Project Level Design Principles

Guidance from the National Infrastructure Commission Design Group

May 2024

The National Infrastructure Commission's Design Group was established in 2019 to inspire renewed ambition for the quality of the UK's infrastructure. Its mission is to inspire, promote and champion design excellence on all major infrastructure projects, helping to deliver infrastructure which has social value and responds creatively to the needs of people, places and the environment.

The group brings together respected leaders in design, with experience spanning architecture, transport, landscape and engineering. They are united by a shared belief in the transformative power of great design. The Group is chaired by Professor Sadie Morgan OBE (founding partner, dRMM Architects) and its members are:

- Anthony Dewar, Civil Engineer
  Professional Head, Buildings and Architecture, Network Rail
- Clare Donnelly, Architect
  Director, Fereday Pollard Architects
- Andrew Grant, Landscape Architect
  Founder and Director of Grant Associates
- Hanif Kara OBE, Structural Engineer
  Co-founder and Design Director of AKTII
- Madeleine Kessler, Architect and Curator
  Principal, Madeleine Kessler Architecture
- Alister Kratt, Landscape Architect and Masterplanner
  Director, LDA Design
- Peter Maxwell, Architect and Town Planner
  Director of Design, London Legacy Development Corporation
- Judith Sykes, Civil Engineer
  Director, Expedition Engineering
- Louise Wyman, Chartered Surveyor and Landscape Architect

Foreword from Sir John Armitt

Since publication of the Design Principles for National Infrastructure in 2020, the world has changed. The Covid pandemic, war in Ukraine and resulting inflationary pressures have all contributed to setting a different backdrop for infrastructure than existed when the Principles were first conceived.

What is impressive, therefore, is how they have stood the test of time. Four headline themes (climate, people, places and value) that remain as pertinent for major projects today as they did at the turn of the decade – and that I think will continue to be highly relevant to projects over the next two or three decades.

And there will be many such projects. Our latest National Infrastructure Assessment envisages around £70bn of public and private money being invested in infrastructure each year during the 2030s and 2040s. Before then, at least 17 new major electricity transmission projects and nine water resource projects will be required before this decade is out.

If these projects are to be successful, and meet public, political and investor expectations, they must have a focused attention on design – in its widest sense – at every single stage.

Good design is absolutely integral to successful project delivery and should not be seen as something that adds cost.

Taking care over how the physical form of a project interacts with its surroundings, enhances the natural environment and improves people's quality of life will all help secure not only procedural approvals but wider community acceptance.

And spending time, particularly upfront at the scoping stage, to get design right first time should also help avoid unnecessary duplication, delays and cost.

Nationally significant projects are called that for a reason – their aims serve a public good, supporting economic and social objectives around which there is a broad consensus. So they should be designed for success: the UK cannot afford for these projects to fail.

The guidance in this document seeks to help projects secure that success, for the benefit of all.

The Commission extends its gratitude to the members of the Design Group, and wider stakeholders, who have helped develop this guidance, which we commend to all major projects.

Sir John Armitt

Sir John Armitt and Sadie Morgan at a National Infrastructure Commission meeting

Preface from Professor Sadie Morgan

Delivering the infrastructure the UK needs for the future requires forward thinking organisations – clients, consultancies, contractors and operators – driven by a desire to solve problems across traditional boundaries.

A number of them have adopted the Commission's high level Design Principles, which have been formally endorsed by government for use by all nationally significant projects.

But the principles were only ever written as a starting point. We are pleased to present this further guidance tool to share examples of good practice and the Design Group's thinking on how to embed design principles throughout project lifecycles.

Our central advice is to:

- Make sure there is a genuine commitment from the most senior levels of the project to using a structured design process from the earliest stages
- Put principles in place before taking any decisions – and once in place, ensure they become a key part of the governance framework, informing all decision making
- Make sure that principles support the widest range of outcomes (not just operational functions) and that they are used to directly inform each design iteration
- Keep revising the principles as new information comes to light and use them to manage an evolving project effectively.

Where this is done well from the start, design principles can help:

- Generate support for schemes from stakeholders
- Deliver the widest possible benefits

- Facilitate a smoother planning and consenting process
- And avoid costly problems later in the project lifecycle.

This guidance unpacks our Design Principles to offer ideas on the kind of things that we would expect project level principles to cover, including:

- Climate – how the project will have the lowest possible carbon impact, how it will enhance the environment and contribute to nature recovery, as well as be ready to withstand growing climate pressures
- People – developing a truly inclusive and accessible design that is sympathetic to the social and community context in which it will operate
- Places – how the project will serve as an active steward for the local landscape, prioritising nature-based solutions and boosting a local sense of identity
- Value – looking beyond the site boundary at how the project can maximise the value of investment, including by working with other partners.

The Design Group's mission is to inspire renewed ambition for the quality of the UK's infrastructure.

So it is my hope, and that of the whole Design Group, that our ideas help inspire project directors and their design champions – but that more importantly, they feel empowered and resourced to pass on that inspiration themselves, creating infrastructure of which we can all be proud.

We look forward to hearing how project principles are being developed and would love to hear from project teams about their experiences.

Professor Sadie Morgan OBE

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Purpose and scope of guidance

This guidance, aimed primarily at client side project directors on major infrastructure projects, explains how to develop and embed project level design principles. It can be applied to projects of all sizes, across all sectors of economic infrastructure, whether private or public sector.

1. This guidance:
   - explains why project level design principles should be made central to the delivery of major infrastructure projects
   - explains how principles can be most impactful in the very earliest stages, alongside the development of an overall design vision
   - provides an overview of the suggested scope of any set of design principles
   - illustrates how principles should be used throughout the lifecycle to support design governance and underpin delivery of the outcomes set out in the business case.

2. The guidance is aimed primarily at client side project directors on major infrastructure projects, whether private or public sector. Project directors should:
   - provide strategic direction and clear leadership
   - demonstrably 'own' the design process
   - maintain a clear focus on design quality throughout
   - recognise that their project represents an intervention on an existing system
   - engender collaborative behaviours to deliver clearly defined outcomes.

3. But project directors cannot be expected to deliver good design on their own. They will need to be supported in their role by a board level design champion, while the whole board will be accountable for the delivery of high quality outcomes for the project. And the project team, led by the director, will be responsible for defining and deploying project level design principles as part of a structured design process, with team members needing to understand how the principles will directly impact their work.

4. The National Infrastructure Commission's remit covers six economic infrastructure sectors: digital, energy, flood resilience, transport, water and waste. The approach to commissioning, funding, financing and delivering major projects varies across these sectors – and across projects within any one sector. This guidance does not explore these differences, but instead provides flexibility for projects to develop bespoke design processes and design principles that best reflect their challenges and complexities. The design process must be fit for purpose, and underpinned by principles that will drive standards and accountability.

5. This is particularly important now because the UK's economic infrastructure needs to be transformed to:
   - meet the challenge of net zero
   - provide climate resilience
   - deliver sustainable economic growth.

6. The Commission's second National Infrastructure Assessment set out proposals across all six sectors and called for increased public and private sector investment. The number of infrastructure projects should therefore increase significantly in the coming years. Some of these will be Nationally Significant Infrastructure Projects with approval through the Development Consent Order (DCO) process, as established by the Planning Act 2008, and some will be delivered through other consenting regimes. This guidance does not draw any distinction between different regimes.

