THE MERSEY GATEWAY PROJECT
(MERSEY GATEWAY BRIDGE)
ENGINEERING DESIGN DEVELOPMENT
& NAVIGATION

PROOF OF EVIDENCE OF
Ian Hunt
This proof of evidence relates to the implications of the following applications and proposed orders:

**Planning Application for full planning permission for works lying within Runcorn comprising improvements to the Central Expressway, Weston Link, the Weston Point Expressway and Junction 12 of the M56 motorway, dated 31 March 2008**

**Planning Application for full planning permission for works lying within Widnes comprising modifications of the northern approaches to the Silver Jubilee Bridge, dated 31 March 2008**

**Listed Building Consent Application for modifications to the carriageway of the Silver Jubilee Bridge, dated 31 March 2008**

**The River Mersey (Mersey Gateway Bridge) Order (application under section 6 of the Transport and Works Act 1992 to the Secretary of State for Transport for an order under section 3(1)(b) of that Act)**

**The A533 (Silver Jubilee Bridge) Road User Charging Scheme Order**

**The Halton Borough Council (Mersey Gateway - Queensway) Compulsory Purchase Order 2008**

**The Halton Borough Council (Mersey Gateway - Central Expressway) Compulsory Purchase Order 2008**

**The Halton Borough Council (A533 Central Expressway) Side Roads Order 2008**

**The Halton Borough Council (A533 Queensway) Side Roads Order 2008**

**The A533 (Silver Jubilee Bridge) Road User Charging Scheme Order 2008.**
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1. **QUALIFICATIONS AND EXPERTISE**

1.1 My name is Ian Hunt.
I am a Chartered Engineer (CEng)
I am a Bachelor of Science (BSc) awarded by City University, London
I am a Fellow of the Institution of Civil Engineers (FICE)
I am a Member of the Institution of Structural Engineers (MIStructE)

1.2 I have been a practising Civil Engineer for more than 40 years and have been involved in the design and construction of highways, bridges, jetties, marine-works and buildings on a regular basis.

1.3 My experience in the design of bridges commenced in 1970 with their structural analysis for compliance with prevailing codes of practice and the specific requirements of the commissioning authorities. Over the years I have become increasingly involved with the conceptual design of bridges and the determination of their form. The resulting structures have gained recognition through the receipt of various awards and prizes. Examples include the cable-stayed bridge over the River Dee (the Flintshire Bridge) and the much lauded Gateshead Millennium Bridge over the River Tyne.

1.4 I have experience in the design and construction of marine structures and infrastructure that has required the manoeuvring and handling of vessels ranging from small boats up to ships in excess of 20,000 dwt. Projects have included development of a ship building and repair yard within an active harbour and provision of a cruise-liner facility within the Port of Liverpool. I have been involved in the design of new canals in the Inland Waterways of England and, for several years, had my own boat for use on the system. For many years I had my own sailing boat and raced sailing dinghies.

1.5 I was a Member of Gifford LLP until March 2009 and am now a consultant to Gifford advising on the design and realisation of works such as bridges.
2. ROLE IN THE MERSEY GATEWAY PROJECT

2.1 I am the Project Director for Gifford responsible for delivery of the Project.

2.2 I have been involved with the Mersey Gateway Project since the commission to act as lead consultant for the scheme identification study was awarded to Gifford in 2001. I have been involved in the initial route developments, preparation and submission of the Major Scheme Appraisal (CD 131) to the Department for Transport, selection of the preferred route and in preparing the statutory applications for the project.

2.3 The extent of the project area can be appreciated by reference to the plan given in Appendix 2.
3. **SCOPE OF EVIDENCE**

3.1 The evidence I will give describes the process and considerations leading to the Reference Design that forms the basis of the applications made for the Project. I will demonstrate the care and attention that has been given to the formulation of the exhibited proposals.

3.2 My proof of evidence will make reference to documents prepared to accompany the applications for the Mersey Gateway. In particular:

3.2.1 The Design and Access Statement *(CD 6)*

3.2.2 Chapter 2 of the Environmental Statement - Construction Methods Report *(CD 14)*

3.2.3 Chapter 7 of the Environmental Statement – Hydrodynamics and Estuarine Processes *(CD 14)*

3.2.4 Chapter 12 of the Environmental Statement – Landscape and Visual Amenity *(CD 14)*

3.2.5 Chapter 18 of the Environmental Statement – Navigation *(CD 14)*

3.3 I will also make reference to areas of work covered by other witnesses within their evidence. My evidence should be considered together with that given by Mike Jones for Engineering and Construction.
4. HALTON AND THE MERSEY ESTUARY

4.1 To talk about the design of a significant piece of new infrastructure it is necessary first to form an understanding of the context into which it will be absorbed. This is described in chapter 12 of the Environmental Statement – Landscape and Visual Amenity (CD 14) and in the Design & Access Statement (CD 6) but I summarise this below.

4.2 Halton comprises two distinct communities on either side of the Mersey Estuary in the vicinity of the Runcorn Gap (a natural narrowing of the estuary). The character of each side is different, and that difference is reflected in the attitudes of each town to the other. Despite the presence of the existing Silver Jubilee Bridge (SJB) there remains a pressing need to reinforce the union within the Borough. The river remains a divide.

4.3 The narrowing at the Runcorn Gap provides an obvious bridging point over the estuary that has been taken advantage of by first the railway bridge in 1868 followed by a transporter bridge opened in 1905. Until it was demolished in 1961 following the opening of the SJB, the Runcorn-Widnes Transporter Bridge was the largest such structure in the world. The railway bridge remains and carries the Liverpool branch of the West Coast Main Line from London and Birmingham into Liverpool. A main line station is located on the Runcorn side of the river and provides an important link with the capital.

The Runcorn Gap viewed from the East
4.4 The Transporter Bridge was replaced by the SJB when it was opened in 1961. Initially the SJB was configured as a single 2-lane carriageway which, on opening, was expected to carry approximately 10,000 vehicles per day. It came under immediate pressure and was widened in the 1970’s to its present configuration carrying four narrow lanes of traffic. Congestion levels have risen and the bridge regularly carries in excess of 80,000 vpd. Congestion is such that trip reliability cannot be guaranteed and local movements between Widnes and Runcorn are discouraged.

4.5 The two towns making up Halton differ. Widnes on the north bank occupies relatively flat featureless land that comprises the Mersey plain. The town itself developed with the chemical industry and there remains a legacy of highly contaminated residue within the superficial soils. The town has expanded from a core of closely packed Victorian terrace housing to absorb many of the original outlying villages.

4.6 To the south, the town stretches down a spur of land that forms the Runcorn Gap including an area around what was the north landing of the Transporter Bridge – an area known as Widnes West Bank. The main line railway and the main road link into Liverpool dominate the spur before swinging north east towards Liverpool and the economically important areas of Speke Garston and the Liverpool John Lennon Airport.

4.7 To its south, Widnes has been limited in its expansion by the Garston and Timperley freight railway line (which serves Fiddlers Ferry Power Station),
and the no longer active St Helens Canal. This latter feature follows the north bank of the estuary and marks the northern limit of the salt marshes that line the tidal waterway.

4.8 Runcorn on the south bank comprises the old town area around the south end of the Runcorn Gap crossings and the Liverpool overspill developments created in the 1960’s and 70’s. The landform rises relatively steeply away from the Mersey as a wooded sandstone ridge which, viewed from the north bank, appears relatively undeveloped. As with Widnes, the older parts of Runcorn are characterised by high-density, predominantly terraced, housing clustered around a compact town centre. Again, this has expanded to absorb adjacent villages. However, it is the new town, built to the east of the existing town which now defines much of Runcorn’s character. It is formed by clusters of purpose-built high-density residential districts, delineated by a series of expressways and bus lanes which provide links with the purpose built commercial and retail centre of Halton Lea. Notwithstanding the generally high density housing and areas of associated development, there are significant areas of open, green space, in particular heath land on Runcorn Hill and the extensive Town Park created as part of the new town.

