of environmental images, as may be seen by reference to Appendix A. These elements may be defined as follows:

1. *Paths.* Paths are the channels along which the observer customarily, occasionally, or potentially moves. They may be streets, walkways, transit lines, canals, railroads. For many people, these are the predominant elements in their image. People observe the city while moving through it, and along these paths the other environmental elements are arranged and related.



2. *Edges.* Edges are the linear elements not used or considered as paths by the observer. They are the boundaries between two phases, linear breaks in continuity: shores, railroad cuts, edges of development, walls. They are lateral references rather than coordinate axes. Such edges may be barriers, more or less penetrable, which close one region off from another; or they may be seams, lines along which two regions are related and joined together. These edge elements, although probably not as dominant as paths, are for many people important organizing features, particularly in the role of holding together generalized areas, as in the outline of a city by water or wall.

3. *Districts.* Districts are the medium-to-large sections of the city, conceived of as having two-dimensional extent, which the observer mentally enters "inside of," and which are recognizable as having some common, identifying character. Always identifiable from the inside, they are also used for exterior reference if visible from the outside. Most people structure their city to some extent in this way, with individual differences as to whether paths or districts are the dominant elements. It seems to depend not only upon the individual but also upon the given city.

4. *Nodes.* Nodes are points, the strategic spots in a city into which an observer can enter, and which are the intensive foci to and from which he is traveling. They may be primarily junctions, places of a break in transportation, a crossing or convergence of paths, moments of shift from one structure to another. Or the nodes may be simply concentrations, which gain their importance from being the condensation of some use or physical character, as a street-corner hangout or an enclosed square. Some

of these concentration nodes are the focus and epitome of a district, over which their influence radiates and of which they stand as a symbol. They may be called cores. Many nodes, of course, partake of the nature of both junctions and concentrations. The concept of node is related to the concept of path, since junctions are typically the convergence of paths, events on the journey. It is similarly related to the concept of district, since cores are typically the intensive foci of districts, their polarizing center. In any event, some nodal points are to be found in almost every image, and in certain cases they may be the dominant feature.

5. *Landmarks.* Landmarks are another type of point-reference, but in this case the observer does not enter within them, they are external. They are usually a rather simply defined physical object: building, sign, store, or mountain. Their use involves the singling out of one element from a host of possibilities. Some landmarks are distant ones, typically seen from many angles and distances, over the tops of smaller elements, and used as radial references. They may be within the city or at such a distance that for all practical purposes they symbolize a constant direction. Such are isolated towers, golden domes, great hills. Even a mobile point, like the sun, whose motion is sufficiently slow and regular, may be employed. Other landmarks are primarily local, being visible only in restricted localities and from certain approaches. These are the innumerable signs, store fronts, trees, doorknobs, and other urban detail, which fill in the image of most observers. They are frequently used clues of identity and even of structure, and seem to be increasingly relied upon as a journey becomes more and more familiar.

The image of a given physical reality may occasionally shift its type with different circumstances of viewing. Thus an expressway may be a path for the driver, and edge for the pedestrian. Or a central area may be a district when a city is organized on a medium scale, and a node when the entire metropolitan area is considered. But the categories seem to have stability for a given observer when he is operating at a given level.

None of the element types isolated above exist in isolation in the real case. Districts are structured with nodes, defined by

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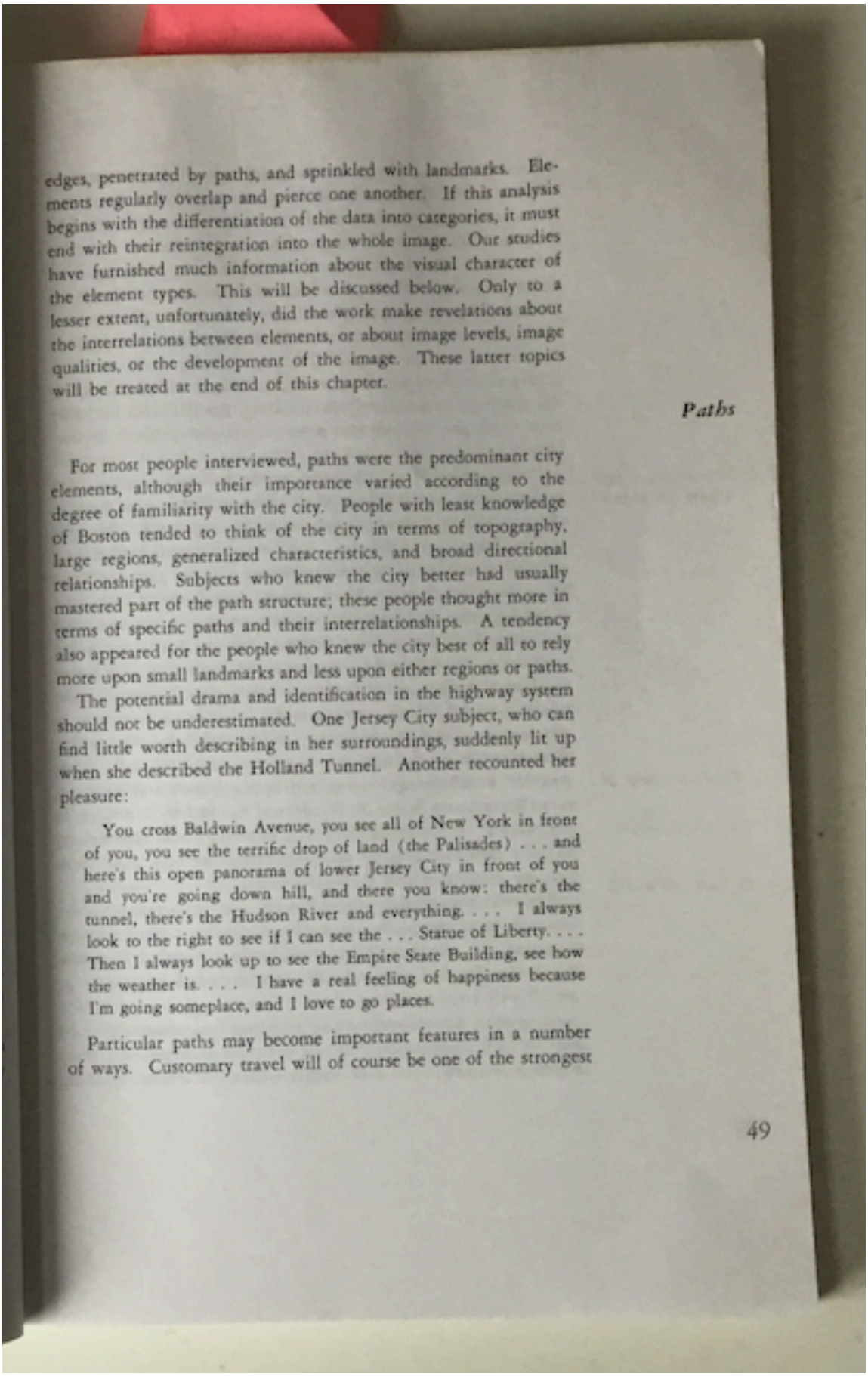

edges, penetrated by paths, and sprinkled with landmarks. Elements regularly overlap and pierce one another. If this analysis begins with the differentiation of the data into categories, it must end with their reintegration into the whole image. Our studies have furnished much information about the visual character of the element types. This will be discussed below. Only to a lesser extent, unfortunately, did the work make revelations about the interrelations between elements, or about image levels, image qualities, or the development of the image. These latter topics will be treated at the end of this chapter.

Paths

For most people interviewed, paths were the predominant city elements, although their importance varied according to the degree of familiarity with the city. People with least knowledge of Boston tended to think of the city in terms of topography, large regions, generalized characteristics, and broad directional relationships. Subjects who knew the city better had usually mastered part of the path structure; these people thought more in terms of specific paths and their interrelationships. A tendency also appeared for the people who knew the city best of all to rely more upon small landmarks and less upon either regions or paths.

The potential drama and identification in the highway system should not be underestimated. One Jersey City subject, who can find little worth describing in her surroundings, suddenly lit up when she described the Holland Tunnel. Another recounted her pleasure:

> You cross Baldwin Avenue, you see all of New York in front of you, you see the terrific drop of land (the Palisades) . . . and here's this open panorama of lower Jersey City in front of you and you're going down hill, and there you know: there's the tunnel, there's the Hudson River and everything. . . . I always look to the right to see if I can see the . . . Statue of Liberty. . . . Then I always look up to see the Empire State Building, see how the weather is. . . . I have a real feeling of happiness because I'm going someplace, and I love to go places.

Particular paths may become important features in a number of ways. Customary travel will of course be one of the strongest

Appendix F- TGN 06/10.

Landscape Institute Technical Guidance Note

Visual Representation of Development Proposals

Technical Guidance Note 06/19

17 September 2019

This guidance aims to help landscape professionals, planning officers and other stakeholders to select types of visualisations which are appropriate to the circumstances in which they will be used. It provides guidance as to appropriate techniques to capture site photography and produce appropriate visualisations.

Contents

1 Introduction

1.1 Purpose of this Guidance

1.1.1 This document aims to help landscape professionals, planning officers and other stakeholders in the selection, production and presentation of types of visualisation appropriate to the circumstances in which they will be used. In doing so, it follows and amplifies the broad principles set out in The Guidelines for Landscape and Visual Impact Assessment 3rd edition (GLVIA3). Consistent with the Environmental Impact Assessment Regulations (EIA Regs), GLVIA3 advocates proportionate and reasonable approaches to the scope of assessments.

1.1.2 In all instances, the principles of clear, open and transparent communication and fitness for purpose should apply. Visualisations produced in accordance with this guidance should assist in informed decision-making.

1.2 Why Visualisations are Required

1.2.1 The world we live in constantly changes and this affects our visual experience. New development is one of the causes of this change. When people are asked to consider the merits of new development proposals or major changes in the landscape, the information available normally includes images illustrating the likely appearance of the proposals. Developers will often illustrate their proposals in brochures using drawings, photographs and artists impressions. Many other kinds of images are used in the formal planning process.

1.2.2 This guidance focuses on the production of **technical visualisations**, described as Visualisation Types, which are intended to form part of a professional Landscape and Visual Impact assessment (LVIA), Townscape and Visual Impact Assessment (TVIA) or Landscape and Visual Appraisal (LVA) that typically accompany planning applications. It is critical that these visualisations are accurate, objective and unbiased. They should allow competent authorities to understand the likely effects of the proposals on the character of an area and on views from specific points.

1.2.3 In contrast, **illustrative visualisations** may be intended for marketing or to support planning applications by conveying the essence of what a proposal would look like in context. These do not have to be based on specific viewpoints and could, for example, include a colour perspective illustration or an artists impression based on a bird's eye view.

1.2.4 Similarly, context photographs and sketches may be effective ways to communicate to stakeholders, in advance of, or association with, more sophisticated Visualisation Types. Generally speaking, they will not be used to explain design proposals *within the planning process*. They may indicate the appearance or context of a landscape or site, show specific points of detail, or be used for internal design iteration. Such illustrations, sketches and photographs are not, therefore, the subject of this guidance.

1.2.5 Technical visualisations can take a variety of generally 'static' forms, including: annotated photographs, wirelines, photomontages and 3D simulations. Plans and sections are potentially effective ways to communicate to stakeholders, in association with visualisations.

1.2.6 Augmented Reality (AR) and Virtual Reality (VR) are 'dynamic' visualisation techniques which are considered separately in this guidance.

1.2.7 Photographs show the baseline conditions; visualisations show the proposed situation; and both combine to simulate the change, for example as photomontages. Visualisations help to show how a proposed development could give rise to change in the character of a place, or affect the quality and nature of views, for example through introduction of new built elements or structures, changes in ground level, and loss of trees, vegetation or landscape features. Visualisations may also be used to illustrate other forms of landscape change, such as changes arising from landscape management or from influences such as climate change.

1.2.8 Depending upon the nature / type of the development or change, visualisations may need to show the development: during construction (if the construction period is of long duration and a notable element of the proposal's visual impact); at specific points in time during operation to illustrate the effectiveness of landscape mitigation; or possibly at decommissioning and restoration (e.g. as with a quarry or landfill site).

1.2.9 Visualisations should provide the viewer with a fair representation of what would be likely to be seen if the proposed development is implemented and should portray the proposal in scale with its surroundings. In the context of landscape / townscape and visual impact assessment, it is crucial that visualisations are objective and sufficiently accurate for the task in hand. In short, visualisation should be fit for purpose.

1.2.10 Visualisations may be used to illustrate other forms of landscape change, such as changes arising from landscape management or from influences such as climate change.

1.2.11 Some types of visualisation are more readily or quickly produced, but all visualisations share a role as a form of graphic communication, intended to represent the anticipated change in the visual environment, to illustrate key components of the proposed change or to give an indication of how much would or would not be visible from a given location.

1.2.12 As a general principle, any visualisation should reasonably represent the proposal in such a way that people can understand the likely landscape and visual change. The degree of detail shown will typically be relative to the design and / or planning stage that has been reached. Visualisations should assist interested parties in understanding the nature of a proposed development within its context, and its likely effects. Their use as part of an iterative process of assessment and design can help inform sensitive siting, design and primary mitigation, all of which are important considerations in the planning process. Showing the development within its context should help to secure better design at an early stage.

1.2.13 Two-dimensional visualisations, however detailed and sophisticated, can never fully substitute what people would see in reality. They should, therefore, be considered an approximation of the three-dimensional visual experiences that an observer might receive in the field.

1.2.14 Note that this guidance cannot provide a complete manual of techniques. Landscape professionals may need to draw upon the expertise of visualisation specialists, particularly for the most sophisticated forms of photography and visualisation.

1.3 A Proportionate Approach

1.3.1 To maintain a proportionate approach, different types of visualisation may be required, depending on:

- the type and scale of project;
- the aim (Purpose) and likely audience (Users) of the visualisation in the decision-making process; and
- the Sensitivity of the receptors and Magnitude of potential landscape and visual change.

1.3.2 The time, effort, technical expertise and cost involved in producing visualisations should be proportionate to these factors.

1.3.3 Other considerations which influence the scope of required visualisations, which should be reasonable and proportionate in relation to Purpose, are:

- The number of viewpoints to be illustrated photographically, and how many of these require visualisations;
- The Visualisation Type (1-4 in the following guidance); and
- The level of detail illustrated within the visualisation, for example as described in the London View Management Framework (see Appendix 6.4)

1.3.4 This guidance represents current best practice, provides a starting point to identify what types of visualisation may be appropriate and sets out approaches to potential visualisation techniques.

1.4 Relationship to previous LI Guidance

1.4.1 This guidance note replaces Landscape Institute (LI) Advice Note 01/11 (Photography and Photomontage for LVIA) and LI Technical Guidance Note 02/17 (Visual Representation of Development Proposals).

1.4.2 Advice Note (AN) 01/11 has been replaced in order to:-

- reflect other sources of guidance and additional research on the topic (see Section 5 - Further Reading);
- accord with the principles of GLVIA3 (2013) - (especially GLVIA3 paras 8.15-8.34);
- encourage best practice in the presentation of visualisations accompanying LVIAs, LVAs and planning applications; and
- ensure that visualisation techniques are properly explained and easily understood by all Users.

1.4.3 TGN 02/17 has been integrated in this guidance in order to provide a single source of guidance from the LI in respect of visualisations. LI AN 01/11 and TGN 02/17 are now withdrawn.

1.4.4 Further information on related landscape and visual assessment, and visualisation advice, may be found on the LI website: https://www.landscapeinstitute.org

1.4.5 These include:

- Glossary and Abbreviations;
- Earth Curvature;
- Camera Auto Settings and Limitations of Zoom Lenses; and
- Examples of Visualisation Types 1-4.

1.5 Visualisation Guidance by Others

1.5.1 This guidance applies to visual representation of all forms of development. The LI recommends its use to its members and to all parties using visualisations as part of the development process. The LI recognises that, for some types of development, targeted or authority-specific guidance may be appropriate.

1.5.2 The Highland Council (THC) Visualisation Standards for Wind Energy Developments 2016, the SNH Visual Representation of Wind Farms 2017 and the London View Management Framework 2012 (LVMF) are examples of 'authority-specific' guidance.

1.5.3 The LI supports Scottish Natural Heritage Guidance: Visual Representation of Wind Farms v2.2 February 2017 (SNH 2017). This Technical Guidance Note is broadly consistent with SNH 2017, particularly in respect of Type 4 Visualisation (see Sections 3 and 4).

1.5.4 The London View Management Framework provides useful guidance for large-scale urban development, and is particularly useful in identifying what it refers to as 'AVR Types' (0 - 3). See 'Further Reading' and Appendices 6.4 and 11.3.

1.5.5 When regulatory authorities specify their own photographic and photomontage requirements, the landscape professional should follow them unless there is a good reason not to do so. Failure to follow such guidance may risk requests for further information during the planning consultation process. Failure to satisfy stated validation requirements could lead to delays in validating planning applications. Seeking early engagement with the competent authority is recommended.

2 Guiding Principles

2.1 This guidance follows the broad principles set out in GLVIA3. Readers should note should note the comments in the Introduction (para 1.2.13) regarding the limitations of two-dimensional images.