7. It is essential that projects use design solutions that deliver clear objectives for a price that can be afforded and to a schedule that is acceptable. This guidance outlines how a structured approach to good design is

not about adding cost and complexity to projects: it is about developing cost effective ways to meet agreed outcomes and reducing the risk of delays.

8. Utilising a structured design process, proportionate to the size, complexity and context of the development, is the way in which all infrastructure projects should be delivered. Proceeding in any different way puts design quality and contextual integration at risk, meaning opportunities to deliver multiple environmental and community benefits will be lost.

9. This guidance applies equally to new projects and to the renewal and upgrade of existing infrastructure.

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Why does infrastructure design matter?

Infrastructure design is about so much more than aesthetics. Using an iterative, structured design process from the project outset can deliver multiple environmental, social, and economic benefits, while limiting adverse impacts.

- Design ensures that projects are delivered efficiently, underpinned by clear objectives.
- Using the design process, projects become affordable, cost effective, integrated and sensitive to environment and place.
- Using the design process from the project outset can limit the risk of increased costs, delays to delivery, and stakeholder opposition.

1. Economic infrastructure has long had the power to transform. Investment in infrastructure – for example, telecommunications, roads, railways and electricity – helps drive economic growth, impacting on people's livelihoods and their quality of life. But simply spending money on projects is not enough. Positive outcomes are far from certain: there may be adverse impacts on the natural environment, or on groups with protected characteristics, and benefits may not always be realised.

2. Design is the iterative process within clearly defined parameters, which will help ensure:
   - project objectives are defined clearly
   - delivery is efficient
   - benefits are shared across multiple partners.

3. Through the design process, schemes can become accessible, affordable, cost effective, integrated and sensitive to environment and place. Projects should avoid the narrow, restrictive interpretation of design as simply 'looking good', important though that is; proper consideration of place, the natural environment and diversity issues are also crucial.

4. When projects start badly – without clear objectives, sufficient resources and required capabilities in place – it is near impossible to establish a structured, effective design process. The Infrastructure and Projects Authority's Project Routemap provides a tested methodology for setting up major projects for success.[1] When infrastructure projects are not set up well, and when the design process is lacking, whole-life benefits are unlikely to ever be fully realised and the original business case may be undermined. There will be a risk of:

- increased costs
- wasted effort
- compromised performance
- poorer value for money
- loss of stakeholder support.

5. Adhering to a structured design process, underpinned by design principles, should not be seen as 'cost additional' – but the very opposite. It can avoid the reactive, ill-conceived, late changes to infrastructure projects that often cause cost escalation and programme delay. By starting well, and putting design principles in place as a key part of governance, projects give themselves the very best chance of success.

6. Design is important for projects of every scale and type. It matters for infrastructure that is visible and used in a physical way, such as transport and energy generation, and also for infrastructure that is hidden and provides services, such as the transfer of water and wastewater in underground networks. The design process allows projects to effectively consider exactly how to define and coordinate multiple project outcomes.

7. When projects use an effective design process and work in a collaborative, open way, then infrastructure can be delivered that will work for climate, people and places. Under the Aarhus Convention, everyone must be allowed to meaningfully participate in decision making where projects affect the environment.[2] Designing infrastructure well, and engaging in a genuine partnership with diverse communities and stakeholders, will help to ensure that the planning, delivery and operational phases are as efficient, effective and beneficial as possible.

8. Our infrastructure can and should be a source of national pride, expressing who we are as a society. Our cultural heritage is informed by our interactions with infrastructure, the care we take in delivering it and the way in which it shapes our lives. We should, therefore, strive to be ambitious, recognising the role infrastructure can play in transforming communities and places, while impacting positively on the environment.

9. We now face many global challenges: becoming resilient to a changing climate, responding to significant biodiversity loss, reaching net zero, and delivering sustainable economic growth. This means it has become necessary to deliver, rapidly, an extensive programme of new infrastructure, in order to provide us with energy and water security, and resilience in the face of storms, flooding and drought. Therefore, an effective approach to design is absolutely essential.

10. Public acceptance of such rapid and extensive change can best be supported by processes that are designed to achieve highest quality outcomes. And public acceptance will become easier to achieve if efforts are made to engage, and collaborate with, those directly affected by change. We know that transformative change is essential, therefore transformative thinking is also required. And that, ultimately, is why infrastructure design matters.

Northala Fields Park in the London Borough of Ealing used substantial volumes of imported construction rubble from major development projects to help create four large conical mounds, serving as a new recreational space and also acting as a natural flood defence. Since its opening to the public in 2008, local residents have been actively engaged in organising activities and programmes in the park. Photography: Marko&Placemakers

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The Design Principles for National Infrastructure

The Design Principles – climate, people, places and value – constitute an ambitious set of interlinked principles which apply to all projects across the six economic infrastructure sectors. The principles provide an overarching, high level vision from which project level principles should be developed.

1. The National Infrastructure Commission Design Group published the Design Principles for National Infrastructure in 2020. It did so having engaged widely with academics, architects, landscape architects, engineers, environmental bodies, government and public interest groups. This engagement identified a strong demand for an ambitious set of interlinked principles that could apply across all economic infrastructure sectors. Stakeholders told the Group that it was important to have a shared vision, with principles that recognised the wider impacts and benefits of national infrastructure.

2. The Design Principles are as follows:
   - Climate – seek opportunities to enable the decarbonisation of society through the mitigation of emissions, and allow the project to adapt over time to build resilience

   - People – design infrastructure for people, not architects or engineers; make it human scale, easy to navigate and instinctive to use, helping to improve quality of life

   - Places – provide a strong sense of identity and improve the natural and built environment; make a positive contribution to landscapes within and beyond the project boundary

   - Value – achieve multiple benefits and solve problems well; add value by defining issues clearly from the outset and providing overall direction for everyone working on the project.

3. In addition to the four principles, the Group also identified that everyone involved in projects should:
   - appreciate the wider context
   - engage meaningfully
   - continually measure and improve.

4. The Design Principles were kept deliberately high level to establish a fresh, unifying, overarching vision for national economic infrastructure. The Design Group had always envisaged that the principles would be used as an outline framework for more detailed design thinking on individual schemes, and for the development of project level principles.

The 128ft replacement Pooley Bridge in Cumbria is the UK's first stainless steel single span bridge and was designed to avoid the need for piers in the river, making the structure more flood resilient. Photograph by Mike Smith

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What are project level design principles and why are they important?

A project's design principles should help guide delivery from project definition through to decommissioning. They should directly address a project's requirements, benefits and outcomes.

- Design principles should form a key part of project governance, driving design decisions from the project outset.
- Developing design principles is an iterative, ongoing process. But once consent is achieved, they should become fixed, outlining how schemes will achieve their outcomes.
- Principles should align all parties around agreed, shared outcomes, facilitating timely, effective delivery.

1. Most infrastructure projects:
   - are inherently complex
   - take many years to be delivered
   - have a long operational life
   - deliver significant cumulative change.