4.9 Assisting in providing this “green” character is the presence of the Bridgewater canal that runs along the north flank of the sandstone ridge. This canal is a spur from the main Bridgewater canal running from Manchester which links with the Trent and Mersey Canal at Preston Brook and forms part of the well used “Cheshire Ring”. The spur used to lock down to the Mersey in Runcorn but has now been in-filled leaving a terminal basin in Runcorn Old Town. The canal remains used by boats and provides an important recreational service within the area.
The Upper Estuary and Manchester Ship Canal
4.10 Along the south edge of the estuary and forming a continuous linear feature is the Manchester Ship Canal. Opened at the end of the 19th century, the canal remains an important commercial waterway linking Manchester with the Irish Sea.

4.11 The most prominent feature of the Estuary landscape is the Fiddler’s Ferry Power Station. Located on the northern bank at the eastern extremity of the Borough, the power station is a well known landmark throughout the area and is readily visible from the Pennines, some thirty miles to the east.

4.12 The Estuary and its saltmarshes are designated as an Area of Special Landscape Value and there are two areas of open ground of particular significance, both on the margins of the Estuary. Spike Island on the north shore (adjacent to Widnes West Bank) and Wigg Island (adjacent to the south shore and the Ship Canal) are designated as Important Landscape Features due to their value to the public and for their nature conservation interest and industrial heritage significance.

4.13 Spike Island is formed around the point where the St Helens Canal enters the River. Formerly the site of a soap works and processing plant, the ‘island’ is now a popular recreation area which also functions as a staging post on the Trans Pennine Trail and provides the setting for the ‘Catalyst’ Chemical Industry Museum. Spike Island affords some of the most expansive views over the Estuary to be found within the Borough.

4.14 Situated on the southern margins of the Estuary, Wigg Island, formerly a repository for the storage and manufacture of munitions is now, in part, a community park with a strong emphasis on the enjoyment and appreciation of the nature conservation interest of the Estuary. A series of bird hides provided at vantage points overlooking the adjacent saltmarsh also permit panoramic views over the whole Estuary.
5. **THE ROUTE**

5.1 I will describe the route from north to south following the areas presented in the plan included in Appendix 2.

5.2 Alternative routes were considered and are described in the evidence given by Mr Nicholson. The present alignment emerged as the preferred arrangement.

5.3 The preferred route was identified as picking up from the existing A562 Speke Road at Ditton and carrying the alignment further east before crossing the river and linking with the existing Central Expressway. By making this the primary route for traffic crossing the river, traffic using the SJB is reduced by approximately 80%. This is better described by Mr Pauling in his evidence.

5.4 The resulting reduction in flows over the SJB makes much of the current highway provision serving that bridge, redundant. This brings with it the advantage of relieving the local residential areas around the SJB and offers the opportunity for further improvements to the amenity of residents and to release land for future developments that could transform both Runcorn and Widnes (see area ‘I’).

5.5 The northern end of the route is currently occupied by a municipal golf course that has been closed to use due to the levels of contamination present in the soil. It is in this area (shown as ‘A’ on the plan) that it is proposed to site the main toll plazas for the crossing.

5.6 The route passes through relatively old commercial properties and disused premises either side of crossing the Garston to Timperley freight line (Area ‘B’ and part of ‘C’). In the late 1980’s, Widnes was bypassed from the north end of the SJB for traffic wishing to connect with St Helens and the M62 to the north by what is now the Widnes Eastern Bypass. Such a link from the SJB now becomes redundant and the Widnes Eastern Bypass will be served from the new crossing via a looped junction constructed within the area occupied by a relatively new business park consisting of light
steel framed buildings (Area ‘C’). Of no architectural merit, these buildings will be taken and demolished with the new junction being formed over what is a highly contaminated area.

5.7 The new highway at this point is approximately 11 metres above the local roads. It continues to climb gradually as it swings south to cross the St Helens canal and the Widnes Warth Saltmarsh before crossing the tidal upper estuary itself. It then crosses the southern salt marshes and Wigg Island (a nature area covering what was industrial waste) continuously climbing to provide sufficient headroom to the Manchester Ship Canal (Area ‘D’).

5.8 The highway has now reached an elevation that matches that of the northern end of the existing Central Expressway. The merge with that road and the modification of the junction with the east-west running Bridgewater and Daresbury Expressways below is achieved in Area ‘F’. Before then the highway passes approximately 24 metres above an industrial area (the Astmoor Industrial Estate) established on the south bank of the canal (Area ‘E’).

5.9 The remainder of the route is along the established Central Expressway, Weston Link and southern end of Weston Point Expressway (Areas ‘G’ and ‘H’) to Junction 12 of the M56.

5.10 To give primacy to the new route, there is a need for junction improvements with the Southern Expressway and the west connection with Weston Point Expressway. There is also a need to modify the Central Expressway by providing local parallel distributor roads and replacing some of the existing foot and bus crossings.
6. QUALITY OF DESIGN

6.1 As can be appreciated from the Project Objectives set out by David Parr (HBC/1/1P), which refers to the need for improvements to Halton's urban environment, a fundamental requirement of Halton Council was for the design

“To transform the urban fabric and infrastructure to develop exciting places and spaces.”

An abiding aspiration for the Mersey Gateway has been that it is more than “just a bridge”.

6.2 The theme for the design is one of maximising the opportunities presented by the Mersey Gateway such that the engineering requirements are fully met but not at the expense of the human condition of those immediately adjacent to the works. How this is achieved is described more fully in the Design and Access Statement.

6.3 Design of any structure is a fusion between form and function. “Form” is often seen as being the softer issues of spacial relationships and harmonies while “function” is the hard-nosed realities relating to purpose and safety. “Form” is the artistic side – the province of artists and architects while “function” is more scientific – the province of engineers. The ratio between form and function varies with the structure. A sculpture, as well as being a work of art, needs to be structurally stable. Form governs all but the contribution of the engineer can be useful. At its best, it can be very successful. For the Angel of the North, Gormley engaged Arup to confirm that his winged statue remained stable within the environmental conditions it was expected to endure. It now stands as a proud monument beside the A1 and is an icon for the NE of England. The B of the Bang, however, is an equally impressive creation standing outside the City of Manchester Stadium but has suffered from too little engineering attention. The impressive radiating spikes have proved vulnerable to wind induced vibrations leading to fatigue failures. The object has had to be fenced off to the public and is now to be dismantled.
6.4 If sculptures stand at one end of the Form/Function table, buildings are somewhere in the middle (and are generally led in design by architects) while bridges are firmly at the other end, where function is by far the most important criterion. This has become increasingly true as structures have become lighter due to modern materials and an improved understanding of their use, while applied loadings have increased. As a result, bridge design has been seen as a process led by engineers. So it is with the Mersey Gateway. An architectural contribution was welcomed by the engineers and Martin Knight Associates were retained to assist Gifford in developing the design. Such a fusion between contributing disciplines to design is recognised in law and the Construction (Design and Management) Regulations (CDM) refer to the “Designer” and not to any specific profession. Those regulations place a heavy responsibility on the Designer for achieving safety in construction and failure to do so can be a criminal offence. It needs to be added that those same regulations also require the proposer(s) of any scheme to be diligent in their selection of their designers and builders.

6.5 The evidence given on Planning by Mr Brooks describes National and Local policies that govern and influence the design of new developments. These are reinforced by guidance produced by the Commission for Architecture and the Built Environment (CABE) (CD 143). The interpretation of those principles and the advice contained within CABE’s published guide have been applied throughout the Mersey Gateway in a manner sensitive to the character of the area being passed through.

6.6 In addition, the potential benefits of more sustainable forms of transport have been recognised both in improved provisions for public transport and cycling on SJB and by designing the new Bridge so that Light Rail Transport (LRT) (or similar guided systems) can be incorporated at some time in the future.

6.7 The context into which the Mersey Gateway is to be set varies. At its northern end the abiding theme is urban. Advantage has been taken of linking into the existing Speke Road in the area of the closed St Michael’s Golf Course by siting the main Toll Plazas within the low lying wooded
area. This minimises the visual intrusion of what might otherwise be seen as wide areas of tarmac and covered toll collection points. Tree screening will be reinforced by additional landscape planting.