2.2 Baseline photography should:

- be sufficiently up-to-date to reflect the current baseline situation;
- include the extent of the site and sufficient context;
- be presented at a size and relative position, on a corresponding sheet, to allow like-for-like comparison with the visualisation;
- be based on good quality imagery, secured in good, clear weather conditions wherever reasonably possible *(see Appendix 4 and GLVIA3 para 8.22)*;
- avoid foreground clutter; and
- in LVA / LVIA baseline photography, if relying on only existing views with no visualisations, clearly identify the extent of the application site in the view *(see Type 1 Visualisations)*.

2.3 Visualisations should:

- provide a fair representation of what would be likely to be seen if the proposed development is implemented;
- be based on replicable, transparent and structured processes *(Section 4)* and use a reasonable choice of agreed viewpoint locations, view directions, view angles and times of day *(Appendix 4)*;
- be reproduced at a suitable size and level of geometric accuracy relative to the baseline photographs *(Sections 3/4 and Appendices 7/8)*;
- be accompanied by appropriate information, including a Technical Methodology and required data within page title blocks *(Appendix 7.2 and 10)*; and
- where necessary, the photography and visualisation should be capable of being verified *(see Visualisation Type 4, Section 4 and Appendix 11)*.

2.4 The producers of visualisations should:

- refer to GLVIA3 paras 8.15-8.31
- use Visualisation Types 1-4, described further below, selected by reference to Purpose of use and anticipated Users, combined with the indicative overall Degree or Level of Effect (a product of Magnitude and Sensitivity) *(see Section 3)*;
- use techniques and media, with appropriate explanation, that represent the proposed scheme and its setting as accurately as reasonably practicable, proportionate to its potential effect;
- where reasonable within project timescales, include maximum effect scenario *(e.g. winter views - see GLVIA3 paras 6.28, 8.15)*; and
- use appropriate equipment and settings *(Sections 3/4 and Appendices 1-5)*.

3 Taking a Proportionate Approach

3.1 Understanding the Proportionate Approach

3.1.1 This section concerns how to determine which type of visualisation is proportionate to the task in hand. When identifying the need for some form of visual representation, landscape professionals, competent authorities and other stakeholders should use this guidance as the basis for reaching agreement on the appropriate Visualisation Type for the project in question. That does not preclude subsequent preparation of other visualisations, but working this way should help to ensure that public interests are secured in a way that is recognised as proportionate and fit for purpose by all those involved.

3.1.2 The factors which determine the appropriate Visualisation Type are:

- the intended Purpose of the visualisation;
- the anticipated Users;
- the stage in the planning application process;
- the Sensitivity of the context / host environment, having regard to the landscape and visual receptors [1]; and
- the likely overall Magnitude of effect of the development in terms of its 'size and scale', 'geographic extent' and 'duration and reversibility' [2].

3.1.3 Selecting the appropriate Visualisation Type requires a staged approach, described in more detail below in this section, and summarised as follows:

- identifying the Purpose and Users of the visualisation;
- identifying the type and nature of the proposed development and early indications of the likely overall Magnitude of effect it would generate;
- examining the context / host environment in which the development would be placed and assessing its overall Sensitivity;
- using the above to arrive at an indicative overall 'Degree or Level of Effect'; and
- selecting the most appropriate Visualisation Type based on the above criteria; and
- explaining the reason for its selection.

3.1.4 The process of selecting Visualisation Types can be considered in terms of a need for increasing levels of scrutiny of information or evidence required, with Purpose and Users considered alongside the likely overall effect of the proposed development on the host environment.

3.1.5 This guidance proposes four Visualisation Types (1-4), from least to most sophisticated, which are described in more detail in Section 4 and summarised in Tables 1 and 2 below.

[1] GLVIA3, paras 6.31- 6.37

[2] GLVIA3, paras 6.38- 6.41

3.2 Working with the Competent Authority

3.2.1 EIA development may be subject to Scoping, which can be used to help determine the appropriate scope and level of detail for the visual components of the LVIA. For non-EIA development, developers are encouraged to request pre-application ('pre-app') advice. If landscape / townscape and visual issues will be a key issue, submission of the proposed visualisation approach, suggested viewpoints and a Zone of Theoretical Visibility (ZTV), will assist in reaching agreement with the competent authority. Draft visualisations which are not fully worked up can be used for pre-app discussions or scoping requests. This should help reduce risk of requests for further information during the planning consultation period, and consequential further costs and delays.

3.2.2 The landscape professional is likely to need to determine an approach to visualisation before having completed (or possibly started) the LVA / LVIA itself. Therefore, a preliminary judgement on the likely overall 'Degree or Level of Effect' will be required. Whilst this should not prejudice the detailed process or outcome of the LVA / LVIA, the context and likely extent of the proposal will be known at an early stage and should be sufficient to inform the initial assessment.

3.2.3 It may be possible at this stage to anticipate a transition from one Purpose and set of Users to another during the course of the project and, therefore, to determine an approach appropriate to the spectrum of Users involved. A typical example is the transition from Planning Application to Planning Appeal.

3.2.4 Although this guidance is particularly aimed at visualisations prepared for use in the decision making process with competent authorities as the intended main Users, visualisations may also be used iteratively during the design process where the Users will be design / planning professionals and their clients.

3.3 Purpose and Users

Purpose

3.3.1 A principal consideration is the of the visualisation, i.e. the Purpose for which it will be used. For example, does it:

- provide basic contextual information in support of a planning application?
- purport to demonstrate the visual change that will be brought about if the development proceeds? or
- aim to prove or disprove if the development is visible, or demonstrate the effectiveness of a mitigation strategy?

3.3.2 Examples of the potential range of Purposes are:

- the illustration of a project prepared for the client as the project develops;
- the illustration of a development proposal prepared to accompany a planning application; and / or
- to illustrate the likely change in a view that may occur as a result of the development being introduced into that view; to inform an LVA or LVIA, e.g. as part of an EIA.

Users

3.3.3 In addition to being clear about the Purpose of the visualisation, it is important to understand and identify the likely Users. Are they:

- people potentially affected by the development who are being asked to give an early opinion as part of a consultation process?
- clients?
- other consultants communicating with the landscape professional?
- those formally commenting on the planning application?
- planning officers considering the merits of an application?
- participants at public inquiry (including members of the public, expert witnesses, legal advisers, Inspectors and Reporters)? and / or
- decision-makers (Councillors, Reporters / Inspectors, Ministers)?

3.4 Combining Purpose / User and Degree or Level of Effect

3.4.1 Having established the Purpose and Users of the visualisations, it is necessary to consider these in relation to the type of development proposed and the likely overall effect it would have on the host environment, having regard to landscape and visual receptors, in line with GLVIA3 principles.

3.4.2 An assessment of the Sensitivity of the context or host environment, together with a judgement of the likely Magnitude of landscape and visual change that may result as consequence of the development, will establish the indicative overall Degree or Level of Effect. This, considered with the Purpose and Users of the visualisation, will help determine which Visualisation Type would best suit the circumstances of the proposal and aid informed decision making.

3.4.3 Sensitivity and Magnitude, as determinants of Degree or Level of Effect, are extensively discussed in GLVIA3, as amended by GLVIA3 Statement of Clarification 1/13 (10-06-13)[3].

3.4.4 The broad principles of assessment are set out in GLVIA3 Figure 3.5. These principles apply to both landscape and visual effects and have clear contributory factors:

- susceptibility and value for Sensitivity;
- size / scale, extent, duration and reversibility for Magnitude.

3.4.5 When assessing Sensitivity and Magnitude and arriving at a judgement of indicative overall Degree or Level of Effect, consideration should be given to the landscape and visual effects of the project as a whole, rather than against individual viewpoints or receptors.

[3] statements of clarification 3 and 4 clarify and augment GLVIA3 paras 3.32-3.36, p.40-41.

3.5 Selecting the Appropriate Visualisation Type

3.5.1 Drawing these threads together, identifying the Visualisation Type, proportionate to the project under consideration, involves combining its Purpose / Users with the indicative overall Degree or Level of Effect of the proposed development. This, in turn, requires an understanding of:

- the landscape / townscape and visual context within which the development may be seen;
- the type of development proposed, its scale and size; and
- the likely overall landscape and visual effect of introducing the development into the existing environment.

3.5.2 The four Visualisation Types proposed in this guidance comprise the following (from least to most sophisticated, in terms of equipment, processing and presentation):

Type 1 annotated viewpoint photographs;
Type 2 3D wireline / model;
Type 3 photomontage / photowire;
Type 4 photomontage / photowire (survey / scale verifiable).

3.5.3 The most sophisticated Visualisation Types are appropriate when the Purpose / User requires the highest levels of accuracy, and the Sensitivity and Magnitude combine to generate the highest Degree or Level of indicative overall Effect.

3.5.4 The Visualisation Types are summarized in Table 2 and described in more detail in Section 4. Types 1-4 are typically all 'static' visualisations (i.e. capable of being printed).

3.5.5 'Dynamic' visualisations such as Augmented and Virtual Reality (AR / VR) are dealt with separately in Section 4.6.

3.5.6 Table 1 provides a broad indication as to appropriate Visualisation Types for different Purposes and Users. Note that Categories 'A' to 'D' illustrate four convenient levels along a scale, not four fixed interpretations.

Table 1: Relationships between Purpose, User and Visualisation Types

Category	Purpose and Users	Appropriate Visualisation Types
A	Evidence submitted to Public Inquiry, most planning applications accompanied by LVIA (as part of formal EIA), some non-EIA (LVA) development which is contrary to policy or likely to be contentious. Visualisations in public domain.	2 - 4
B	Planning applications for most non-EIA development accompanied by LVA, where there are concerns about landscape and visual effects and effective mitigation is required. Some LVIAs for EIA development. Visualisations in public domain.	1 - 4
C	Planning applications where the character and appearance of the development is a material consideration. LVIA / LVA is not required but supporting statements (such as Planning Statements and Design and Access Statements) describe how the proposal responds to landscape context and policies. Visualisations in public domain.	1 - 3
D	To inform the iterative process of assessment and design with client, and / or pre-application consultations with the competent authority. Visualisations mainly confidential.	1 - 2

3.5.7 The decision as to appropriate Visualisation Type should be based on a proportionate approach, taking account of its Purpose / Users and indicative overall Degree or Level of Effect (based on Sensitivity and Magnitude) of the proposed development. In all cases, professional judgement should be applied, and agreement reached with the competent authority wherever possible.

3.5.8 A combination of simpler and more sophisticated graphics may be appropriate to illustrate specific points. So, for example, 3D models, or annotated viewpoint photos (Types 1 and 2) at less important locations, may usefully support more sophisticated (Types 3 and 4) visualisations at key locations.

3.5.9 However, different interpretations of scale between visualisations should be avoided unless there is a specific reason to do so, which should be explained in the Visualisation Type Methodology, the subject of the next section.

3.5.10 When making a final choice it will be important to consider:

- The contextual Sensitivity and Magnitude of landscape and visual effects of the development overall (rather than that applying to a single location) and the application of a proportionate and consistent approach.

- Cost of the visualisation; several factors are relevant here. Firstly, it depends on what readily available technologies are available to the landscape professional. Secondly, it depends on the nature (type, size and scale) of the development and thirdly, on the degree of realism required. For example, wind farm visualisations are less expensive to prepare than for mixed use or other forms of development, because wind farms consist of a number of single objects of the same size and shape with the same surface finish. However, subject to the proportionality principle, cost considerations should not override the reasonable requirement for appropriate visualisations.

- Available technology – some techniques are dependent on particular technologies / software (e.g. digital photo / panoramic viewers) which not all of those preparing visualisations will have access to. Nor will competent authorities necessarily be able to view particular technologies.

- The nature of the development and how it may best be illustrated. For example, where a development is predominantly screened from view, a photowire image may be more helpful than a photomontage, as it can indicate the position of the development beyond any screening.

3.6 Introducing Visualisation Types 1-4

3.6.1 Table 2 below sets out the general aims of Visualisation Types 1-4, together with indications of appropriate locational accuracy, photographic equipment and presentational approaches.

3.6.2 Note that it is not possible to categorise every possible kind of visualisation into Types 1-4; some inevitably straddle categories. If a visualisation does not fit neatly into one of the four categories, that does not make it unacceptable, provided it is fit for purpose and not misleading, and is clearly explained in the Visualisation Type Methodology.

Table 2 Visualisation Types 1-4		Type 1	Type 2	Type 3	Type 4
		Annotated Viewpoint Photograph	3D Wireline / Model (non-photographic)	Photomontage / Photowire	Photomontage / Photowire Survey / Scale Verifiable
Aim of the Visualisation		To represent context and outline or extent of development and of key features	To represent 3D form of development / context	To represent appearance, context, form and extent of development	To represent scale, appearance, context, form, and extent of development
Photographic Equipment	**Tripod**	Recommended but discretionary	Not relevant	Recommended	Necessary
	Panoramic head	Not relevant		Recommended for panoramas	Necessary for panoramas
	Minimum Camera / Lens	Cropped frame or FFS + 50mm	Not relevant	Cropped frame or FFS + 50mm	Full Frame Sensor (FFS) + 50mm FL lens [1]
Locational Accuracy	**Source of camera/viewpoint location data**	GPS, OS Maps, geo-referenced aerial photography	Varies according to technology	Use good quality data: GPS, OS Maps, geo-referenced aerial photography, LiDAR	Use best available data: High resolution commercial data, LiDAR, GNSS, or measured / topographic surveys
	Survey-verified [2]	Not relevant			When appropriate
Data & Presentation	**Verifiable (SNH) [3]**	Not relevant			Required
	3D model	Not required	Required		
	Image Enlargement [4]	Typically 100%	Not relevant	Typically 100%	100% - 150%
	Form of Visualisation	sketch / outline / arrows	massing / wireline / textured	wireline / massing / rendered / textured to agreed AVR level [5]	
	Viewpoint mapping	Dedicated viewpoint location plan			Dedicated viewpoint location plan, + individual inset maps recommended
	Reporting of methodology and data sources	Outline description of sources and methodology recommended		Data, sources and methodology recommended	Verifiable data, sources and methodology required

Table 2 footnotes:

1 FFS+50mm FL - note exceptions to 50mm lens FL. See Section 4 and Appendices 01 and 06.

2 Survey-verified means the camera position and survey features being recorded by highly accurate survey processes. See Section 4 Locational Accuracy & Appendix 14.

3 Verifiable (SNH) has the same meaning as in SNH 2017 - the photographic process and image scaling is capable of being verified to agreed standards by reference to the original photograph with metadata. See Appendices 6 & 11.

4 Image Enlargement - see 3.8 below.

5 AVR level - see Appendix 6.4.

3.7 Visualisation Type Methodology

3.7.1 For any given project for which visual representation may be required, the proposed approach to visualisation should be set out in a brief description, explaining:

- the anticipated Purpose / Users;
- the indicative assessment of Sensitivity and Magnitude and resulting likely indicative overall Degree or Level of Effect; and
- other factors influencing the selection of the Visualisation Type.

3.7.2 This may be combined with a preliminary selection of proposed viewpoints and submitted to the competent authority and, ideally, agreed prior to submission of any planning application. See also GLVIA3 para 6.18.

Examples

3.7.3 The following are examples of using Tables 1 and 2 to arrive at an appropriate Visualisation Type 1-4. Letters A-D refer to the 'Category' column in Table 1 above.

(1) ***A single house**, submitted as a planning application in a prominent location within a designated landscape, might be regarded as:*

- *Purpose / User C, Planning Application;*
- *High-Medium Sensitivity, Small-Negligible Magnitude;*
- *likely Slight-Moderate Degree or Level of Effect.*

*This would suggest **Type 1** visualisations - perhaps an annotated photograph (40° at A3 width) indicating the extent (width / height, or outline) of the proposed development.*

(2) *Pre-application discussions with developer over **proposals to re-work a large clay waste tip** on the edge of a National Park, screened as requiring EIA. Accurate output from a 3D model is required to understand the nature and magnitude of visual impacts from key sensitive locations and determine the need for fully rendered photomontage to form part of a formal LVIA.*

- *Purpose / User D, pre-application discussions;*
- *High Sensitivity context, Large Magnitude;*
- *likely Substantial Degree or Level of Effect.*

*This would suggest **Type 2** (3D modelling) - outputs required for informed discussion, not determination of planning application.*

(3) ***A small quarry / extension**, submitted as a planning application, in a landscape considered of medium to high sensitivity to the proposed change, might be regarded as:*

- *Purpose / User B, accompanying an LVA;*
- *Medium Sensitivity, Medium Magnitude;*
- *likely Moderate Degree or Level of Effect.*

*This would suggest **Type 3** - photowires or photomontages (40° at A3 width or 90° at A1) indicating the appearance of the proposed development.*

(4) ***A large housing site**, submitted as a planning application with potential implications on a local designation (e.g. Conservation Area or Important Landscape Area) might be regarded as:*

- *Purpose / User B, accompanying an LVA;*
- *High-Medium Sensitivity context, Large-Medium Magnitude;*
- *likely Substantial Degree or Level of Effect.*

*This would suggest **Type 3** photowires or photomontages, or possibly **Type 4** (surveyed) if close-proximity sensitive views were required.*

(5) ***A large wind farm** in a locally-designated landscape area, the subject of a public inquiry, might be regarded as:*

- *Purpose / User A, part of an EIA;*
- *High-Medium Sensitivity, Large Magnitude;*
- *likely Substantial Degree or Level of Effect.*

*This would suggest **Type 4** visualisations, where surveyed locational accuracy is not necessary but image enlargement, to illustrate perceived scale, would be appropriate.*

(6) *Planning application for **a very large energy from waste plant** building with 90m twin stacks and plume emissions on an edge of town industrial estate, within potential visual range of important views from a Grade 2 Registered Historic Park (designated heritage asset):*

- *Purpose / User A / B (Planning / Public Inquiry);*
- *High Sensitivity, Large-Medium Magnitude;*
- *likely Substantial Degree or Level of Effect.*

*This would suggest **Type 4** visualisations, where surveyed locational accuracy may not be necessary but image enlargement, to illustrate perceived scale, would be appropriate.*

(7) ***A proposed new tower block** with potential implications on a designated landscape / townscape, subject to a planning application, might be regarded as:*

- *Purpose / User A / B (Planning / Public Inquiry);*
- *High Sensitivity, Large Magnitude;*
- *likely Substantial or Very Substantial Degree or Level of Effect.*

*This would suggest **Type 4** visualisations. In addition, if the precise visual relationship between the tower block and other buildings is of particular importance, surveyed locational accuracy may be appropriate.*

3.7.4 The preceding examples are just that - examples - and should not be regarded as templates. This approach can be used in preparing a Visualisation Type Methodology. It is not a sophisticated LVA / LVIA, but a review of basic criteria, known early in the project, to inform selection of appropriate Visualisation Types.

