MOTT MACDONALD

Western Link

Stage 2 - Bridges Feasibility Study

17 October 2017

Warrington Borough Council

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Issue and Revision Record

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S2.0	17/10/17	O Lucas	R Mathews	R Langley	First Draft
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Contents

Executive summary

Warrington Borough Council has received development funding from the Department for Transport (DfT) to develop an Outline Business Case (OBC) for the Western Link scheme. Mott MacDonald has been commissioned by Warrington Borough Council to produce the Western Link OBC, which includes a Scheme Assessment Report as a key component. This report comprises a bridges feasibility study that will inform the engineering assessment and cost appraisal that is to be carried out for each scheme option in the Stage 2 Scheme Assessment Report.

Western Link consists of a new single carriageway link road between Sankey Way (A57) and Chester Road (A56) to the west of Warrington Town Centre. The rationale behind the development of this scheme is that it will address a range of transport issues within Warrington. These include alleviating town centre congestion, providing a faster and more direct north - south connection and unlocking land immediately south-west of the town centre for housing and employment development.

A Stage 1 Scheme Assessment Report was completed in May 2017 with the Stage 1 Bridge Feasibility Study submitted as an accompaniment to that report. The Scheme Assessment Report detailed the methodology for refinement from 44 route options down to 6 feasible options that were to be taken forward to public consultation.

This report pertains to Stage 2 of the Option Assessment Process. At this stage Mott MacDonald is to consider the 6 feasible route options and identify the preferred route option to be presented to the Department for Transport (DfT). It has been identified that there are 13 possible bridge crossings that form the 6 proposed route options – these structures are detailed in Table 1 overleaf. For each crossing, a brief report has been produced that lists indicative sizes, span options, possible construction types and any constraints that may impact its implementation. Additionally, for each structure, an outline general arrangement drawing has been produced showing a potentially feasible option suitable for costing purposes. These drawings are included in Appendix B.

Based on the information available at this stage in the design process, it is not believed that there are any significant technical issues that would prevent the Western Link Scheme from being implemented from a structures only standpoint. However, each crossing has its own limitations and requirements that will need further investigations at subsequent stages in the design process. In particular the following risks and constraints have been identified as significant for this project:

- Interface with Network Rail for Walton Viaduct Underbridge, West Coast Main Line and Ditton Goods Line Overbridge. Any works that impact on Network Rail's infrastructure will have to undergo a lengthy approval process.
- Clearance levels over the River Mersey - Establishing clearance levels for new structures spanning over the River Mersey is likely to involve several stakeholders and could be a lengthy process.
- Vertical sight lines for the existing Forrest Way Bridge have been assessed to be unsatisfactory to accommodate a 30mph or 40mph highway alignment. It is recommended that a replacement structure is constructed alongside the existing structure to accommodate the proposed Western Link highway alignment.

- Existing 132kV electricity lines that run throughout the study area will require diversion to allow for safe construction of bridge structures along the route.
- To accommodate the proposed junction to the A57 Sankey Way, a new grade separated structure will be required.
- To accommodate the proposed junction to the A56 Chester Road, the proposed Manchester Ship Canal Viaduct may have to be widened at the southern end to accommodate the additional lanes necessitated by the junction.
- The West Coast Main Line Viaduct has insufficient clearance to accommodate a 3.5m wide combined footpath and cycleway. It is believed that through this structure, the footpath / cycleway will have to be locally reduced to 2.7m width.
- A flood defence wall will be required between Walton Viaduct and West Coast Main Line Viaduct to minimise the risk of flooding to the new link road where existing ground levels have been lowered locally beneath tidal groundwater level.

A brief summary of the main data for each crossing is provided in Table 1 below, with the locations of each structure shown in the location plan overleaf:

Structure Ref	Structure Name	Routes Carried	Structural Type	Traverses	Overall Length	Number of Spans
1	Manchester Ship Canal Viaduct	Yellow, Orange, Red, Purple	New Overbridge	Manchester Ship Canal	474m	9
2	Walton Viaduct	All	Replace Existing Underbridge	Chester to Warrington Rail Line	N/A	N/A
3	West Coast Main Line Viaduct	All	Existing Underbridge	West Coast Main Line	N/A	N/A
4	Forrest Way Bridge	All	Replace Existing Overbridge	River Mersey	180m	3
5	East Ditton Goods Rail Viaduct	Purple, Green	New Overbridge	Barnard Street Ditton Goods Rail Line Old Liverpool Road Sankey Brook	82.9m	4
6	West Ditton Goods Rail Viaduct	Red, Pink	New Overbridge	Sankey Brook Ditton Goods Rail Line Old Liverpool Road	44.3m	3
7	St Helens Canal Bridge	Red, Pink, Purple, Green	New Overbridge	St Helens Canal	15.4m	1
8	Sankey Brook Bridge	Orange	New Overbridge	Sankey Brook	13.2m	1
9	Ditton Rail and St Helens Canal Bridge	Orange	New Overbridge	Ditton Goods Rail Line St Helens Canal	43m	1
10	West River Mersey Crossing	Yellow	New Overbridge	River Mersey Garston Rail Line St Helens Canal	355m	7
11	East River Mersey Crossing	Pink, Green	New Overbridge	River Mersey	62m	1
12	Centre Park Link	Pink, Green	Widening of Current Proposed Overbridge	River Mersey	45m	1
13	Chester Road Fixed Bridge	Pink, Green	Widening of Existing Overbridge	Former Walton Lock Navigational Channel	57.9m	3

Table 1 - Structures Summary

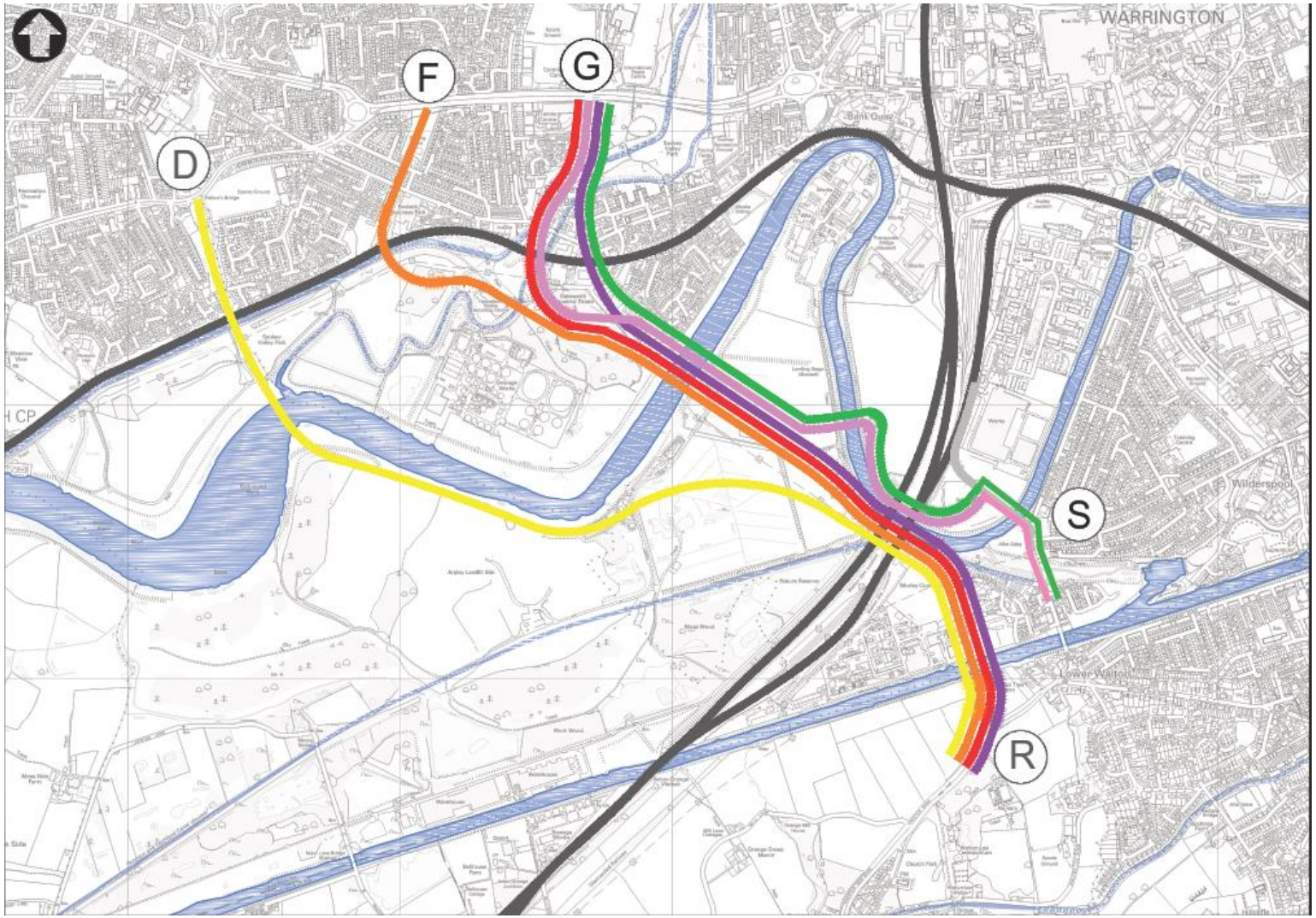

Figure 1 - Route Location Plan

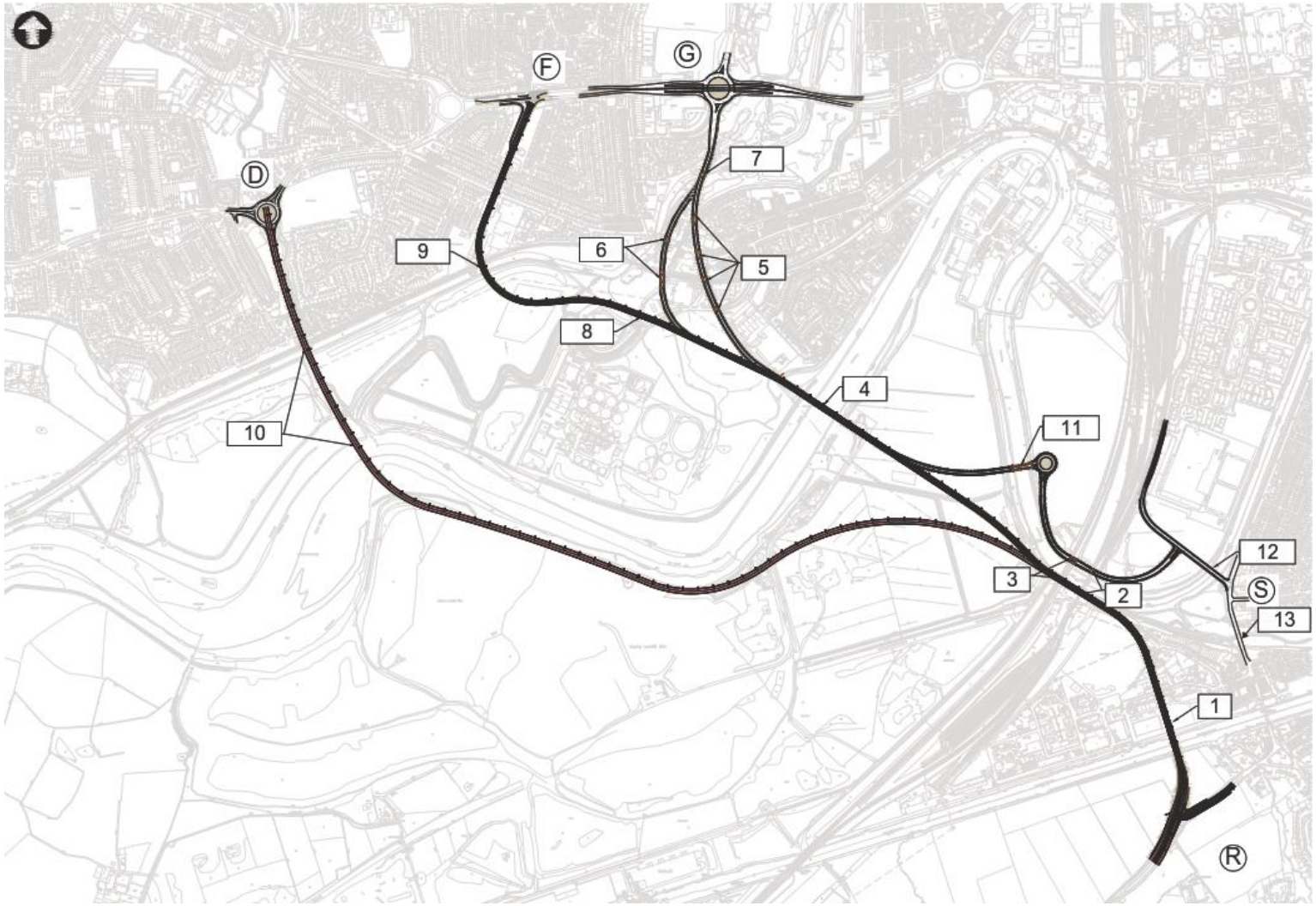

Figure 2 - Structure Location Plan

1 Structures

1.1 Manchester Ship Canal

1.1.1 Introduction

The Manchester Ship Canal Viaduct is required for the Yellow, Orange, Red and Purple routes in the route option plan. The proposed alignment for this structure is shown in Figure 3 below:

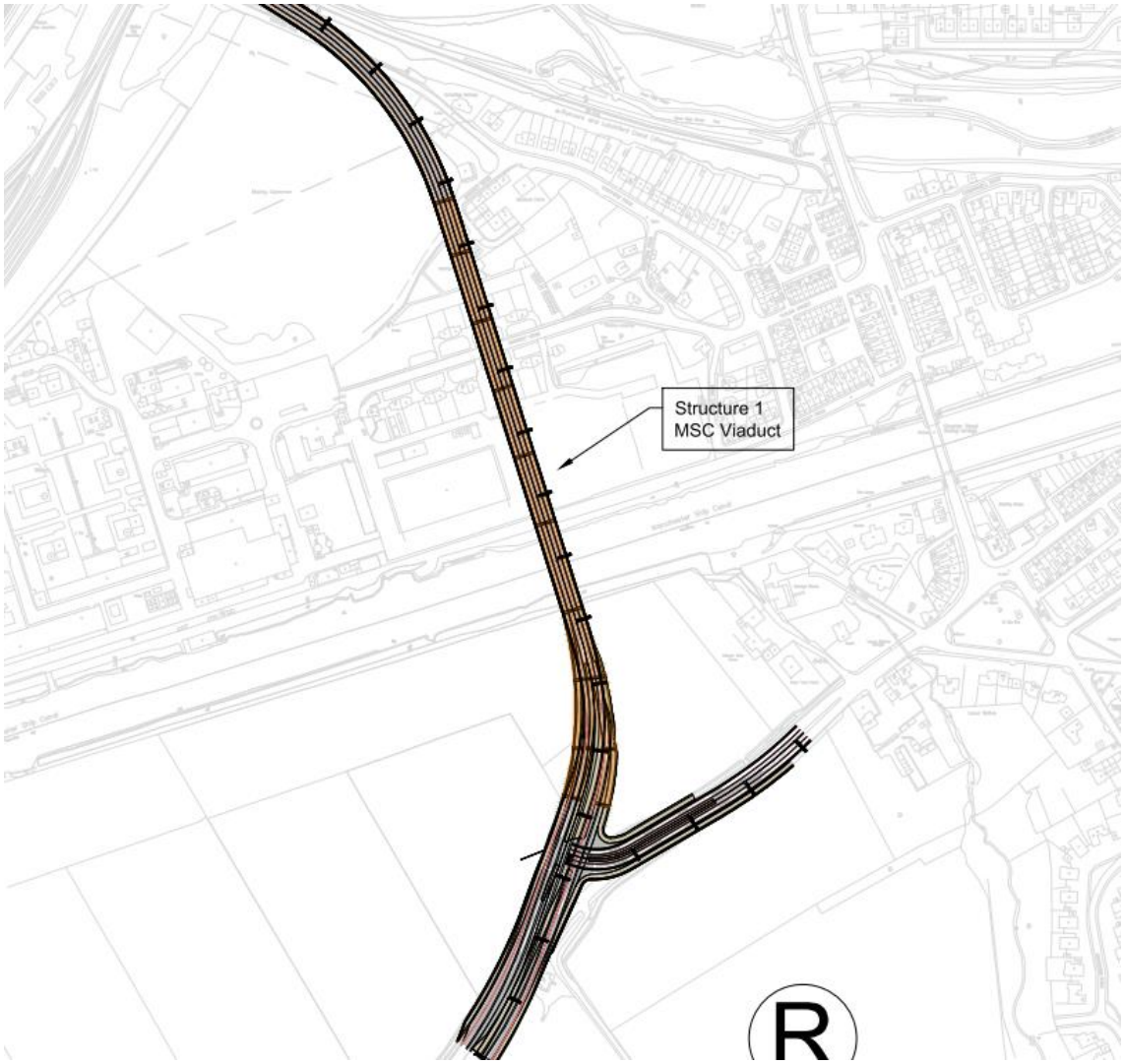

Figure 3 - Manchester Ship Canal Location Plan

The route extends from the existing single-carriageway A56 Chester Road (Junction R in Route Option Plan) then heads north towards the Manchester Ship Canal, crossing it at a point close to Baronet Road roundabout. The route then travels northwest across the south-eastern corner of Morley Common towards Walton Viaduct.