6.8 There is a need to respond to the better characteristics of Widnes – the well detailed red brick municipal buildings and the previous local head office of ICI (the Waterloo Centre) - while taking advantage of the necessary demolition of other relatively low grade buildings. The design imperative is to reflect these better characteristics within the finishes of the new structures, while enabling more sensitive development and improved access within the provisions of the new highway. Severance can be minimised by ensuring transparency through the linear barrier that the new road presents. Thus, in the area of Victoria Road adjacent to the Waterloo Centre, the Widnes Loops Junction which includes subsidiary toll plazas for the link with the Widnes Eastern Bypass leading up to St Helens and the M62, has been kept distinct from the local roads leading to West Bank. The fact that the highway is carried over 12 metres above the local roads by necessity of crossing the freight line becomes a virtue by providing a wide, airy open space that might be used for a variety of purposes. Opportunity must be given for Halton to exploit fully the aims and ambitions of their regeneration strategy (CD 127).

The Waterloo Centre

6.9 South of Widnes the St Helens Canal forms a line that defines a distinct change in landscape character. The highway now passes into the more ecologically sensitive environment that is the Mersey Estuary. While not being a Special Protected Area (SPA) itself, the Upper Estuary is adjacent to one and has some ecological importance of its own. The design here
needs to respect the fact that it is passing through a sensitive area and needs to tread as lightly as it can.

6.10 To minimise land take, the highway needs to be supported on a bridge rather than what would otherwise be a high and wide embankment. The salt marshes provide a habitat for a variety of species. The tidal estuary itself provides an interesting vista of shifting sand banks and shallows. The quality of the waters of the Mersey is steadily improving and that process should be supported. The design of the new structure must reflect those values and develop them. It is appreciated that there is a need to minimise the number of supports within the salt marshes while maximising the amount of natural light that continues to reach the land below.

6.11 Within the tidal estuary the requirement is to interfere as little as possible with the complex hydrodynamics of the river and its ever changing morphology.

6.12 There is also a need to acknowledge the proximity of the existing structures at the Runcorn Gap. The new bridge will be viewed within the same context as those structures and needs to harmonise with them. All this, while recognising that public monies are involved and that there is a responsibility to achieving economic efficiency within the project.

6.13 South of the estuary, it is the ship canal that provides the distinction between the natural environment of the estuary and an environment more affected by man. It forms an appropriate place to end the estuarial crossing and change the aspect of the design. The highway is now very much higher than the land in the Astmoor Industrial Park. A structure is still required to carry the highway in order to save taking valuable land. The height of such a structure above the business area is such that it will inevitably enjoy a certain grandeur. The space below can then be returned to use and should be capable of being put to a useful commercial purpose.

6.14 The existing junction between the Expressways is within a wooded area and features the Bridgewater Canal. The new highway needs to link directly with the Central Expressway and provide grade separation with the
east-west running Bridgewater and Daresbury Expressways. A new junction is required that suits the new traffic movements and maintains the character of the area.

6.15 The link with the Central Expressway and the works along the route bring the new works into close contact with Halton and its people. The design needs to recognise that it must be capable of realisation without causing excessive disruption. The structures will be more immediate with the general public and need to match with those already established within the Expressway system.

6.16 The level of detailing needs to reflect the different characters of the environment through which the route passes while maintaining a unifying theme throughout the length of the new road.
7. THE ARCHITECTURE OF BRIDGES

7.1 The basic function of a bridge is to get from one side of an obstacle to the other – safely. It is primarily an engineered structure that must suit its purpose. Generally, as it carries a public highway, it is a public work funded or at least supported by the public purse. It is therefore a duty to consider economy within its design. That said, bridges are important components within the landscape. They can become icons in their own right. They can become symbolic of an area and used as identification. One has only to think of Tower Bridge in London, the Golden Gate Bridge in San Francisco, Sydney Harbour Bridge, the Forth Bridge .... the list could go on. They matter as pieces of civic architecture.

7.2 Bridges are an important component of the built environment: highly visible forms that have a significant impact on their locality. Their design must reflect a broad range of architectural issues that are as applicable to bridges as to buildings. The architectural approach to bridge design is complementary to that of the structural engineer. Context, composition, scale and function are juxtaposed with fundamental engineering demands for safety, efficiency, economy, durability and constructability as the basis for lasting quality.

7.3 While the central feature of the Mersey Gateway will inevitably be the 2km long structure over the estuary, there are also a large number of supplementary structures within the Project that will be very much closer to the general public and deserve careful attention in their own right (these are described in Section 9 below).

7.4 The importance of considering all the structures that make up the Mersey Gateway and not solely the new bridge over the estuary, was recognised in the preparation of the Design and Access Statement for the project (CD 6).

7.5 Both local planning authorities and applicants are urged to consult CABE at the earliest opportunity where they consider a proposal raises, or is likely to raise, significant design quality and access issues. The Project Team
has had regard to this advice during design development, and has undertaken pre-application consultation with the CABE Review Panels at the following stages of the design process:

7.5.1 Initial early design review – 21 March 2007

7.5.2 Interim design review – 5 December 2007

7.6 The word “Panels” is used advisedly. Each review had different CABE representation who had different concerns and who responded differently. This can be gauged from CABE’s informal responses (see Appendix 3, ‘a&b’). These differing views were all of value and contributed to design development. This culminated in a formal response from CABE that fully supports the Reference Design that forms the basis of the applications.

7.7 The formal response from CABE is contained in their letter dated 24 June 2008 to the Secretary of State for Transport (REP/3).

7.8 The submissions to CABE relied heavily on visual evidence. This culminated in the Design and Access Statement prepared for the Mersey Gateway in accordance with Circular 01/2006 ‘Guidance on Changes to the Development Control System’ (CD 76). The circular outlines the statutory requirements for a Design and Access Statement to accompany all planning applications.

7.9 The approach taken to the design of all bridges that make the Mersey Gateway is best expressed by two extracts from the Design and Access Statement.

“6.1.9 Bridge design unites two sets of values that underpin modern architecture: the ‘romantic’ view of external appearance and the ‘classical’ understanding of underlying form. Beautiful, efficient bridge design should satisfy both artistic and scientific analysis to be visually legible and structurally truthful. Resolving the relationship between the two is the key to every project.”
“6.1.10 The most memorable and successful bridge designs stand naturally within their context. They generate such an intrinsic relationship with their setting – whether coastal, rural or urban – that the view becomes unimaginable without their contribution. But the design response to context runs deeper than just the physical environment. Cultural and historic factors generate an equally powerful response, particularly as not all contexts are visually memorable. Ancient routes and future development, local sensitivities and vernacular precedent all can strongly define the ‘place’ of the bridge.”

7.10 The application of those two extracts to the design of the new bridge across the estuary is described in more detail below. The same principles have been extended to the proposals for the other structures within the project that are described in Section 9.
8. THE MERSEY GATEWAY BRIDGE

8.1 The Mersey Gateway Bridge forms the central feature of the Project and will attract the greatest interest. It is located in what is a sensitive area: the Upper Mersey Estuary. It is adjacent to two existing crossings of the Mersey both of which are Grade II listed: the Aethelfleda Bridge carrying the Liverpool branch of the West Coast Main Line railway and the Silver Jubilee Bridge. Both these structures feature lattice construction though it is the tied-arch of the SJB that is visually dominant. The new bridge had to be sympathetic to the existing structures. The design should look to complement rather than rival the SJB.

The Silver Jubilee Bridge

8.2 The New Bridge will have a total length of 2.13km from abutment to abutment. This consists of two approaches over the salt-marshes on each bank and a central, 1,000m, crossing over the tidal estuary. The north approach viaduct is approximately 550m long from the north abutment to the edge of the Widnes Warth Saltmarsh. On the south bank the viaduct is approximately 580m long from the edge of the Astmoor Saltmarsh, over part of Wigg Island and over the Manchester Ship Canal to the south abutment. The new crossing over the tidal estuary consists of a 1,000m cable-stayed bridge of four spans supported from three towers with the central tower being shorter than the other two.
8.3 The challenges presented in bridging the Mersey Estuary stem from four main sources:

8.3.1 The tidal character of the Upper Estuary;
8.3.2 The proximity to the Specially Protected Area (SPA) to the west of the Runcorn Gap;
8.3.3 The legacy left from the area’s industrial history and the potential for residual contamination; and
8.3.4 The need to maintain navigation rights.