3.7.5 The selected Visualisation Type (1-4) should be clearly stated on all visualisation pages, such that recipients can understand the approach being taken.

3.8 Viewing Distance and Image Enlargement

3.8.1 Table 2 introduces the concept of 'image enlargement', which is carried forward into the detail of Visualisation Types 3-4 , described in the next section.

'Monocular' and 'Binocular' viewing

3.8.2 Printed photographic images have a theoretical viewing distance at which the scale of the view is reconstructed, although this assumes that cameras and humans have similar optical systems, which they do not. The essential difference is that cameras (for this purpose) are monocular, and humans are generally binocular. In addition, the fact that reality is viewed as a 3D space, whereas photographs are viewed as 2D projections, combine to alter perceptions of 'scale' and 'depth' between reality and photography. See Section 5 'Further Reading' for more information.

3.8.3 Whilst mathematical viewing distances have historically been quoted alongside visualisations, it is generally regarded that viewing distances of between 500mm – 550mm (approximately arm's length) are the most practical and widely used. All scale-representative views should, therefore, be accompanied by a note: "To be viewed at comfortable arm's length".

100% Reference Image

3.8.4 A 'mathematically correct' image is established for a 50mm FL approximately 39.6 Horizontal Field of View (HFoV) image, printed at a size of 390mm x 260mm on an A3 sheet, and held at 542mm[1] from the eye. This 'monocular view' represents a reference point of 100% in this guidance note, against which enlargements, such as 150%, can be described. For example, a 50% increase in image size can be described as a 150% enlargement.

3.8.5 Changes in the relative size of printed images are described in other documents as the 'Effective Focal Length' (EFL) at which an image is presented. 50mm EFL equates to 100% and 75mm EFL equates to 150%. For simplicity, this guidance describes the enlargement by percentage, related to the 100% reference image.

150% Enlargement Factor

3.8.6 Whilst presenting a 50mm FL image (39.6° HFoV) at A3 size is a straightforward use of the camera image, this approach has been found to be lacking in respect of expansive projects in open landscapes or seascapes, such as windfarms. This is because, for a 50mm FL image printed at A3 and held at comfortable arm's length, the scale of the viewed image is smaller than reality.

3.8.7 As a result of research in Scotland over the last decade (see Section 5 - Further Reading) there is a consensus that increasing the printed image size by 150% (as if a 75mm FL lens had been used) provides a better impression of scale for most viewers using two eyes (binocular vision). This is particularly appropriate for projects such as windfarms, whether viewed on a desktop or on site.

3.8.8 The approach of this guidance is, therefore, to recognise that, for larger-scale projects with more distant components such as windfarms, the approach taken in SNH 2017 (put simply, a 150% enlargement) is appropriate.

3.8.9 This brings with it some issues:

a) Paper size or constrained Field of View

Adding 50% to the image size increases the presentation size (digital or paper). Conversely, the site can only be represented

[1] Note that 542mm simply establishes a mathematical reference point. Generally, there is no need to hold the image at such a specific distance.

if it can be accommodated within an A3 sheet (27°HFoV x 18.2° VFoV) or A1 sheet (53.5°HFoV x 18.2°VFoV). If it occupies a greater vertical or horizontal FoV, then alternatives must be considered.

This is accounted for in the SNH Guidance, in that exceptions to its standard can be discussed and agreed with SNH.

b) Appropriateness in all situations

Whilst the 150% enlargement overcomes the scale issues for the expansive projects for which it was designed, it may over-compensate for projects in more constrained environments, such as urban or small-scale enclosed landscapes. In these situations, less enlargement may be appropriate.

3.8.10 Research by the LI Working Group in the preparation of this guidance, carried out across several cities, suggests that, in mid- to smaller-scale landscapes / townscapes, an enlargement around half-way between 100% and 150% results in a binocular relationship between the presented image and reality.

3.8.11 In addition, there will be situations - for example very close urban contexts or developments of considerable height or width - where scaling at less than 150% may provide more flexibility to fit an image on the page.

3.8.12 In these instances, the landscape professional should present the logic, behind opting for a particular enlargement factor, to the competent authority.

3.8.13 Notwithstanding the above, SNH considers that consistent use of 150% enlargement is beneficial.

Other means of achieving enlarged images

3.8.14 An A3 (50mm FL, 39.6° HFoV) sheet, when printed at A2 size, is enlarged by 141%. This provides a basic way to create a printed page with improved image scaling, simply by printing an A3 figure, enlarged to fill an A2 sized sheet. This will, however, result in some loss of resolution compared to an image which is created to be placed in an A2 sheet at full resolution. It should not, therefore, be used in the more rigorous context of Visualisation Type 4.

3.8.15 A 35mm FL lens on a FFS camera will capture a HFoV of 54.4°, which is very close to the requirements of an SNH 2017 planar A1 panorama (53.5° HFoV). Whilst it will not satisfy SNH 2017 Guidance (which requires the 50mm / FFS combination) a 35mm FL image of sufficient resolution and clarity may, therefore, provide an A1-width planar panoramic image, without stitching and re-projecting of multiple 50mm images.

3.8.16 In either case, the practitioner should ensure that image quality is appropriate for the Purpose, and set out the approach in the Visualisation Type Methodology (3.7) and Technical Methodology (Appendix 10).

4 Description of Visualisation Types 1-4

4.1 Visualisation Types 1-4

4.1.1 The main characteristics of Visualisation Types 1-4 are introduced below. More detail on these 'static' visualisations is provided in the sections which follow, including a separate subsection on 'dynamic' visualisations, namely AR / VR.

Type 1 Annotated Viewpoint Photograph:

Reproduced at a size which aids clear understanding of the view and context, these simply show the extent of the site within the view, and annotate any key features within the view.

Type 1 is the most basic form of visual representation with a focus on the baseline information.

Type 2 3D Wireline / Model:

This covers a range of computer-generated visualisation, generally without a photographic context. Wirelines and other 3D models are particularly suited to graphically describing the development itself.

Type 2 visualisations use basic graphic information to assist in describing a proposed development and its context.

Type 3 Photomontage / Photowire:

This Type encompasses photomontages and photowires which will commonly be produced to accompany planning applications, LVAs and LVIAs. They provide a reasonable level of locational and photographic accuracy, but are not suitable for the most demanding and sensitive of contexts. Type 3 visualisations do not need to be accompanied by verification data, nor is a precise survey of features and camera locations required. Although minimum standards are set for image presentation, the visualisations do not need to be reproduced with scale representation.

Type 3 visualisations offer an appropriate level of detail and accuracy for a range of EIA and non-EIA projects.

Type 4 Photomontage / Photowire (survey / scale verifiable):

Type 4 photomontages and / or photowires require the use of equipment and processes which provide quantifiable verification data, such that they may be checked for accuracy (as per industry-standard 'AVRs' or 'Verified Views'). Precise survey of features and viewpoint / camera locations may be included where warranted. Type 4 visualisations are generally reproduced with scale representation.

Type 4 visualisations represent the highest level of accuracy and verifiability for use in the most demanding of situations. See also Appendix 11, Verified Photomontages.

4.1.2 In providing flexibility across Visualisation Types 3 and 4, there is inevitably some degree of overlap between them, for example in terms of image scaling or presentation size. Whilst Type 3 will be acceptable in many situations, only Type 4 methodology and equipment can provide the levels of verifiable accuracy which are appropriate to high Sensitivity contexts and Purposes.

4.2 Type 1: Annotated Viewpoint Photograph

4.2.1 Viewpoint photographs are often used in LVIAs and LVAs and may usefully be annotated to show the extent or position of the site and other features. 3D-modelling is not required - the annotations of site extent (horizontally) may be estimated by reference to site features such as field or plot boundaries.

4.2.2 Single images will be planar (i.e. as captured by the camera). Alternative lens types may be considered - see Appendix 1. Where single images can capture the site (e.g. 39.6° x 27°) and be presented at A3, they may be supported by two baseline panoramic images (maximum 60° HFoV) presented on an A3 sheet. This is purely to show the location of the full-size single image frame in its context and, as such, should be noted as being 'for context only'. Wide panoramas on an A3 sheet are too small to provide a representation of the proposed development.

4.2.3 Where panoramic images are required to capture the site, they may be presented as cylindrical panoramas of up to 90° HFoV at A1 width with an image size of 820mm x 250mm (see Appendix 8). This sizing equates to around 96% image 'enlargement'.

4.2.4 Locational accuracy is moderately important, and reasonably precise locations can be determined from GPS data, OS maps or aerial photography.

4.2.5 Refer also to the Technical Methodology, Appendix 10.

Table 3: Suitable photographic / print formats (Type 1):

Camera / lens	FFS + 50mm lens	Cropped frame + 28 or 35mm lens
Sheet size	A3	
Image size (mm)	390 x 260	
Presented Field of View (H x V)	39.6° x 27°	Either 35mm = slightly narrower than FFS+50mm, or crop 28mm image to match FFS+50mm
Sheet size	Cylindrical Panoramic image @ A1 width	
Presented Field of View (H x V)	90° x 27° (VFoV as appropriate)	
Image size (mm)	820 x 250 minimum (height as appropriate)	

Type 1 Summary

Type 1 visualisations are simple, annotated photographic illustrations which often accompany LVAs.

- Use a Full Frame Sensor camera with 50mm lens, or cropped-frame sensor camera with 35mm or 28mm fixed lens. See Appendix 1.
- Images will typically be presented with a single frame on an A3 sheet.

4.3 Type 2: 3D Wireline / Model

4.3.1 This Type covers the use of 'static' presentation of 3D models which are visual representations distinct from photographically-based photomontages.

4.3.2 The main examples are computer-generated 3D wirelines (also described as 'wireframes') and 'massing' models, potentially with computer-generated context, such as buildings, terrain or other surrounding features.

4.3.3 'Dynamic' visual representations, such as 'augmented reality' or 'virtual reality' (AR or VR), are dealt with separately in Section 4.6 below.

4.3.4 Images to be included in reports should be of sufficient size to communicate a sense of the scale of the development. An A3 Sheet, as with Types 1 and 3, would generally be appropriate. An image based on a 3D model to show proposed development layout (for example, an aerial view) need have no specific FoV or location reference, but should have a realistic sense of perspective.

4.3.5 Computer models generally do not convey landscape context unless they are extremely sophisticated. Most planning applications should be accompanied by photographs or photomontages, rather than solely relying on Type 2 visualisations to convey an impression of a development proposal.

4.4 Type 3: Photomontage / Photowire

4.4.1 Type 3 visualisations are photomontages or photowires (photographs with wireline overlays) where site photography forms the basis of the imagery, which is then overlaid by a 3D wireframe, massing or rendered model. Type 3 are suitable for representing proposals where precise perception of scale of the printed image, and the highest levels of locational accuracy, are not necessary. If the key criteria for Type 4 cannot be guaranteed, then the visualisation will be classified as a Type 3. 'Type 3' should be clearly stated on all visualisations.

Table 4: Suitable photographic / print formats (Type 3):

Camera / lens	FFS + 50mm lens	Cropped frame + 28 or 35mm lens
Presented Field of View (H x V)	39.6° x 27°	Either 35mm = slightly narrower than FFS+50mm, or crop 28mm image to match FFS+50mm
Sheet size	A3	
Image size (mm)	390 x 260	
Enlargement relative to FFS / 50mm	100%	100 - 120%
Sheet size	Cylindrical Panoramic image @ A1 width	
	90° x 27° (VFoV as appropriate)	
Enlargement relative to FFS / 50mm	96%	
Image size (mm)	820 x 250 minimum (height as appropriate)	

Lens and Camera

4.4.2 Full-Frame Sensor cameras (FFS) are appropriate. Cropped-frame cameras (e.g. Canon APS-C / Nikon DX) are acceptable when a fixed lens of 35mm FL is used. Alternatively a 28mm lens could be used and the resulting photographs cropped to achieve the same FoV as a 50mm FL lens with an FFS. See Appendix 1.2. Note that different cropped-frame lens / camera combinations will result in slightly different FoV and enlargement factors.

Purpose

4.4.3 Type 3 visualisations are intended to represent design, form and context to a reasonable degree of objectivity and accuracy, one which can be understood and relied on by competent authorities and others. This category covers a wide range of applications including non-verifiable viewpoint locations, such as those from moving vehicles / drones and other such situations where the viewpoint coordinates cannot be replicated with the same degree of accuracy / precision as Type 4 visualisations. It would also be appropriate where photographs have been taken by a 3rd party, provided these are prepared in accordance with the principles set out in this guidance and supported by a clear methodology.

4.4.4 Type 3 visualisations should not be selected when printed scale representation is required.

4.4.5 Single images are planar (i.e., as captured by the camera). Alternative lens types may be considered - see Appendix 1.

4.4.6 Where single images can capture the site (e.g. 39.6° x 27°) and be presented at A3, they may be supported by two baseline panoramic images (maximum 60° HFoV) presented on an A3 sheet. This is purely to show the location of the full-size single image frame in its context and, as such, should be noted as being 'for context only'. Wide panoramas on an A3 sheet are too small to provide a

representation of the proposed development. They do not replace baseline photographs, which should be presented at the same size and scale as their corresponding visualisations.

Presentation

4.4.7 Imagery will typically be presented as two related sheets: Baseline photograph and photomontage. These should be presented at the same size to allow direct comparison. A wireframe may be included to explain alignment between the 3D model and site features.

4.4.8 Visualisations should be accompanied by a Technical Methodology, setting out the criteria listed in Appendix 10.

Panoramas

4.4.9 Where panoramic images are required to capture the site for visualisation, they may be presented as cylindrical panoramas of up to 90° HFoV at A1 width with an image size of 820mm x 250mm (see Appendix 8). This sizing equates to around 96% image 'enlargement' (i.e. a slight reduction from the 100% reference). When a wider FoV than 90 degrees needs to be captured, this should be done by using adjoining A1 sheets.

Locational Accuracy

4.4.10 It is important to disclose the level of locational accuracy of Type 3 visualisations, which should be determined on the basis of proximity of viewpoint to the site and on Sensitivity of receptors / importance of the view. The level achieved should be clarified in the methodology and the same approach should be taken for all visualisations presented. Typically, horizontal accuracy of 1-2 metres can be obtained from aerial photography. However, this may vary according to the aerial photography source and location (see Appendix 14) and this should be considered when reporting on locational accuracy in the methodology.

Type 3 Summary

Type 3 visualisations will be appropriate for many planning applications, LVAs and LVIAs, where photomontage is required but a verifiable process and printed scale representation are not needed.

- Use a Full Frame Sensor camera with 50mm lens or cropped-frame sensor camera with 35mm or 28mm fixed lens.
- Images will typically be presented with a single frame on an A3 sheet, providing an enlargement in the range 100-120% subject to camera / lens combination.
- The enlargement factor should be stated on each page, together with the label 'Visualisation Type: 3'.
- For very wide linear infrastructure, consider presenting cylindrical panoramas up to 90° at A1 width, with multiple sheets for very wide panoramas.
- Accompany visualisations with a Technical Methodology (see Appendix 10).

4.5 Type 4: Photomontage / Photowire (survey / scale verifiable)

4.5.1 Type 4 visualisations are photomontages or photowires, produced using quantifiable data, with procedural transparency and appropriate levels of accuracy. This involves using a defined camera / lens combination and establishing the camera location with sufficient locational accuracy to enable accurate scaling and location of the 3D model within the view. In addition, the print presentation size can be determined to provide binocular image scaling when appropriate (see Section 3.8). Note that, due to the variable nature of digital viewing devices, images cannot be assumed to provide a perception of scale unless printed at the specified size. See Appendix 7 for more details. 'Type 4' should be clearly stated on all visualisations.

4.5.2 See Appendix 6 'Preparing Photomontages' and Appendix 8 'Panoramas'.

Lens and Camera

4.5.3 Base photography should be carried out with a Full Frame Sensor (FFS) camera and 50mm Focal Length prime lens, unless there are exceptional conditions where wider-angle lenses are required to fully capture the scene (e.g. tall tower blocks - see below). In such cases, any departures from FFS + 50mm FL should be explained and agreed with the competent authority.