The overall length of the bridge structure is approximately 474m, with a further 210m of reinforced soil embankments forming the northern and southern approaches to the structure.

1.1.2 Data

Bridge Ref	1
Routes Carried	Yellow, Orange, Red, Purple
OS Ref	SJ 60076 86031 (Approx.)
Status	New Overbridge
Spans	Manchester Ship Canal
Skew	$0^o – 2^o$
Minimum Soffit Level	26.4mAOD (Confirmed with Peel Ports)

Table 2 - Manchester Ship Canal Data

1.1.3 Site Appraisal

1.1.3.1 Site Overview

The topography of the site between the A56 Chester Road and the south bank of the Manchester Ship Canal comprises open undeveloped fields. Along the northern bank of the Manchester Ship Canal, there are several industrial warehouses and vacant plots of land. Morley Common, a recreational sports field, is situated to the north of the site between Eastford Road and Baronet Road. To the east of Morley Common, along Eastford Road, there is a row of residential properties. In the south-east corner of the site, there is an electricity pylon, which supports 132kV electricity lines. There are two sets of electricity lines that run from this pylon; one electricity line runs parallel with Eastford Road along the east of the site whilst the other line runs from east to west across the middle of Morley Common.

1.1.3.2 Construction Methodology

Construction would start with piling and excavation for foundations starting from each abutment and working towards the Manchester Ship Canal. Substructures would follow in the same order releasing the end spans for steelwork erection and allowing deck construction to be supplied with resources from the approach embankments. Approach span steelwork would be delivered to site in 13.5m or 27m long sections, site welded into complete spans and erected using large (400t-500t) crawler cranes. The canal span steelwork would be erected using a 1000t super-lift lattice jib crane from one location on each side of the Ship Canal. Steel would be weathering steel to avoid the need for maintenance painting with 3mm sacrificial thickness to allow for the proximity of the Mersey Estuary.

Clearances to existing HV electricity lines would need to be checked prior to siting the cranes and electrical isolations (or diversion) taken during any activities that could place construction personnel, plant or materials within arcing distance. Deck concrete would use GRP or precast concrete permanent formwork between the beams and either travelling cantilever forms or precast concrete units for the edge cantilevers.

1.1.3.3 Ground Conditions

Maps available from the British Geological Survey show that superficial deposits at the site should comprise coastal sand overlying Helsby Sandstone Formation, which is part of the Sherwood Sandstone Group. Publicly available borehole records from the British Geological Survey indicate that bedrock is approximately 5m below ground level on the banks of the Manchester Ship Canal at approximately 5mAOD, falling to –1m AOD adjacent to the River Mersey.

Where bedrock is below 5m AOD, then it is expected that the pier and abutment foundations will comprise groups of bored concrete piles socketed into the sandstone bedrock. It is expected that approach span foundations will comprise 12No. 900mm diameter bored piles of length 8-12m. It is expected that canal span foundations will comprise 18No. 900mm diameter bored piles of length 10-15m.

Where sound bedrock is at a higher level, then there may be an opportunity to reduce costs by using barrettes instead of piles, or spread footings, if rock-head is within 3m of ground level.

1.1.3.4 Clearances

Peel Ports have stated that the minimum soffit level of the proposed Manchester Ship Canal viaduct is to be no lower than that of the adjacent Acton Grange Viaduct. This corresponds to a vertical clearance of 22.02m above the normal water level of the Manchester Ship Canal. The normal water level of the canal at this location is 4.38mAOD, meaning a minimum soffit level for the structure of 26.4m AOD. The canal width is fairly constant across the site and has a clear span of approximately 48m between banks. Confirmation will be required from Peel Ports as to any constraints on the position or level of pile caps and piers outside the 48m maximum waterway.

A vertical clearance of 6.7m is required beneath the electricity lines that run across the site. A full survey of the power lines will be required to confirm clearances for both construction and operation of the highway. The preferred option would be to divert the power lines to allow safe unrestricted access.

1.1.4 Implications of Site Constraints

1.1.4.1 Clearance over Manchester Ship Canal

The vertical clearance requirement for the structure to span over the Manchester Ship Canal means that road level is required to be approximately 20-25m above existing ground level. This necessitates the use of long approaches to the crossing at a steep gradient (6%). Consequently, the structure will require a large number of tall piers supported on deep foundations. The span lengths have been selected to maximise span and reduce the number of foundations, whilst remaining within the constraints of road transport lengths for beams and weights for economic lifting.

1.1.4.2 Morley Common and Nearby Residential Properties

To accommodate the proposed alignment, it will be necessary to acquire parts of Morley Common. To minimise land take, it is proposed that a reinforced soil retaining wall is used along this section of highway as opposed to traditional earthwork embankments. The alignment will also require the construction of a reinforced soil embankment up to 10m in height near residential properties along Eastford Road. Available borehole logs suggest that these

embankments may require ground improvement or driven precast concrete piles to control settlement and ensure geotechnical stability

1.1.4.3 Industrial Works

The existing Baronet Road on the north bank of the Manchester Ship Canal currently provides access to the Solvay chemical plant. It will be necessary to ensure that vehicle access along this or an alternative route is maintained during the temporary construction stage and in the permanent state once the bridge is operational. The proposed span arrangements allow for Baronet Road to continue beneath one of the approach spans.

The bridge location will have to give sufficient clearance to the operational chemical plant to eliminate the risk of any vehicle passing through the parapet and impacting on the works. It is assumed that operational safety within the works is adequate for the proximity to housing and hence this should not pose a risk to the viaduct. This will need to be confirmed prior to finalising the bridge alignment.

1.1.5 Bridge Proposal – Steel Composite with 4No. Steel Plate Girders Haunched at Canal Piers

The bridge proposal presented below is provided as a robust feasible solution for consideration in a future detailed design. Other feasible structural forms and span arrangements exist and advantages may become apparent when full ground investigation data is available.

1.1.5.1 Construction Type

For this structure, it is believed that a steel composite structure with a reinforced concrete deck is the most suitable construction type. This is likely to comprise constant depth plate girders for the approach spans and haunched plate girders for the Manchester Ship Canal span.

1.1.5.2 Review of Potential Crossing Locations

The proposed alignment has not been finalised and it is possible that the location of the crossing may move by up to 50m south east of the location shown in Figure 3. As the canal is of a fairly constant width it is not expected that utilising a different crossing point will have a significant impact on the length of the main span over the ship canal, however it may impact the overall length of the structure and span arrangements.

1.1.5.3 Review of Proposed Span Arrangements

To achieve the required clearance over the Manchester Ship Canal, a central span of 70m is required. The resultant 6m clearance between foundations and the edge of the waterway should avoid any additional constraints from canal shipping, but this will have to be confirmed by Peel Ports. Optimisation of span lengths would be carried out during preparation of the outline design, but at this stage it is expected that the bridge will comprise 9 spans of lengths between 40-70m – similar to the span arrangement of the nearby Thelwall Viaduct.

For economic purposes, it is proposed that the road will be carried on traditional earthwork embankments when road level is up to approximately 5m above ground level, with reinforced soil walls or embankments used when road level lies between 5m and 10m above ground level. A multi-span highway viaduct will be used for sections of the route, where the road level exceeds 10m. Height limitations for any earthworks is expected to be governed by the strength of underlying ground and the embankment's visual impact on surrounding areas. It is expected that some form of ground improvement will be required under the reinforced soil walls. This will be assessed following the recommendations of the Geotechnical Investigation Report.

Where the route lies in close proximity with existing properties, reinforced soil walls will be utilised to minimise land take. The proposed earthwork embankment lengths and heights will be finalised at detailed design stage.

The deck will comprise a single carriageway of 7.3m width with a 3.5m footpath/cycleway on either side.

1.1.5.4 Indicative Sizes for Scheme 2 Cost Appraisal

For the purposes of the Scheme 2 cost appraisal, the parameters in Table 3 can be assumed for this structure. At this stage in the design process it is only possible to provide indicative quantities based upon the high-level design work carried out thus far. The values presented below are not final and will change during the subsequent design phases as more information becomes available.

Construction Type	Steel Composite with 4No. Constant Depth Steel Plate Girders (Haunched Plate Girders for MSC Span)
Total Bridge Length	474m
Number of Spans	9
Indicative Span Lengths	40m, 54m, 54m, 70m MSC Span, 54m, 54m, 54m, 54m, 40m
Member Sizes	<u>Ship Canal Span - Pier Girder - 28m</u> Top Flange – 800mm x 55mm Web – 35mm x (2390mm – 3875mm – 2390mm) Bottom Flange – 1000mm x 70mm (50+20mm doubler) <u>Ship Canal Span - Span Girder – 42m</u> Top Flange – 650mm x 45mm Web –30mm x 2400mm Bottom Flange – 800mm x 55mm <u>Approach Spans - Pier Girder – 27m</u> Top Flange – 500mm x 45mm Web – 30mm x 2400mm Bottom Flange – 800mm x 55mm <u>Approach Spans - Span Girder – 27m</u> Top Flange – 500mm x 35mm Web – 25mm x 2400mm Bottom Flange – 600mm x 45mm
Number of Piers	8
Pier Dimensions	2No. Reinforced Concrete Leaf Piers for MSC Span: with pot bearings under each girder.

	2.5m Thickness x 12.5m Width x 11.8m Height 2.5m Thickness x 12.5m Width x 16.2m Height 6 Piers comprising 2No. Reinforced Concrete Columns: with pot bearings supporting a full depth steel cross girder 2.0m Diameter x 7.7m Height 2.0m Diameter x 10.6m Height 2.0m Diameter x 16.7m Height 2.0m Diameter x 13.9m Height 2.0m Diameter x 11.5m Height 2.0m Diameter x 8.3m Height
Total Reinforced Earthwork Lengths	210m
Deck Width	15.3m
Deck Thickness	<u>Ship Canal Span</u> 250mm Reinforced Concrete Deck 4200mm Plate Girder Depth at Haunches 2600mm Plate Girder Depth across Span <u>Approach Span</u> 250mm Reinforced Concrete Deck 2600mm Constant Plate Girder Depth
Approximate Steel Tonnage	~ 2300 tonnes
Foundation Type	Each pier to comprise pile group foundations
Indicative Foundation Sizes	Approach span foundations to comprise 12No. 900mm diameter bored piles of length 8-13m supporting 7m x 11m x 1.8m pile caps Canal span foundations to comprise 18No. 900mm diameter bored piles of length 10-15m supporting 8m x 15m x 2.0m pile caps.

Table 3 - Manchester Ship Canal Indicative Sizes

1.2 Walton Viaduct

1.2.1 Introduction

There are currently two proposed alignment options for an underbridge through the existing Walton Viaduct. The Yellow, Orange, Red and Purple routes utilise Spans 5, 6 and 7 on the Southern bank of the River Mersey. The Pink and Green Routes utilise Spans 10, 11 and 12 on the Northern bank of the River Mersey. Both proposed alignments for this structure are shown in Figure 4 below:

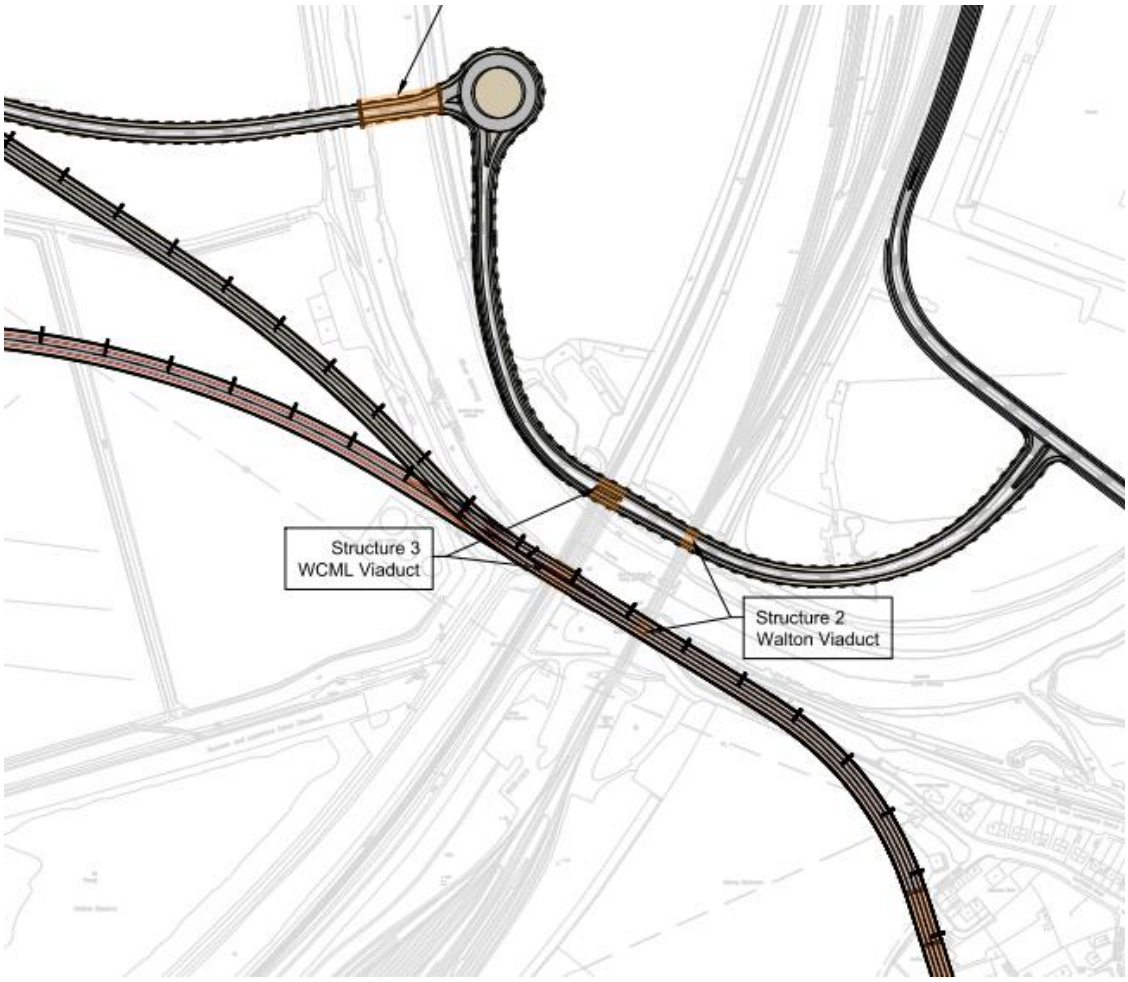

Figure 4 - Walton Viaduct Location Plan

For this structure, it is proposed that both intermediate piers between the three spans are removed and a new Network Rail standard composite ‘E’ type deck is constructed.

1.2.2 Data

Bridge Ref	2

Routes Comprised	North of River Mersey – Pink and Green South of River Mersey – Yellow, Orange, Red and Purple
OS Ref	SJ 59842 86523
Status	Existing (New single span underbridge to be constructed to replace existing 3 spans)
Approximate Carriageway Width (Total)	14.3m
Minimum Vertical Clearance	5.7m

Table 4 - Walton Viaduct Data

1.2.3 Existing Structure Appraisal

1.2.3.1 Overview

Walton Viaduct was constructed circa 1836 and currently carries the Helsby Freight Line over the River Mersey. The structure is a 12-span masonry arch viaduct constructed from stone. Eastford Road underbridge currently passes under the structure through Span 5, on the southern bank of the River Mersey, as shown in Figure 5 below. Span 5 has historically been modified from its original masonry arch structure to a precast concrete portal.