2. Project level design principles should guide projects from their inception right through to operational use – and beyond. Proceeding without principles in place to retain consistency of design thought is inherently risky. Design principles should form a key part of project governance, providing a framework for taking design related decisions and managing an evolving project. As major projects proceed, implementing late changes becomes increasingly costly and much more difficult; having design principles in place from the outset will help to manage this risk.

3. The design process effectively begins in the earliest stages of all infrastructure projects, when:
   - operational requirements are defined
   - project scope is agreed
   - shared outcomes are identified.

4. Having a clear design vision supported by design principles is one of the most important early stage outputs. But there is no requirement for detailed design work in these early stages. Instead, the design process should focus on facilitating strategic assessment of the benefits and opportunities of different approaches, alongside the likely environmental impacts, human factors and engineering challenges. It is important to avoid becoming 'locked in' to a solution too early in the process, as this can lead to sub-optimal decision making and poorer value for money.

5. Principles should support the widest possible set of outcomes (i.e. beyond the merely operational) and these outcomes should, in turn, inform the narrative for each design principle. As the project design matures, and as the complexity of the project considerations increases, the team should plan for sufficient 'reflection time', to ensure the design principles are continuing to have the anticipated impact and that they will contribute to delivery of the final outcomes being sought.

6. Project level design principles should directly address the Design Principles for National Infrastructure of climate, people, places and value, plus any supporting organisational or sectoral principles. There should be a clear logic to the structuring of the design principles, from strategic to project level, within an easy-to-understand hierarchy.

7. A project's design principles should:
   - reflect the overarching design vision and address the agreed project requirements, benefits and outcomes
   - firmly anchor the proposal, supporting a design narrative that's relevant to the local context
   - recognise place including landscape, the natural environment, culture and heritage
   - be informed by the people affected, including residents, community groups, infrastructure users, interest groups, and local employers
   - reflect an inclusive approach to ensure equitable delivery of benefits and prevention from harm
   - demonstrate that opportunities have been identified to deliver wider benefits and outcomes beyond the project, utilising systems thinking
   - be clearly written, with quantifiable measures, so that final outcomes can be tested against them.

8. The development of design principles is an iterative, ongoing activity throughout any project. While it is important for principles to be developed from the very earliest stages, they must also evolve. The most successful schemes are those that refine their approach to reflect:
    - any significant new information coming to light
    - a deeper understanding of community and place
    - the development of detailed designs.

9. As the project progresses, the design principles will become increasingly 'fixed' until consent is achieved. Specific requirements and standards for each element of the scheme should then be set out in other supplementary documents, such as design codes. What is key is that at any point in time, the set of design principles should represent a coherent, visionary articulation of the scheme, including how it will achieve its outcomes. And, at an agreed point in time, the principles should become fixed, sufficient to underpin the design quality of the project, post consent.

10. Principles should not just 'sit on the shelf' but drive decision making on the project day-to-day, including:
    - allowing clear comparisons to be made at the option appraisal stage, about the extent to which each option will deliver the design vision in accordance with the design principles
    - informing the details and metrics for each stage of the project, including relevant success criteria and key performance indicators
    - informing project briefs and the response requirements/evaluation criteria for design and construction tenders
    - featuring significantly at all phase or stage gate reviews

- forming the basis of compliance statements to support the discharge of requirements, post consent
- informing the final, agreed approach to benefits monitoring and measurement.

11. The design principles should be capable of aligning all parties around agreed, shared outcomes. And significant changes to the principles should always be communicated. Local communities, planning authorities, funders and other stakeholders will then have confidence that the project is being developed in a structured manner, working to an agreed set of principles. This can be a key factor in facilitating timely, effective delivery.

12. The principles will also help to foster a shared understanding across the whole project team of the outputs and outcomes being sought. Teams should commit to a regular critique of the principles and, when doing so, should:
    - engage widely and meaningfully
    - utilise internal peer review
    - respond creatively to feedback
    - demonstrate a genuine commitment to the design process.

13. The principles will help to underline the message that everyone on the team has a role to play in good design, and discussion of the principles will help to enhance collaboration. Whenever new members join the team, and whenever specialist, external consultants are engaged, project directors should ensure that the design principles and project outcomes form a key part of the induction process.

5

The importance of effective leadership

Project directors will have overall responsibility for design quality. But all members of a project team must buy in to the design process to deliver infrastructure of the highest quality. Project directors should:

- Understand how important it is to establish and maintain a clear, unifying design direction, and work to embed an ambitious design culture from the outset.
- Ensure their team develops a sound understanding of place, community, the natural environment and economic context through inclusive consultation and engagement.
- Ensure that the board scrutinises the project's compliance with the design principles.
- Be supported by a board level design champion.

1. This guidance is targeted at project directors on the client side. Organisations will need to appoint directors who have the right skills, behaviours and experience to act as inspiring, visionary leaders throughout the lifecycle, recognising that their project is adding an intervention onto an existing system. Project directors will have overall responsibility for design whether delivered by internal teams or external consultants. Directors will need to recognise the points at which specialist expertise will need to be brought onto the project – and they will understand how important it is to establish and maintain a clear, unifying design direction.

2. The very best project directors will:
   - insist on the right behaviours being demonstrated across the team
   - embed an ambitious design culture from the very earliest stages
   - look critically at their own organisation or team, to ask whether there is sufficient capacity, capability and commitment to design as a structured process that will drive the project.

3. Project directors may need to take decisive action in the initial phases of projects to:
   - embed the required culture and foster a spirit of true collaboration from day one
   - facilitate skills development, including delivery from external training providers, where necessary
   - develop a shared understanding of likely design challenges on the scheme
   - ensure the benefits of inter-disciplinary working are recognised and monitored
   - bring in an independent advisor to provide an assessment of design maturity across the team.

4. All members of the team should understand what is meant by design quality. Project directors should inspire the team to follow a well planned design process that delivers infrastructure of the highest design quality. This will mean infrastructure:
   - is delivered on time and within budget
   - meets requirements, performs well, is reliable, durable, efficient, and easy to maintain and operate
   - acts as a 'good neighbour' to nearby communities
   - is visually appealing, has a strong identity and fits into the wider context
   - delivers multiple benefits that people value, equitably enhancing quality of life
   - impacts positively, overall, on the environment and biodiversity.

5. A genuine commitment to quality will have a material impact on project briefs and client requirements – and, ultimately, on any final project outcomes. Effective leadership will continually stress the importance of design process and quality outcomes, recognising that these can be strengthened via:
   - regular external scrutiny through design reviews
   - learning from other projects
   - integrated thinking
   - collaborative behaviour
   - holding each other to account.

6. Project directors should see the design process as a way of facilitating meaningful local consultation, providing a framework for early consideration of environmental, social and economic issues – and for identifying community ambitions. This approach can help leaders to significantly 'de-risk' projects, speeding consent and thereby saving costs. It is for project directors to decide

on the exact format local consultation should take, cognisant of the local context.

7. Project directors should ensure the project team develops a sound understanding of place, community, the natural environment and economic context to inform their work. The approach must be evidence led, should align with local plans and strategies, and be informed by well structured consultation and stakeholder engagement. This will help the project to identify wider beneficial outcomes and respond to the local context.