4.5.4 Table 5 represents the range of approaches suitable for Type 4 visualisations. Note that the stated percentage enlargement figures are relative to a 50mm FL image printed on an A3 sheet at 390mm x 260mm image size (para 3.8.4, 100% Reference Image).

Table 5: Suitable photographic / print formats (Type 4)

Camera / lens	FFS + 50mm lens	
Option	1	2
Captured Field of View (HFoV x VFoV)	39.6° x 27°	
Image scaling (see 3.8)	'Monocular'	'Binocular'
Sheet size	Single image @ A3	
Projection (see App 8)	Planar	
Image size (mm)	390 x 260	
Presented Field of View (H x V)	39.6° x 27°	27° x 18.2°
Enlargement relative to FFS / 50mm	100%	150%
Sheet size	Panoramic image @ A1 width	
Projection (see App 8)	Cylindrical (for baseline and very wide linear infrastructure)	Planar
Presented Field of View (H x V)	90° x 27°	53.5° x 18.2°
Enlargement relative to FFS / 50mm	96%	150%
Image size (mm)	820 x 250 minimum (height as appropriate)	

Note that exceptions to lens and image sizes are acceptable if explained and agreed with the competent authority

Presentation

4.5.5 Imagery will typically be presented as three related sheets: Baseline photograph; wireline / wireframe or photowire composite; and photomontage. These should be presented at the same size to allow direct comparison.

4.5.6 Visualisations should be accompanied by a Technical Methodology, setting out the criteria listed in Appendix 10. In addition, a clear written description should be provided to explain the procedures involved in image capture and processing.

Locational Accuracy

4.5.7 For Type 4, the minimum level of locational accuracy is similar to the upper end of the Type 3 range.

4.5.8 The degree of accuracy should be determined on the basis of proximity of viewpoint location to the site and on Sensitivity of receptors / importance of the view. Typically, horizontal accuracy within 1-2 metres can be obtained from aerial photography. See Appendix 14.

4.5.9 In situations where the subject of the photomontage is close and the Sensitivity is high (typically in important urban and heritage contexts) high levels of locational accuracy may be required to establish intervisibility between the viewpoint, the subject of the photomontage and other elements in the scene, e.g. when assessing if a development interrupts a sensitive skyline or not. Such accuracy may be obtained from survey techniques providing sub-metre accuracy (see Appendix 11.4, survey-verified photography).

Image Scaling

4.5.10 The objective of Type 4 visualisation is to present a printed image which gives a realistic impression of scale and detail. Where scale-verifiable output is not possible (Appendix 1.1.7), verified photomontages can still be regarded as Type 4, provided they are supported by quantifiable data and a technical methodology, and agreed by the competent authority.

Table 5, Option 1: 100% enlargement

4.5.11 This is a 39.6° HFoV photograph presented within a 390 x 260mm frame. This option does not provide for binocular image scaling when printed. Nonetheless, it is included within Type 4 for the following reasons:

- where 150% enlargements would be problematic for large / close sites (due to impractical paper sizes), an option is still required for use in the planning process which maintains high levels of accuracy (e.g. levels 'A' or 'B' in Table 1);
- even though a 100% enlargement image will not provide 'binocular' perception scaling, it may still be useful and practical in its own right.
- once the 50mm / FFS combination is engaged, the EXIF metadata of the source RAW / JPG photographs can be interrogated and verified (as per SNH 2017), irrespective of how they are presented - see Appendix 11.2; and
- appropriately captured source photographs are capable of meaningful survey and verification when required - see Appendix 11.4.

4.5.12 In the majority of situations, and wherever context is important to understanding of the proposal, an A1 width 90° cylindrical baseline photograph will provide a 100% enlargement contextual reference.

Table 5, Option 2: 150% enlargement

4.5.13 SNH 2017 effectively requires an image enlargement of 150%, in other words 50% over that which is 'mathematically correct for monocular vision' (see Section 3.8). Option 2 of Table 5 corresponds with this approach. This is regarded as the default enlargement factor for Type 4 visualisations.

4.5.14 The SNH 2017 guidance is endorsed by the LI for windfarms and similar projects which are viewed in expansive landscapes over medium to far distances. Refer directly to the SNH 2017 guidance for full details and requirements.

4.5.15 The image capture and presentation process should be capable of being verified, in accordance with SNH 2017 guidance. See Appendix 11, Verified Photomontages.

4.5.16 As noted at 3.8.10, in mid- to smaller-scale landscapes or townscapes, enlargement factors around halfway between 100% and 150% may be a more appropriate. This guidance does not propose any definitive rule, but considers that this reduced level of enlargement may provide an option for consideration by practitioners and the competent authority.

4.5.17 In either case, the principle, of producing an image which represents the scale of the proposal, is maintained. The proposition, that different approaches may be applied to image scaling, recognises that this depends on context and distance. However, a consistent approach to image scaling should be applied within any project.

Other Approaches

4.5.18 There are circumstances where it may be appropriate to depart from using a 50mm lens on site and from setting up pages with a 150% enlargement. These are described below.

Wider Vertical Field of View (VFoV)

4.5.19 The proposed development, viewed at close quarters, may not be captured by a 50mm lens with FFS camera, or fit within the A3 or A1 width x A4 height page sizes - for example, a tall building or high-voltage overhead lines. Alternative lenses may be required in exceptional circumstances - see Appendix 1.

4.5.20 In such instances, alternatives such as increasing the vertical height of the page (to A2 landscape, A1 landscape width with A3 landscape or even A1 landscape width and height) may be appropriate. Reasons for adopting such dimensions should be set out in the Technical Methodology. Wherever practical, 150% enlargement should be maintained.

Wider Horizontal Field of View (HFoV)

4.5.21 The edge distortion of planar panoramas results in them being unsuitable for images with a wide HFoV. Where the required HFoV exceeds 53.5°, multiple planar panoramas of 53.5° may be butted, or overlapped by 25-50% to provide a wider total HFoV. The extent of overlap may be determined by the total HFoV to be shown. In either case (butting / overlapping) the approach should be clearly explained.

4.5.22 If there is a particular reason to show very wide panoramas, (for example, for linear infrastructure occupying a wide FoV) the use of cylindrical projection (Table 5, Option 1, A1 width) may be considered and, if justified, the reasons explained in the Technical Methodology and the projection set out clearly on the presentation page.

Type 4 Summary

Type 4 visualisations enable the highest level of locational accuracy and image scaling where required:

- For sites / settings which can be captured either as single images or panoramically, use a 50mm lens with Full Frame Sensor camera.
- If the site / setting cannot be captured with the 50mm lens (e.g. close, tall buildings), consider alternative lenses - see Appendix 1.
- Images will typically be presented with a 150% enlargement (27°@ A3, or 53.5° @ A1)
- The enlargement factor should be stated on each presentation page, together with the label 'Visualisation Type: 4'.
- Present Planar projection panoramas for views up to 60° HFoV.
- 100% size (39.6° HFoV @ A3) may be considered and agreed with the competent authority where higher levels of enlargement are not practical.
- For wider view angles, use overlapping or butted planar panoramas.
- For very wide linear infrastructure, consider presenting cylindrical panoramas up to 90° at A1 width, with multiple sheets for very wide panoramas.
- Wherever wider context is important to understanding of the proposal, include an A1 width 90° cylindrical baseline photograph.
- Accompany visualisations with a Technical Methodology (see Appendix 10) including a clear written description of procedures involved in image capture and processing.

4.6 Dynamic Visualisations

4.6.1 Emerging visualisation technologies such as Augmented Reality (AR) and Virtual Reality (VR) currently require specialist skills and technology / software and may have significant cost implications and may, therefore, be beyond the scope of many landscape professionals, their clients and competent authorities. However, as these technologies develop, they are likely to become more widely available and used.

Augmented Reality

4.6.2 Augmented Reality (AR) visuals typically use phones, tablets or headsets. AR visuals have the advantage of being able to present moving elements (such as vehicles or turbines) within the view, and, if used on site, of moving the viewpoint. Images can be captured on site and subsequently used off site. Depending on the viewing screen size, visuals will be presented at a range of scales, so care is needed when interpreting their outputs. Similarly, the cameras of such devices are likely to be wide-angle (in the region of 30-35° HFoV). Note that levels of locational accuracy can be improved with surveying techniques, and that specialist devices with precision lenses, or connected to digital cameras, may come into use. It is likely that, under such circumstances, AR could in the future satisfy the requirement of Type 3 visualisations.

Virtual Reality

4.6.3 Virtual Reality (VR) headsets use computer-modelled backgrounds rather than photographic backgrounds, due to their ability to move location within the model. This is a disadvantage in terms of realism, but an advantage in terms of being able to study movement within or around a development. As such, they present an alternative approach to visualising development. Subject to the quality of the hardware used, image resolution may be relatively poor, compared to print outputs.

Summary

4.6.4 AR and VR visuals are under constant development. Although their preparation and use is beyond the scope of this guidance, they are expected to become increasingly important and common in visualisation, as the technologies mature and improve. For more information on Augmented and Virtual Reality, refer to the LI Digital Realities Technical Information Note.

5 Further Reading

Best Practice Guidance

Landscape Institute and IEMA (2013) - Guidelines for Landscape and Visual Impact Assessment 3rd edition (GLVIA3)

Scottish Natural Heritage (2017) - Visual Representation of Wind Farms: good practice guidance (version 2.2) (SNH 2017)

The Highland Council (2016) - Visualisation Standards for Wind Energy Developments

London View Management Framework Supplementary Planning Guidance (2012)

Research

Alan Macdonald (2012) - Windfarm Visualisation

University of Stirling (2012) - Report on perception of scale and depth in landscape photographs

Appendices

Methodology

Equipment

App 1 Camera Equipment
App 2 Camera Settings
App 3 Site Equipment

On Site

App 4 In the Field
App 5 Night-time Photography

Presentation

App 6 Preparing Photomontages
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App 12 Matching Photography and 3D Modelling
App 13 Tilt Shift Lens
App 14 Locational Accuracy

Technical Information Notes (LI web site)

Glossary and Abbreviations
Earth Curvature
Camera Auto Settings and Limitations of Zoom Lenses
Examples of Visualisation Types 1-4

Appendix 1 - Camera Equipment

1.1 50mm FL + FFS - Visualisation Types 1,3,4

Cameras

1.1.1 The following specifications are based on a 50mm Focal Length (FL) and Full Frame Sensor (FFS) combination, and are suitable for all types of photography and visualisation. See 1.2 below for an alternative specification (cropped frame) which is acceptable for Types 1 and 3.

1.1.2 Whilst 35mm film itself is largely outdated for technical applications, it is worth being aware of the origin of the term 'Full Frame Sensor'. The point of reference for FFS as a term of specification is the frame size of pre-digital (35mm film strip width) film frames, which is 36mm x 24mm. Whilst Medium and Large Format camera equipment can be used for this work it is considered that this equipment is beyond the scope of this guidance.

Lenses

1.1.3 Lens / camera combinations result in images which capture a Field of View (FoV). The Horizontal Field of View (HFoV) is the angle between the left and right edges of the image. The Vertical Field of View (VFoV) is the angle between the top and bottom of the image. A 'standard' lens (50mm FL + FFS) in landscape orientation typically captures a HFoV of just under 40° and a VFoV of 27°.

1.1.4 50mm FL sits between 'wide-angle' lenses, which can create distortion towards the edges of images, and telephoto lenses, which can create an unnatural visual 'stacking' effect. Whilst both of these can be effective in artistic photography, the 40° HFoV image captured by a 50mm lens is regarded as being the closest to human eyesight, albeit that we typically have wider peripheral vision.

1.1.5 A fixed 50mm FL lens is considered the benchmark for landscape technical photography. A fixed FL lens ensures that the image parameters of every photograph are the same, simplifies the construction of panoramas, and ensures compatibility of photography for all viewpoints. In addition, 50mm FL lenses minimise optical distortion and allow for verification, where required (See Appendix 11).

1.1.6 Where a site or proposal would exceed the VFoV of a landscape-orientated photograph, the camera may be used in portrait orientation, giving HFoV 27° and VFoV 39.6°.

Non-50mm FL Lenses

1.1.7 If a 50mm FL lens cannot capture the view in landscape or portrait orientation (for example, if the highest point of the development is approaching 18° above horizontal) the use of wider-angled prime lenses should be considered, working through the following sequence of fixed lenses in this order: 35mm FL > 28mm FL > 24mm FL > 24mm FL Tilt-Shift. Tilt-Shift Lenses are considered at Appendix 13. In these unusual situations, the reasoning for the choice and the approach used should be documented, and the agreement of the competent authority should be sought (see Appendix 10 Technical Methodology).

1.1.8 Zoom lenses should not be used for the principal photograph from any location, but can sometimes be helpful for distant views to clarify detail, where that is not readily apparent in a 50mm lens image. If presented for such purposes, they should be shown

Appendix G- Extract from Global Streets Design Guide (Global Designing Cities Initiative 2016 page 81)

Global Street Design Guide

Global Designing Cities Initiative

Global Street Design Guide

About Island Press

Since 1984, the nonprofit organization Island Press has been stimulating, shaping, and communicating ideas that are essential for solving environmental problems worldwide. With more than 1,000 titles in print and some 30 new releases each year, we are the nation's leading publisher on environmental issues. We identify innovative thinkers and merging trends in the environmental field. We work with world-renowned experts and authors to develop cross-disciplinary solutions to environmental challenges.

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Global Street Design Guide

Global Designing Cities Initiative

Global Designing Cities Initiative

Skye Duncan

Director, Global Designing Cities Initiative

The Global Designing Cities Initiative (GDCI) focuses on the critical role of streets within urban environments around the world. In partnership with the National Association of City Transportation Officials (NACTO) and working with a Global Expert Network, the GDCI is committed to sharing industry best practices, facilitating peer-to-peer mentoring, and fostering regular communication. The GDCI facilitates the exchange of ideas to help a variety of stakeholders shape streets to promote public health and safety, quality of life, multimodal mobility, economic development, environmental sustainability, and equity. GDCI believes that by working together, cities can save time and money, share lessons learned, scale up best practice implementation, and more effectively achieve their policy goals and objectives.

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GDCI Core Project Team

Skye Duncan
Director

Ankita Chachra
Program Manager

Abhimanyu Prakash
Program Manager

Fabrizio Prati
Program Manager

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Linda Bailey

Executive Director

Matthew Roe

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The National Association of City Transportation Officials is a 501(c)(3) nonprofit association that represents large cities on transportation issues of local, regional, and national significance. NACTO views the transportation departments of major cities as effective and necessary partners in regional and national transportation efforts and promotes their interests in federal decision making. The organization facilitates the exchange of transportation ideas, insights, and best practices among large cities, while fostering a cooperative approach to key issues facing cities and metropolitan areas. As a coalition of city transportation departments, NACTO is committed to raising the state of practice for street design and transportation by building a common vision, sharing data, peer-to-peer exchange in workshops and conferences, and regular communication among member cities.

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Transportation Officials Consultant Team
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6

Designing Streets for People

People use urban streets for mobility or for stationary activities, for leisure or for work, out of necessity or by choice. People of all ages and abilities experience streets in different ways and have many different needs. Whether sitting, walking, cycling, using collective or personal transport, moving goods, providing city services, or doing business, the various activities that streets accommodate and facilitate shape the accessibility and livability of the city.

The types of users and the overall volume of people on a given street depend on many variables such as the time of day, the size of the street, the urban context, and the local weather. Each user moves at a different speed and takes up a different amount of space within the limited geometry of the street. Therefore, the overall capacity of the street will be determined by the mix of transportation modes that the street design accommodates.

Design streets to balance the needs of diverse users in order to shape an enticing environment that ensures access, safety, comfort, and enjoyment for everyone.

Paris, France

6.1 | A Variety of Street Users

In most cities, streets constitute the largest percentage of public property, and this space must be equitably distributed between the needs of the many different users of urban streets. Designs must accommodate people walking, cycling, taking transit, enjoying public spaces, providing city services, doing business, or driving. This chapter identifies design elements and strategies to support safe and inviting spaces for the variety of people using urban streets.

Pedestrians

Pedestrians include people of all abilities and ages, sitting, walking, pausing, and resting within urban streets. Designing for pedestrians means making streets accessible to the most vulnerable users. Design safe spaces with continuous, unobstructed sidewalks. Include visual variety, engage building frontages, design for human scale, and incorporate protection from extreme weather to ensure an enjoyable street experience.

Cyclists

Cyclists include people on bicycles, cycle-rickshaws, and cargo bikes. Facilities should be safe, direct, intuitive, clearly delineated, and part of a cohesive, connected network to encourage use by people of all ages and confidence levels. Cycle tracks that create an effective division from traffic, are well coordinated with signal timing, and are incorporated in intersection design form the basis of an accessible and connected cycle network.

Transit Riders

Transit riders are people using collective transport such as rail, bus, or small collective vehicles. This sustainable mode of transportation dramatically increases the overall capacity and efficiency of the street. Dedicated space for transit supports convenient, reliable, and predictable service for riders. Accessible boarding areas promote safe and equitable use. The space dedicated to a transit network should be aligned with demand, meeting service needs without sacrificing streetscape quality.