8.4 The last point is primarily a case of providing sufficient clearances to permit the passage of vessels. In this case the primary navigation route is the Manchester Ship Canal and consultations with the owner/operator (the Manchester Ship Canal Company) provided the designers with the necessary dimensions to secure sufficient air-draught and width. Navigation issues are discussed more fully in Appendix 1.

8.5 The site lies due east of Liverpool John Lennon Airport and is under the approach flight path from the east. Consultations with the Airport confirmed that no structure could be higher than 150m AOD. This too is discussed in Appendix 1.

8.6 The tidal variations in the Upper Estuary require an approach to construction that must be recognised in the design of the structure. The tide is “out” for very much longer than it is “in”. This means that large areas of the estuary remain uncovered by water for much of the working
day. This will have an impact on possible construction methods which, in turn, limit structural decisions. I will discuss this point in more detail later in my evidence.

8.7 Geotechnical investigations have confirmed that the underlying sandstones dip from the Runcorn side to the north. At the southern end of the New Bridge the rock level is relatively high (approximately 5m below ground level). It remains relatively shallow across the tidal estuary falling to the north such that the depth to rock at the north bank is still only 20m below ground level. Under the Widnes Warth Saltmarsh, however, the rock head falls substantially and there is a significant thickness (approximately 30m) of stiff Glacial Till overlying the sandstones. The whole ancient river valley is covered with shallow alluvial deposits (sands and silts) – so foundations will almost certainly be piled. The underlying sandstones are an important aquifer that requires protecting and we are fortunate in that the geology favours construction of the Project. The worst areas of residual contamination are on the north bank. The layer of till in this area provides an almost impermeable protection to the aquifer while providing a good stratum in which to found the approach viaducts. Installation of piles in this area will not open possible pathways for pollution to migrate into the aquifer below. The sands forming the bed of the tidal estuary have little contamination and the shallow rock head provides good bearing capacity for heavy foundations. Founding the heavily loaded towers of the cable-stayed structure in the sandstones should present few difficulties.
8.8 It is the environmental considerations and the need to avoid disturbance of the SPA referred to in paragraph 8.3 above that dictate many of the design criteria.

8.9 The upper Mersey Estuary is flooded and emptied on each tidal cycle. Much of the natural fluvial flow has been diverted along the Manchester Ship Canal and there is very little river flow in the upper estuary. This means that the basin formed above the Runcorn Gap is overly wide for such flows. The result is that the sand banks within the estuary are continually being moved on the flood and ebb tides with the channels through them changing to no particular pattern. This process is better described in the evidence of Mr Norton. It was considered essential that this natural movement of the channels should be interfered with as little as possible by the new works.

8.10 In this regard it was always recognised that the complex patterns of movement in the estuary are not amenable to prediction by modelling in the traditional sense given the variability of the factors initiating change.
While the tidal regime could be modelled, other factors such as storm flows, discharges etc complicate the system. However, what can be modelled is the effect of the works on a river bathymetry determined at a particular instant of time and the changes initiated by those works on the hydrodynamics of the river. These could then be assessed against the changes predicted by the model under the same circumstances but without the proposed works. The latter results reflect the natural changes that do occur and are readily observed in practice.

8.11 Some of the historic changes in morphology of the Upper Estuary are evidenced by contemporary mapping but a more comprehensive record of short-term change has been obtained by regular over-flying and photographing the estuary. These have indicated how rapid channel shifting within the Upper Estuary can be.

8.12 Modelling could also be used to determine whether the new works had any significant affect downstream of the Runcorn Gap (within the SPA) over and above those effects predicted without the works.

8.13 A very large mathematical model was prepared which divided the flow into a series of curvilinear streams and provided up to 10 layers within the water column. That model was calibrated against the natural hydrology of the river to ensure its suitability. The results of the modelling is discussed more fully in the evidence of Mr Norton (HBC/13/1P).

8.14 Given the sensitivity of the estuary, it was considered a design condition that the proposed permanent works should exhibit no change to any natural changes to river morphology that already occur within the SPA below the Runcorn Gap and that changes within the Upper Estuary should be relatively small in the context of the existing natural changes in the bed levels.

8.15 Modelling results indicated that a multi-span crossing with piers at 100m centres within the tidal estuary had effects downstream of the Runcorn Gap and produced changes local to the new crossing of a scale that were considered not to be acceptable.
8.16 A clear span structure would, of course, have been satisfactory in that it would have no interference within the tidal estuary but it was discounted on the grounds of both cost and requiring support towers that would have intruded into the protected air space. Construction of the necessary end support structures would also have had a very large impact on the environmentally sensitive salt-marshes.

8.17 By and large bridge costs are proportional to span length. The shorter the spans, the cheaper the bridge. On the other hand, the greater the number of supports within the tidal river, the greater the impact on the river hydrology. Various support positions were considered in the modelling and a 3-support configuration was found satisfactory. The predicted changes to the modelled natural changes of bed bathymetry were very small – particularly when placed in the context that nature is causing movement in the sand banks exceeding 2 metres – and there was no predicted change initiated by the permanent works downstream of the Runcorn Gap. The resulting arrangements of supports indicated that the 1,000m crossing could be achieved with maximum individual spans in the region of 350m. This is well in the range of a cable-stayed structure which is also a very economic form of structure for long span bridges. It remained important, however, that the physical dimensions of supports within the water column be kept to a minimum.

8.18 It had been noted from the morphological records of the Upper Estuary that channels tended to hold to either bank. That being the case it was preferred that the supports should be kept a reasonable distance from each bank edge to avoid velocity increases that could have an impact on bank stability. This requirement had an influence over the final design proposal exhibited. Moving the outer towers away from the banks increases the lengths of the deck cantilevers they are supporting and shortens those of the central tower. This means the height of the central tower can be less than the outer towers. This, in turn, has cost implications (costs increasing with span length as referred to earlier) so there are compromises to be made.
8.19 The salt marshes on each bank are considered to be ecologically valuable. It was recognised that supports should be as small as possible and spaced to cause minimum damage. The network of scrapes, channels and rivulets needs to be maintained. There is a distinct advantage in being able to treat the positioning of each support to the approach viaducts individually. In order to maintain the grasses that comprise the salt marshes, it is desirable to avoid over-shadowing by the bridge deck as much as possible. Split structures were seen as beneficial in that they would allow sunlight and rain to fall through the central gap. Such an arrangement also simplifies construction and increases the repetition of details – both factors that contribute to economy.

8.20 Finally, as a design requirement, there was a need for the new structure to facilitate or at least accommodate a possible future Light Rail Transport (LRT) or some other form of public transport. The relatively long spans thought desirable for the approaches (spans of 70m to 100m) result in a relatively deep deck to provide sufficient structural stiffness. A depth of deck was proposed sufficient to accommodate an LRT within it rather than sharing deck space with other traffic. This permits a narrower deck (reducing shadowing of the saltmarsh) and improves safety by providing a distinct corridor.

8.21 There are visual benefits in having a prismatic deck throughout the length of the structure from abutment to abutment and there will be significant cost savings through repetition in production if details are kept constant. It was considered to be desirable to maintain the same form of deck structure throughout the length of the bridge having each carriageway supported on its own deck but combining the decks where they cross the river. This is necessary in order to provide sufficient torsional stiffness and permit a central array of cables from single shafted towers. A box structure is called for to meet these requirements but it is not necessary for the webs to be solid. There is an opportunity to echo the lattices of the existing bridges to structural advantage.

8.22 The factors listed above have an influence on the individual components of the new bridge. These are discussed below.
8.23 Tower Design

8.23.1 The main driver for tower design is the need to interfere as little as possible with the hydrodynamics of the river. This led to the immediate recognition that a single tower stem within the water column is preferable to a multiple configuration.

8.23.2 A study into the design of the towers was undertaken, first with a comparative analysis of singular, inverted Y-form, A-form and other tower types followed by an evolutionary study of the selected singular tower in two and three-tower arrangements. The singular towers have been detailed to provide a continuous form from water level to tower top, with the cross section evenly reducing with height. Clear, simple shaping of the form will provide crisp shadow lines that emphasise the slenderness of the design and these include a feature rebate into which the tower cable anchorages will be made.