8. The development of design principles should take place in an inclusive and transparent manner. *All* communities and stakeholders who will be (or perceive that they will be) affected by the project should be invited to participate. The development of principles can be a useful mechanism for striking a balance between competing priorities on a project and for securing compromises between different stakeholders who may have contrasting perspectives.

9. Project directors should utilise engagement experts, as required, to ensure that engagement is:
   - inclusive, supportive and respectful
   - suitably flexible, deploying different communication methods, as necessary
   - clearly defined, well planned and regularly undertaken
   - framed by clear parameters for involvement
   - underpinned by a comprehensive understanding of community and place
   - mindful of the likely impact of the scheme on individuals and communities
   - designed to offer genuine opportunities for collaboration and benefit sharing.

10. Project directors will be responsible for ensuring a robust process is followed throughout the lifecycle to develop, test and embed design principles across the team. Further details are set out in the following section of this guidance. They will need to maintain overall coherence and manage the risk of individual disciplines developing principles that might be inconsistent with each other. Project directors should also lead the periodic review and refinement of the principles at key project milestones.

11. The project director should secure agreement from the board that it will scrutinise compliance with the principles as a key part of the scheme's overall governance arrangements. It is vital for a project to regularly assess whether it is proceeding in a manner consistent with the principles, which will therefore likely deliver the overall design vision. These assessments should be clearly documented and the board should consider public reporting of compliance.

12. Project directors should be supported by a board level design champion. Design champions will be accountable for the implementation of a sound design process, delivery of quality design outcomes and for the project maximising wider benefits. Government has already fully endorsed the principle of design champions sitting at board level. A design champion is best placed to ensure that the principles are used to truly underpin the governance of design and are not seen as an add on – or worse, ignored. This becomes particularly important should the scheme face programme or budgetary pressures – this is when it becomes vital for creative problem solving to continue to be used to ensure design integrity is not compromised.

6

Project level design principles through the lifecycle

This section shows the process through which design principles can be developed and embedded within a project, from project definition through to decommissioning. It provides an illustration of how design principles can be used at each stage.

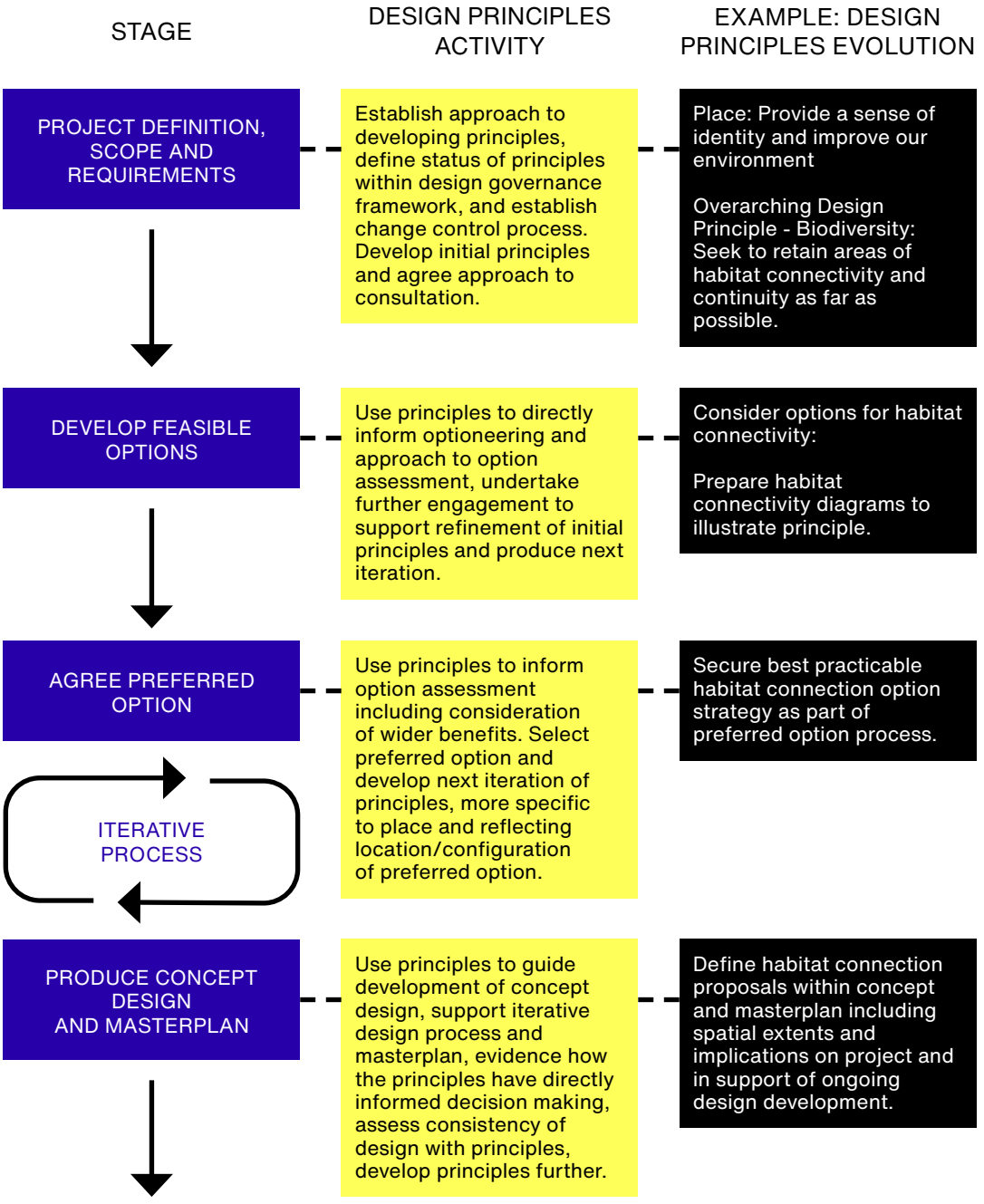
- Project teams should always adopt an approach that gives their scheme the best chance of delivering high quality design outcomes through a structured design process.
- Principles should directly inform a project's design as it matures, but they should remain overarching as the project brief expands and deepens.