Motorists

Motorists are people driving personal motor vehicles for on-demand, point-to-point transportation. This includes drivers of private cars, for-hire vehicles, and motorized two-and three-wheelers. Streets and intersections must be designed to facilitate safe movement and manage interactions between motor vehicles, pedestrians, and cyclists.

Freight Operators and Service Providers

Freight operators and service providers are people driving vehicles that move goods or conduct critical city services. These users benefit from dedicated curb access and allocation of space for easy loading and unloading as well as dedicated routes and hours of operation. Emergency responders and cleaning vehicles need adequate space to operate, which must be accommodated while ensuring the safety of all other street users.

People Doing Business

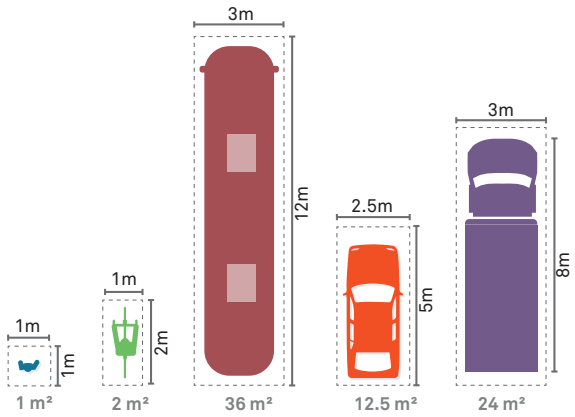
People doing business include vendors, street stall operators, and owners or renters of commercial storefronts. These users provide important services that support vibrant, active, and engaging street environments. Adequate space should be allocated to these uses. Provide regular cleaning, maintenance schedules, power, and water to support commercial activity and improve local quality of life.

6.2 | Comparing Street Users

Comparing the size of and space occupied by different street users reveals the advantages of designing streets for transit, cycling, and walking. Providing high-quality facilities for these spatially efficient, affordable, and sustainable transportation modes allows the same street to accommodate more people. Reducing the amount of space devoted to movement and storage of private vehicles maximizes the amount of space available for other activities that add to the quality of the street.

Scale and Size

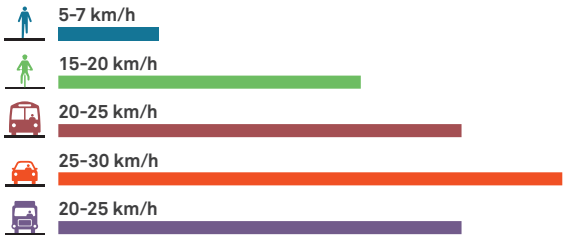
People and vehicles take up different amounts of space when they are moving. Each needs an operational envelope that feels comfortable and supports safe movement. While walking and cycling use the least amount of space for movement and storage, and have the greatest flexibility, the comfort and safety of these modes is heavily influenced by the amount of space available to them.



Operational envelope for different users and vehicles.

Speed of Movement

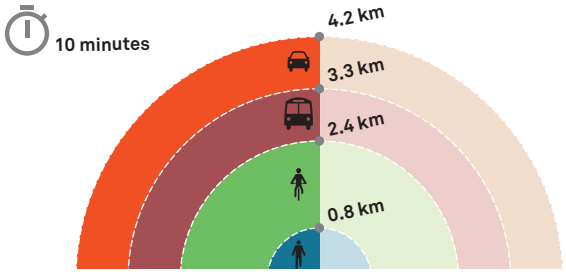
Vehicle speed is a key risk factor in road traffic injuries and death. High-impact speeds drastically increase the risk of severe injury or death in the event of a crash. People moving at low speeds have more time to observe the street around them, have more reaction time, and have very short reaction distances. Street design, human perception and comfort, and the activity of other people all impact moving and operating speeds.



Average speeds for different users and vehicles.

Travel Time and Distance

Understanding how far a person can travel in 10 minutes provides a basic measure of the number of destinations easily available to them. A person walking in a city center has access to many more destinations than a person driving in a low-density setting. Planning around 5-, 10-, and 15-minute distances, especially for transit stops and neighborhood cycle and walking networks, can help inform the potential of a street to become an important part of the active transportation network.



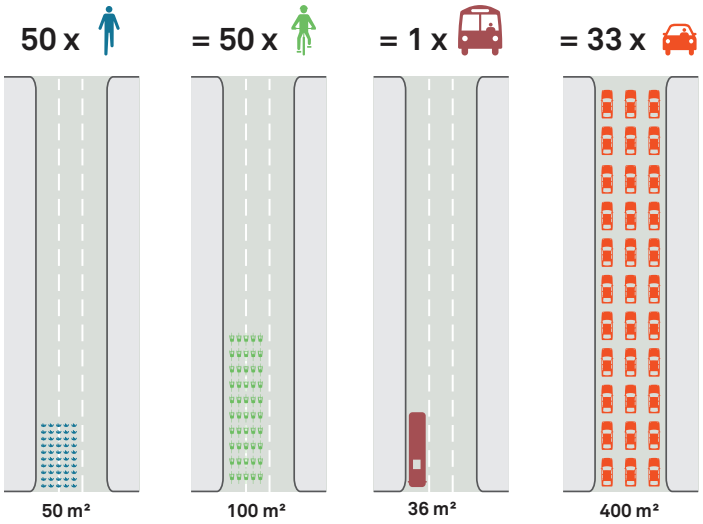
Average distance traveled by different users and vehicles in 10 minutes.

Mass and Vulnerability

Mass plays a very prominent role in the event of a crash. When a heavy vehicle collides with a lighter vehicle, the occupants of the light vehicle are far more at risk of sustaining severe injury. Pedestrians, cyclists, and motorcyclists have the greatest risk of severe injury when colliding with a motor vehicle and are commonly referred to as vulnerable users. Compared with other street users, this group is particularly exposed to injury as they are not protected by a vehicle shell.

Space Occupied by 50 People

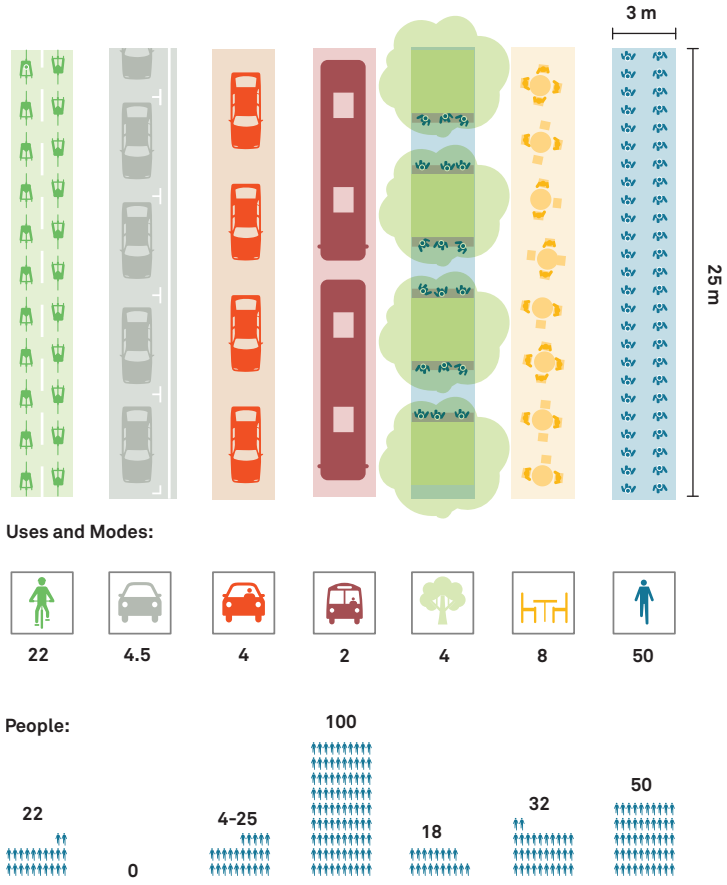
While a bus needs three times as much space as a car, its carrying capacity per lane is unrivaled among other on-street modes. As land in urban areas becomes increasingly scarce, use the space within the street most efficiently to serve the largest number of people.



Space Occupied by Uses, Modes, and People in a Given Area

Analyze the way street designs allocate space among different users in order to support a variety of activities and modes of transportation.

Consider how the same 3 m x 25 m strip can be used for various uses and by different numbers of people.



6.3 | Designing for Pedestrians

6.3.1 | Overview

Every trip begins and ends with walking, and therefore everyone is a pedestrian on a city's street at some point. Providing continuous and unobstructed clear paths ensures walkable neighborhoods for everyone. Each sidewalk's clear path should be complemented with active street edges and accessible facilities to make the journey comfortable and engaging.

Cities are places for people, and they use streets for not only walking, but also resting, sitting, playing, and waiting. This requires making people the highest priority in street design, with careful consideration for the most vulnerable users: the young, the elderly, and those with diminished perceptual or ambulatory abilities.

The types and volumes of people using a given street will depend on the surrounding land use and density, key destinations, and time of day. Without an enclosed vehicle and moving at slower speeds, pedestrians engage all of their senses when using urban streets. How people use streets will depend on the space available to them, the facilities that offer a moment to pause, and the overall street experience.

Street designs should always prioritize safe facilities for pedestrians, and measure their success from the pedestrian perspective. A walkable city that is easy and safe to navigate offers a level of independence and equity to its citizens.

Pedestrians need continuous and unobstructed moving paths, well-lit spaces, inviting building edges, shaded places to rest and walk, and wayfinding signs for a safe and comfortable street experience.

Speed

Walking speed depends on age and ability, as well as the purpose and length of the trip. It is influenced by pavement quality and topography, and the size, altitude, and climate of the city. While walking speeds range from **0.3 m/s–1.75 m/s** or **1 km/h–6 km/h**, people who walk with assistance—in form of canes, walkers, or other devices—are limited to speeds of **0.3 m/s–0.5 m/s**. People with motorized wheelchairs and other personal mobility devices may be faster, and people using skates or skateboards can reach speeds near that of cycles. Ensure that urban streets allow for a variety of speeds, whether someone is walking quickly with purpose, meandering slowly, pausing for a rest, or stopping to talk, sell goods, or eat. Accommodate fast walkers with low delay, and slow walkers with protection from vehicle conflicts and places to rest during long crossings. Consider these variables when determining lane configuration, signal timing, and sidewalk width.

0 km/h
0 m/s

5 km/h
1.4 m/s

6–7 km/h
1.6–1.9 m/s

10 km/h
2.7 m/s

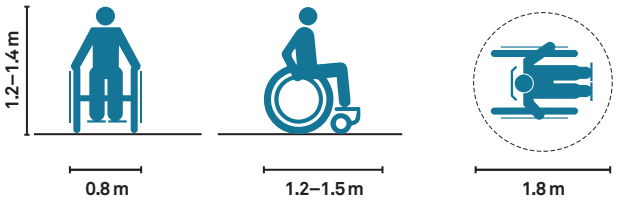
15+ km/h
4+ m/s

Variations

An alert adult who can see clearly, walk confidently in any environment, and react quickly to motor vehicles is the exception rather than the rule, and should not be used as the design case. Instead, select street attributes using a variety of "design pedestrians," discussed in more detail below. All pedestrians benefit from shorter crossing distances, refuge areas, ample room to wait at intersections, intersection control that prioritizes their movement, and sidewalks that are laterally and vertically separate from all but the lowest-speed and lowest-volume traffic. Provide enough room on busy sidewalks for people walking in groups to pass each other. Use pedestrian countdown signals and minimize wait time while maximizing pedestrian signal phase length.

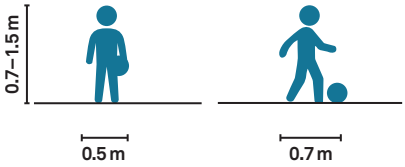
People with Disabilities

Integrate the needs of people who have impaired vision or hearing, people in wheelchairs, and those who walk with canes or gait trainers. Sidewalks must be wide enough to allow two people in wheelchairs to pass one another, with clear paths on low-volume streets being wider than **2 m** and never less than **1.8 m**. Clear paths should be unobstructed, level, and with a smooth surface. Design accessible ramps with shallow slopes at all crossings, preferably **8%**, and provide cut-through paths in medians, pedestrian refuge islands, and corner islands.



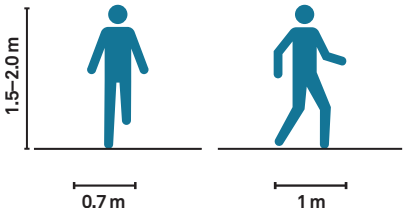
Children

With a world population that includes two billion children under 15 years old, all streets should be fundamentally safe for children traveling with or without adults. Children are less capable of judging speed than adults, placing the responsibility of providing safe movement options on designers and drivers. Their shorter height and slower walking speed must be accounted for in pedestrian crossing design and signal timing. Safe intersections for children have low through-traffic speeds, signals timed for a slow walking speed, very low turning speeds, and highly visible pedestrian crossings. Designs should indicate to drivers that children are present on neighborhood streets. The design of all streets must account for children by limiting the speed of vehicles and introducing efficient pedestrian infrastructure, especially signals.



Adults and Seniors

The global population is aging, but a large number of streets do not accommodate the needs of seniors. As pedestrians, older adults are a small portion of the population but account for a high percentage of road deaths. Danger increases when the pedestrian signal phase is too short, when there are broken or missing pedestrian ramps, and when markings are faded or hard to see. Design safe streets for seniors by providing refuge islands for every two to three traffic lanes, and providing curb extensions to reduce crossing distances and improve visibility at the pedestrian crossing. Prevent parking within **6 m** of pedestrian crossings to increase visibility.



6.3.2 | Pedestrian Networks

Pedestrian networks must be safe, comfortable, and enjoyable. Compared to other users, pedestrians cover less ground in the same amount of time, and experience the street the most intensely.

Moving without the protection of an enclosed vehicle, pedestrians engage all senses and are the most vulnerable users.

Look at the finest grain of the city fabric and the various types of pathways that can work together to create a comprehensive and continuous network. Design pedestrian networks to be:

- **Connected and Permeable**
- **Accessible and Comfortable**
- **Safe**
- **Relevant to Context**

Connected and Permeable

Connected
To be useful, sidewalks and pedestrian crossings must offer a continuous clear path. Even short stretches of sidewalk that are unpaved, uneven, obstructed, or that end abruptly disincentivize walking and create serious barriers for wheelchair users.

Permeable
Create pedestrian links in order to shorten walking routes when possible. Paths and streets that end in cul-de-sacs should be extended to connect to nearby streets. Encourage the creation of pedestrian links through large blocks to achieve a finer-grain urban fabric and improve connectivity.

Choice
Provide multiple routes to move between key destinations. If one path is closed for maintenance, others should still be available.

Key Destinations
Carefully design pedestrian experiences within walking distance of key destinations such as transit stations, parks, schools, commercial districts, and neighborhood main streets. People are more likely to walk from one destination to another if the experience is convenient, comfortable, and enjoyable. Areas around key destinations and transit stops should include spaces that allow groups of people to congregate without blocking the paths of others.

Accessible and Comfortable

Accessibility
All streets should be universally accessible, accommodate different walking speeds, and be legible for all users. Pay particular attention to the needs of children, the elderly, and people with disabilities.

Capacity and Comfort
Ensure that sidewalk networks, hierarchy, and width relate to their context. Sidewalks should not require people to walk in single file, but allow pairs and groups to comfortably walk past each other. Downtown areas need wide sidewalks and clear paths for higher pedestrian volumes at peak periods. Neighborhood streets should allow space for outdoor uses and commercial activities, while residential streets with narrower clear paths should include additional landscaping.

Safe

Pedestrian Spaces
Pedestrian spaces must be safe for all users at different times of the day. They should be well-lit, provide accessible slopes and gradients, be free of obstructions, and offer eyes on the street for natural surveillance and crime prevention.

Intersections
Intersection are critical nodes in a network in which pedestrians are exposed to the highest risk of fatality and injury. Provide visible, clear, short, and direct crossings at intersections. Install curb extensions and refuge islands to shorten crossing distance and provide protected areas for pedestrians waiting to cross. Crossings should always be marked, and when possible raised, for increased safety.