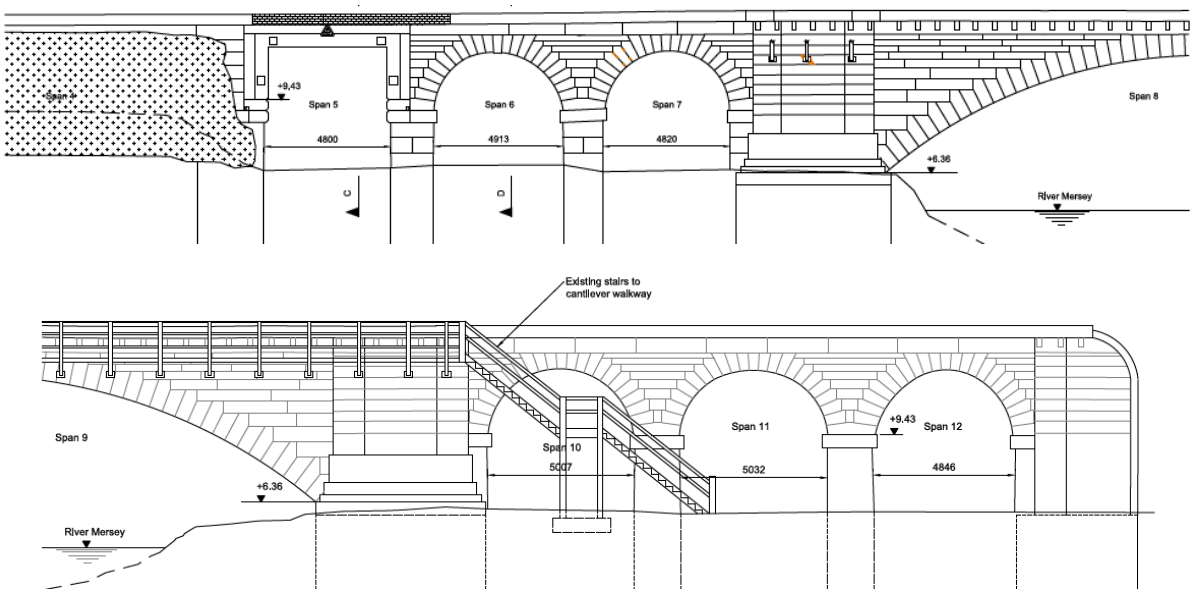

Figure 5 - Walton Viaduct Upstream Elevation

Presently, there is a wooden footbridge that spans over the River Mersey on the upstream elevation of the structure blocking access to masonry arch Spans 6, 7, 10 and 11. Span 4 to the south of the proposed southern alignment comprises a span of the disused Runcorn and Latchford Canal. This span has historically been infilled.

1.2.3.2 Existing Condition

The most recent detailed examination found the Eastford Road Span to be in good condition. The two-adjacent masonry arch spans were also found to be in good condition with only minor defects, typically comprising minor fractures.

1.2.3.3 Clearances

The current concrete portal structure that carries Eastford Road has limited headroom with a vertical clearance of 4635mm. The current Eastford Road ground level at Walton Viaduct is 6.75mAOD, thus, for the southern alignment, it is expected that ground level would need to be reduced to 5.65m AOD to achieve the desired Network Rail headroom of 5700mm. It has been assumed at this stage that a similar reduction in ground level would be required for the northern alignment.

1.2.3.4 Ground Levels

A full topographic survey of the site is currently unavailable but should be undertaken at a later stage if this crossing forms part of the final proposed route. At this stage of the study, existing ground levels have been interpolated between contours.

Within the scope of the survey, a full dimensional survey should be carried out to determine the horizontal and vertical clearances for each arch.

1.2.4 Site Appraisal

1.2.4.1 Site Overview

The existing topography of the site is characterised by undeveloped land with medium vegetation. The existing Eastford Road is a single-track highway that is primarily used by HGVs accessing industrial works. Network Rail currently utilise an access route through Spans 2 and 3 and the resulting highway alignment may be required to maintain this access route.

The proposed road alignment is adjacent to the River Mersey and is in an area with a high probability of flooding. Presently, Eastford Road floods most winters at the bridge site.

Historically, Network Rail had a proposal to construct a new rail bridge immediately to the east of Walton Viaduct. It is expected that a vertical clearance requirement of 5.7m would be required for the proposed structure. If it were to proceed, it would be necessary to liaise with Network Rail regarding the interface of the new highway with any future proposed rail structures.

1.2.4.2 Ground Conditions

Maps available from the British Geological Survey show that superficial deposits at the site should be Tidal Flat Deposits comprising clay, silt and sand overlying Helsby Sandstone Formation which is part of the Sherwood Sandstone Group. From the available BGS boreholes in the vicinity of the structure, the ground conditions typically comprise a layer of soft alluvial clay overlying sands and gravels and sandstone at depth.

There are no available drawings for the structure that indicate the foundation type or founding strata and previous structural investigation works carried out to achieve these parameters have yielded inconclusive results. As part of the Western Link scheme, structural investigation works comprising inclined coring into the existing viaduct have been scoped. The results and

conclusions drawn from these investigation works should determine ground conditions and extent of the existing foundations for detailed design stage.

1.2.4.3 Construction Methodology

The proposed construction methodology is shown on drawing 382900-MMD-07-XX-CD-S-0003. It is summarised below.

- The existing footway stairs on the south bank of the River Mersey would be demolished and reconstructed parallel with the river in line with the pier between spans 7 and 8.
- Road level in span 6 would be reduced to 500mm below final road level and a propping slab of reinforced concrete placed between the two piers.
- A height restriction beam would be fixed across span 6 to protect the masonry arch from impact and Eastford road traffic would be diverted into this span allowing piling of foundations adjacent to the south pier of span 5 and the north pier of span 7.
- New substructures would be constructed from below road level without any interruption of rail traffic in the form of L shaped concrete walls dowelled into the existing piers to provide a continuous horizontal load path beneath the new road level.
- L shaped flood walls would be constructed in line with the northern substructure with new highway drains out-falling into the river via headwalls and “Tideflex” valves.
- The new deck and cill beams would be assembled, complete with waterproofing membrane and bottom ballast off-line and transported via Self Propelled Modular Transporters (SPMTs) to allow rapid installation following demolition of existing superstructures of spans 5, 6 and 7.
- Existing rail signals, power and communication cables would be diverted during rules of the route possessions onto a temporary bridge erected at a suitable level to allow installation of the new deck.
- Existing superstructures of spans 5, 6 and 7 would be demolished using a 7 to 10 day blockade possession for lifting of track & ballast, demolition, making good retained masonry, installing new cill beams and deck, connection of deck drainage and re-installation of track. the risks and costs associated with managing bridge strikes. Removal of the existing spans will affect existing switches either side of the bridge location and a crossing (717a and b points) directly over it, thus the Overhead Line Equipment will have to be de-wired to allow a crane to lift out the crossing and points as complete components.
- Rail signals, power and communication cables would be re-diverted during rules of the route possessions off the temporary bridge and onto the new deck followed by removal of the temporary service bridge.

1.2.5 Implications of Site Constraints

1.2.5.1 Vertical Clearance

As the current vertical clearance of the structure is insufficient for the proposed replacement underbridge, it will be necessary to lower the existing road level by between 1.0 and 1.5m. Lowering the existing ground level at this location will make the highway even more susceptible to localised flooding. It will therefore be necessary to construct a flood wall or embankment to mitigate the possibility of river levels over-topping the road and a surface water storage system to mitigate surface water flooding of the carriageway.

To retain the existing structural arrangement, it would be necessary to lower the existing road level by more than 2m. Further lowering of the road would impinge on the arch foundations and would necessitate pumping of the highway drainage system.

Owing to the potential depths of water from the two causes, it is likely that flood walls will need freeboard above the 1 in 200 year river level of 7.5m AOD. Surface water drains will need to cater for 1 in 30 year rainfall, and surface water storage will need to allow for the worst combination of rainfall and river level, likely to be in the range 1 in 30 year rain plus 2 in four weeks river level, to 1 in two weeks rainfall plus 1 in 30 year river level. Total expected length of wall is between 180m and 220m. Possible construction forms include a concrete clad driven sheet pile wall, or an insitu reinforced concrete L shaped wall on a plastic sheet pile cut-off wall, tied down using stainless steel ground anchors. Selection will depend on cost, driveability of plastic piles and the permeability of soil strata determined by the ground investigation.

1.2.5.2 Unknown Founding Stratum

There is some limited information on foundation depth from coring carried out for scour assessments, but this only covers the River Mersey spans and is somewhat inconclusive. As the current foundation level is uncertain, there is a possibility that lowering the existing ground level might expose the pier foundations and/or reduce lateral support needed to prevent arch spreading. If lowering the ground level would lead to undercutting of the existing foundations, it would be necessary to consider underpinning the structure. Similarly, if reduction in ground level could increase the risk of lateral sliding of foundations, then temporary lateral propping or a permanent propping slab beneath carriageway level will be required to mitigate the risk.

1.2.5.3 Horizontal Clearance

The horizontal clearance of Spans 5 and 6 is approximately 4513mm. This is not sufficient to allow for a 3650mm carriageway lane width, minimum 600mm kerb either side, and the assumed H4a vehicle restraint system that would be required for the two piers either side of the carriageway. Consequently, re-use of the existing spans would result in unacceptable risk to both vehicle occupants and the railway viaduct. Thus, despite the time and cost associated with lifting and reinstating the railway track components, this is the only viable alternative.

1.2.6 Option 1 - New Single Span Steel E-Deck Underbridge Across Spans 5, 6 and 7.

1.2.6.1 Proposed Structure

The proposed structure would consist of a new Network Rail Standard “E” type bridge deck on precast concrete cill beams, which would in turn bear partly on new mini-piled substructures and partly on the remaining south pier of span 5 and north pier of span 7. These new substructures would be connected into the adjacent masonry with resin anchored stainless steel dowels to promote load sharing and prevent any differential movement. New substructures would be constructed from road level without any interruption of rail traffic and the new deck and cill beams would be assembled off-line and transported in their final position via the use of SPMTs to allow rapid installation following demolition and making good of the parts of the existing superstructure being demolished. Structural depth between underside of ballast and soffit of bridge would be less than that of the existing concrete portal, minimising the depth of excavation needed to achieve the required headroom.

1.2.6.2 Span Arrangement

This proposed option would involve the removal of both existing piers between Spans 5 and 7 and the installation of plate girder beams to span over a combined carriageway and footpath cycleway.

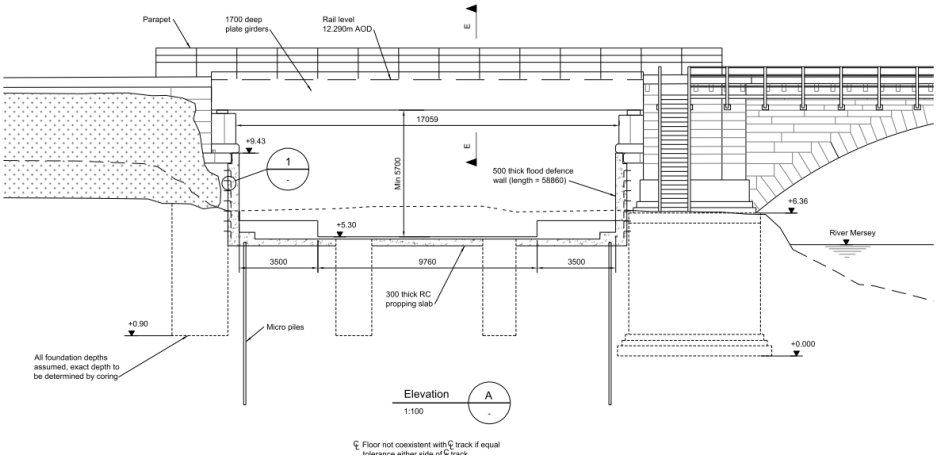

Figure 6 - Walton Viaduct Replacement Underbridge Option 1

1.2.6.3 Indicative Sizes for Stage 2 Cost Appraisal

For the purposes of the Stage 2 cost appraisal, the parameters in Table 5 can be assumed for this structure. At this stage in the design process it is only possible to provide indicative quantities for the non-standard components including foundations. The values presented below are not final and will change during the subsequent design phases as more information becomes available.

Construction Type	Simply supported steel and steel/concrete composite deck on reinforced concrete substructures
Total Bridge Length	20m
Number of Spans	1
Span Lengths	18.0m
Member Sizes	Refer to NR Standard drawings Series NR/CIV/SD/1200
Deck Width	9.1m including walkways
Deck Thickness	330mm
Deck Volume of Concrete	40m^3
Substructure Type	Precast concrete Cill beam to NR Standard drawings Series NR/CIV/SD/1800
Approximate Steel Tonnage	120-130t
Foundation Type	Mini-piled L shaped footing dowelled to existing piers with 7No. 600kN working load mini-piles 10 - 12m deep per footing.

Indicative Foundation Sizes	2No. 8.0m by 4.8m by 0.6m thick bases with 8.0m by 0.6m by 4m high walls. Possible 8m x 8m x 0.3m propping slab to resist arch thrusts.

Table 5 - Walton Viaduct Indicative Sizes

Indicative quantities for the flood wall on the west side of Walton Viaduct are detailed in the report for the West Coast Main line underbridge. For the wall on the east side of Walton viaduct, expected requirements are a 100m long concrete clad cantilever sheet pile wall or reinforced concrete "L" wall flood defence varying from 0.5m to 2.5m in height. The following quantities are expected:

- For "L" wall: 150m3 reinforced concrete, 300m2 plastic sheet-pile cut-off wall, 350 linear m of 40mm diameter S/Steel bar inclined ground anchors to resist sliding and uplift
- For Sheet piles: 75m3 reinforced concrete, 600m2 113kg/m2 steel sheet piles.

1.2.7 Option 2 - New Single Span Steel E-Deck Underbridge Across Spans 10, 11 and 12.

1.2.7.1 Proposed Structure

The proposed structure would be identical to Option 1 above however the road alignment would comprise Spans 10, 11 and 12.

1.2.7.2 Span Arrangement

This proposed option would involve the removal of both existing piers between Spans 10, 11 and 12 and the installation of a Network Rail “E” type bridge deck to span over a combined carriageway and footpath cycleway.

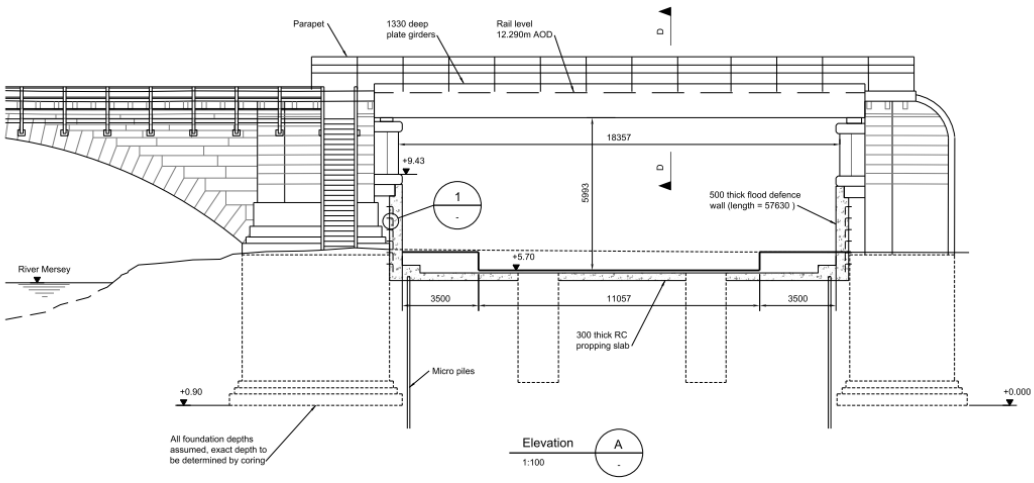

Figure 7 - Walton Viaduct Replacement Underbridge Option 2

1.2.7.3 Indicative Sizes for Stage 2 Cost Appraisal

Refer to Table 5 above.