8.23.3 The single central tower configuration, with a central cable array, provides the most open aspect to drivers using the crossing and will offer extraordinary new views of the SJB, Runcorn, Widnes and the Estuary.
8.23.4 The study also considered the heights of the three towers and established that the most successful relationship is a ratio of 1.2:1 between the twin outer and single central towers. This also provides the most balanced functional composition. Although at first sight the shorter centre tower is unusual, the design is guided by the constraints and will provide an elegant composition with a legibility, and character which is entirely rooted in its context.

8.24 **Cable Array Design**

8.24.1 There are two generic types of cable array associated with the cable-stayed bridge form: ‘harp’ and ‘fan’. There are also combinations of the two types. For the Mersey Gateway a number of cable array options have been modelled with the various tower options and with deck connections along the centreline of the bridge as well as at the outer edge.

![CABLE ARRAY OPTIONS](image)

8.24.2 The fan arrangement comprises a series of stay cables, which tend towards a common focal point. There are some engineering benefits but the connections to the deck are all variable geometries. In terms of visual composition this tends to bring attention to the tops of the towers and is often used with the inverted Y tower where it is particularly elegant, although this is not applicable where the towers are so markedly variable in
height. It is also suitable for use with singular towers. However, at the Mersey Gateway there is a stronger visual case for the harp so the simplicity of the tower design is not compromised.

8.24.3 The harp arrangement comprises a series of parallel stay cables and is particularly elegant when used in a single plane along the bridge centreline; however it is not tolerant of visual irregularities in geometry. The basic geometry of the cable arrays has been developed to ensure it is uniform across the three towers with a common internal angle between arrays. This unifies the visual composition and brings additional benefits of commonality of detailing at the cable terminations. The preferred cable array, deck and tower combination comprises the paired harp array, singular towers and central line of anchor points.

8.24.4 The paired arrangement of stay cables may lead to one side of each tower having greater visual weight in some views. This is in addition to the variation caused in some lighting conditions where daylight and sunlight, and shadow, cause stay cables aligned towards the viewer to register differently to those aligned away. However, the simple proportional relationship between towers, cable array and deck is balanced and follows a natural order so that no one element is visually dominant.

8.24.5 The colour of the sleeves for the cables has been carefully considered, as these will vary from highly visible (especially to road users) to invisible depending on lighting conditions and proximity. The Estuary setting is similar to that of the Second Severn Crossing and not dissimilar to the Flintshire Bridge, both of which employ cable sleeves with a pale blue-green colour to good effect. The use of this colour range for the Mersey Gateway
is also likely to be successful and will provide a visual reference to the similar paint colour used for the SJB.

The Flintshire Bridge

8.24.6 The sleeved cables will be a substantial size (approximately 350mm in diameter) and will be highly visible to road users on the bridge. Careful detailing of the anchorages between carriageways and their coordination with highway lighting columns will ensure the overall high quality of composition is maintained from macro to micro scale.

8.25  Deck Design

8.25.1 The single tower with a central plane of cables, affects how the deck transfers load. Cables along each edge of the deck require the deck to transfer any load outward to those supporting cables – an inherently stable situation. A central plane of cables, however requires the opposite load transfer direction – i.e. from the edge inwards towards the centre. If loads are heavier on one side of the centre line when compared with the other, there is an out-of-balance twisting action imposed on the deck. The structure has to be capable of carrying these torsional forces. This requires the deck to be relatively deep.
8.25.2 For economic reasons there are advantages to maintaining construction details throughout the bridge. Thus there are advantages to keeping the cable-stayed deck details similar to those of the approach spans. Whereas, however, the approach viaducts are separate and parallel with each carrying its own carriageway, the cable-stayed length requires the two deck elements to be joined to form a deep structure across the central stay cable anchorage area.

8.25.3 Considerable analysis of the appearance of the main span deck design has been undertaken to provide a structure which is both elegant and reasonably transparent as well as functional and structurally efficient. The deck module is also designed to facilitate pre-casting for ease and safety of erection and the unit size must remain within tolerable weight limits.

8.25.4 The deck is formed from an upper and lower deck, respectively carrying highway and (potentially, in the future) light rail traffic. These decks are joined with inclined members to form 6m tall ‘Warren’ trusses, arranged in four planes. A comparative design analysis was undertaken to study the varying transparency and pattern of a number of truss structural options and the submitted proposal provides the optimum balance between the structural solution and a visual lightness demanded by the open estuary setting. The fine detailing in the structural members and in junctions between components such as cable anchorages and deck has been carefully developed with, for example, the adoption of circular inclined members to reduce visual impact and increase structural efficiency.
Mersey Gateway Bridge

8.25.5 The parapet string course along the outer edge of the deck is inclined upwards to catch the daylight and provide a clear linear element that is read continuously across the open water, and on to ground at each end of the bridge. Edge protection including a largely transparent windshield would sit to the outer edge of the deck and has been considered as part of the overall composition for their appearance as well as function.

8.25.6 The soffit view has been carefully considered since, to viewers on Wigg Island and other locations including the Estuary, this will be one of the prominent views. Careful detailing in the concrete formwork and the inclination of the outer planes of the trusses provide visual interest though longitudinal shadow lines and planes and through the repetitive pattern of the truss members.

8.26 Lighting

8.26.1 Careful consideration has been given to the position of highway lighting. It is proposed luminaires are mounted on poles between the carriageways to allow a maintenance regime that prevents risk of falls from the bridge. Lampposts are coordinated with stay cables to maintain a complementary rhythm.

8.26.2 The driver experience will be maximised by positioning the highway lighting along the centre of the bridge, away from the
edges, and by providing largely transparent windshields on the outer edges. Signage for junctions to either end of the bridge will be kept as far as possible from the cable-stayed open water sections so as not to compromise the overall appearance.

8.26.3 Consideration has been given to the positive and negative issues regarding architectural lighting of the cable array and towers. Although floodlighting has been installed on the SJB, architectural lighting is not generally undertaken on UK bridges. There are no proposals to floodlight the Mersey Gateway Bridge.

8.26.4 Aircraft warning lamps will be required and these should be accessible from within the towers, and include fail-safe, alarm and redundancy systems, to ease maintenance and safety issues.

8.26.5 The below deck sections of the towers will be illuminated to assist with River navigation.

8.27 Approach Spans

8.27.1 In very large cable-stayed bridges the junction between the main cable-suspended length of deck and the approach spans is often a difficult transition, as the depth of structure and cross section changes. For the New Bridge, the design of the approach spans benefits from a constant height cross section to the main span and this allows the twin decks to flow seamlessly from main span to approaches. The Reference Design approaches will comprise independent decks on in situ concrete piers at spans varying from approximately 70m to 100m with the simple, elegant design of the piers using smaller scale features originating in the main tower design.

8.27.2 The design of the in situ concrete abutments at each end of the new bridge allows the geometry of the main span truss deck to flow seamlessly into the shallower structures spanning St Helens Canal and Astmoor. This design terminates the form of the main
span in a clear and logical manner and uses the length of the abutment to ensure the transition from approach to crossing is legible and gradual, as opposed to a step change at the junction between the differing height decks.

The South Abutment

8.27.3 The cross section geometry of the new bridge deck generates an asymmetrical triangular facet in elevation, between the vertical face of each abutment and the underside of the highway deck. As well as breaking down the visual scale of the vertical faces of the abutments – significant size structures in their own right – the use of an angular facetted geometry particularly assists with the span at the St Helens Canal, where the abutment is highly skewed in plan as the highway oversails the canal. The facetted design suits the skewed arrangement and creates a more dynamic and elegant form than could be achieved in a simple orthogonal design.
8.27.4 The inclined face of the abutment will be formed in flat concrete, with the vertical faces of the abutment formed in the ribbed finish specified throughout the project, so maintaining a consistent familial appearance. Through the different appearances of shadow and reflected light, the abutments will be animated and articulated as considered three-dimensional forms, which respond directly to their contexts.
9. **SUPPLEMENTARY STRUCTURES**

9.1 While not enjoying the prominence of the Estuary Crossing itself, the other structures necessary within the Mersey Gateway have significance in their own right.