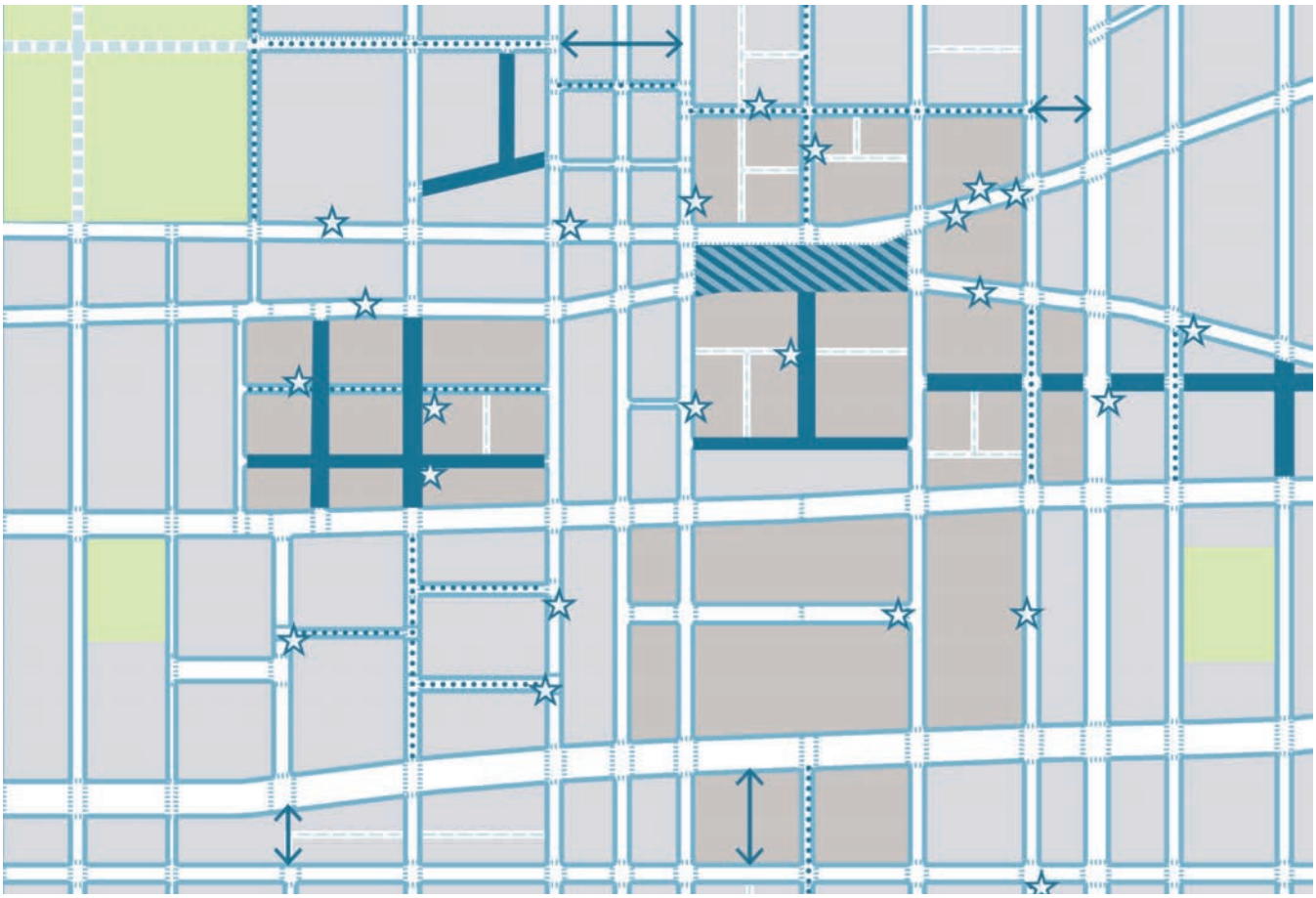
Relevant to Context

Human Scale and Complexity
Design facades and edges of buildings or spaces that define the pedestrian network to be engaging and interesting. Support varied building heights, architectural details, signage, entrance spacing, transparency levels, and landscaping to break down the scale and rhythm of the block and make walking distances feel shorter. Include a variety of shading and lighting devices on building facades to provide a comfortable walk.

Character and Identity
Iconic streets invite the opportunity for unique street furniture, wayfinding, landscaping, paving, signage, and lighting. Historic areas, promenades, and well-known corridors can strengthen the character of a neighborhood through the design of the street.

Topography
Steep elevation changes can limit street network connectivity and complicate access to critical services and key destinations. Combine steps and ramps with rest areas and landscaping.

Green Corridors
Opportunities to incorporate trees and landscaping should be identified throughout the city, along with particular corridors for additional greening. Green corridors should be provided on streets surrounding parks, large boulevards, central urban areas, and local neighborhood streets. Select native species to best suit local climates. Green corridors can help reinforce the character and identity of a neighborhood. *See 7.2: Green Infrastructure.*



Pedestrian Networks: Fine-grain pedestrian networks with a variety of pedestrian-priority spaces support a walkable city. Continuous sidewalks that are free of obstructions, frequent at-grade crossings, and small blocks allow pedestrians to conveniently and safely reach their destinations. Interesting and permeable building edges designed with human scale in mind provide an engaging and enjoyable walking experience.

- Pedestrian-only streets
- Plazas
- Shared spaces
- Laneways
- Walkways
- Sidewalks
- Pedestrian links
- Parklets and pocket parks

New Delhi, India. A narrow laneway provides a convenient shortcut between neighborhoods.

São Paulo, Brazil. Parklets on a neighborhood sidewalk provide a place to pause.

Paris, France. Wide sidewalks provide space for promenading and people watching.

6.3.3 | Pedestrian Toolbox

Use the following collection of elements as a visual checklist to ensure a comprehensive approach to prioritizing pedestrians and providing universal accessibility. Items marked with an asterisk (*) are discussed in more detail in the following pages.

Sidewalks*

Sidewalks should be continuous and provide a clear path consistent with pedestrian volumes, but always wide enough to allow two people using wheelchairs to pass one another. Allocate space for building entrances and commercial activity outside the clear path. Street furniture, trees, and utilities should serve as a buffer between the clear path and moving traffic.

Pedestrian Crossings*

Safe and frequent pedestrian crossings support a walkable urban environment. Pedestrian crossings should be located at all intersections in addition to mid-block points where pedestrian traffic is anticipated or desire lines are observed. Support marked crossings with signals and stop controls, raised elements, refuge islands, and narrow corner radii. Slow vehicular traffic approaching pedestrian crossings.

Pedestrian Refuges*

Pedestrian refuges reduce crossing distance and provide waiting areas for people who cannot cross the full width of the street in the pedestrian interval. Use pedestrian refuge islands whenever speeds and vehicle volumes make single-stage crossings dangerous for some users, and in most streets of three or more lanes of traffic.

Sidewalk Extensions*

Sidewalk extensions are an extension of the sidewalk, usually at the point of the intersection, visually and physically narrowing the roadway and shortening crossing distances. They make pedestrians waiting to cross the street more visible to drivers, calm traffic speeds, and increase the available curb space for people waiting to cross. Large sidewalk extensions can accommodate street furniture, benches, vendors, transit stops, snow storage, planters, and trees.

Pedestrian Ramps

Install pedestrian ramps at every pedestrian crossing and change of level. They should be built of non-slip materials and have a maximum slope of **1:10 (10%)**, ideally **1:12 (8%)**. These ramps are critical for people pushing strollers or carts, or using wheelchairs. They should be aligned perpendicularly to the pedestrian crossing.

Guidance for the Visually Impaired

Employ strategies such as accessible pedestrian signals at intersections, tactile paving strips on sidewalks, station edges, and pedestrian ramps to facilitate accessibility for people with vision impairment. These elements provide guidance to assist blind people and the visually impaired in navigating the city.

Signage and Wayfinding

Provide consistent pedestrian signage in a clear visual language that can be universally understood. Provide information to allow users to switch between mobility modes and navigate local street networks. Illustrate walking and cycling times and distances in wayfinding signs and maps.

Pedestrian Countdown Signals

Install pedestrian signals at intersections to allow pedestrians to cross the street safely. Display crossing time duration with a numerical timer during the clearance interval. The clearance time is generally based on a **1-m/s** walking speeds applied to the total crossing distance. Since many pedestrians walk below this speed, provide frequent refuge or time the walk signal to allow for a **0.5-m/s** speed.

Lighting

Well-lit spaces are critical to pedestrian safety, creating lively, inviting spaces at night and preventing crime. Place pedestrian-scaled lighting along all streets, ensuring appropriate illumination levels and spacing to avoid dark spots between light sources. Brightness levels should be greater along commercial streets and softer in residential areas. Poles and fixtures should never obstruct walking paths. *See 7.3.1: Lighting Design Guidance.*

Seating

Provide frequent opportunities for people to pause and rest. Seating should have comfortable backs, offering a mix of shaded and unshaded seats suited to the local climate. Placement should allow legroom that does not block the clear path. In larger pedestrian areas, provide movable chairs and a variety of seating arrangements to invite conversation and social activity.

Water Fountains

Provide drinking fountains with fresh, potable water to offer sustainable alternatives to bottled water and ensure an essential water source in many communities. Use creative designs to encourage use, and ensure that fountains are maintained to clean and safe standards. Provide access for children and people in wheelchairs with varied heights.

Weather Protection

Incorporate awnings and canopies into building facades where possible to add shelter and character to the street, and offer protection from the weather during snow, rain, or extreme heat. Install stand-alone shade structures in larger pedestrian-only areas if shade trees are not present or are immature.

Curbs

Provide curbs to create a structural edge between the sidewalk and adjacent cycle or travel lanes. Curbs discourage vehicles from entering or blocking pedestrian areas, and many are integrated with a gutter to assist in channeling water. Curbs should not be more than be **15 cm** high. They should incorporate ramps at pedestrian crossings to facilitate safe access.

Waste Receptacles

Provide conveniently available receptacles for waste to help maintain a clean and enjoyable pedestrian environment. Place waste receptacles near corners, vendors, crossings, and parklets, adjacent to clear paths. Receptacles should be sized in accordance with expected use and local collection and maintenance plans. Solar–powered compactors can increase collecting capacity in high volume areas.

Active Building Edges

Building frontage design plays a critical role in shaping the overall pedestrian experience. The design of the ground floor influences the character of the street and the level of pedestrian engagement. Frequent entrances, appropriate transparency levels, visual variation, and textures all contribute to shaping an enticing street environment.

Trees and Landscaping

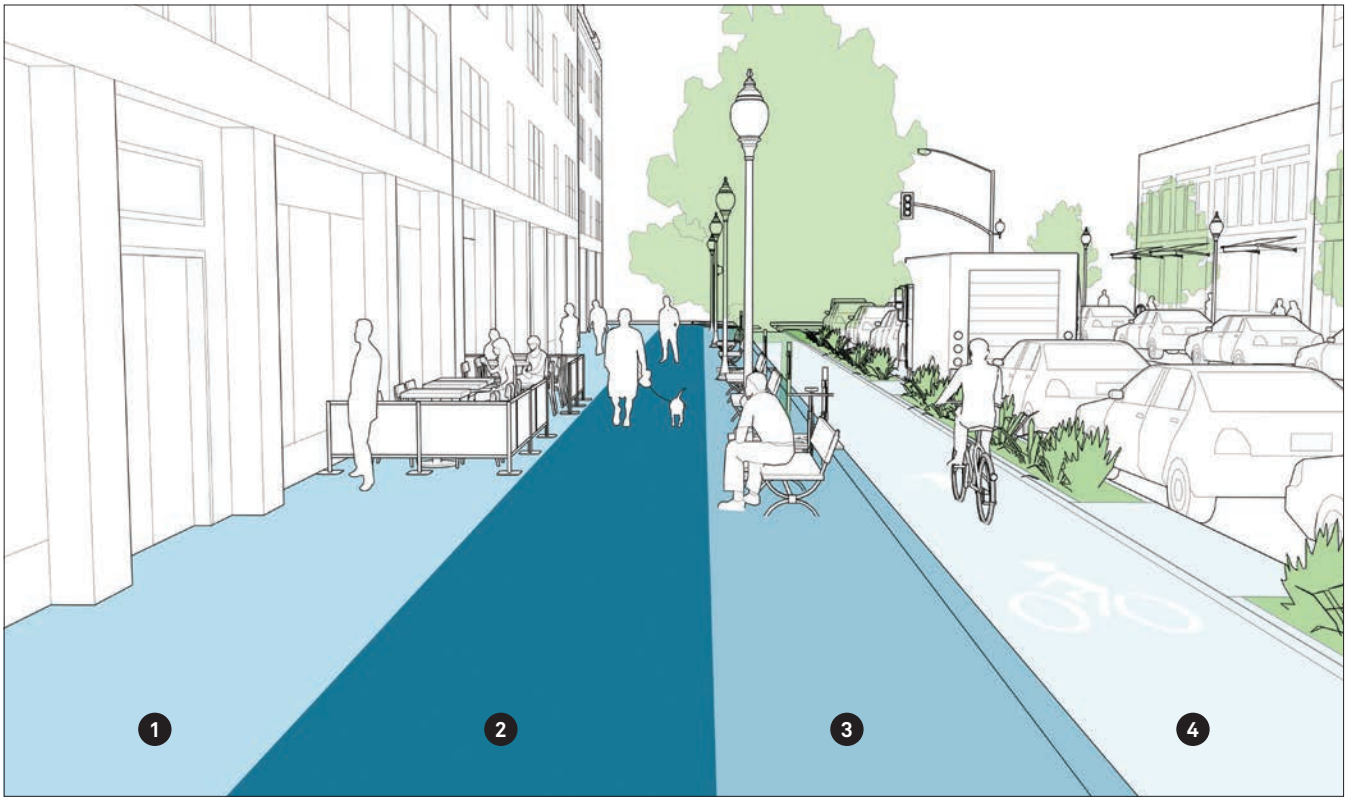
Include landscaping where possible to create a pleasant walking environment, contribute to the character of a neighborhood and encourage active transportation choices. Landscaping improves microclimatic conditions, cleans the air, filters water, and increases the biodiversity of a city, offering physical and mental health benefits.

6.3.4 | Sidewalks

Sidewalks play a vital role in city life. As a conduit for pedestrian movement and access, they enhance connectivity and promote walking. As public spaces, sidewalks serve as the front steps to the city, activating streets socially and economically. Safe, accessible, and well-maintained sidewalks are a fundamental and necessary investment for cities, and have been shown to enhance general public health and maximize social capital.

Just as roadway expansions and improvements have historically enhanced travel for motorists, superior sidewalk design can encourage walking by making it more attractive.

Curb cuts for vehicle access should be limited in areas with high pedestrian volumes, and when unavoidable, they must maintain accessible levels, slopes, and clear path minimums.



Frontage Zone

1 The frontage zone defines the section of the sidewalk that functions as an extension of the building, whether through entryways and doors or sidewalk cafés and sandwich boards. The frontage zone consists of both the facade of the building fronting the street and the space immediately adjacent to the building.

Clear Path

2 The pedestrian clear path defines the primary, dedicated, and accessible pathway that runs parallel to the street. The clear path ensures that pedestrians have a safe and adequate place to walk and should be **1.8–2.4 m** wide in residential settings and **2.4–4.5 m** wide in downtown or commercial areas with heavy pedestrian volumes.

Street Furniture Zone

3 The street furniture zone is defined as the section of the sidewalk between the curb and the clear path, in which street furniture and amenities such as lighting, benches, newspaper kiosks, transit facilities, utility poles, tree pits, and cycle parking are provided. The street furniture zone may also contain green infrastructure elements such as rain gardens, trees, or flow-through planters.

Buffer Zone

4 The enhancement or buffer zone is defined as the space immediately next to the sidewalk, and may consist of a variety of different elements. These include curb extensions, parklets, stormwater management features, parking, cycle racks, cycle share stations, and curbside cycle tracks.

Sidewalk Types

Residential Sidewalks

While residential streets require less capacity than bustling urban centers, sidewalks must always maintain a comfortable and accessible clear path. The frontage zone may vary depending upon whether buildings are set back from the street edge and how fences, front yards, stoops, or planting strips are designed. Residential sidewalks are used for walking, playing, and socializing and should include street trees and planting where possible. The furniture zone should be designed to accommodate additional play facilities or green infrastructure where possible. Curb cuts for vehicle access should be minimized.

MALMÖ, SWEDEN

This residential sidewalk in Malmö provides a clear walking path, and is lined with ground floor residential uses. Frequent entrances and front yard planting support an engaging walking experience.

Malmö, Sweden

Neighborhood Main Street Sidewalks

Neighborhood main streets include mixed-use street frontage alternating between residential and commercial uses. Main street sidewalks should accommodate moderate pedestrian volumes with large numbers of people stopping, sitting, and pausing as well as the extensions of ground floor uses. Sidewalks should be appropriate to the local climate and well lit, with frequent pedestrian seating. Curbside parking or transit facilities may require shelters or parking meters in the curb zone. The curb zone can be designed to accommodate green infrastructure.

FORTALEZA, BRAZIL

Avenida Monsenhor Tabosa was redesigned in 2014, costing 5,9 million reais, or US $1.65 million. Improved sidewalks with wide clear paths replaced 200 m of parking and service lanes along the 700-m length of the project, and new shade structures, lighting, bus stop areas, and seating opportunities improved the pedestrian experience and accessibility. Raised crossings and intersections were also included to induce speed reduction.

Av. Monsenhor Tabosa; Fortaleza, Brazil

Commercial Sidewalks

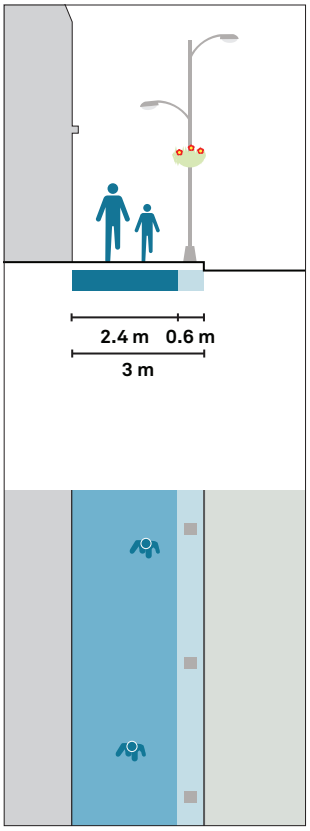
Commercial streets are characterized by large pedestrian volumes, active ground floors, street-facing entrances, commercial activity spilling onto the sidewalk, and loading activities. Commercial streets range from large streets to small alleys and laneways. The sidewalks on wider commercial corridors should have clearly defined frontage zones and street furniture zones to accommodate restaurant seating, commercial goods, benches, street planting, signs, street lights, and other necessary infrastructure. The curb zone may also include transit facilities and may have curb cuts or loading ramps for freight services.