1.3 West Coast Main Line Viaduct

1.3.1 Introduction

There are currently two proposed alignment options for an underbridge through the existing West Coast Main Line (WCML) River Mersey Viaduct. The Yellow, Orange, Red and Purple routes utilise Spans 1 and 2 on the southern bank of the River Mersey. The Pink and Green routes utilise Spans 4 and 5 on the northern bank of the River Mersey. The proposed alignments for this structure are shown in Figure 8 below:

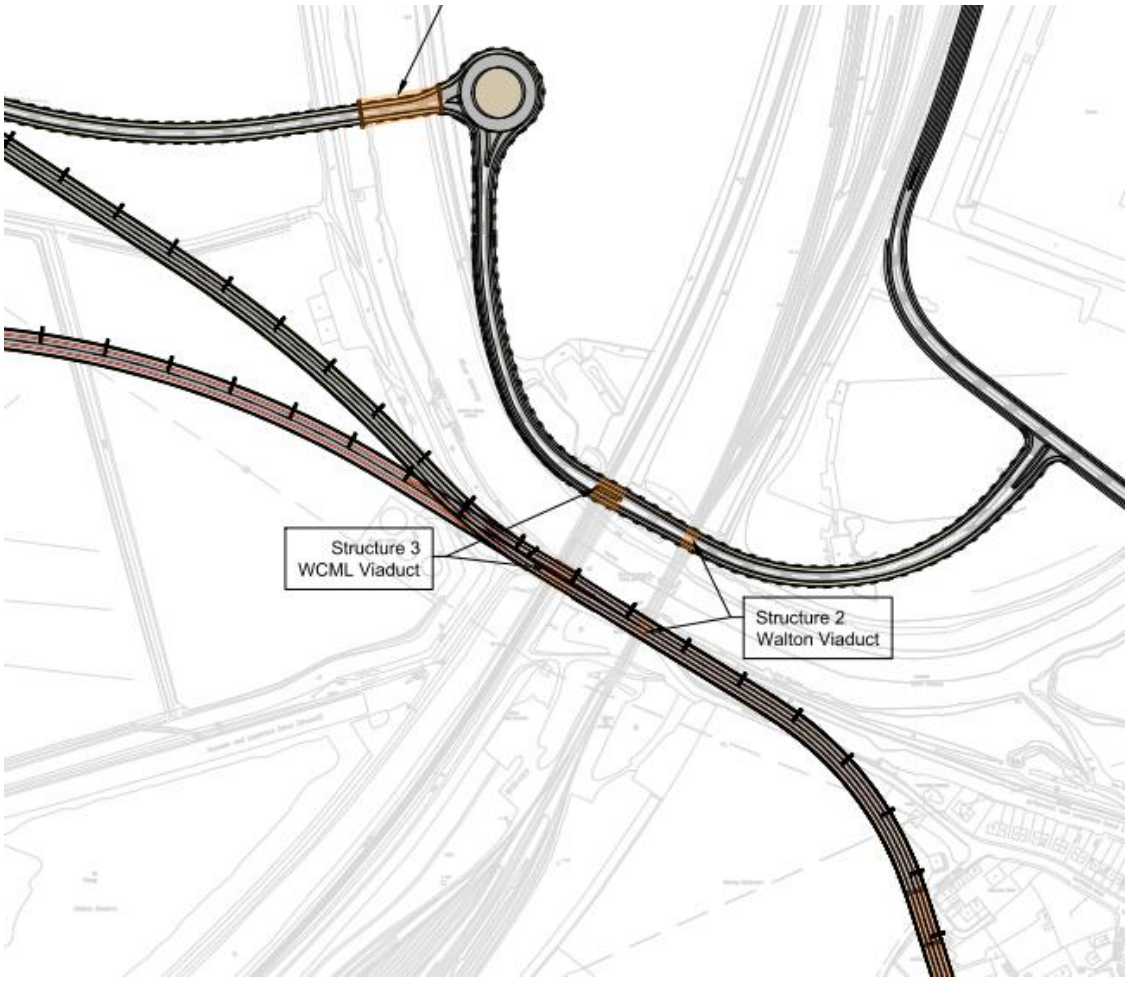

Figure 8 - West Coast Main Line Viaduct Location Plan

For this structure, no modifications are proposed to the existing rail viaduct. It is proposed that one lane of traffic and one cycleway lane pass through each arch span. It is proposed that a vehicle restraint system up to H4A standard is adopted for the central pier between spans. Additionally, a flood defence wall is to be constructed adjacent to the River Mersey between this underbridge and the Walton Viaduct underbridge.

1.3.2 Data

Bridge Ref	3

Routes Comprised	North of River Mersey – Pink and Green South of River Mersey – Yellow, Orange, Red and Purple
OS Ref	SJ 59842 86523
Status	Existing (New Vehicle Restraint System and flood wall to be constructed)
Approximate Carriageway Width (Total)	13.3m
Minimum Required Vertical Clearance	5.7m

Table 6 - West Coast Main Line Viaduct Data

1.3.3 Existing Structure Appraisal

1.3.3.1 Overview

The existing structure is a multi-span viaduct that carries the West Coast Main Line over the River Mersey. The viaduct comprises a single metal truss over the River Mersey and two twin span masonry arch approach spans on either side. The arches are constructed from blue engineering brick. Figure 9 below shows an elevation of the structure. Spans 1 and 2 are situated on the southern bank of the River Mersey, Spans 3 and 4 are situated on the northern bank. The existing single track Eastford Road currently passes through Span 1 of the viaduct.

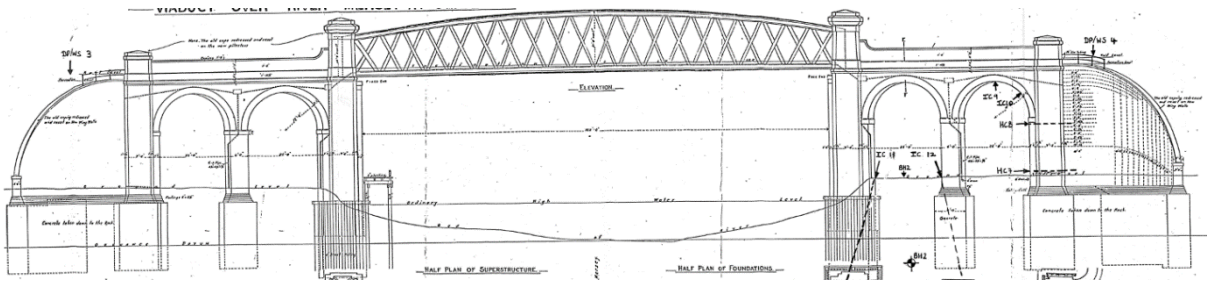

Figure 9 - West Coast Main Line Upstream Elevation

1.3.3.2 Existing Conditions

The most recent detailed examination stated that the bridge was in fair condition with a number of minor structural defects typically comprising spalling and open joints to the abutments. An underwater inspection was carried out in 2007 and concluded that the bridge was in fair condition. It noted that repointing works was required to much of the pier brickwork.

It may be necessary to carryout remediation works to these structural defects. This is likely to comprise repointing any mortar loss and stitching of any open joints.

1.3.4 Site Appraisal

1.3.4.1 Site Overview

The existing topography of the site is characterised by undeveloped land with medium vegetation. The existing Eastford Road is a single-track highway that is primarily used by HGVs to access industrial works.

The proposed road alignment is adjacent to the River Mersey and is in an area with a high probability of flooding. Presently, Eastford Road floods most winters at the bridge site.

1.3.4.2 Ground Conditions

Maps available from the British Geological Survey show that superficial deposits at the site should be Tidal Flats Deposits comprising clay, silt and sand overlying Helsby Sandstone Formation which is part of the Sherwood Sandstone Group. From the available BGS boreholes in the vicinity of the structure, the ground conditions typically comprise a layer of soft alluvial clay overlying a layer of sands and gravels thought to comprise the weathered upper metres of bedrock.

The foundations for the viaduct arch span piers comprise spread footings founded on the sands and gravels layer. The foundations for the River Mersey piers are caissons comprising spread footings founded on the sands and gravels layer encased within steel sheet piles founded at a greater depth within the sands and gravels layer. Figure 10 below shows a plan view of the foundations.

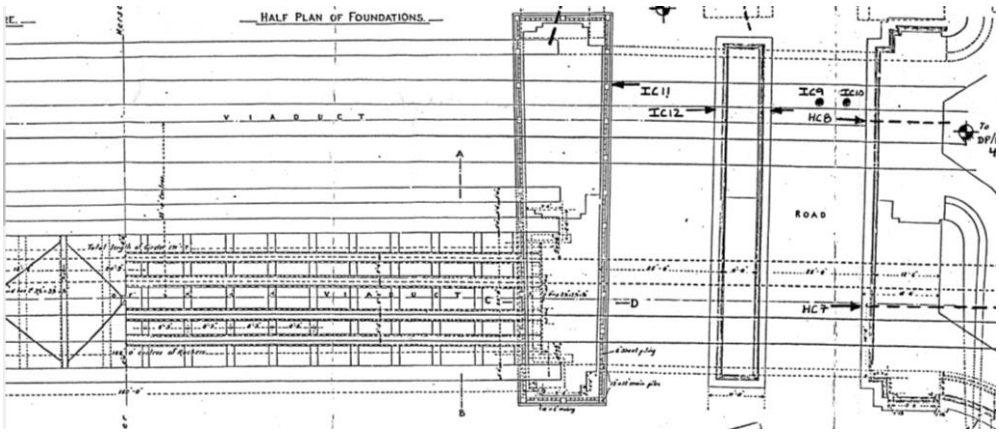

Figure 10 - Plan View of West Coast Main Line Viaduct Foundations

1.3.4.3 Clearances

The existing vertical clearance of the approach arches is approximately 10m which is sufficient to meet Networks Rail's clearance requirement of 5.7m for a rail underbridge. Consequently, it will not be necessary to lower the ground level at the proposed site location.

The horizontal clear spans of existing arches are approximately 7.5m.

1.3.5 Implications of Site Constraints

1.3.5.1 Flood Risk

In order to reduce the possibility of localised flooding of the highway as it rises up from Walton Viaduct, it will be necessary to construct a flood wall adjacent to the River Mersey between this underbridge and the Walton Viaduct underbridge.

1.3.5.2 Horizontal Clearance

As the current horizontal clearance of the Eastfield Road span is insufficient to accommodate a single carriageway and accompanying footpath / cycleway it will be necessary to carry one lane of traffic and a footpath / cycleway through each approach span.

The existing horizontal clearance is 7.5m. This should be sufficient to accommodate a single lane of traffic and cycleway with vehicle restraint but a full clearance study will be required at a subsequent design stage. It may be necessary to locally reduce the cycleway width should horizontal clearance be deemed unsatisfactory.

It is not practicable for the scheme to provide a replacement single span overbridge or underbridge structure owing to cost and disruption to West Coast Main Line train services.

1.3.6 Option 1 - Use Existing Approach Spans 1 and 2

1.3.6.1 Proposed Structure

This proposed route would utilise Spans 1 and 2 of the viaduct on the southern bank of the River Mersey. The proposed underbridge would not require any modification of the existing structure. The proposal is to split the single carriageway between the two arches, with a single 3.65m wide lane and 2.7m wide combined footway/cycleway in each arch. This will provide space for H4a vehicle restraint barriers to protect the central pier. No changes to the fabric of the structure are proposed, but the scheme may affect future access for inspection and maintenance. Space and if necessary cast-in fixings, will therefore be provided for the construction of temporary access decks with headroom to the highway to allow maintenance to be carried out with only limited night-time closures for access installation and removal. This will minimise traffic delay and the cost of maintenance. Ownership and responsibility for maintenance of bridge will remain with Network Rail.

1.3.6.2 Span Arrangement

The proposed route through the structure will utilise one lane of traffic through each arch – Spans 1 and 2. Horizontal clearance should be sufficient; however, a gauging survey will be required following confirmation from Network Rail of the necessary vehicle restraint system.

1.3.6.3 Construction Methodology

Work would commence with construction of the proposed flood alleviation wall constructed against (but separated from) the north pier of Span 2. To maintain traffic flow along the existing Eastford Road, construction would then continue in Span 2 with road construction up to the upper road base level across the full span width. Relocation and lowering of the existing drainage chamber out of the proposed carriageway would then be carried out to permit installation of an HGV rated cover and frame. If approved by Network Rail, threaded resin anchor sockets would be drilled and fixed into the pier and abutment brickwork to provide restraint for temporary access, which would then be used to complete brickwork maintenance

and repairs to the pier faces and arch structure. The permanent vehicle restraint systems would be installed to protect the piers and then traffic diverted onto the temporary surface to allow road construction for Span 1. The process would be repeated for Span 1 but with kerbs, verge surfacing and road wearing course being installed to allow one way working during completion of the verge and surfacing in Span 2.

1.3.6.4 Indicative Sizes for Scheme 2 Cost Appraisal

For the purposes of the Scheme 2 cost appraisal, indicative quantities for works over and above normal highway construction are as follows:

- Construction of a 100m long concrete clad cantilever sheet pile wall or reinforced concrete "L" wall flood defence from Span 2 to connect with the north pier of the modified Walton Viaduct underbridge. The following quantities are expected:
  - For "L" wall: 150m3 reinforced concrete, 300m2 plastic sheet-pile cut-off wall, 350 linear m of 40mm diameter S/Steel bar inclined ground anchors to resist sliding and uplift
  - For Sheet piles: 75m3 reinforced concrete, 600m2 113kg/m2 steel sheet piles.
- Relocation of drainage chamber in northern arch span.
- 180 linear m of H4a vehicle restraint barrier
- 144 No. M16 threaded resin anchor sockets with blanking plugs for scaffold access restraint fixings.
- Scaffold access and 10% pointing to 1500m2 brickwork at 2-10m above ground level.

1.3.6.5 Alternatives considered

For this route, there is no feasible alternative for the overall concept, but different forms of vehicle restraint would affect the available width of verge/footway. Options that could be considered include;

- Steel open box beam safety fence fixed to posts mounted in the central reserve
- Steel open box beam safety fence fixed to brackets mounted on the central brick pier
- Vertical concrete barrier set with movement clearance to brick pier
- Vertical concrete barrier set against brick pier separated by a compressible board

1.3.7 Option 2 - Use Existing Approach Spans 4 and 5

1.3.7.1 Proposed Structure

This proposed route would utilise Spans 4 and 5 of the viaduct on the northern bank of the River Mersey. As in Option 1, the proposed underbridge would not require any modification of the existing structure. The proposed structural arrangement would be as has been stated for Option 1.

1.3.7.2 Span Arrangement

The proposed route through the structure will utilise one lane of traffic through each arch – Spans 4 and 5. Horizontal clearance should be sufficient; however, a gauging survey will be required following confirmation from Network Rail of the necessary vehicle restraint system.

1.3.7.3 Construction Methodology

As per Option 1 above.

1.3.7.4 Indicative Sizes for Scheme 2 Cost Appraisal

As per Option 1 above.

1.3.7.5 Alternatives considered

As per Option 1 above.