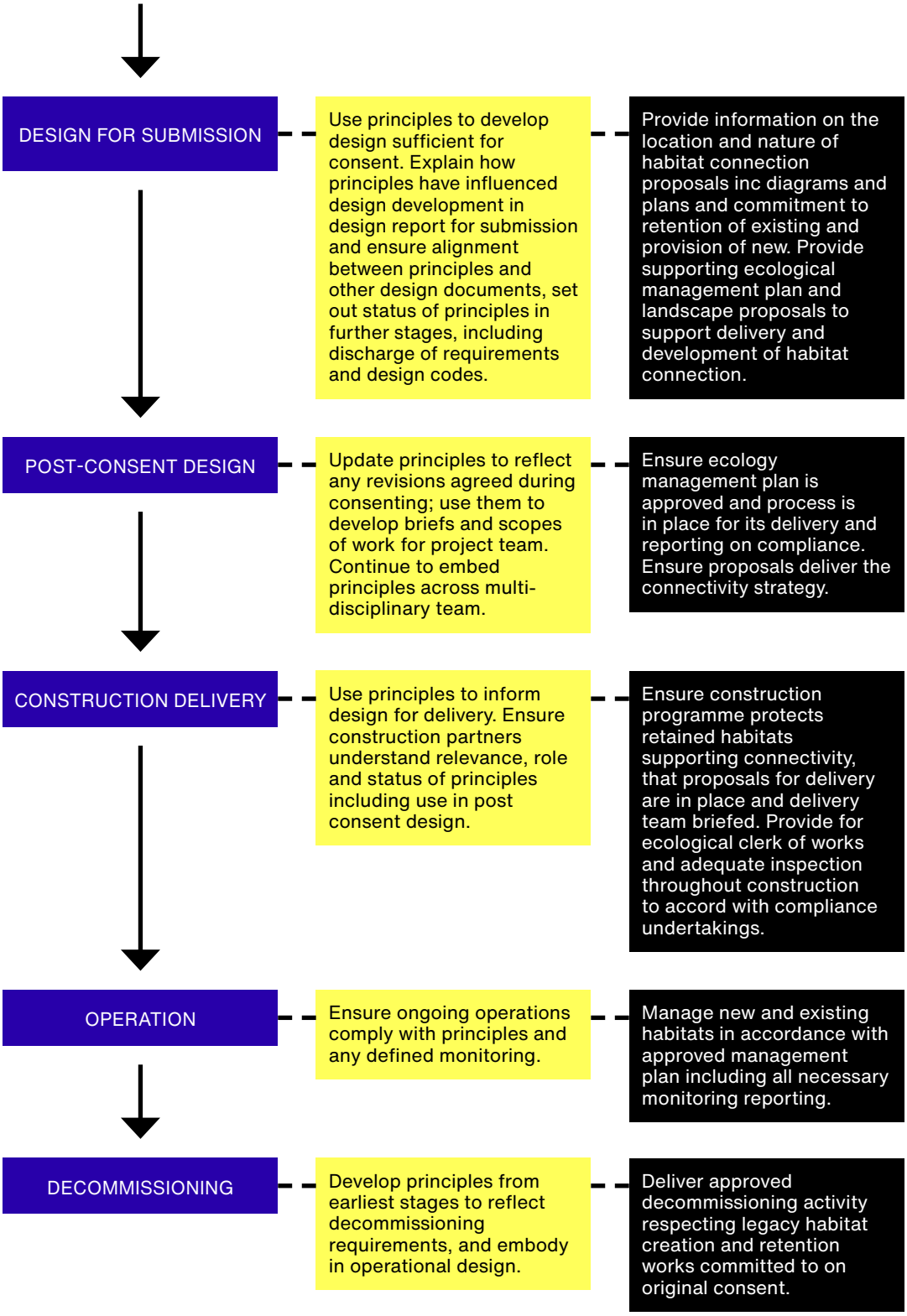
1. This guidance will not attempt to set out the ideal design process that should be followed by specific projects, given the guidance covers six economic infrastructure sectors. In addition, every project will have a unique set of requirements, technical challenges, consenting issues and procurement processes. But there is value in setting out a generic lifecycle and providing an indication of how the design principles might look at each stage. An illustrative example for habitat connectivity is provided in the diagram on pages 40 and 41.

2. Broadly, the design principles should be used to directly inform the design as the project progresses, but principles should remain overarching as the project brief expands and deepens. And, in advance of construction, the principles will need to be translated into clear metrics about exactly what needs to be delivered, how, where and when, and at what cost.

3. There will need to be appropriate alignment, throughout the project lifecycle, between the various design related documents that may be generated at different stages. The whole project team must understand the role and status of these documents, likely to include:
   - the project description supporting environmental assessment
   - the design chapter within the environmental statement
   - the design and access statement or similar design report, describing the design process undertaken
   - the project's design principles, submitted for approval to support the governance of design post consent, plus any supporting design code
   - the landscape and ecological management plan
   - the construction phase delivery plan.

Knight Architects developed an innovative new standard footbridge design for Network Rail, which is cheaper and quicker to produce than a steel equivalent, and adaptable to a range of locations. Here a prototype is shown in situ just north of Craven Arms, in the Shropshire hills. Photograph by Paul White


STAGE
DESIGN PRINCIPLES ACTIVITY
EXAMPLE: DESIGN PRINCIPLES EVOLUTION
PROJECT DEFINITION, SCOPE AND REQUIREMENTS
Establish approach to developing principles, define status of principles within design governance framework, and establish change control process. Develop initial principles and agree approach to consultation.
Place: Provide a sense of identity and improve our environment
Overarching Design Principle - Biodiversity: Seek to retain areas of habitat connectivity and continuity as far as possible.
DEVELOP FEASIBLE OPTIONS
Use principles to directly inform optioneering and approach to option assessment, undertake further engagement to support refinement of initial principles and produce next iteration.
Consider options for habitat connectivity:
Prepare habitat connectivity diagrams to illustrate principle.
AGREE PREFERRED OPTION
Use principles to inform option assessment including consideration of wider benefits. Select preferred option and develop next iteration of principles, more specific to place and reflecting location/configuration of preferred option.
Secure best practicable habitat connection option strategy as part of preferred option process.
ITERATIVE PROCESS
PRODUCE CONCEPT DESIGN AND MASTERPLAN
Use principles to guide development of concept design, support iterative design process and masterplan, evidence how the principles have directly informed decision making, assess consistency of design with principles, develop principles further.
Define habitat connection proposals within concept and masterplan including spatial extents and implications on project and in support of ongoing design development.


DESIGN FOR SUBMISSION
Use principles to develop design sufficient for consent. Explain how principles have influenced design development in design report for submission and ensure alignment between principles and other design documents, set out status of principles in further stages, including discharge of requirements and design codes.
Provide information on the location and nature of habitat connection proposals inc diagrams and plans and commitment to retention of existing and provision of new. Provide supporting ecological management plan and landscape proposals to support delivery and development of habitat connection.
POST-CONSENT DESIGN
Update principles to reflect any revisions agreed during consenting; use them to develop briefs and scopes of work for project team. Continue to embed principles across multi-disciplinary team.
Ensure ecology management plan is approved and process is in place for its delivery and reporting on compliance. Ensure proposals deliver the connectivity strategy.
CONSTRUCTION DELIVERY
Use principles to inform design for delivery. Ensure construction partners understand relevance, role and status of principles including use in post consent design.
Ensure construction programme protects retained habitats supporting connectivity, that proposals for delivery are in place and delivery team briefed. Provide for ecological clerk of works and adequate inspection throughout construction to accord with compliance undertakings.
OPERATION
Ensure ongoing operations comply with principles and any defined monitoring.
Manage new and existing habitats in accordance with approved management plan including all necessary monitoring reporting.
DECOMMISSIONING
Develop principles from earliest stages to reflect decommissioning requirements, and embody in operational design.
Deliver approved decommissioning activity respecting legacy habitat creation and retention works committed to on original consent.

4. This section of the guidance focuses solely on the design principles and how they will develop as the project progresses. It is recognised that the process will be iterative rather than strictly linear.