NEW YORK CITY, USA

Broadway is one of the main commercial corridors in New York City, running 21 km down the length of Manhattan. The wide sidewalks are typically between 6–8 m wide, catering to heavy pedestrian volumes and allowing space for large street trees, bus stops, street furniture, and for commercial activities to spill out. Recent sidewalk widening expanded the width to 14 m in areas of midtown.

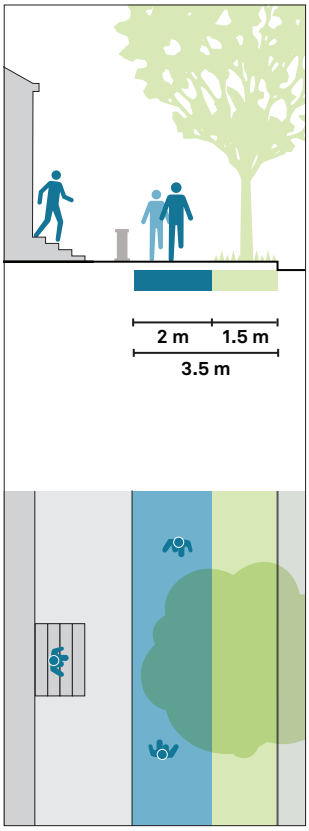
Broadway; New York City, USA

Geometry



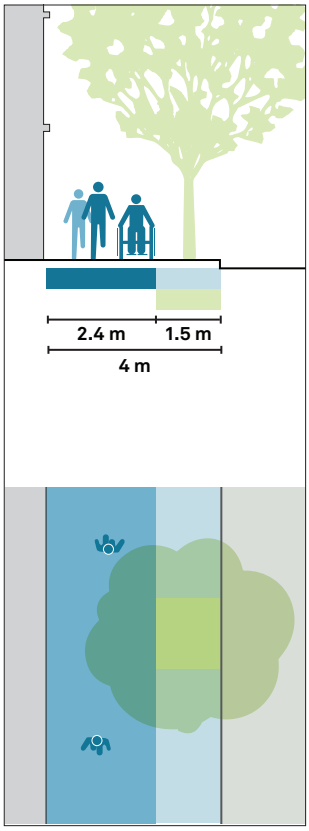
Narrow Sidewalk

Quiet streets in low-density contexts might have too narrow sidewalks. A recommended minimum clear path of **2.4 m** and an absolute minimum of **1.8 m** should be provided. When streets are too narrow for trees, other alternatives to landscaping should be explored. If comfortable sidewalks cannot be provided on both sides of a street, a shared street is preferred. Locate utilities and other obstructions immediately against the curb.



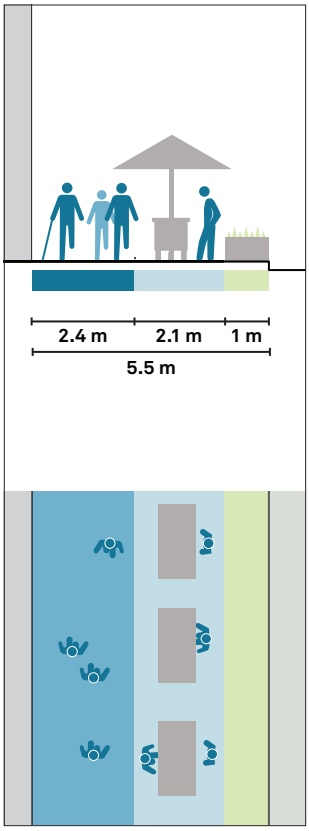
Ribbon Sidewalk

In low-density streets where the sidewalk sits between a planting strip and a set-back building, provide a minimum width of **2 m**. Tree pits should not be less than **1.5 m** wide. Locate utility poles in the planting strip.



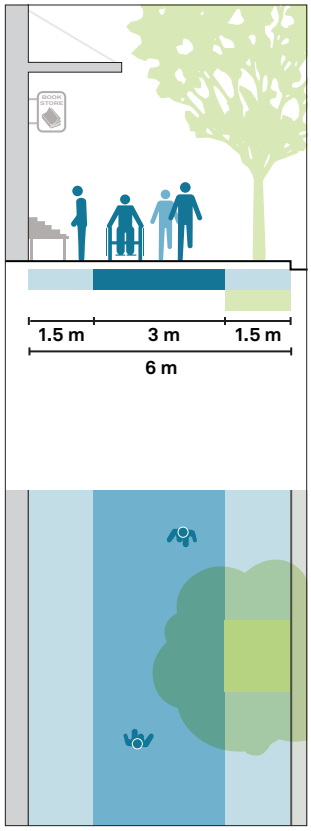
Narrow Sidewalk with Trees

Medium-density residential streets should maintain a clear walking path of **2.4 m** or more. When space allows, trees should be planted between the clear path and the moving or parking lane. Tree pits should be at least **1.5 m** wide.



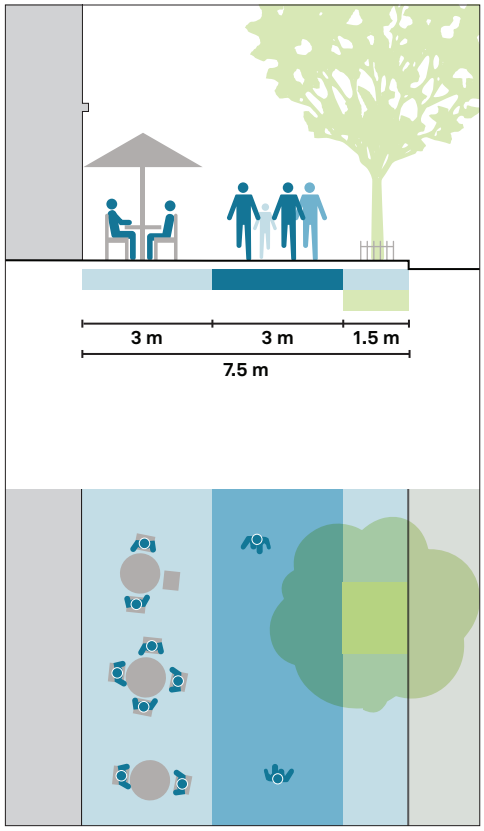
Neighborhood Main Street 1

On small retail streets with low but persistent pedestrian traffic, sidewalks should provide a minimum clear path of **2.4 m** in addition to space for commercial activities. When there is not enough width to plant trees, provide landscaping strips or planters.



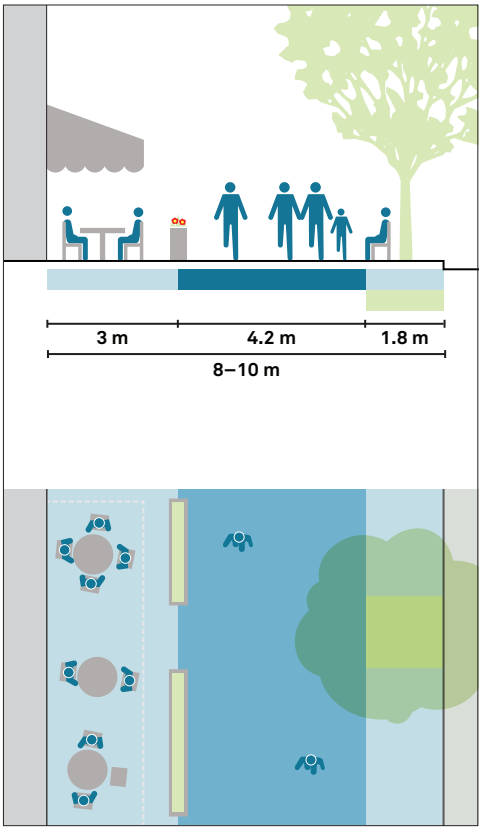
Neighborhood Main Street 2

Neighborhood main streets should provide a clear path of **2.4 m** to allow moderate volumes of people to comfortably pass one another. Space for commercial activity to extend from storefronts should be allocated on the building side. Tree pits, planters, and seating should provide a buffer between pedestrians and moving vehicles or cycles.



Medium Commercial Sidewalk

Commercial corridors should provide a clear path of **3 m** or more to allow a continuous flow and enable people to comfortably pass one another. Ground-floor activities from adjacent buildings can be encouraged to activate the sidewalk by providing flexible and dedicated space on the sidewalk adjacent to the clear path.



Wide Commercial Sidewalk

Busy commercial corridors with heavy pedestrian flows and activities should be designed, when possible, with a width of **8–10 m**, allowing for commercial activity, street furniture, transit stops and shelters or queuing spaces, landscaping, and green infrastructure.

Design Guidance

Sidewalks are a fundamental form of urban infrastructure that facilitate walking, socializing, interacting, and doing business. They must be provided on all urban streets and be accessible to all users.

Dimensions

Sidewalk design should go beyond the minimum in both width and amenities. Pedestrians and businesses thrive where sidewalks are designed at an appropriate scale, with sufficient lighting, shade, and street-level activity.

These considerations are extremely important for streets with high traffic volumes, where pedestrians may avoid the area because they feel unsafe.

Sidewalks should be delineated by a vertical or horizontal separation from moving traffic to provide adequate buffer space and a sense of safety for pedestrians. Do not use shoulders or stopping lanes as a substitute for sidewalks.

Clear Path

Provide sufficient width, **1.8–2 m**, so two people using wheelchairs can comfortably pass each other.

Clear paths must be free of fixed objects and major gaps or deformities that would make them inaccessible.

At driveways, clear paths should be continuous and step-free through the conflict zone.

If existing trees obstruct the clear paths for pedestrian movement, extend the sidewalk beyond the tree line to create additional space.

Do not place transit shelters directly within the path of travel. When the space is not sufficient, install a transit bulb or a boarding island.

Building Edges and Facades

Facades and storefronts should be designed to respond to the pedestrian's eye level, with a focus on how each building meets the sidewalk. The lower 5 m of a building is the portion directly visible and most intensely experienced by the pedestrian.[1]

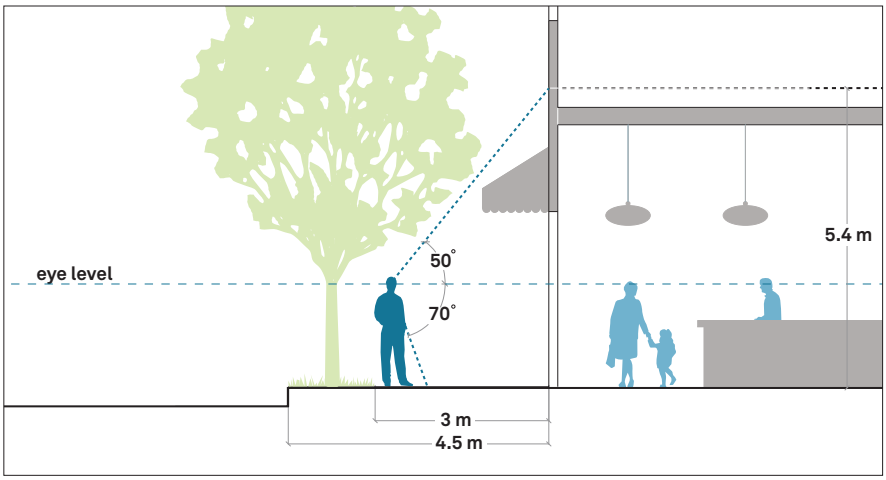
Provide or encourage lighting, signage, awnings, and other elements that are scaled to the pedestrian realm and add to the texture of the street.

Provide frequent building entrances to foster active spaces.

Provide an open or glazed frontage that engages pedestrians, encourages pausing, provides passive surveillance, and links public and private space.

Sidewalk cafés foster street life and have the potential to increase business along a corridor. Where provided, these must maintain accessible clear paths.

Urban arterials or high-volume downtown streets directly abutting the pedestrian realm should be buffered in some manner. Planting, street furniture, and, occasionally, vehicle parking or loading bays can provide a valuable buffer between the pedestrian and vehicle realm.



Human field of vision is geared toward looking ahead and downward. When walking, the head is generally inclined 10 degrees down and sees 50 degrees above and 70 degrees below eye level. This places great importance on the design of the ground floor of buildings adjacent to the sidewalk.

Utilities

Realign utilities such as lighting poles, service boxes, telephone booths, gas valves, water fountains, and manholes so that a clear walking path is free of obstructions. Where this is not possible, widen sidewalks to provide additional pedestrian space.

Coordinate with relevant agencies and utility companies to ensure street designs accommodate space for new utilities without impeding accessibility. Utilities with surface components should align with the finished road and sidewalk elevations to avoid tripping hazards or risk of injury.

Trees and Landscaping

Include trees and planting to provide shade and a sense of enclosure to the street. Plant native species to enhance biodiversity. Preference tree species whose roots have a limited impact on the integrity of the sidewalk.

When streets are redesigned, existing trees should be retained where possible. If existing trees must be removed, the same number of trees should be planted within the street.

Construction Sites

Any construction project that obstructs the sidewalk should be mitigated by providing a temporary sidewalk with a safe and convenient passage or a clearly marked detour. Provide adequate lighting beneath scaffolding and other construction sites.

RESHAPING SIDEWALKS; CHENNAI, INDIA

Before

After

Chennai, India

In 2013, the Institute for Transportation and Development Policy (ITDP) released *Footpath Design: A Guide to Create Footpaths*, providing basic guidance for sidewalk design in the Indian context. Sites that previously had narrow footpaths, high curbs, and were blocked by obstacles have been redesigned and reconstructed to provide a safe place for pedestrians to walk out of the roadbed.

Accessible sidewalks should be provided on both sides of all streets in urban areas.[2]

6.3.5 | Pedestrian Crossings

Safe and frequent pedestrian crossings support a walkable environment. Pedestrians are especially sensitive to minor shifts in grade and geometry, detours, and the quality of sidewalk materials and lighting. Pedestrian crossing design has the potential to shape pedestrian behavior, while guiding people toward the safest possible route.

São Paulo, Brazil. A colorful pedestrian scramble in the city center.

Design Guidance

Location

Pedestrian crossings can be located at an intersection or mid-block.

Provide pedestrian crossings at all legs of intersections. Pedestrians are unlikely to comply with a three-stage crossing and may place themselves in a dangerous situation as a result.

Install a pedestrian crossing where there is a significant pedestrian desire line. Frequent applications include mid-block bus stops, metro stations, parks, plazas, monuments, or public building entrances.

Spacing

Provide level crossings every **80–100 m** in urban environments.[3] Distances over **200 m** should be avoided, as they create compliance and safety issues.

If it takes a person more than three minutes to walk to a pedestrian crossing, he or she may decide to cross along a more direct, but unsafe route.

Pedestrian crossing spacing criteria should be determined according to the pedestrian network, built environment, and desire lines. Designers should take into account both existing and projected crossing demand.

Marking

Always mark the pedestrian crossing, regardless of the paving pattern or material.

High-visibility ladder and zebra markings are preferable to parallel or dashed pavement markings. These are more visible to approaching vehicles and have been shown to improve yielding behavior by drivers.

Signalization

Where vehicle speeds are above 30 km/h and pedestrian volumes and crossing demands are moderate to high, provide signalized crossings to support a safe walking environment.

Uncontrolled crossings are generally safe on streets with low traffic volumes, and speeds below 30 km/h.

Length (Crossing Distance)

Keep crossing distances as short as possible using tight corner radii, curb extensions, pedestrian refuge islands, and medians.

Medians and refuge islands create a two-stage crossing for pedestrians, which is easier and safer when crossing multiple lanes of traffic.

Width

A pedestrian crossing should be at least as wide as the sidewalks it connects to and not be less than **3 m** wide.

Visibility and Daylighting

Provide adequate waiting areas for pedestrians to see oncoming traffic and increase visibility for drivers by adding curb extensions or refuge islands.

Restrict parking or install curb extensions in order to make pedestrians more visible to motorists and cars more visible to pedestrians. This is called *street daylighting* and must be provided at all crossings.