1.4 Forrest Way

1.4.1 Introduction

Forrest Way bridge is an existing overbridge and forms a crossing over the River Mersey for all 6 route options. The existing overbridge has inadequate vertical sightlines to accommodate a new 40mph highway. Therefore, it is proposed that a new structure is constructed adjacent to the existing bridge to carry the proposed highway over the River Mersey. The proposed alignment for this crossing is shown in Figure 11 below:

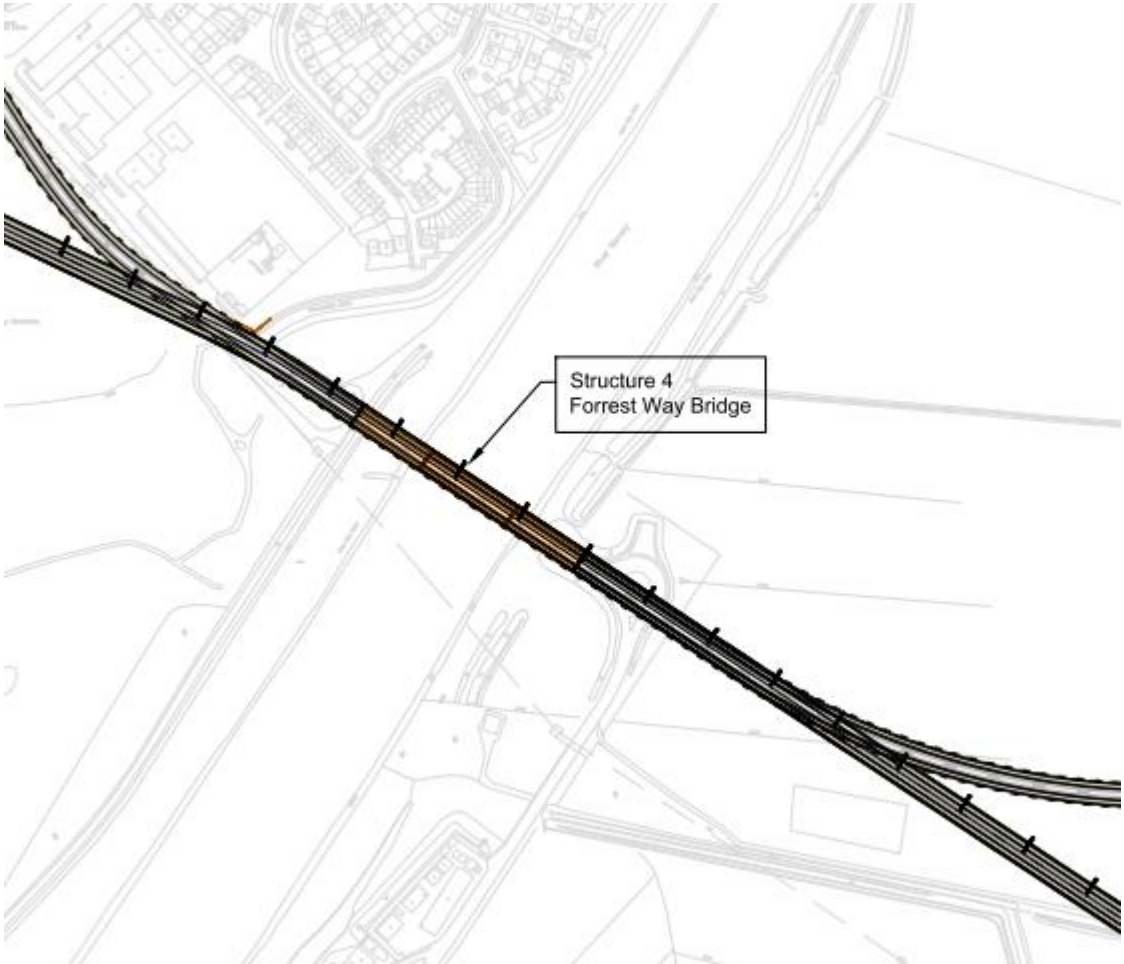

Figure 11 - Forrest Way Location Plan

1.4.2 Data

Bridge Ref	4
Routes Comprised	All 6 route options
OS Ref	SJ 59030 87114 (Approx.)
Status	Existing overbridge to be replaced off line with new overbridge

Spans	River Mersey
Skew	0º
Minimum Soffit Level for Navigable Span	Existing 15.3mAOD. (The minimum soffit level for any new overbridge is to be confirmed with Peel Ports. Existing value has been assumed for the purposes of the Stage 2a feasibility study)

Table 7 - Forrest Way Data

1.4.3 Existing Structure Appraisal

1.4.3.1 Overview

The existing structure was constructed in 1988 and carries Forrest Way Bridge over the River Mersey. The deck comprises a 2-lane carriageway of width 7.3m with a 1.85m footpath on either side. The structure is a 5-span steel composite structure comprising 2 main trapezoidal steel box sections and a reinforced concrete deck. The steelwork is weathering steel and the piers and abutment are constructed from reinforced concrete. The foundations comprise raking piles.

1.4.3.2 Existing Conditions

A Principal Bridge Inspection was carried out for Forrest Way Bridge in 2011. The report concluded that the structure was generally found to be in good condition with a small number of elements in poor condition. A Principal Bridge Inspection incorporating an inspection of the box girder interiors was subsequently carried out by Mott MacDonald in 2017 and generally found the structure to be in good condition.

1.4.3.3 Clearances

The superstructure soffit of the main span is at 15.3mAOD leaving a 10m clearance to the River Mersey. It is believed that at the time of construction, it was planned to open the river to navigable craft up to a point beyond the bridge. It is not currently known what clearance level would be required for a new structure at this location. This is set to be confirmed with Peel Ports prior to detailed design stage. At this stage in the design process it has been assumed that any new structure at this location would have to comply with the existing 10m clearance requirements.

1.4.3.4 Vertical Sight Lines

The existing approach spans have a severe gradient causing poor vertical sightlines over the structure. A vertical alignment assessment of the structure has been carried out by Mott MacDonald and concluded that the existing profile is insufficient to accomodate either a 30mph or 40mph highway and can not be utilised in its current arrangement. As the cost associated with maintaining temporary access over the River Mersey for any structural modification works and the cost and technical feasibilty of carrying out the necessary structural modification works is considered greater than that of a new structure; it is therefore proposed that a new structure is constructed adjacent to the existing structure with a suitable vertical profile.

1.4.3.5 Capacity

The stated capacity for the structure is HA + 30 units of HB. This capacity has been taken from a Bridge History Sheet for the structure from Cheshire County Council Department of Highways and Transportation.

Based on the date the structure was constructed and its intended usage, it seems unlikely that the design capacity for the structure would be less than HA + 37.5 units of HB; however, at this point there is no evidence to affirm this assertion.

Ultimately, as it is proposed that a new structure is constructed adjacent to the existing structure the existing capacity of the structure is immaterial. It is proposed that any new structure is designed to accommodate a minimum Highway Live Loading of LM1, LM2, LM3 (SV80 & SV100) to BS EN1991-2 UK National Annex (Equivalent to HA + 37.5 units of HB).

1.4.4 Site Appraisal

1.4.4.1 Site Overview

The topography of the site at the location of the Forrest Way crossing typically comprises open undeveloped fields. 132kV electricity lines run parallel to the existing structure along the downstream elevation of the bridge. These power lines are suspended from pylons approximately 15m above ground level.

1.4.5 Implications of Site Constraints

1.4.5.1 Vertical Sight Lines

As the existing vertical sightlines across the bridge are insufficient to accommodate a new 40mph highway, it will be necessary to construct a new structure with a suitable vertical alignment. It is therefore proposed that a new structure is constructed adjacent to the existing structure with spans arranged to suit the constraint of the ethylene pipeline on the south bank of the River Mersey.

1.4.6 Bridge Proposal – New Steel Composite Structure

The bridge proposal presented below is provided as a robust feasible solution for consideration in a future detailed design. Other feasible structural forms and span arrangements exist and advantages may become apparent when full ground investigation data is available.

1.4.6.1 Construction Type

For this structure, it is believed that a steel composite structure with a reinforced concrete deck is the most suitable construction type. This is likely to comprise haunched plate girders for the River Mersey span.

1.4.6.2 Review of Potential Crossing Locations

The proposed alignment has not been finalised and it is possible that the location of the crossing may move by up to 50m south east of the location shown in Figure 11. As the River Channel is of a fairly constant width it is not expected that utilising a different crossing point will have a significant impact on the length of the bridge.

1.4.6.3 Span Arrangements

Span optimisation lengths would be carried out at optioneering stage, but at this stage it is expected that the bridge will comprise 3 spans of lengths between 50 - 67.5m – similar to the span arrangement of the nearby Thelwall Viaduct.

For economical purposes, it is proposed that the road will be carried on traditional earthwork embankments when road level is up to approximately 10m above ground level. A multi-span highway viaduct will be used for sections of the route, where the road level exceeds 10m. Height limitation for any earthworks is expected to be governed by the strength of underlying ground and the embankment's visual impact on surrounding areas.

Where the route lies in close proximity with existing properties, reinforced earth walls will be utilised to minimise land take. The proposed earthwork embankments lengths and heights will be finalised at detailed design stage.

The deck will comprise a single carriageway of 7.3m width with a 3.5m footpath/cycleway on either side.

1.4.6.4 Indicative Sizes for Scheme 2 Cost Appraisal

For the purposes of the Scheme 2 cost appraisal, the parameters in Table 8 can be assumed for this structure. At this stage in the design process, it is only possible to provide indicative quantities based upon the high-level design work carried out thus far. The values presented below are not final and will change during the subsequent design phases as more information becomes available.

Construction Type	Steel Composite
Total Bridge Length	180m
Number of Spans	3
Span Lengths	55.0m, 67.5m, 55.0m
Member Sizes	Pier Girder Top Flange – 650mm x 45mm Web – 30mm x 4090mm Bottom Flange – 800mm x 65mm Span & Approach Girder Top Flange – 600mm x 40mm Web – 25mm x 2515mm Bottom Flange – 650mm x 45mm
Number of Piers	2No. reinforced concrete leaf piers comprising (12.5m wide) with pot bearings under each girder
Pier Dimensions	2.5m Thick x 8.9m Height 2.5m Thick x 8.7m Height
Total Reinforced Earthwork Lengths	N/A
Deck Width	15.3m

Deck Thickness	250mm Concrete Deck 4200mm Plate Girder Depth at Haunches 2600mm Plate Girder Depth at Span
Approximate Steel Tonnage	~900 Tonnes
Foundation Type	Each pier to comprise pile group foundations
Indicative Foundation Sizes	900mm Diameter Bored Piles 20-25m deep. 18No. Per main span pile cap of 8m x 15m x 2m and 12 No per approach span pile cap of 7m x 11m x 1.8m.

Table 8 - Forrest Way Indicative Sizes

1.5 East Ditton Goods / Arpley Rail Viaduct

1.5.1 Introduction

The East Ditton Goods / Arpley viaduct is required for the Purple and Green routes in the route option plan. The proposed alignment for this structure is shown on the right-hand side of Figure 12 below.

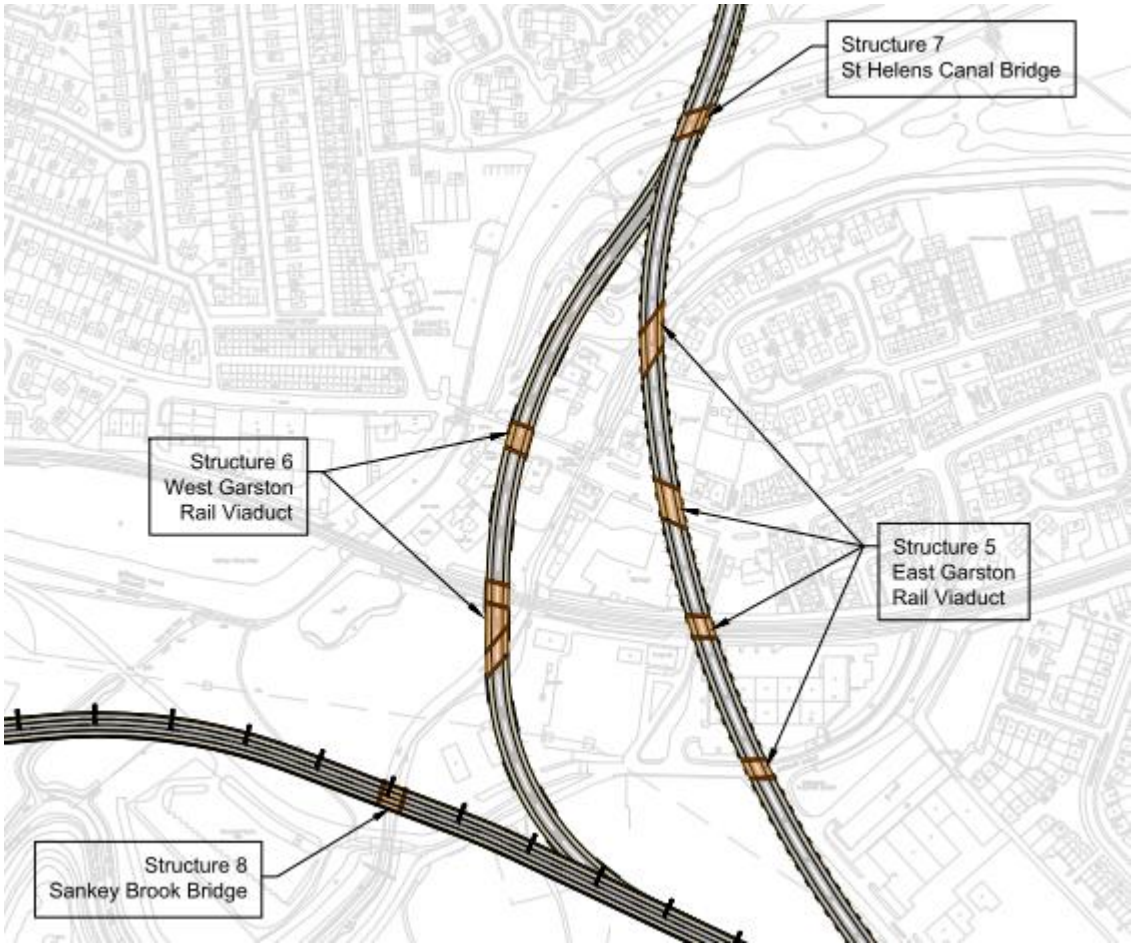

Figure 12 - East Ditton Goods / Arpley Rail Viaduct Location Plan

The proposed route spans over Barnard Street, Ditton Goods / Arpley rail line, Old Liverpool Road and Sankey Brook. Between bridge spans, the highway is proposed to be carried on a reinforced soil retaining wall.

1.5.2 Data

Bridge Ref	5
Routes Comprised	Purple and Green
OS Ref	SJ 58523 87536
Status	New Overbridge

Spans	Barnard Street, Ditton Goods / Arpley Rail Line, Old Liverpool Road, Sankey Brook
Skew	45º (Maximum)
Minimum Vertical Clearance	5.7m over Barnard Street. 5.8m over Ditton Goods / Arpley Rail Line. 5.7m over Old Liverpool Road. 0.6m over 1 in 200 year flood level for Sankey Brook.

Table 9 - East Ditton Goods / Arpley Rail Viaduct Data

1.5.3 Site Appraisal

1.5.3.1 Site Overview

The proposed site is situated close to Gatewarth Recycling Centre. The Ditton Goods / Arpley rail line runs east to west across the site. To the south of the site, the topography typically comprises undeveloped fields containing dense vegetation. To the north of the site, the topography typically comprises newly constructed residential properties and industrial warehouses. To the north east of the site is Sankey Valley Park. Sankey Brook and the St Helens canal run almost parallel to each other from the north east of the site to the south west. To the south of the site, there are 132kV electricity lines that run parallel to the south bank of the St Helens Canal.

1.5.3.2 Ground Conditions

Maps available from the British Geological Survey show that superficial deposits at the site consist of Tidal Flats Deposits which typically comprise a layer of sands and gravels, overlying a thick layer of stiff glacial till roughly 3-5m below ground level.

It is expected that the foundations for each bridge abutment will comprise pile foundations into the stiff glacial till layer.

1.5.3.3 Clearances

Based upon consultation with Network Rail, the desirable clearance over the Ditton Goods / Arpley Rail Line from rail level to bridge soffit is 5800mm.

The minimum clearance requirement over the Sankey Brook is 0.6m above the 1 in 200-year flood level.

A clearance of 5700mm has been assumed over Old Liverpool Road based on highways guidance for new overbridges over existing highways. A clearance of 5700mm has also been assumed for any structure spanning over Barnard Street, however it may prove a more desirable option to tie the new link road in with Barnard Street using an elevated junction. This option will be explored at more detail at detailed design stage.

A vertical clearance of 6.7m is required beneath the electricity lines that run across the site. A full survey of the power lines will be required at a later stage to determine the allowable level for any highway passing underneath.

1.5.4 Implications of Site Constraints

1.5.4.1 Ditton Goods / Arpley Rail Line

As the proposed alignment crosses over the Ditton Goods / Arpley Rail line, it will be necessary to obtain a possession on the line for any structural works carried out within the track exclusion zone. It is expected that the bridge foundations and abutments would be constructed outside the track exclusion zone with the superstructure beams erected during the course of "Rules of the Route" type possessions. The same type of possessions will be required for installation of the permanent formwork and concreting of the deck.

1.5.4.2 Clearance Beneath Electricity Lines

At detailed design stage, an assessment must be carried out to determine whether the structure can achieve the required clearance beneath the electricity lines. At this stage in the design process, it is not currently expected that these cables will require diverting for this route.

1.5.5 Bridge Proposal

1.5.6 Bridge Proposal – Multi-Span Viaduct

The bridge proposal presented below is provided as a robust feasible solution for consideration in a future detailed design. Other feasible structural forms and span arrangements exist and advantages may become apparent when full ground investigation data is available.

1.5.6.1 Construction Type

There are a number of possible options for the four bridge spans identified. Due to the span lengths involved (15-30m), it is proposed that the bridge comprises prestressed Y concrete deck beams.

1.5.6.2 Review of Proposed Alignment

The current proposed alignment has not been finalised and it is possible that the location of the crossing may vary by up to 10m either side of the location shown in Figure 12. Due to the skewed profile of Sankey Brook, changing the proposed alignment will alter that particular crossing and a greater span may be necessary. It is possible that a variation in alignment may necessitate longer retained earth lengths than those that have been identified.

1.5.6.3 Span Arrangements

To achieve the required clearance over Barnard Street, a span of approximately 13.3m is required. A span of 14.9m is required to span over the Arpley Goods Rail Line and a span of approximately 26.8m is required over Old Liverpool Road. Due to the high skew angle of Sankey Brook, a span of approximately 29.5m is required at a skew of approximately 45°.