Project definition, scope and requirements

- develop a comprehensive understanding of the case for change and the issues that need to be addressed; set out an agreed project definition and requirements
- use early engagement to explore stakeholder issues and identify the potential to deliver wider benefits beyond any site boundary and the operation of the infrastructure itself
- define the scope and set out ambitions for the project in a short, compelling design vision, encapsulating project benefits and outcomes; secure corporate commitment to the design vision
- establish the approach to developing design principles from the design vision, set out how the principles will be incorporated within the project's framework for decision making, define their intended status and instigate a formal change-control process for them
- prepare the initial draft of design principles reflecting the requirements of the project, consult on the principles to establish stakeholder buy-in, and consider independent design review input
- use the principles to help inform the evaluation and appointment of consultant teams.

Develop feasible options

- undertake project optioneering, working within the framework of the design vision and design principles, and using a multi-disciplinary team
- use the principles to inform the approach to multi-

criteria assessment and ensure consideration of the wider benefits that could be realised
- utilise the mitigation hierarchy to help inform the optioneering process
- refer to National Policy Statements and relevant spatial and local plans when considering site/ route options, to ensure there is detailed, careful and comprehensive consideration of all possible alternatives
- undertake further engagement with statutory consultees, local communities, and those who will be operating the asset(s), to inform consideration of options and in support of refinement of the initial design principles
- produce next iteration of project level design principles, as required, and start to develop concept design brief.

Agree preferred option

- undertake detailed, quantitative assessment of the options and sub-options developed previously; ensure that evaluation is undertaken clearly and transparently, with direct reference to the design vision, the design principles and the outcomes being sought
- ensure the assessment takes full account of the potential for options to deliver wider value through the project
- produce a comprehensive report summarising how each option performs and select a preferred option that: meets project requirements, will deliver wider benefits through effective alignment with other spatial plans, has the least adverse impacts, will deliver positive environmental outcomes, and is considered likely to achieve consent.

- develop next iteration of principles, which should become more specific to place, reflecting the location/configuration of the preferred option
- confirm concept and masterplan brief.

Produce concept design and masterplan

- produce single preferred design concept within agreed scope that: meets project requirements, will deliver wider benefits, has the least adverse impacts, will deliver positive environmental outcomes, is considered likely to achieve consent, and provides sufficient flexibility to align with the agreed consenting strategy
- ensure design principles are used to guide development of the concept design, including testing different options and detailed consideration of how the asset will be used and operated
- evidence how design principles have directly informed decision making, with reference to consultation, design review, environmental assessments, and ongoing development of the design, as appropriate
- respond specifically to stakeholder feedback, including from affected communities and protected characteristics; secure agreement from receiving local authorities to support their role, post consent
- consider use of an independent design review process, which should include assessment of the consistency of the design with the project principles
- further develop the project principles to fully reflect the Design Principles for National Infrastructure (Climate, People, Places, Value), with a focus on: communities; users; diverse demographics; neighbouring interests; landscape; the natural environment; and technical challenges.

Design for submission

- use the design principles to further develop the scheme to a level sufficient for consenting process, resolve key elements in relation to operation and maintenance while retaining flexibility for post consent design development and the construction phase
- distil important changes to the emerging design solution into key principles to be captured as commitments; continue to check that new principles are complementary to the core principles of the project
- consider undertaking a further independent design review

A 85m high summit provides a landscaped hiking trail planted with 200 trees, a ski slope and a climbing wall – all formed by the sloping roof of a huge energy from waste plant in Copenhagen, Denmark. Copenhill, designed by Bjarke Ingels Group, opened in 2017. Photograph by Laurian Ghinitoiu

- set out, in the submission documents, a clear articulation of how: the design principles have been used to influence design development; the principles are ‘embedded’ in the design submitted for consent; the design will help secure delivery of the project’s outcomes
- begin to prepare for the translation of the chosen design into works information for tenders
- set out the status of the design principles in forthcoming stages, including how they will be used to: govern the discharge of requirements where some flexibility has been approved at consent; demonstrate compliance; develop key performance indicators to help monitor and report on progress; inform design codes and other design-related documents as may be appropriate.

Inside Copenhill, modern waste treatment machinery is all arranged in height order, which forms the building’s sloped rooftop and resulting 9,000-metre-squared ski and recreational terrain. Photograph by Soren Aagaard

Post consent design

- update design principles to reflect any revisions agreed during the consenting process
- develop detailed briefs and scopes for design development of key components of the project, ensuring full compliance with commitments made in the design principles at the consenting/planning stage; confirm basis of compliance
- ensure principles continue to be used as the basis for resolving/informing outstanding design issues
- continue to embed principles across the multi-disciplinary team, which will become increasingly important as multiple, new specialists come onto the project post consent in support of delivery/ construction
- monitor and report against design outcomes and performance indicators.

Construction delivery

- ensure alignment between design principles, any related design documents (eg design codes), and the metrics required for tender evaluations for contractors and consultant teams
- ensure the principles inform the development of design for delivery including specification and drawings
- work with construction partners to ensure they understand the relevance of design principles during the construction phase, including how principles will be used to govern post consent design development and any formal compliance requirements
- finalise design information to enable construction to take place safely and to the agreed design quality
- ensure environmental outcomes are based on the project's design principles and plan for delivery of the

outcomes via, for example, a landscape ecological management plan
- consider promotion of the design principles with all stakeholders and communities that will be impacted during construction, to demonstrate accountability and transparency
- monitor and report against design outcomes and performance indicators; undertake a lessons learned exercise on completion so that other infrastructure projects can benefit.

Operation

- ensure ongoing operations comply with relevant design principles and defined monitoring, for example in landscape management or building maintenance
- provide relevant information to facilitate the measurement of any operational performance monitoring of the project
- ensure arrangements are in place for post project reviews (for example, benefits realisation and post occupancy evaluation).

Decommissioning

- ensure that any decommissioning considerations are factored into the design from the earliest stages of the project
- develop design principles from the earliest stages that reflect the need to ‘design for decommissioning’ and explain how this phase will be undertaken in accordance with, for example, relevant standards including the waste hierarchy
- ensure that engagement activity in earlier phases of the project has incorporated plans for the eventual decommissioning phase.

5. As the project moves through the pre consent stages set out above, it is crucial that the project team record the evolution of the design principles and design changes that have been implemented, along with the supporting rationale. The use of a ‘change record’ will help to illustrate that the scheme is proceeding in a structured, consistent manner, giving confidence to stakeholders and planning authorities.

7

What might be included in any set of project level design principles?

Project level design principles should flow from the Design Principles for National Infrastructure – Climate, People, Places and Value. This section sets out how these high level principles can be used, alongside any sectoral or organisational design principles, to inform project level principles.

1. It would be contradictory for this guidance to set out exactly what any set of design principles should contain. Bespoke principles are always required, reflecting the specific places, contexts, constraints, and requirements of a project. The most impactful design principles are those that make clear, specific statements and avoid generic, vague language that could be applied to any project.

2. The Design Principles for National Infrastructure establish a framework for project level design principles. The project principles will also be informed by relevant sectoral or organisational design principles.

3. Project teams should give thought to the optimum structure, hierarchy and grouping of the principles, from strategic through to project specific. Major projects or fleets of projects may require cross-cutting principles, which would then be supplemented by principles that relate to specific places or requirements. Teams should consider the point at which design principles will likely become fixed, which is generally at consent stage, with further required detail then encapsulated in design codes, specifications, or similar.