9.2 On the Widnes side there are five structures:

9.3 **Ditton Junction**

9.3.1 The bridge carrying the new highway over the rearranged Ditton Junction will be framed within landscaped embankments. The chosen structure is simple providing a wide and clear vista flanked by solid abutments. Massing is avoided by providing the surface of the concrete walls with a finish that breaks it into defined panels. The result will be light and airy *(CD 6 DAS p.43: 8.1 Ditton Junction Bridge).*

9.4 **Freight Line Bridge**

9.4.1 The highway crosses the Garston to Timperley Rail Freight Line on a skew. The opportunity has been taken to terminate the approach embankment north of the railway with a square crossing of the track. The new Freight Line Bridge is structurally simple to avoid conflict with rail operations and to minimise possessions for construction and maintenance. Visually, it needs to be unnoticed other than as a backdrop to the space that will be formed under the new bridge over Victoria Road.

9.5 **Victoria Road Viaduct**

9.5.1 The highway continues south from the Freight Line Bridge on a high level, multi-span viaduct connecting the Freight Line Bridge to the edge of the Widnes Loops Junction and includes the crossing of Victoria Road *(CD 6 DAS p.44: 8.2 Victoria Road Viaduct).*
9.5.2 The abutment walls facing the Victoria Road need to harmonise with the fabric of Widnes in this area. This can be categorised at its best as being largely red brick with fine detailing. It is proposed to face the new structures with a similar brick with the long lengths of wall being broken into tall vertical panels echoing the adjacent Waterloo Centre.

9.5.3 The new bridge deck will provide a plain concrete soffit broken into four discrete spines emphasising the flow of the structure. These, in turn, will be supported on a series of plain concrete columns. Spans have been determined to provide as flexible a space as possible below the structure. Hard landscaping will be provided and it is envisaged that the space could afterwards be available for a wide variety of uses.

9.5.4 A solid parapet has been chosen to minimise traffic noise and provide some visual relief from traffic passing over Victoria Road.

9.6 The Widnes Loops

The following new structures and earthworks would be required in this section of the works (CD 6 DAS p.45: 8.3 Widnes Loops Junction):

9.6.1 Two bridges over the new Widnes Loops Junction carriageways;

9.6.2 Embankments carrying the new highway at high level;

9.6.3 A bridge to carry the Widnes Loops Junction southbound on-slip over itself;

9.6.4 Toll plazas connecting the Project to the Widnes Eastern Bypass.

9.6.5 The new Widnes Loops Junction forms the link between the Mersey Gateway and the Widnes Eastern Bypass leading up to the M62 Junction 7. They will be heavily trafficked and have to
provide tolling facilities similar to those at the north end of the new highway. There is a need to separate and distinguish the very “highways context” loops from the urban Victoria Road area. This must be achieved both visually and physically to ensure safety and minimise traffic intrusion. A barrier will be formed by the abutment of the Victoria Road Bridge being extended by appropriate landscaping to the Garston to Timperley Rail Freight Line to the north and behind the Waterloo Centre to the south.

9.6.6 Within the loops themselves, the structures will be relatively utilitarian and designed to minimise excavation from the contaminated underlying ground. Simple concrete box-type structures are proposed with relatively plain finishes relieved by ribbing or similar. Parapet details will be carried through from the Victoria Road structure, being solid concrete. This will also help to mitigate traffic noise within the wider area of South Widnes.

9.6.7 The visual concept becomes an increasingly tall earthwork carrying the main highway through the flat expanse of the toll plaza and the looped access roads. The new structures then sit inside the earthwork piercing it to permit the passage of traffic.

9.7 St Helens Canal Bridge

9.7.1 To complete the transition from the Widnes Loops to the Mersey Gateway Bridge requires a structure to cross the St Helens Canal and the Trans-Pennine Trail. There is also a possibility of a new access road along the north bank of the canal to link between Widnes West Bank and the proposed Development Area being taken forward in the Regeneration Strategy (Appendix 5: B4027/B/PL/700A).

9.7.2 The new structure is integral with the north abutment of the New Bridge itself so essentially forms part of that element. A slim deck is required to permit any future LRT to access the New Bridge under the new structure while still providing sufficient
headroom to the canal. The columns will be spaced sufficiently widely to permit passage of an independent LRT structure between them. This results in a very light and airy structure that will be high above the canal and boulevard. A similar ‘spined’ structure is envisaged to that provide for Victoria Road but with simpler finishes. Plain concrete is proposed.

9.7.3 Parapet railings will be an extension to those on the New Bridge. These will be taken to link with a normal highway safety fence detail that will be carried along the edge of the slip roads within the loops.

9.7.4 During construction of the New Bridge, it is anticipated that the St Helens Canal area would form the main reception / transition area for the main bridge units. As such, it is assumed that it will be necessary to temporarily infill the canal (maintaining its drainage water transfer function) to provide a working area. On completion, the canal would be reinstated with some minor changes to the alignment. A corridor for the Trans-Pennine Trail cycle and footpath would be maintained throughout the works.

9.7.5 The landscaping scheme would link the new earthworks with the leisure facilities offered by Spike Island, the St Helens Canal and the Trans-Pennine Trail.

9.8 On the Runcorn side the structures fall into three groupings.

9.9 Astmoor Viaduct

9.9.1 As with the north end of the New Bridge, there is need for a transition between the South end and the Bridgewater Junction. This is achieved by the Astmoor Viaduct (Appendix 5: B4027/B/PL/902A and 903).

9.9.2 The new carriageway crosses the Astmoor Industrial Estate at a height of approximately 24m above existing ground level. The
area of the works will need to be cleared of existing light industrial buildings. The deck of the new viaduct is likely to be constructed in situ on a temporary scaffold falsework (although a precast solution cannot be ruled out). On completion of the works, the area below the viaduct would be available for future development.

9.9.3 The elevated structure will vary in width up to a maximum of about 60m wide before the southbound slip road splits off onto a separate alignment. The structure splits again at the point where the northbound on-slip road merges with the main line. The main line of the New Bridge will remain at high level while the two slip roads reduce in level to the south to allow the slip roads to tie in with the roundabout at the Bridgewater Junction.

9.9.4 The north end of Astmoor Viaduct is integral with the south abutment of the New Bridge. The south abutment of the Astmoor Viaduct will be approximately 85m wide and will be at three levels to accommodate the slip roads. The abutment wall forms a retaining wall to the earthworks associated with the Bridgewater Junction.

9.9.5 The deck of the viaduct will be kept slim to permit any future LRT to exit through the South Abutment of the Mersey Gateway Bridge and be carried on a separate structure(s) through the supports of the viaduct. The actual route of any future LRT system is not known, but the spacing of the viaduct supports permits a flexible design in the future. The deck is shown as splitting into four spines which follow the varying highway arrangement above. This permits the slip roads to branch from the core of the structure in a visually coherent manner.

9.9.6 The Reference Design for the viaduct is circa 340m long and comprises 12 spans with approximately 20m end spans and 30m intermediate spans. The deck will be supported by reinforced concrete rectangular plate piers, approximately 2m by 5m in
cross section, under each spine.

9.10 **Bridgewater Junction**

9.10.1 Like the Widnes Loops Junction, the Bridgewater Junction is a complex of structures and slip roads to provide grade separation and access to and from the Central Expressway (N-S) and the Daresbury/Bridgewater Expressways (E-W) (*Appendix 5: B4027/4/SK/428*).

9.10.2 A two-level interchange is envisaged with east-west movements achieved through a new roundabout at the lower level and with the Mersey Gateway linking with the Central Expressway at the higher level. Slip roads would link the elevated highway to and from the north and south with the roundabout and permit the interchange with the E-W highways. The design of the junction is dictated by the need to maintain the existing traffic arrangements for as long as possible in order to minimise disruption.

9.10.3 The design of the structure forming the main N-S route needs to permit construction over the live expressway system. The establishment of the proposed gyratory system will require the phased demolition of the existing structures over the expressways and canal and their replacement by filling or new structures in the case of the canal bridges. Retaining walls are also required to separate the various movements and to limit the land take. A complex traffic management scheme will be required during construction to maintain access and minimise disruption.

9.10.4 The five-span high-level bridge at the Bridgewater Junction will be about 150m long and 27m wide. The substructure is likely to be of piled foundations and reinforced concrete piers. The superstructure could be of fabricated steel or prestressed concrete beams to allow erection to fit in with the phased traffic management regime that will be required to maintain traffic flows during the works (*CD 6 & 7: DAS p48: 8.6 Bridgewater*).
9.10.5 Tall abutment structures will be required at both ends of the high level bridge. The north abutment will link with the south abutment of the Astmoor Viaduct while the south abutment will be constructed on the south bank of the Bridgewater Canal. Finishes will be selected to match with other structures on the Bridgewater Canal. The flanking walls to the South Abutment will be taken through to link with the abutments of the new bridges serving the slip roads. The concept is to form an integrated structure along the south bank of the canal.