A reinforced soil retaining wall will be required between spans and a traditional earth embankment required for the northern and southern approaches to the viaduct. The overall length of the proposed retaining wall is approximately 220m.

1.5.6.4 Proposed Foundations

It is proposed that pile group foundations are used to support each abutment. It is expected that 600mm diameter bored piles bearing in the stiff glacial till layer will be required.

1.5.6.5 Indicative Sizes for Scheme 2 Cost Appraisal

For the purposes of the Scheme 2 cost appraisal, the parameters Table 10 can be assumed for this structure. At this stage in the design process it is only possible to provide indicative quantities based upon the high-level design work carried out thus far. The values presented below are not final and will change during the subsequent design phases as more information becomes available.

Construction Type	Prestressed concrete Y-Beams with an in-situ concrete deck
Total Bridge Length	82.9m
Number of Spans	4
Span Lengths	13.3m, 14.9m, 26.8m, 29.5m
Member Sizes	For Barnard Street and Ditton Good / Arpley Rail line spans, the deck is expected to comprise: 10No. Y3 Concrete Deck Beams 2No. YE3 Concrete Deck Beams For Old Liverpool Road and Sankey Brook, the deck is expected to comprise: 10No. Y5 Concrete Deck Beams 2No. YE5 Concrete Deck Beams
Number of Piers	N/A Each deck forms a discrete single span bridge with abutments linked by reinforced soil embankments.
Abutment Dimensions	12m x 2.4m x 4-7m high on 14m x 1m x 3m foundations
Total Reinforced Earthwork Lengths	Approx. 220m
Deck Width	15.0m
Deck Thickness	200mm
Approximate Steel Tonnage	N/A
Foundation Type	Pile Group Foundations
Indicative Foundation Sizes	600mm diameter bored piles 20-25m long. (8 No. piles per abutment)

Table 10 - East Ditton Goods / Arpley Rail Viaduct Indicative Sizes

1.6 West Ditton Goods / Arpley Rail Viaduct

1.6.1 Introduction

The West Ditton / Arpley goods viaduct is required for the Red and Pink routes in the route option plan. The proposed alignment for this structure is shown on the left-hand side of Figure 13 below.

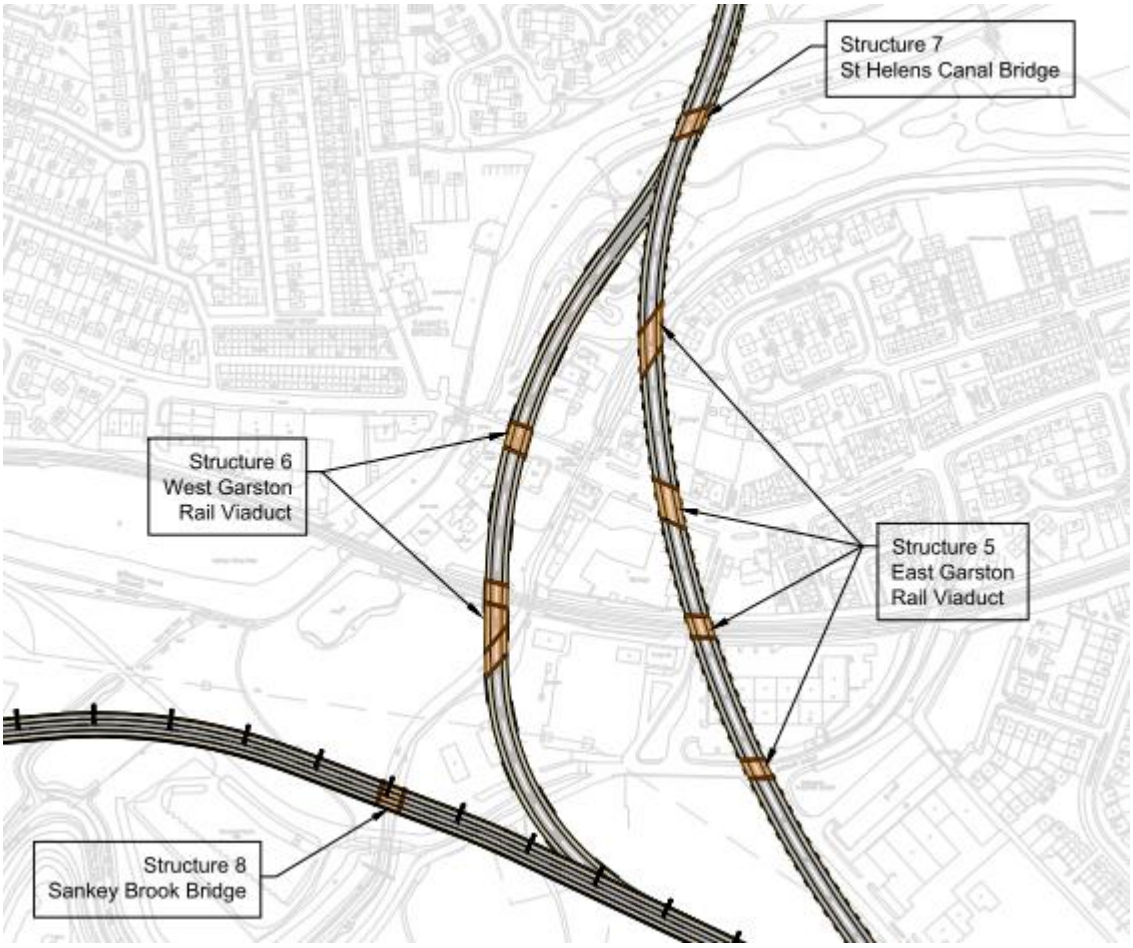

Figure 13 - West Ditton Goods / Arpley Rail Viaduct Location Plan

The proposed route spans over the Sankey Brook, Arpley Goods Railway line and Old Liverpool Road. Between spans, the highway is proposed to be carried on a reinforced soil retaining wall.

1.6.2 Data

Bridge Ref	6
Routes Comprised	Red and Pink
OS Ref	SJ 58523 87536
Status	New Overbridge

Spans	Sankey Brook, Arpley Goods Rail Line, Old Liverpool Road
Skew	45º (Maximum)
Minimum Vertical Clearance	5.8m over Arpley Goods Rail Line. 5.7m over Old Liverpool Road. 0.6m over 1 in 200 year flood level for Sankey Brook.

Table 11 - West Ditton Goods / Arpley Rail Viaduct Data

1.6.3 Site Appraisal

1.6.3.1 Site Overview

The proposed site is situated close to Gatewarth Recycling Centre. The Arpley Goods rail line runs east to west across the site. To the south of the site, the topography typically comprises undeveloped fields containing dense vegetation. To the north of the site, the topography typically comprises newly constructed residential properties and industrial warehouses. To the north east of the site is Sankey Valley Park. Sankey Brook and the St Helens canal run almost parallel to each other from the north east of the site to the south west. To the south of the site, there are 132kV electricity lines that run parallel to the south bank of the St Helens Canal.

1.6.3.2 Ground Conditions

Maps available from the British Geological Survey show that superficial deposits at the site consist of Tidal Flats Deposits which typically comprise a layer of sands and gravels overlying a thick layer of stiff glacial till roughly 3-5m below ground level.

It is expected that the foundations for this structure will comprise piles, driven or bored into the stiff clay layer.

1.6.3.3 Clearances

Based upon consultation with Network Rail, the desirable clearance over the Arpley Goods Rail Line from rail level to bridge soffit is 5800mm.

The minimum clearance requirement over the Sankey Brook is 0.6m above the 1 in 200-year flood level.

A clearance of 5700mm has been assumed over Old Liverpool Road based on highways guidance for new overbridges over existing highways.

A vertical clearance of 6.7m is required beneath the electricity lines that run across the site. A full survey of the power lines will be required at a later stage to determine the allowable level for any highway passing underneath and/or any need for diversion prior to construction.

1.6.4 Implications of Site Constraints

1.6.4.1 Arpley Goods Rail Line

As the proposed alignment crosses over the Arpley Goods Rail line, it will be necessary to obtain a possession on the line for any structural works carried out within the track exclusion

zone. It is expected that the bridge foundations and abutments would be constructed outside the track exclusion zone with the superstructure beams erected during the course of "Rules of the Route" type possessions. The same type of possessions will be required for installation of the permanent formwork and concreting of the deck.

1.6.4.2 Clearance Beneath Electricity Lines

At detailed design stage, an assessment must be carried out to determine whether the structure can achieve the required clearance beneath the electricity lines. At this stage in the design process, it is not currently expected that these cables will require diverting for this route.

1.6.5 Bridge Proposal – Multi-Span Viaduct

The bridge proposal presented below is provided as a robust feasible solution for consideration in a future detailed design. Other feasible structural forms and span arrangements exist and advantages may become apparent when full ground investigation data is available.

1.6.5.1 Construction Type

There are a number of possible options for the spans over the Sankey Brook and Arpley Goods Rail Line. Due to the span lengths involved (15-20m), it is proposed that the bridge comprises prestressed Y concrete deck beams.

1.6.5.2 Review of Potential Crossing Locations

The current proposed alignment has not been finalised and it is possible that the location of the crossing may vary by up to 15m east of the location shown in Figure 13. Due to the skewed profile of Sankey Brook, changing the proposed alignment will alter that particular crossing and a greater span may be necessary. It is possible that a variation in alignment may necessitate longer retained earth lengths than those that have been identified.

1.6.5.3 Span Arrangements

To achieve the required clearance over the Sankey Brook, a span of approximately 17.7m is required at a skew of approximately 45°. A span of 14.8m is required to span over the Arpley Goods Rail Line and a span of approximately 17.8m is required over Old Liverpool Road.

At this stage in the design process it believed that the highway could either tie in with Barnard Street using an elevated junction or span over at 5.7m clearance. For the purposes of the Stage 2 costing appraisal, it will be assumed at this stage that an elevated junction would be utilised though it is possible that this could change at the next stage.

A reinforced soil retaining wall will be required between the Sankey Brook span and Arpley Goods Rail Line Span, and between the Arpley Goods Rail Line Span and Old Liverpool Road span. Additionally, a reinforced soil retaining wall will be required for the northern and southern approaches to the viaduct. The overall length of the proposed reinforced earth embankment is approximately 200m.

1.6.5.4 Proposed Foundations

It is proposed that pile group foundations are used to support each abutment. It is expected that 600mm diameter bored piles bearing in the stiff glacial till layer will be required.

1.6.5.5 Indicative Sizes for Scheme 2 Cost Appraisal

For the purposes of the Scheme 2 cost appraisal, the parameters in Table 12 can be assumed for this structure. At this stage in the design process it is only possible to provide indicative quantities based upon the high-level design work carried out thus far. The values presented below are not final and will change during the subsequent design phases as more information becomes available.

Construction Type	Prestressed concrete Y-Beams with an in-situ concrete deck
Total Bridge Length	44.3m
Number of Spans	3
Span Lengths	17.7m, 14.8m, 17.8m
Member Sizes	For all spans, the deck is expected to comprise: 10No. Y Concrete Deck Beams 2No. YE Concrete Deck Beams
Number of Piers	N/A Each span forms a distinct bridge with integral abutments linked by reinforced soil walls
Abutment Dimensions	6 N0. @ 12m x 7m x 2.4m infilled precast concrete sections on 14m x 1m x 3m pile caps
Total Reinforced Earthwork Lengths	Approx. 200m
Deck Width	15.0m
Deck Thickness	200mm
Approximate Steel Tonnage	N/A
Foundation Type	Pile Group Foundations
Indicative Foundation Sizes	600mm diameter bored piles. 48No. 20-25m in length

Table 12 - West Ditton Goods / Arpley Rail Viaduct Indicative Sizes

1.7 St Helens Canal

1.7.1 Introduction

The St Helens Canal bridge is required for the Red, Pink, Purple and Green route options in the route option plan. The proposed alignment for this crossing is shown in Figure 14 below.

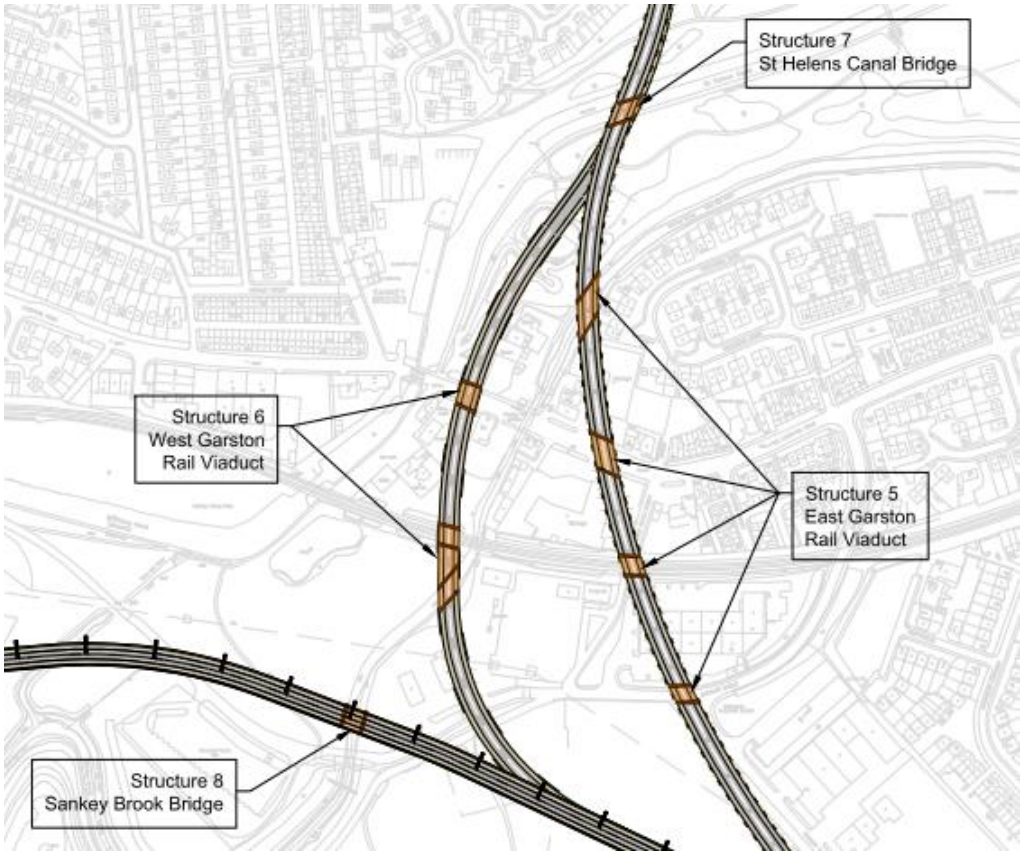

Figure 14 - St Helens Canal Bridge Location Plan

The proposed route travels north through Sankey Valley Park, crosses the St Helens Canal and then connects to the A57 Sankey Way at Junction G in the Route Option Plan.

1.7.2 Data

Bridge Ref	7
Routes Comprised	Red, Pink, Purple and Green
OS Ref	SJ 58634 87857
Status	New Overbridge
Spans	St Helens Canal
Skew	45° (Approx.)
Minimum Vertical Clearance	0.6m over St Helens Canal 1 in 200-year Flood Level or 2.4m to tow path.

Table 13 - St Helens Canal Bridge Data

1.7.3 Site Appraisal

1.7.3.1 Site Overview

The proposed crossing is situated within Sankey Valley Park. The park typically comprises areas of open grassland and areas of medium woodland. The St Helens Canal runs from east to west across the site. A tow path runs parallel to the canal on the south of the canal.

1.7.3.2 Ground Conditions

Maps available from the British Geological Survey show that superficial deposits at the site consist of Tidal Flats Deposits which typically comprise a layer of sands and gravels, overlying a thick layer of stiff glacial till roughly 3-5m below ground level. It is expected that the foundations for this structure will comprise pile group foundations founded in the stiff clay layer.

1.7.3.3 Clearances

The minimum clearance requirement over the St Helens Canal is the higher of 0.6m above the 1 in 200-year flood level or 2.4m above the tow path.

1.7.4 Bridge Proposal – Prestressed Concrete Y-Beams

The bridge proposal presented below is provided as a robust feasible solution for consideration in a future detailed design. Other feasible structural forms and span arrangements exist and advantages may become apparent when full ground investigation data is available.

1.7.4.1 Construction Type

For this structure, it is believed that a reinforced concrete deck is the most suitable construction type. This is likely to comprise prestressed Y-Beams with a reinforced concrete slab on top. It is proposed that the bridge is founded on pile group foundations bearing on the stiff glacial till layer.