4. Project teams should also recognise the close relationship between design, cost, deliverability and safety. Design principles should capture the importance of the construction, operational, and decommissioning phases proceeding in a way that allows for cost control, supports delivery and minimises risks to workers and end users. Good design will impact positively on all of these elements if the process is properly structured.

5. The following sections take each of the Design Principles for National Infrastructure in turn, providing further

information about the likely areas that will be covered in any set of project principles.

Climate

6. Project teams should recognise the importance of designing across boundaries to meet the multiple challenges presented by the climate crisis. This will require a proactive approach, establishing principles that span different geographies, sectors and legislative areas.

7. Designers are uniquely placed to challenge fragmented responsibilities, putting in place principles around which different organisations can unite. Isolated solutions are unlikely to have the impact required; design principles will need to look at the environment as whole, be landscape led, and contribute to nature recovery. There will need to be alignment between the design principles and the project's documented approach to the environment, ecology and biodiversity.

8. Teams should work innovatively to reduce a project's carbon impact. Design principles should be put in place that set out:
   - how existing assets will be reused, wherever possible
   - how waste will be minimised or eliminated
   - and how materials will be used in the most efficient way possible.

9. Wherever possible, principles should set out a commitment to nature based solutions. And the design process should be used to agree how carbon emissions over the whole lifespan will be minimised, controlled and measured, in construction, operation and decommissioning phases. Design principles should

reflect wider carbon budgets, sectoral commitments and the path to net zero. There will need to be good alignment between the principles and the construction environmental management plan.

10. The design process should be used to 'build in' resilience to climate change, so that infrastructure asset owners are able to anticipate, adapt, resist, absorb, recover and transform, as set out in the resilience framework developed by the Commission.[3] Principles may be needed to address any interdependencies of critical infrastructure, thus avoiding catastrophic impacts associated with multiple system failures. Finally, the principles may include commitments to designing for ongoing flexibility, so that the asset, once operational, can be modified as required.

People

11. Projects will fail unless the design process is used to develop a comprehensive understanding of the context in which assets will operate. This should include spatial and environmental considerations, social demographics, and diverse communities. The development of design principles should therefore be informed by a detailed understanding of local population, community needs, land use, amenity outcomes being sought, and any resulting impacts – including how these can be addressed.

12. There should be an understanding across the team that communities hosting infrastructure will often not be direct beneficiaries, hence the vital importance of delivering wider benefits, beyond the narrow scope of provision of a new or upgraded asset and associated

mitigation. The team should see the development of principles as providing an opportunity to engage in an early, meaningful and inclusive way with communities, and projects should avoid tokenistic 'consultation' late in the day. The project approach should provide clear parameters for involvement.

13. A genuine commitment to designing for people, will see a comprehensively inclusive design approach adopted from the outset. Projects should look beyond minimum compliance and towards better practice, avoiding the pitfall of seeking to address accessibility issues only once a solution has been developed in detail. Design principles should set out the approach that will be adopted, recognising that infrastructure schemes can include or exclude users. By designing infrastructure with human diversity at its core we can create design solutions that are accessible and inclusive to all users. This includes providing access to public infrastructure such as rail, or access to the natural environment, which might not have existed prior to the development.

14. Infrastructure projects are often places of work and the consideration of good quality and inclusive workplace environments is important during both construction and operation.

Places

15. Design principles should reflect a commitment to landscape-led, regenerative approaches, enhancing the environment and making a positive contribution to place. Designers should recognise the importance of 'stewardship' – acting carefully and responsibly and not seeking to exploit – so that schemes will provide a positive inheritance for future

generations. Design principles should set this out unequivocally.

16. Well-functioning ecosystems are central to human existence and quality of life. The UK has suffered significant decline in the natural environment and infrastructure projects should contribute to the efforts now required to address nature recovery as part of a comprehensive response to place. Design principles should explain how the requirements for biodiversity net gain, nature recovery and other environmental outcomes will be met, and how nature based solutions will be used to minimise the need for engineered solutions.

17. Projects should be ambitious, recognising that infrastructure has the potential to give places a strong sense of identity and to enable delivery of significant benefits. Project teams should embrace this fact, setting out principles that demonstrate a desire to inspire communities, enhance places, align with local plans and provide solutions that people will be proud of. Design principles should capture how the form, composition, proportion, materiality and appearance of built infrastructure reflects, and responds to, context.

Value

18. The UK's infrastructure requires significant investment. And each scheme needs to use an effective design process to maximise the value from this investment. Project teams should identify opportunities to secure wider economic, environmental and social benefits – and should develop principles that set this out, as proof of a genuinely holistic approach. Importantly, opportunities can present themselves at any point in the project

lifecycle and the team will need to continue to work in a collaborative, multi-disciplinary way, looking to solve multiple problems with a single solution wherever possible.

19. Design principles should demonstrate a commitment to looking 'beyond the site boundary' and beyond the core operational purpose of infrastructure provision. Successful projects will develop a detailed knowledge of national, regional and local planning context, responding to policy ambitions and, ideally, making positive contributions towards them. Design principles should signal to potential partners that there are routes to effective collaboration, with infrastructure projects 'unlocking' the potential for wider benefits and boosting economic return on investment.

20. The monitoring and measurement of benefits is crucial. This should always be a core part of the design process and design principles should capture how it will be undertaken. A truly collaborative design process, involving all those who may be involved in subsequent data gathering, can help devise solutions. A set of design principles can act as a published commitment to measuring scheme value in its widest sense.

Case studies

Lower Thames Crossing

The A122 Lower Thames Crossing (LTC) will be the largest road building project since the construction of the M25, connecting the A2 and M2 in Kent and the M25 south of junction 29 and crossing under the River Thames through a tunnel. With 14.3 miles of new road and around 50 new bridges and viaducts, it will almost double the road capacity across the Thames east of London and help to relieve the congested Dartford Crossing. The scheme includes seven green bridges, two new public parks and around 60km of new or improved public rights of way for walkers, cyclists and horse riders.

The LTC design principles evolved from the project's design narrative, a short document developed early in the design process. It was led by the project and landscape architects, and developed through workshops with representatives of all the different project team disciplines. The process led to the route being broken down into different character areas, with the narrative identifying potential design approaches, opportunities and constraints for each. Although the narrative was used primarily as an internal document to help ensure the various design and project disciplines were united around a common design approach, stakeholders were also invited to comment. The narrative heavily influenced the proposals taken to statutory consultation.

In 2018, in parallel, National Highways published its 10 Principles of Good Design. When LTC began to define its project principles after statutory consultation, the team structured them to reference the overarching National Highways' themes (Connecting People, Connecting Places, Connecting Processes) while also capturing the key design approaches that had emerged from the narrative. There was detailed engagement with statutory stakeholders on the principles throughout the consultation process and

examination. The principles have been used to secure both overarching/project-wide design approaches and more detailed issues important to specific stakeholders and places.

As the project is now moving into the delivery stages, the development team has been holding a number of workshops with the successful contractors to emphasise the importance of the principles as they develop their detailed designs. The LTC client team has also developed assurance processes and named a design champion to oversee compliance with the design principles in collaboration with the contractors throughout the detailed design process.

The main challenge in developing the principles has been striking the right balance between specificity (to secure important commitments) and flexibility (to allow innovation and improvements to the project reference design). Other challenges have included achieving sufficient clarity in the principles, and getting the tone right for the qualitative aspects of design – wanting to be ambitious and deliverable at the same time.