9.10.6 The two existing slip road bridges over the canal will need to be replaced with two new slip road bridges on the new alignment of the slip roads on and off the new roundabout. These will be single span structures with decks formed of either fabricated steel or prestressed concrete beams placed over the canal during brief possessions agreed with the canal company. The north abutments to these new bridges will link with the walls necessary to form the new roundabout and form a continuous structure along the north edge of the canal towpath.

9.11 Upgrading the Central Expressway

9.11.1 There are four footbridges over the Central Expressway (Appendix 5: Central Expressway Bridges).

9.11.2 The bridge immediately south of the Halton Lea junction will not require modifying – so no changes are proposed.

9.11.3 The two northernmost footbridges can be retained but the changes to the roadway that they cross will necessitate additional protection (and, possibly strengthening) of the intermediate supports. The spiral ramps of the existing north bridge of the pair encroach into the new roadway. Accordingly they will need to be removed and replaced by new ramps to current standards.
9.11.4 The southernmost footbridge of the four will need to be replaced in its entirety. This will require improved access arrangements within the footway system that meet current standards. It is proposed to relocate the crossing on a new alignment to the north of the existing bridge. The replacement bridge will be a single span structure assumed to be a tied arch. It is anticipated that the bridge will be installed during a short night closure of the expressway (*Appendix 5: B4027/4/B/1801*).

9.11.5 The existing busway bridge will be replaced with a visually similar structure to the footbridge but with a wider deck to carry highway loading. The new bridge will be installed just to the south of the existing bridge in a manner similar to the new footbridge.

9.11.6 Lodge Lane Junction needs to be modified to change the priority of traffic flow from the Southern Expressway to the Weston Link. The junction will be modified to make provision for dual two lanes of through traffic from the Central Expressway to the Weston Link with single lane slip roads for traffic movements to and from the Southern Expressway. These works require the construction of a new single span bridge, along with modifications to the earthworks and highway alignment. The new bridge will be a simple structure similar in appearance to others on the Expressway network.

9.11.7 Weston Link Junction also needs to be modified to change the priority of traffic flow from the northbound to the southbound section of the Weston Point Expressway. The present structures will remain or be demolished in part. The new link between Weston Point Expressway and Weston Link will require retaining walls to contain the existing brine pipeline and a new equestrian bridge and ramps to maintain the existing bridleway (*Appendix 5: B4027/4/SK/428*).
10. CONSTRUCTION

10.1 Design of any bridge is not simply a matter of form and line. It has to be capable of being built. Very often, the construction process can impose more significant loadings upon the structure than any that it might be subjected to in service. For a large bridge – and the New Bridge is a very large bridge – how the bridge is to be constructed has a fundamental influence on the structure itself. Issues such as component size, ease of transport, ease of assembly, contribute to the final structural solution – and it is that solution that must influence the architecture. The practicalities of constructing the New Bridge are described in the Construction Methods Report (Appendix 10 of Mr Jones’ Engineering and construction Proof of Evidence (HBC/5/1P)).

10.2 The appearance of the Mersey Gateway Bridge is very much a product of the practicalities behind its construction. The module underlying the rhythm of the cross member spacing within the trusses is determined from a sensible appreciation of unit weights that can be handled. The spacing of the stay cables is determined by the selected module combined with the practicalities of cantilever construction. Tower design is influenced by the need to carry out as much work as possible at ground level rather than at height. The design looks to exploit the virtues of repetition and production line techniques as much as possible in order to gain the benefits of improved safety and economy.

10.3 The main point I would wish to draw attention to is the nature of the Upper Estuary and the difficulties that it presents to construction. The tide is out more often than it is in. It is not that one is working over water; it is that the water, when it is there (and very often is completely absent), is very shallow. The constructor will face real difficulty accessing the works and bringing plant and materials to the workface.

10.4 Traditionally, marine construction involves the use of floating plant and heavy loads can be transported on barges or the like. Such displacement methods will not be available for the Mersey Gateway and either fixed
platforms will be necessary or an amphibious operation embarked upon.

10.5 The illustrated design permits the structure to be broken down into small components suitable for transporting and placing over a temporary support system or to be formed from relatively large units. I believe we have identified workable solutions which Mr Jones will expand upon within his evidence, but there could still be scope for an enterprising contractor to demonstrate real innovation. Halton Council would look to enable this in the procurement process.
11. AFFECTED PARTIES

11.1 Mr Peter Black (MG Party No. 25, TWA Ref. 59)

11.1.1 Mr Black has objected to the Mersey Gateway on several fronts. I will leave it to others to respond as appropriate but one issue raised relates to the appearance of the bridge and it is proper that I respond.

11.1.2 Mr Black says: “Far from being a new iconic attraction for Halton, the new bridge will be an ugly concrete structure that will actually detract from the existing iconic Silver Jubilee Bridge.”

11.1.3 I presume Mr Black is using the word “concrete” in a pejorative sense since the proposed bridge is a combination of steel and concrete. I would take issue that concrete bridges are inherently “ugly” since there are many fine examples demonstrating a contrary view. Good examples are London’s Waterloo Bridge over the Thames and, I suggest, the new Flintshire Bridge across the Dee.

11.1.4 In the more general sense, I take great comfort in the expressed views of CABE (see Appendix 3 and Rep 3) and the support they give to the design. As with many things, however, it is difficult to please everybody and Mr Black is entitled to his view.

11.2 Royal Yachting Association (RYA) (MG Party No. 87, TWA Ref. 39)

11.2.1 The objections to navigation are subject to discussion. The Borough Council has offered to meet the RYA on several occasions.

11.3 West Bank Boat Club (MG Party No. 466)

11.3.1 The Boat Club have drawn attention to the link provided by the Sankey Canal (referred to within my evidence as the St Helens
Canal) with the marina at Fiddlers Ferry. They suggest that vessels with masts as high as 56 feet (17 metres) might look to use the canal.

11.3.2 A meeting has been held with the club treasurer (Mr Frank Smith) and some of his club members to explain the proposed works and a reply to the Boat Club’s letter sent to them.

11.3.3 Essentially, the situation is as described by me in Appendix 1. The length of canal referred to is presently closed to navigation although there is a desire to reopen it between Widnes and Fiddlers Ferry. Surveys of the canal indicate that the draft will be limited to no more than 1.5 metres (5 feet). This in itself will limit the size of vessel able to make passage.

11.3.4 The canal owners (Halton BC) have set operating conditions for the canal requiring a minimum headroom of 5 metres and a width of 10 metres.

11.3.5 Boats with masts higher than the 12.5 metre clearance being provided by the proposed bridge over the canal, will need to have their mast unstepped.

11.4 The Mersey Conservator (MG Party No. 104, TWA Ref. 65)

11.4.1 The Acting Mersey Conservator has made no objection to the proposed towers interfering with Navigation. His concerns centre upon the potential for the works within the river having an adverse impact on morphology. As explained in the evidence of Mr Norton, the modelling undertaken has indicated no propensity for such adverse impacts and it is proposed that a considered Estuary Management Plan will provide suitable mechanism for monitoring the estuary and identifying any need for intervention.
11.5 Mr Fraser Clift (MG Party No. 105, TWA Ref. 66)

11.5.1 Mr Clift was the Acting Mersey Conservator for the River Mersey until 2008. He has raised objections to the Mersey Gateway in so far as the works affect the River Mersey. His concerns over river morphology have been addressed in the responses given to the new Acting Mersey Conservator referred to in 11.4 above and his concerns over navigation in the responses to the RYA (11.2 above), Trinity House (11.6 below) and MDHC (11.9 below).

11.6 Trinity House (MG Party No. 97, TWA Ref. REP 4)

11.6.1 The majority of the matters raised by Trinity House refer to wordings within the orders and will be addressed by others. Their main concern with respect to maintenance of navigation and its safety refers to marks and lighting. They very generously acknowledge the consultations that have already occurred and I confirm that their reasonable requirements will be incorporated into the works as a mandatory requirement of the constructors.