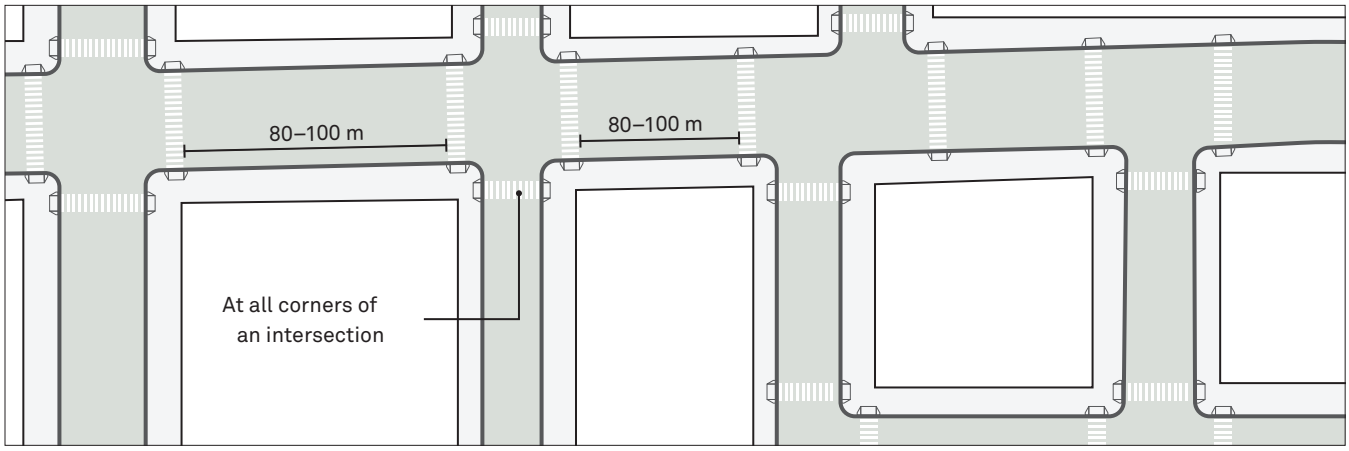
Additional Safety Measures

The presence of a pedestrian crossing does not alone render a street safe. Based on pedestrian and traffic volumes, speed, and roadway width and configuration, pedestrian crossings may require additional safety measures such as refuge islands, signals, or traffic calming strategies.

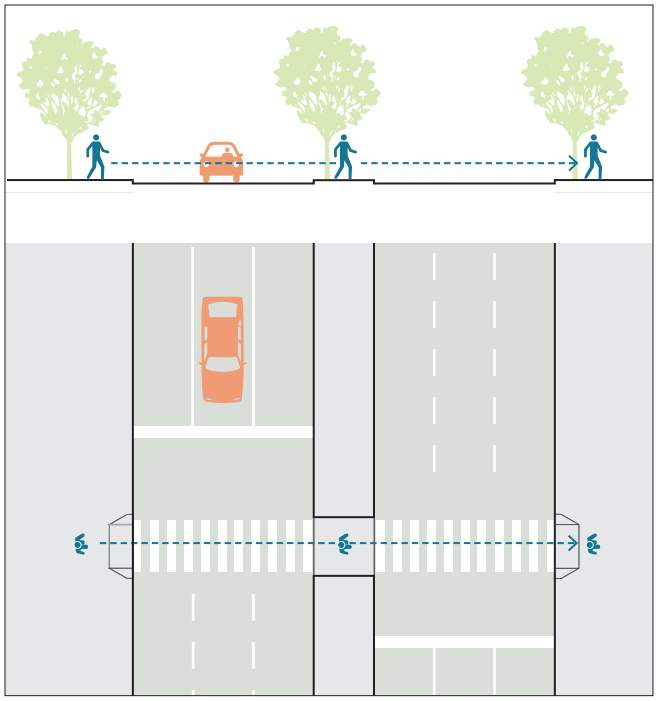
Grade Separation

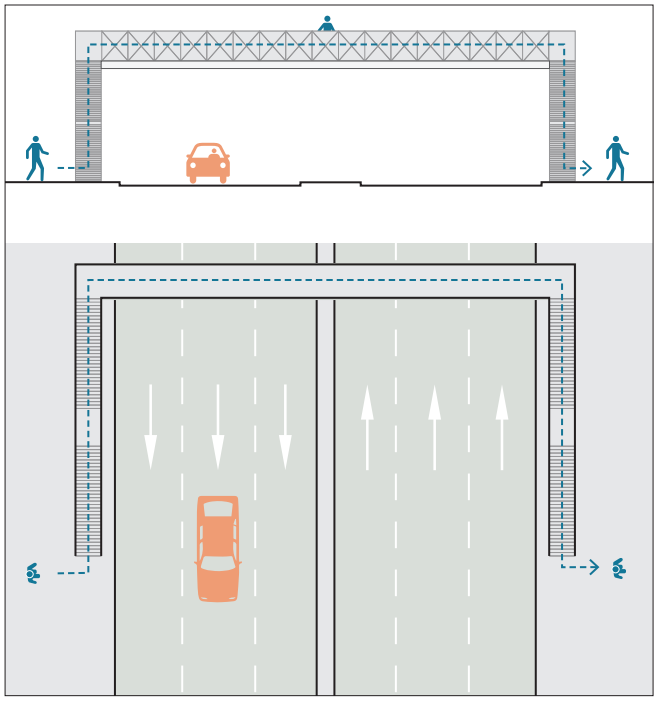
Always provide pedestrian crossings at grade, except in instances where they cross limited-access highways or natural feature such as rivers.

Pedestrian overpasses and underpasses take up sidewalk space, dramatically increase walking distance, and are frequently avoided by pedestrians in favor of a more direct crossing. They are very expensive and need regular maintenance to keep them clean and safe. In many cases, they are underutilized and poorly maintained. By removing pedestrians from the natural surveillance of the street, they raise personal safety issues.



Pedestrian Crossing Spacing: Safe, accessible crossings should be provided every 80–100 m, and at all legs of an intersection, to ensure a connected walkable network.

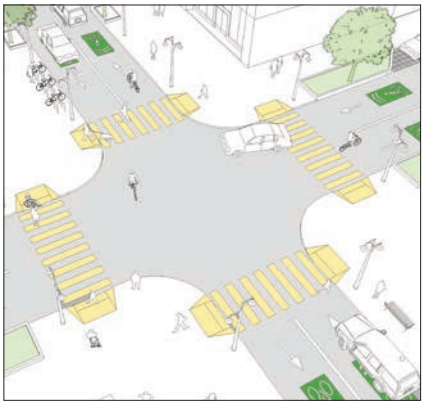




At-Grade Pedestrian Crossings: Unless connections are required across limited access highways, heavy rail lines, or natural features, pedestrian crossings should be provided at the same level as the street. Elevated crossings unnecessarily increase walking distances and times, take up valuable sidewalk space, and cost up to 20 times the price of at-grade signalized crossings.

Provide level crossings every 80–100 m at minimum. If it takes a person more than three minutes to walk to a pedestrian crossing, he or she may decide to cross along a more direct, but unsafe or unprotected, route.

Crossing Types



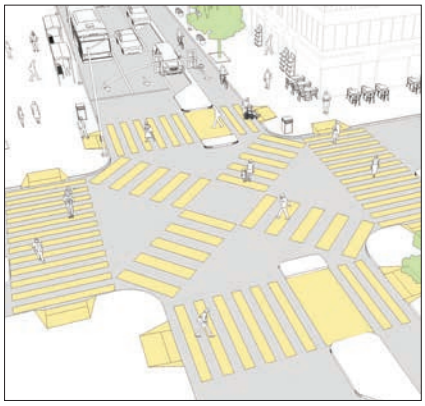
Pedestrian Volumes	Low to High
Signalized	Yes
At Intersection	Yes
Mid-Block	No
Vehicular Speed	Any Speed
Vehicular Volumes	Low to High

Conventional Crossing

Pedestrian crossings should be aligned as closely as possible with the pedestrian clear path. Inconvenient deviations create an unfriendly pedestrian environment.

Many pedestrian crossings are designed using inadequate, narrow striping, setbacks from intersections, and deviations from the pedestrian clear path, resulting in considerable crossing distances.

Intersection crossings should be kept as compact as possible, facilitating eye contact by moving pedestrians directly into the driver's field of vision.



Pedestrian Volumes	High
Signalized	Yes
At Intersection	Yes
Mid-Block	No
Vehicular Speed	Any Speed
Vehicular Volumes	Medium to High

Diagonal Crossings

A diagonal crossing, also called pedestrian scramble, is a type of crossing in which a dedicated phase allows pedestrians to cross the intersection in every direction at the same time. During this phase all vehicular traffic is stopped.

This type of signalized crossing avoids conflicts between pedestrians and turning vehicles.

It should be applied only at intersections with high pedestrian volume and should be designed to provide enough space for large numbers of people to gather on the sidewalk corners.

If not well-coordinated, it can create long waiting times for both pedestrians and motorists. Reduce waiting time for pedestrians for higher compliance and increased safety.

Pedestrian Volumes	Medium to High
Signalized	No
At Intersection	Yes
Mid-Block	Yes
Vehicular Speed	Below 30 km/h
Vehicular Volumes	Medium to High

Raised Crossings

Non-signalized crossings at intersections and mid-block can be raised, extending the level of the sidewalk across the street.

This helps calm traffic, improve accessibility, and increase visibility between motorists and pedestrians.

Raised crossings can be applied in busy neighborhood main streets and commercial streets, or where small neighborhood streets with slower speeds meet larger corridors. *See 11.5 and 11.6: Small Raised Intersection and Neighborhood Gateway Intersection.*

Pedestrian Volumes	Low to Medium
Signalized	No/Actuated
At Intersection	No (prefer raised)
Mid-Block	Yes
Vehicular Speed	Above 30 km/h
Vehicular Volumes	Medium

Traffic Calmed Crossings

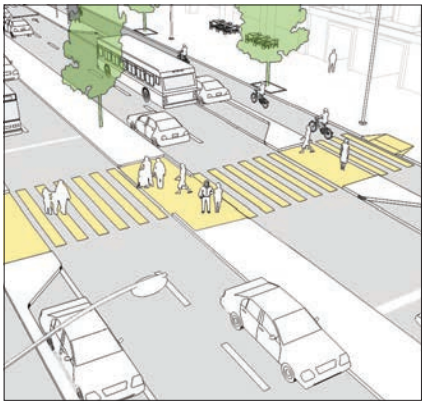
At mid-block crossings where motorist compliance is low, use vertical deflection measures such as speed bumps, tables, and cushions to reduce motorist speed and warn them of the presence of an upcoming pedestrian crossing.

Vertical speed control elements should be set back **5–10 m** from the crossing according to vehicular speed. A series of bumps before the crossing increases compliance levels.

Use pedestrian-activated warning lights, flashing beacons, or High Intensity Activated Crosswalks (HAWK) to increase motorists' awareness and improve pedestrian safety.

The pedestrian crossing could also be raised to increase mutual visibility between pedestrians and motorists.

In streets with high vehicular volumes, give preference to conventional crossings with fixed signalization.



Pedestrian Volumes	Low to Medium
Signalized	Actuated
At Intersection	No
Mid-Block	Yes
Vehicular Speed	Above 30 km/h
Vehicular Volumes	Medium

Staggered Crossings

Staggered crossing should only be applied when the depth of the cut-through allows full accessibility. They allow pedestrians to face the direction of oncoming vehicles, increasing visibility along the crosswalk.

The minimum width of the median should be **3 m** and the offset between the two legs of the pedestrian crossing should not exceed **1 m**, keeping crossing distances to a minimum.

The stop bars at this type of mid-block crossing should be set back **5–10 m**.

If vehicular volumes are high or compliance levels are low, other strategies, such as calming the crossing using speed bumps, tables, cushions, or implementing fixed signalization should be employed.

Pedestrian Volumes	Low
Signalized	No
At Intersection	No
Mid-Block	Yes
Vehicular Speed	Below 30 km/h
Vehicular Volumes	Low

Pinchpoint/Yield Crossings

Crossing design in conjunction with pinchpoints, provides short crossing distance at mid-blocks.

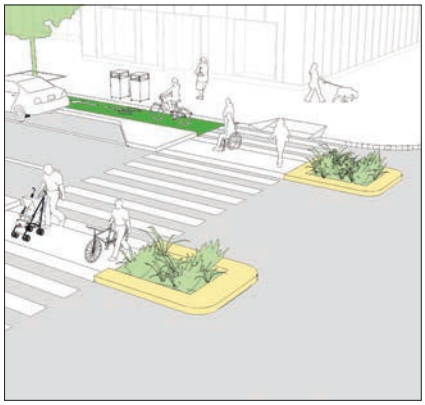
By reducing the roadway from two lanes to one lane at a mid-block, drivers are forced to reduce speed and yield to traffic coming from the opposite direction.

Maintain a lane width of **3.5 m** at the pinchpoint for emergency vehicle access.

6.3.6 | Pedestrian Refuges

Medians or refuge islands create a two-stage crossing for pedestrians, making it easier and safer to cross multiple lanes of traffic.

They should be installed in all streets where pedestrians have to cross three or more lanes or in narrower streets where speeds and vehicular volumes make single-stage crossings prohibitive or unsafe.



Pedestrian Refuge Islands

Pedestrian refuge islands should be at least **1.8 m** deep but have a preferred depth of **2.4 m**.

The width of the cut-through should equal the width of the pedestrian crossing or be at least as wide as the clear path. When the cut-through is wider than **3 m**, install bollards to impede vehicles from parking or manoeuvring in the pedestrian refuge.

A pedestrian refuge island is ideally **10–12 m** long, providing enough protection at each end of the waiting space. Longer islands can be used to deter motorists from using the space for U-turns.

Pedestrian refuge islands should be clearly visible to drivers, be well lit, and provide reflectors for improved nighttime visibility.

Pedestrian refuge islands should include curbs, bollards, or other features to protect people waiting to cross.

Median Tips

All pedestrian refuges at intersections should have a tip or nose that extends past the pedestrian crossing.

This protects people waiting on the median from moving vehicles and slows turning motorists.

To further reduce crossing distance, provide curb extensions at intersections where curbside parking is available.

Align median tips with sidewalk edges to reduce the speed of turning vehicles and maintain pedestrian crossing aligned with the clear path.

Median Cut-Throughs

Cut through raised medians to provide level crossing. Cut-throughs should be provided where there is a significant pedestrian desire line, in front of transit stops and key destinations, or when the distance to the closest safe pedestrian crossing is more than **80–100 m**.

For streets with more than one lane per direction or speeds above **30 km/h**, crossings should be signalized or traffic calmed.

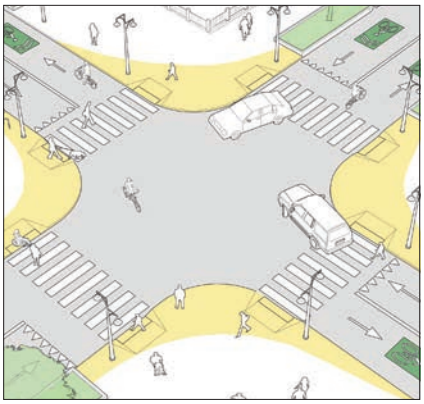
If not signalized, the crossing should be raised or traffic calmed.

Medians should be at least **1.8 m** deep but have a preferred depth of **2.4 m**.

The width of the cut-through should be equal to the width of the pedestrian crossing, or at least as wide as the clear path.

6.3.7 | Sidewalk Extensions

Providing sidewalk extensions reduces pedestrian crossing distances and increases the pedestrian space. Sidewalk extensions physically and visually narrow the roadway while increasing the available waiting space and provide areas for street furniture and benches, transit stops, trees, and landscaping. They may be implemented throughout the city, may be different sizes, and may combine stormwater management and other public space enhancement.

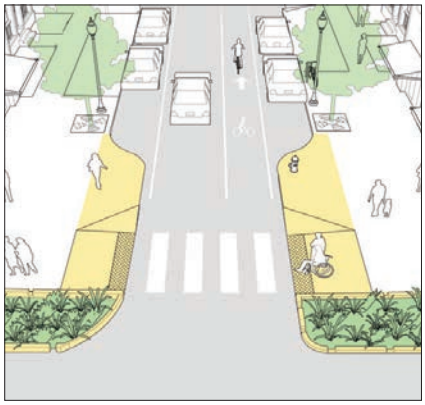


Corner Alignments

Corner alignment extends the sidewalk by designing sidewalk corners with the tightest radius possible. Corner alignments increase mutual visibility between pedestrians and motorists, increase waiting space, and reduce the crossing distance.

These can be generally applied using temporary pavement materials and be implemented without operational changes. Sidewalk corners with wide corner radii invite vehicles to turn at faster speeds and increase pedestrian exposure.

Aligning sidewalks expand the pedestrian area, allowing a more direct walking path and a better pedestrian ramp alignment, thereby improving accessibility.



Bulb-Outs

Bulb-outs are extensions of the sidewalk into the parking lane. They should be installed whenever on-street parking is present to increase visibility, reduce the crossing distance, provide extra waiting space, and allow for seating or landscaping.

In advance of a full reconstruction, gateways can be designed using striping or signage that communicates the entrance to a slow zone.

The length of a bulb-out should at least be equal to the width of the pedestrian crossing, but should preferably extend to the stop bar.

Bulb-outs are often used as traffic calming measures and are referred to as **pinchpoints** when applied mid-block, **gateways** when installed at the entrance to a low-speed street, and **chicanes** when used to form an S-shaped path of travel to lower vehicle speed. *See 6.6.7: Traffic Calming Strategies.*

When used to align a bus stop with the parking lane, bulb-outs are called bus bulbs. *See 6.5 Designing for Transit Riders.*

Slip Lane Removal

Slip lane removal extends the sidewalk to include the travel lane and the traffic island. Slip lanes are sometimes provided at intersections of major urban roads to facilitate vehicle turn to the detriment of pedestrian safety. Slip lanes allow vehicles to turn at higher speeds and reduce motorist and pedestrian visibility, creating potentially unsafe conditions for pedestrians.

Removing slip lanes does not necessarily involve operational changes but can drastically reduce the risk of right-turn collision between vehicles and pedestrians attempting to cross.

Slip-lane removals reduce pedestrian exposure and increase the available pedestrian space, making room for street furniture and landscaping.