LTC is a project still early in the delivery stages and without an approved DCO. But the design principles have been key in securing essential mitigations and giving confidence to stakeholders that design has been considered 'holistically'. National Highway processes (such as taking design proposals through independent design review) have been incorporated into the principles, meaning they now have a legal underpinning that can be relied upon to influence design outcomes. The principles have also been an important part of the induction process for contractors, setting out, succinctly, the client team's aspirations and stakeholder priorities.

(top) The project team identified an opportunity to address historic severance caused by the M25 and to provide a new bridge improving public rights of way for walkers, cyclists and horse-riders. Photograph by National Highways.

(bottom) The project's design narrative promoted the proposal to consolidate connectivity between communities, recreation routes and habitats in a single high quality green bridge across the new road. Photograph by National Highways.

Case studies

Tideway

Even when it rains only lightly in London, untreated sewage overflows from the Victorian sewers into the River Thames. Tideway is the development of a new 'super sewer', 25km long and 7.2m in diameter, running from Acton in west London through to Abbey Mills in east London. The tunnel will intercept, store and transfer sewage waste away from the Thames, protecting the river for the next 100 years. Preparatory work started in 2015 and construction has now taken place across 24 different sites. The project will complete in 2025.

The project's design principles were developed in parallel with the designs for the project through a multidisciplinary process. Early drafts were shared with statutory stakeholders and then refined, and key issues raised through public consultation were also incorporated. As the project was seeking to secure permission for parameters through the DCO process, the principles were referenced in the Order itself to secure the salient, qualitative aspects of the design. They were also used to secure elements of mitigation.

Throughout the tendering period, the fact that the principles were part of the Order was emphasised by the client team and handed over to the successful contractors, who became responsible for delivery against the principles. The principles were a touchstone in interdisciplinary design reviews, independent design reviews, and client design assurance processes. And, with several post DCO requirements to discharge, compliance with the principles was independently monitored by external stakeholders.

The vision section of the principles document states an ambition to 'build on Sir Joseph Bazalgette's legacy and maintain the long term sustainability of London as a world class city and improve the quality of its largest open space,

the River Thames'. One of the main challenges has been translating this aspiration into the detail of proposals, even with over 200 separate design principles to support it. However, having this ambition so clearly stated has also made it much easier for people joining the project to quickly understand design aspirations.

The principles protected continuity in the design and safeguarded the inclusion of features important to stakeholders. For example, the recently completed extension to Putney Embankment includes new artwork by Claire Barclay to mark its location on the start line of the University Boat Race. The principle underpinning this was drafted in direct response to the wishes of the local borough and recreational boat users on this busy part of the Thames, and resulted from early public consultation exercises.

Using principles rather than proscribed design solutions has also ensured there has been flexibility for the contractors to follow distinctive placemaking design solutions at each site, while meeting project-wide aspirations. For example, the designs of the new foreshore structures at Chelsea Embankment and King Edward Memorial Park have developed in a flexible and creative way to meet the project objective 'to create new, high quality, public spaces and enhance habitats and biodiversity' through the inclusion of both attractive new public realm and intertidal terraces.

(top) The designs of the new foreshore structures at Chelsea Embankment and King Edward Memorial Park have developed in a flexible and creative way to meet the project objective 'to create new, high quality, public spaces and enhance habitats and biodiversity'. Image credit: Tideway

(bottom) New public realm proposals 'build on Sir Joseph Bazalgette's legacy ... and improve the quality of its largest open space, the River Thames'. Image credit: Tideway

Case studies

Sizewell C

Sizewell C is a project to construct a 3,200 megawatt nuclear power station with two European Pressurised Reactors in East Suffolk. It will be capable of powering six million homes. The site extends to an area of over 600ha and lies within a designated National Landscape. The project was granted its DCO in 2022.

Design principles were established in the early project phases to govern the design of all main elements of the project – from early design thinking right through to delivery. The design principles were consulted upon during informal and formal consultation stages and were agreed with the local planning authority in support of their ongoing responsibilities to discharge DCO requirements. The design principles were subject to review from the Design Council and submitted for approval with a view to controlling the delivery of the project. Collectively, the design principles were structured to help to define and establish how the project will fulfil the criteria of 'good design', set out in Overarching National Policy Statement for Energy.

Design principles were split into two categories:

- Overarching design principles: structured under eight themes including project and contextually specific landscape and amenity, biodiversity, structures, safety and delivery.
- Detailed design principles: prepared to support the preparation of detailed design submitted as part of the DCO, structured under two themes – Landscape and Built Development. In the case of alternative designs, or where details were not submitted as part of the DCO, the designs must be in general accordance with the detailed design principles.

One of the challenges was to ensure the design principles provided guidance at an appropriate level of detail to deliver good design, but without defining specific outcomes that related to detailed design responses. The principles were therefore structured to support an approach to flexibility appropriate to the nature of the project and the site. It was considered key to ensure that the design principles directly informed the design process and designs submitted for DCO approval, but that they also supported ongoing design post DCO consent. Discussions with the local planning authority were extremely important in securing agreement about the level of required design commitment pre and post DCO submission.

There are many examples of the positive impacts that will result from the overall approach taken to design principles. Overarching design principle 18 related to the integration of the main power station structures into the local landscape and with existing power generation:

‘Sizewell C structures will complement the existing structures within the landscape, most notably Sizewell A and B, as far as reasonably practicable’

This principle was supported by detailed design principles including:

54 (buildings)

> ‘The arrangement of the turbine halls on the north-south axis of the site will be spaced symmetrically within the immediate foreground of the nuclear island buildings to provide clear separation of the volumes’

and 38 and 39 (landscape)

‘Mature screening will exploit the existing woodland at Goose Hill and Sizewell Belts to retain and complement the architectural composition of the existing power station with the new Sizewell C structures’.

‘New planting and landforms will be established at the earliest practicable opportunity’.

This ‘cascade’ of design control was further supported by a strategic diagram relating to massing and arrangement of built form, plus design commitments to coastal defences and woodland. This will support the integration of the power station in long coastal views from where this axial arrangement of buildings will be appreciated.

Sizewell C structures will complement the existing structures within the landscape, most notably Sizewell A and B, as far as reasonably practicable. Image credit: LDA Design/Grimshaw

End notes and useful resources

1. Infrastructure and Projects Authority (2022), Project Routemap – Setting up projects for success

2. United Nations Economic Commission for Europe (1998), UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention)

3. National Infrastructure Commission (2020), Anticipate, react, recover – Resilient infrastructure systems

National Highways (2018), The road to good design

National Highways (2022), People, places and processes: A guide to good design at National Highways

Network Rail (2019), Our Principles of Good Design

Water Resources All Company Working Group (2023), Water resources: Design principles and user guidance

Forthcoming publications (as at May 2024) of relevance are expected to include:

- Advice from the Planning Inspectorate on good design for NSIPs, which will illustrate how this can be achieved in practice, drawing from the evidence base
- Design principles from Natural England to inform landscape-led approaches to new reservoir developments
- Design principles for electricity transmission, developed by the Electricity System Operator, to support accelerated expansion of the transmission network

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