11.7 Mr M McLaughlin (MG Party No. 3, TWA Ref. 37)

11.7.1 In an email to the Department for Transport, Mr McLaughlin lists additions to his original objections among which is the query: “Climate change is likely to increase water levels by up to 2 metres, has this been factored in for the new bridge?”.

11.7.2 I will leave others to answer in terms of flooding, etc, and I will respond as to the impact of changes to tidal levels on the design of the bridge and navigation.

11.7.3 Any rise in sea levels that may or may not occur will have no impact on the new Mersey Gateway Bridge from a structural engineering point of view. Its ability to carry load will be unchanged. In its construction, any additional depth of water could be beneficial since it may permit increased use of floating
plant.

11.7.4 From a navigation point of view, any increase in water levels above existing MHWS will reduce the available headroom. This can occur at present where conditions might be such that high tide levels are in excess of the mean figure. The risk is that the number of occasions when this occurs may increase. However, this is not an entirely negative effect since it will also mean that the periods that levels are at or higher than MHWS are extended, permitting a longer period of time for boats to make passage.

11.8 Civil Aviation Authority (CAA) (MG Party No. 10)

11.8.1 While not raising an objection to the scheme, the CAA write to confirm the principles they expect of any new scheme being put forward for planning approval. I confirm that we have consulted both the CAA and Liverpool John Lennon Airport in specifying aircraft warning lights to be mounted on the bridge towers. The need for the contractor to comply with the requirements of those authorities/bodies in carrying out the Works will be incorporated into the contract documentation should the Mersey Gateway be permitted.

11.9 Liverpool John Lennon Airport (MG Party No. 6 & 103)

<table>
<thead>
<tr>
<th>Comment</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) No crane or other temporary structure to be higher than 150m AOD</td>
<td>A requirement will be included in any contract documentation (see CAA above).</td>
</tr>
<tr>
<td>b) Aircraft warning lights in accordance with CAA, 2007 CAP 168 requirements to temporary equipment</td>
<td>A requirement will be included in any contract documentation (see CAA response above).</td>
</tr>
<tr>
<td>c) No bridge tower above 150m AOD</td>
<td>No bridge tower is proposed to be higher than 150m AOD.</td>
</tr>
<tr>
<td>d) Bridge towers to be equipped with aircraft warning lights in accordance with CAA 2007 CAP 168 requirements</td>
<td>Aircraft warning lights will be required within the contract documentation (see CAA response above).</td>
</tr>
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<td>Comment</td>
<td>Response</td>
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<tr>
<td>e) All highway lighting to below the horizontal</td>
<td>This is a reasonable request and is in line with present guidelines to avoid light pollution. The specifications included within the contract documentation will incorporate the latest requirements.</td>
</tr>
<tr>
<td>f) Architectural lighting to be agreed with Liverpool John Lennon Airport</td>
<td>At present there are no proposals to install architectural lighting to the new bridge. It is acknowledged that the existing SJB does have such lighting. Should there be a proposal to illuminate the structure there would be a fresh application.</td>
</tr>
<tr>
<td>g) Minimise roosting opportunities</td>
<td>The problems presented by starlings roosting within the structure of the existing SJB are recognised. Recommendations will be included within the contract documentation to minimise details that permit or enable nest building within the new structure.</td>
</tr>
<tr>
<td>h) The bridge to be inspected regularly and nesting birds humanely removed</td>
<td>The new bridge will fall under an established maintenance regime similar to that employed on the SJB.</td>
</tr>
</tbody>
</table>

11.10 **Mersey Docks and Harbour Company (MDHC) (MG Party No. 103)**

<table>
<thead>
<tr>
<th>Comment</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) 56 days notice</td>
<td>The reasonable requirements of MDHC as Navigation Authority will be incorporated into any eventual contract documentation. These will form an obligation to be observed by the contractor and his sub-contractors.</td>
</tr>
<tr>
<td>b) Temporary works to be lit</td>
<td>All temporary works and equipment will be lit and marked as a requirement of the contractor within the contract – see the response to Trinity House referred to above.</td>
</tr>
<tr>
<td>c) Towers to be lit</td>
<td>The towers will be lit – see the response to Trinity House above.</td>
</tr>
</tbody>
</table>

11.11 **Manchester Ship Canal Company (MSCC) (MG Party No. 103)**

<table>
<thead>
<tr>
<th>Comment</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) No obstructions within the Ship Canal</td>
<td>The reasonable requirements of MSCC to maintain their operation of their facility will be incorporated into any contract documentation associated with the construction and maintenance of the Mersey Gateway. The proposals for the new bridge over the canal recognise those requirements and no works are proposed within the canal.</td>
</tr>
<tr>
<td>b) Vertical clearance to be maintained</td>
<td>The new bridge will be no lower than those at Runcorn Gap and the minimum vertical clearance will be maintained at 28.63m AOD.</td>
</tr>
<tr>
<td>c) Comply with MSCC requirements</td>
<td>The reasonable requirements of MSCC will be included within any eventual contract</td>
</tr>
<tr>
<td>Comment</td>
<td>Response</td>
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</tr>
<tr>
<td>d) Works on MSCC land</td>
<td>The MSCC Safety Notes can be incorporated into any contract documents as part of MSCC’s reasonable requirements.</td>
</tr>
<tr>
<td>e) Navigation lights and signs</td>
<td>Lighting and signing to the new bridge over the Ship Canal will be agreed with MSCC and incorporated into the requirements within the contract.</td>
</tr>
<tr>
<td>f) Highway lighting not to affect safe navigation</td>
<td>The need for safety is fully understood and there will be a requirement within any contract documents for permanent and temporary lighting to avoid direction into or along the canal.</td>
</tr>
<tr>
<td>g) No obstructions within the Bridgewater Canal</td>
<td>No piers or permanent obstructions are proposed within the Bridgewater Canal.</td>
</tr>
<tr>
<td>h) Navigation clearances to the Bridgewater Canal</td>
<td>The minimum navigation clearance of 5.0m above normal water level of 25.26m AOD for the permanent structures has been provided in the proposals. The permission for a temporary reduction to 4.15m during construction is understood and will be included within the information that will be provided to contractors.</td>
</tr>
<tr>
<td>i) Temporary closures</td>
<td>The reasonable requirements of MSCC as operators of the Bridgewater Canal will be included within any contract documentation to be produced for the Mersey Gateway. The contractor will be required to liaise with MSCC and avail themselves of any planned closures that might be available.</td>
</tr>
<tr>
<td>j) Indemnification against loss from (i)</td>
<td>This is not a “Navigation” issue but will figure in any agreement between the Council and MSCC.</td>
</tr>
<tr>
<td>k) Time limits for works within the canal</td>
<td>The wording of the objection is not fully understood since it is believed that the period between 1st March and 30th October will be the canal’s busiest. This would suggest that narrowing of the canal should be avoided then. However, the general tenor of the comments are understood and any reasonable limits to construction during the year can be incorporated within MSCC’s reasonable requirements within the contract documents. The present proposals do not require any narrowing of the canal to permit construction of the works. However, a short term temporary closure will be required when demolishing the existing structures. The contractor will be required to agree the timing and method of such work with MSCC.</td>
</tr>
<tr>
<td>l) Short term temporary closures</td>
<td>See above.</td>
</tr>
<tr>
<td>m) Indemnification against loss from (l)</td>
<td>As (j) above.</td>
</tr>
</tbody>
</table>
12. OVERALL CONCLUSIONS

12.1 I would summarise my evidence as follows:

12.2 The design of the works submitted for consent has taken due regard of the natural and built environment of Halton and permits the Borough to execute its future development plans.

12.3 The design of the works submitted for consent permits the improvement of public transport within Halton and provides much improved conditions for cyclists and pedestrians to cross the river.

12.4 The design of the new bridge will provide a unique structure that will become identifiable as being a signature feature within Halton and the North West of England.

12.5 The impact of the Mersey Gateway on the normal workings of the Mersey Estuary is minimal. Major navigation corridors are unaffected with the required headroom and beams for the vessels normally using them being maintained.

12.6 Construction of the Mersey Gateway has been considered and the impacts assessed.