1.7.4.2 Review of Potential Crossing Locations

The current proposed alignment has not been finalised and it is possible that the location of the crossing may vary by up to 40m to the east of the location shown in Figure 14. As the canal width and skew profile is fairly constant at this location, it is not thought that altering the location of the crossing will have a significant impact on the clear span of the structure.

1.7.4.3 Review of Proposed Span Arrangements

The clear span over the canal is approximately 15.4m and the bridge crosses the canal at a skew of approximately 45°. It is expected that for this structure minor earthwork embankments will be required to form the approach to the crossing.

1.7.4.4 Indicative Sizes for Scheme 2 Cost Appraisal

For the purposes of the Scheme 2 cost appraisal, the parameters in Table 14 can be assumed for this structure. At this stage in the design process it is only possible to provide indicative quantities based upon the high-level design work carried out thus far. The values presented

below are not final and will change during the subsequent design phases as more information becomes available.

Construction Type	Reinforced concrete with prestressed concrete Y-Beams
Total Bridge Length	15.4m
Number of Spans	1
Span Lengths	15.4m
Member Sizes	10No. Y1 beams 2No. YE1 beams
Number of Piers	0
Pier Dimensions	N/A
Total Reinforced Earthwork Lengths	N/A
Deck Width	15.0m
Deck Thickness	200mm
Approximate Steel Tonnage	N/A
Foundation Type	1.2m thick abutment walls on 1.5m thick pile cap on bored concrete piles
Indicative Foundation Sizes	8No. 600mm diameter piles 20-25m long per 14m x 3m x 1.5m pile cap

Table 14 - St Helens Canal Bridge Indicative Sizes

1.8 Sankey Brook

1.8.1 Introduction

The Sankey Brook bridge is required for the Orange route option in the route option plan. The proposed alignment for this crossing is shown in Figure 15 below.

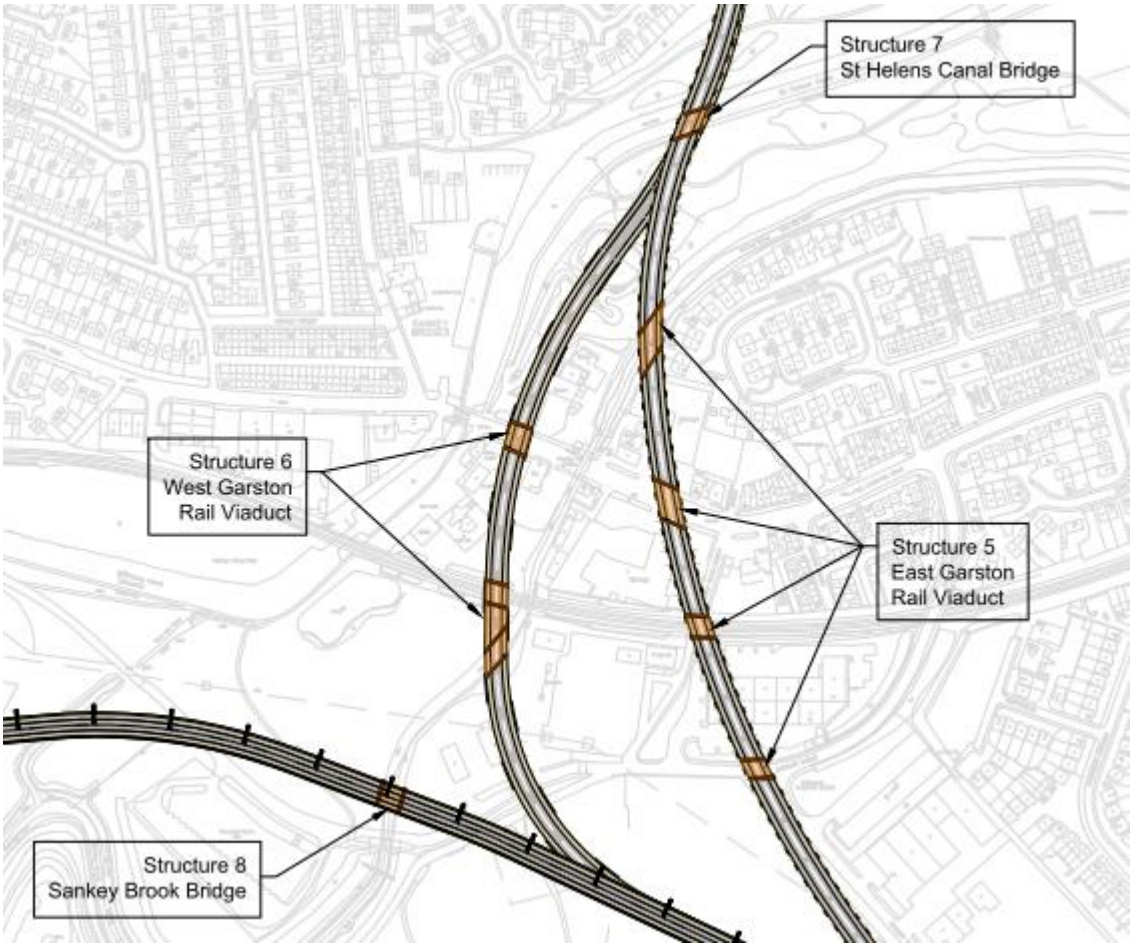

Figure 15 - Sankey Brook Bridge Location Plan

The proposed route extends west from Forrest Way bridge crossing and crosses Sankey Brook close to Gatewarth Recycling Centre.

1.8.2 Data

Bridge Ref	8
Routes Comprised	Orange
OS Ref	SJ 58446 87419
Status	New Overbridge
Spans	Sankey Brook

Skew	15-20° (Approx.)
Minimum Clearance	0.6m over Sankey Brook 1 in 200-year Flood Level

Table 15 - Sankey Brook Bridge Data

1.8.3 Site Appraisal

1.8.3.1 Site Overview

The topography of the site at the proposed crossing location typically comprises undeveloped fields with medium woodland. To the north east and south west of the site are existing industrial plots which may have to be acquired depending on the final crossing location. To the south of the proposed crossing location, there is an existing structure that carries Barnard Street over Sankey Brook. 132kV electricity lines run from east to west across the site crossing the watercourse approximately 20m to the north of the proposed crossing location. Existing ground level outside the clear river channel is below 1 in 200 year tidal flood level and hence there is a risk that the Environment Agency (EA) could require the bridge length to be increased to span the entire width of flood plain. The single span proposed is justified on the grounds that it provides sufficient flow area for extreme river flows and so would only act as a barrier to tidal surge and thus would alleviate rather than exacerbate flooding. This would have to be confirmed by the EA should this route be selected as the preferred scheme.

1.8.3.2 Ground Conditions

Maps available from the British Geological Survey show that superficial deposits at the site consist of Tidal Flats Deposits which typically comprise a layer of sands and gravels, overlying a thick layer of stiff Glacial Till. For this structure, it is expected that the foundations will comprise piled foundations founded in the stiff clay layer.

1.8.3.3 Clearances

The minimum clearance requirement over Sankey Brook is 0.6m above the 1 in 200-year flood level.

1.8.4 Bridge Proposal – Prestressed Concrete Y-Beams

The bridge option presented below is provided as a robust feasible solution for consideration of outline costings. Other potential options may become apparent after completion of the ground investigation.

1.8.4.1 Construction Type

For this structure, it is believed that a reinforced concrete integral bridge is the most suitable construction type. This is likely to comprise prestressed Y-Beams with a reinforced concrete slab on top. It is proposed that the bridge is founded on pile group foundations bearing on the stiff glacial till layer.

1.8.4.2 Review of Potential Crossing Locations

The current proposed alignment has not been finalised and it is possible that the location of the crossing may vary by up to 20m either side of the location shown in Figure 15. It is not expected that utilising a different crossing point will have a significant impact on bridge span lengths as the Sankey Brook is typically of constant width at this location.

1.8.4.3 Review of Proposed Span Arrangements

The clear span over the watercourse is approximately 13.2m and the bridge crosses the watercourse at a skew of approximately 15-20°. It is expected that for this structure minor earthwork embankments will be required to form the approach to the crossing.

1.8.4.4 Indicative Sizes for Scheme 2 Cost Appraisal

For the purposes of the Scheme 2 cost appraisal, the parameters in Table 16 can be assumed for this structure. At this stage in the design process it is only possible to provide indicative quantities based upon the high-level design work carried out thus far. The values presented below are not final and will change during the subsequent design phases as more information becomes available.

Construction Type	Reinforced concrete with prestressed concrete Y-Beams
Total Bridge Length	13.2m
Number of Spans	1
Span Lengths	13.2m
Member Sizes	10No. Y1 beams 2No. YE1 beams
Number of Piers	0
Pier Dimensions	N/A
Total Reinforced Earthwork Lengths	N/A
Deck Width	15.0m
Deck Thickness	200mm
Approximate Steel Tonnage	N/A
Foundation Type	Integral 4m high 1.2m wide piled abutments
Indicative Foundation Sizes	8No. 600mm diameter piles 20-25m long for each abutment

Table 16 - Sankey Brook Bridge Indicative Sizes

1.9 Ditton Rail and St Helens Canal Bridge

1.9.1 Introduction

The Ditton Rail and St Helens Canal Bridge is required for the Orange route in the route option plan. The proposed alignment for this structure is shown in Figure 16 below.

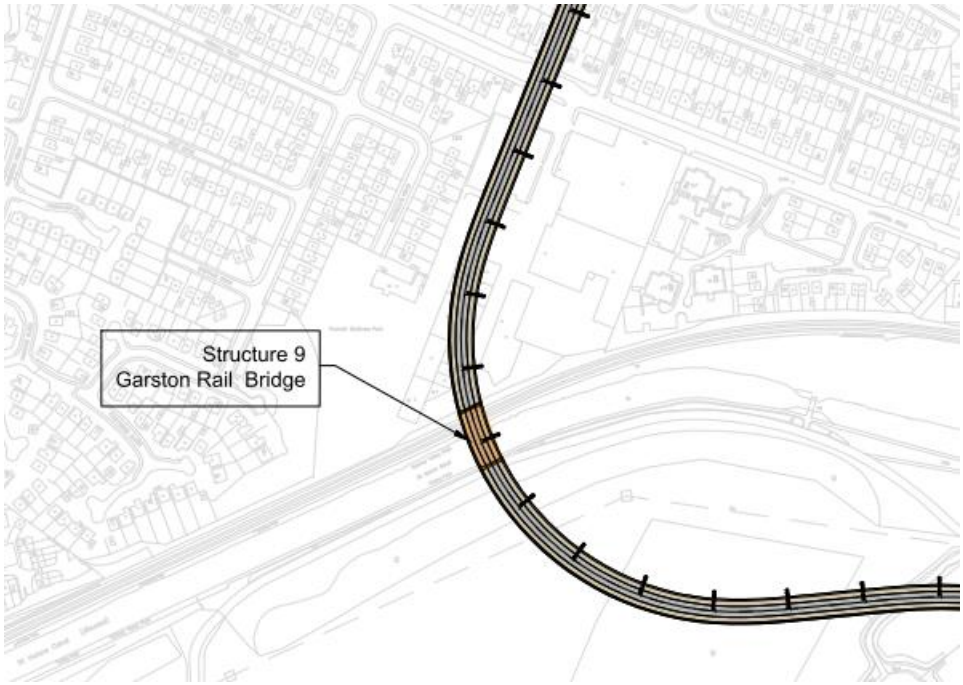

Figure 16 - Ditton Rail and St Helens Canal Bridge Location Plan

The proposed route crosses over the St Helens Canal and Ditton Goods / Arpley Railway line. Due to the close proximity of the St Helens Canal to the railway line, it is proposed that both features are crossed using one single-span bridge structure.

1.9.2 Data

Bridge Ref	9
Routes Comprised	Orange
OS Ref	SJ 57942 87565
Status	New Overbridge
Spans	St Helens Canal, Ditton Goods / Arpley Rail Line
Skew	20-30º
Minimum Clearance	5.8m over Ditton Goods / Arpley Rail Line. 0.6m above 1 in 200-year flood level for St Helens Canal

Table 17 - Ditton Rail and St Helens Canal Bridge Data

1.9.3 Site Appraisal

1.9.3.1 Site Overview

The proposed structure is situated close to Gatewarth Recycling Centre. The Ditton Goods / Arpley rail line runs east to west across the site. To the south of the site, the topography typically comprises undeveloped fields containing dense vegetation. To the north of the site, the topography typically comprises residential properties and industrial warehouses. The St Helens Canal runs alongside the Ditton Goods / Arpley rail line from east to west and contains a tow path on its southern bank. To the south of the site there are 132kV electricity lines that roughly run parallel to the south bank of the St Helens Canal.

1.9.3.2 Ground Conditions

Maps available from the British Geological Survey show that superficial deposits in this location are tidal flats deposits comprising sands and gravels overlying a thick layer of stiff glacial till roughly 3-5m below ground level. It is expected that the foundations for this structure will comprise pile foundations founded within the stiff clay layer.

1.9.3.3 Clearances

Based upon consultation with Network Rail, the desirable clearance over the Ditton Goods / Arpley Rail Line from rail level to bridge soffit is 5800mm. The minimum clearance requirement over the St Helens Canal is 0.6m above the 1 in 200-year flood level.

A vertical clearance of 6.7m is required beneath the electricity cables that run across the site. A full survey of the cables will be required at a later stage to determine the allowable level of any road passing underneath or any need for permanent diversion.

1.9.4 Implications of Site Constraints

1.9.4.1 Garston Rail Line

As the proposed alignment crosses over the Ditton Goods / Arpley Rail line, it will be necessary to obtain a possession on the line for any structural works carried out within the track exclusion zone. It is expected that the bridge foundations and abutments would be constructed outside the track exclusion zone with the superstructure beams erected during the course of "Rules of the Route" type possessions. The same type of possessions will be required for installation of the permanent formwork and concreting of the deck.

1.9.4.2 Clearance Beneath Electricity Lines

At detailed design stage, an assessment must be carried out to determine whether the structure can achieve the required clearance beneath the electricity lines. At this stage in the design process it is not currently expected that these cables will require diverting for this route, but crane siting studies will be required to confirm this.

1.9.4.3 Existing Residential Properties

The proposed alignment will require the acquisition and subsequent demolition of several residential properties located along Old Liverpool Road. To minimise land take for the north

approach, it is proposed that reinforced earth retaining walls are utilised where the embankments would otherwise encroach on adjacent properties.

1.9.5 Bridge Options

The bridge options presented below are provided as a robust feasible solutions for consideration of outline cost. Other potential options exist and may provide advantages depending on the results of ground investigations.

1.9.5.1 Review of Potential Crossing Locations

The current proposed alignment has not been finalised and it is possible that the location of the crossing may vary by up to 40m to the east of the location shown in Figure 16. As the width of the St Helens Canal is fairly constant at the proposed crossing location, it is not expected that altering the location of the crossing will have a significant impact on the required span lengths.

1.9.5.2 Review of Proposed Span Arrangements

To achieve the required clearance over the St Helens Canal and Garston Rail Line, a single span of approximately 43m is required at a skew of approximately 20-30°. For this crossing, a two-span structure was not considered feasible as there is insufficient clearance for an intermediate pier between the railway line and canal.

1.9.5.3 Construction Type

Due to the span lengths involved, it is believed that an integral steel composite structure with a reinforced concrete deck and reinforced earthwork approach embankments is the most suitable construction type for this structure. This is likely to comprise 4No. constant depth steel plate girders.

Alternatively, it may be possible to utilise a concrete structure. Due to the span lengths involved, this is likely to comprise prestressed W concrete deck beams with an in-situ reinforced concrete deck on top.

1.9.6 Bridge Option 1 – Integral Steel Composite – 4No. Plate Girders

1.9.6.1 Proposed Structure

The proposed structure for this option is an integral steel composite structure comprising 4No. weathering steel plate girders at 3.5m centres with a 250mm in-situ reinforced concrete deck.

1.9.6.2 Proposed Span Lengths

The proposed span length for this structure is 43.0m from the centre of each abutment. It is proposed that both the Ditton Rail line and St Helens Canal are crossed in a single span.

1.9.6.3 Proposed Foundations

The proposed foundation for this structure are pile group foundations within the stiff glacial till layer. It is expected that 900mm bored piles will be required.

1.9.6.4 Indicative Sizes for Scheme 2 Cost Appraisal

For the purposes of the Scheme 2 cost appraisal, the parameters in Table 18 can be assumed for this structure. At this stage in the design process it is only possible to provide indicative quantities based upon the high-level design work carried out thus far. The values presented

below are not final and will change during the subsequent design phases as more information becomes available.

Construction Type	Steel Composite – 4No. Plate Girders
Total Bridge Length	43.0m
Number of Spans	1
Span Lengths	43.0m
Member Sizes	Top Flange – 650mm x 40mm Web – 25mm x 1910mm Bottom Flange – 800mm x 50mm
Number of Piers	0
Pier Dimensions	N/A
Total Reinforced Earthwork Lengths	124m
Deck Width	15.0m
Deck Thickness	250mm Reinforced Concrete Deck 2000mm Constant Plate Girder Depth
Foundation Type	12m x 3m x 9m high abutment walls on Piled Foundations
Indicative Foundation Sizes	12No. 20-25m long 900mm diameter piles per 15m x 4m x 1.5m abutment pile cap

Table 18 - Ditton Rail and St Helens Canal Bridge Option 1 Indicative Sizes

1.9.7 Bridge Option 2 – Integral Concrete Deck Beams – 4No. W-Beams

1.9.7.1 Proposed Structure

The proposed structure for this option is an integral reinforced concrete structure comprising 4No. prestressed reinforced concrete W-Beams at 3m centres with a 200mm in-situ reinforced concrete deck.

1.9.7.2 Proposed Span Lengths

The proposed span length for this structure is 43.0m from the centre of each abutment. It is proposed that both the Ditton Rail line and St Helens Canal are crossed in a single span.

1.9.7.3 Proposed Foundations

The proposed foundation for this structure are pile group foundations within the stiff glacial till layer. It is expected that 900mm bored piles will be required.

1.9.7.4 Indicative Sizes for Scheme 2 Cost Appraisal

For the purposes of the Scheme 2 cost appraisal, the parameters in Table 19 can be assumed for this structure. At this stage in the design process it is only possible to provide indicative quantities based upon the high-level design work carried out thus far. The values presented below are not final and will change during the subsequent design phases as more information becomes available.

Construction Type	Reinforced Concrete – 4No. W-Beams
Total Bridge Length	43m
Number of Spans	1
Span Lengths	43m
Member Sizes	4No. W19 Beams 2300mm Depth
Number of Piers	0
Pier Dimensions	N/A
Total Reinforced Earthwork Lengths	124m
Deck Width	14.0m
Deck Thickness	200mm
Approximate Steel Tonnage	Concrete Structure
Foundation Type	14m x 3m x 9m high abutment walls on Piled Foundations
Indicative Foundation Sizes	14No. 20-25m long per 18m x 4m x 1.5m abutment pile cap

Table 19 - Ditton Rail and St Helens Canal Bridge Option 2 Indicative Sizes

1.10 West River Mersey Viaduct

1.10.1 Introduction

The West River Mersey Viaduct is required for the Yellow route in the route option plan. The proposed alignment for this structure is shown in Figure 17 below:

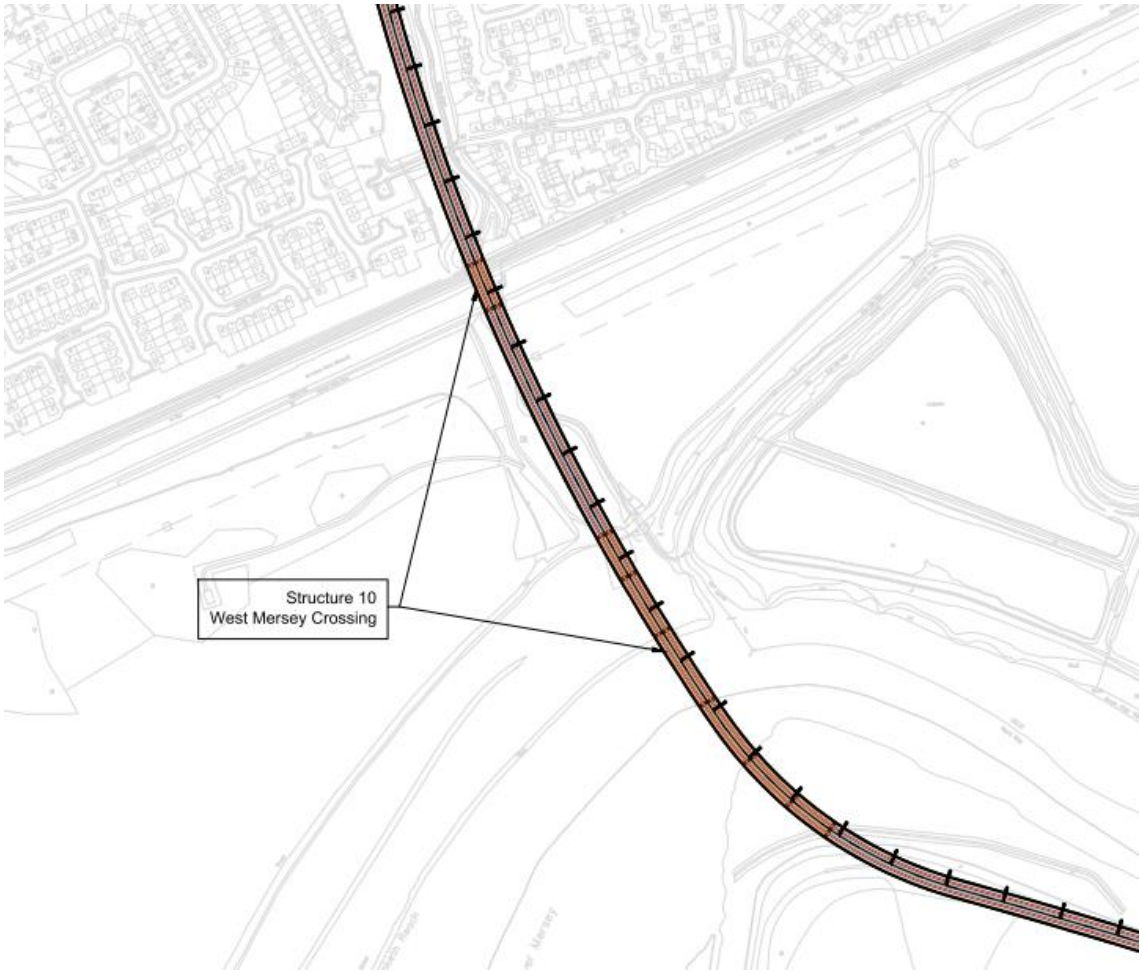

Figure 17 - West River Mersey Crossing Location Plan

The proposed route runs from the south-east skirting the boundary of Arpley Landfill. The route spans over the River Mersey close to its confluence with the Sankey Brook then travels north on a reinforced earthwork embankment. The route then spans over the Ditton Goods / Arpley Railway line and the St Helens Canal. Due to the close proximity of the railway line to the St Helens Canal, it is proposed that these features are crossed with a single span.

The combined overall length of both bridge structures is approximately 315m, with a further 400m of the route carried on piled reinforced soil embankments.

1.10.2 Data

Bridge Ref	10

Routes Comprised	Yellow
OS Ref	SJ 57593 86986
Status	New Overbridge
Spans	River Mersey, St Helens Canal, Ditton Goods Rail Line
Skew	10-15º
Minimum Clearance	10m over River Mersey (The minimum clearance for this crossing is to be confirmed with Peel Ports. For the purposes of the Stage 2a feasibility study, 10m has been assumed based on clearance requirements for Forrest Way bridge upstream). 5.8m over Ditton Goods Rail Line. 0.6m over 1 in 200-year flood level for St Helens Canal.

Table 20 - West River Mersey Viaduct Data

1.10.3 Site Appraisal

1.10.3.1 Site Overview

The River Mersey runs from East to West across the site with the Ditton Goods / Arpley Railway Line and St Helens Canal running parallel to each other approximately 100m north of the River Mersey. Arpley Landfill is situated to the south of the site with the proposed alignment skirting along the northern boundary of the landfill. Gatewarth landfill is situated between the northern bank of the River Mersey and southern bank of the St Helens Canal. Across this stretch of land, Whittle Brook runs north to south connecting the St Helens Canal to the River Mersey. To the north of the Ditton Goods Rail Line is a residential estate. Running from east to west across the site, roughly parallel to the south bank of the St Helens Canal are a set of 132kV electricity lines.

1.10.3.2 Ground Conditions

Maps available from the British Geological Survey show that superficial deposits in this location consist of tidal flats deposits typically comprising sands and soft clay overlying a layer of stiff to very stiff glacial till. There were no publicly available boreholes in the vicinity of this structure that achieved bedrock, therefore it is not possible at this stage to determine the depth to rock head. Bedrock can be assumed to be greater than 10m below ground level based upon the furthest depth of borehole penetration. For this structure, it is expected that pier foundations will comprise piled foundations acting in skin friction in glacial till or socketed into bedrock if bedrock is within practical depth.
The alignment traverses both Arpley landfill and Gatewarth landfill, as such it is expected that at these locations there will be significant depths of artificial compressible fill. It is expected that the reinforced earth retaining wall would necessitate the provision of a piled ground support transfer platform.

1.10.3.3 Clearances

The required clearance over the River Mersey is not currently known and will be determined at subsequent design stages following communication with Peel Ports and other stakeholders. At this stage, it has been assumed that any crossing at this location will be required to adhere to

the minimum clearance requirements employed by Forrest Way bridge situated upstream. Therefore, an initial clearance of 10m from normal water level to the soffit of the structure has been assumed. At the proposed crossing location, the clear span of the River Mersey is 140m.

Based upon consultation with Network Rail it is expected that the minimum clearance desired for a new overbridge over the Ditton Goods rail line is 5.8m.

The minimum clearance requirement over the St Helens Canal is the greater of 0.6m above the 1 in 200-year flood level or 2.4m to the tow path.

As it is proposed that the St Helens Canal and Ditton Goods rail line are crossed with a single span, the more stringent clearance requirement from the Ditton Goods rail line will be adopted for the span.

A vertical clearance of 6.7m is required beneath the electricity lines that run across the site. A full survey of the power lines will be required at a later stage to determine the allowable level should any road be required to pass underneath.

1.10.4 Implications of Site Constraints

1.10.4.1 Whittle Brook

The proposed alignment travels parallel to Whittle Brook. To allow for construction of the reinforced earthwork embankment for the section of route between the River Mersey crossing and Ditton Goods rail line crossing, it will be necessary to divert or culvert the existing watercourse. Since the embankment and abutments will be constructed in the flood plain, consent will be required from the EA for the resulting loss of storage volume and measures will be required during construction to mitigate the risk of flooding of the works during the highest spring tides. The expected ground conditions are likely to require piling of both the bridge supports and the reinforced soil embankments

1.10.4.2 Clearance Beneath Electricity Lines

The clearance requirement beneath the existing electricity lines that run across the site is likely to form a severe constraint on any alignment at this location. To mitigate the risk of having to construct around live electrical lines and achieving suitable clearance, it is expected that these lines will need to be diverted which is likely to have a significant impact on cost.

1.10.4.3 Ditton Goods Rail Line

As the proposed alignment crosses over the Ditton Goods Rail line, it will be necessary to obtain a possession on the line for any structural works carried out within the track exclusion zone. It is expected that the bridge foundations and abutments would be constructed outside the track exclusion zone with the superstructure beams erected during the course of "Rules of the Route" possessions. The same type of possessions will be required for installation of the permanent formwork and concreting of the deck.

1.10.5 Bridge Proposal

The bridge options presented below are provided as a robust feasible solutions for development at outline and detailed design. The span arrangements have not been fully optimised and hence revised span lengths and numbers may prove to be more economic or quicker to construct.

1.10.5.1 Review of Potential Crossing Locations

The current proposed alignment has not been finalised and it is possible that the location of the crossing may vary by up to 50m either side of the current location. Since the River Mersey has a variable channel width at this location, the span lengths required for this structure would vary if a different crossing point is chosen at a later stage.

1.10.5.2 Review of Proposed Span Arrangements

The width of the River Mersey at the proposed crossing location is approximately 140m. It may be possible to cross the River Mersey using a single clear span, however it is likely to be more prudent to utilise 3 spans with two piers constructed between the flood embankments on flood plain at or below Mean High Water Springs level.

Span optimisation would be carried out prior to detailed design stage, however, based on reasonable lengths of girder for road transport and the span arrangement adopted for the nearby Thelwall Viaduct, it is expected that 6 spans with span lengths of 40m, 55m, 55m, 70m, 55m and 40m will be required for the River Mersey crossing, and a single 40m span to cross the St Helens Canal and Ditton Goods / Arpley Rail Line.

For the River Mersey crossing, shorter spans would reduce the cost of superstructure steelwork, but this is likely to be more than offset by the increased cost of construction of more piled foundations, particularly if this required piling within the normal tidal range.

To achieve the required clearance over the St Helens Canal and Ditton Goods Rail Line, a single span of approximately 40m is required. For this crossing, a dual span structure was not considered feasible as there is insufficient clearance for an intermediate pier between the railway line and canal.

Between the Ditton Goods rail line crossing and the River Mersey crossing, it is proposed that the alignment is carried on a reinforced soil embankment. Additionally, reinforced soil embankments will be required for the approaches to both crossings. It is expected that the overall length of piled reinforced earthworks that are required will be approximately 400m.

1.10.5.3 Construction Type

Due to the typical span lengths (50-70m) involved, it is believed that a steel composite structure with a reinforced concrete deck is the most suitable construction type for the River Mersey crossing. This is likely to comprise 4No. constant depth plate girders for the approach spans with haunched girders at the piers of the 70m span. Alternative construction forms, such as segmental precast or balanced cantilever insitu prestressed concrete could give reductions in deck cost but would give higher foundation costs.

To cross the St Helens Canal and Ditton Goods / Arpley Rail line, it is believed that an integral steel composite structure with a reinforced concrete deck and reinforced earthwork approach embankments is the most suitable construction type. This would likely comprise 4No. constant depth steel plate girders.

Alternatively, it may be possible to utilise a reinforced concrete structure for this crossing. Due to the span lengths involved, this is likely to comprise prestressed W concrete deck beams with an in-situ reinforced concrete deck on top.

1.10.6 River Mersey Crossing Proposal – Steel Composite with 4No. Steel Plate Girders Haunched at River Mersey Piers

1.10.6.1 Indicative Sizes for Scheme 2 Cost Appraisal

For the purposes of the Scheme 2 cost appraisal, the parameters in Table 21 can be assumed for this structure. At this stage in the design process it is only possible to provide indicative quantities based upon the high-level design work carried out thus far. The values presented below are not final and will change during the subsequent design phases as more information becomes available.

Construction Type	Steel Composite with 4No. Constant Depth Steel Plate Girders (Haunched Plate Girders for River Mersey Span)
Total Bridge Length	315m
Number of Spans	6
Span Lengths	40m, 55m, 55m, 70m, 55m, 40m
Member Sizes	<u>River Mersey Span - Haunched Pier Girder</u> Top Flange – 650mm x 45mm Web – 30mm x 4090mm Bottom Flange – 800mm x 65mm <u>River Mersey Span - Span Girder</u> Top Flange – 600mm x 40mm Web – 25mm x 2515mm Bottom Flange – 650mm x 45mm <u>Approach Spans - Pier Girder</u> Top Flange – 500mm x 45mm Web – 30mm x 2500mm Bottom Flange – 800mm x 55mm <u>Approach Spans - Span Girder</u> Top Flange – 500mm x 35mm Web – 25mm x 2530mm Bottom Flange – 600mm x 45mm
Number of Piers	5
Pier Dimensions	2 No. Reinforced Concrete Leaf Piers for River Mersey Span:

	2.5m Thickness x 14.0m Width x 12.3m Height 2.5m Thickness x 14.0m Width x 12.3m Height 3 No. Piers comprising 2No. RC Columns: 2.0m Radius x 9.0m Height 2.0m Radius x 9.5m Height 2.0m Radius x 7.0m Height
Total Reinforced Earthwork Lengths	Approximately 400m
Deck Width	15.0m
Deck Thickness	<u>River Mersey Span</u> 250mm Reinforced Concrete Deck 4200mm Plate Girder Depth at Haunches 2600mm Plate Girder Depth across Span <u>Approach Span</u> 250mm Reinforced Concrete Deck 2600mm Constant Plate Girder Depth
Foundation Type	Each pier to comprise pile group foundations
Indicative Foundation Sizes	Approach span foundations to comprise 12No. 900mm diameter bored piles of length 20-25m supporting 7m x 11m x 1.8m pile caps 70m Mersey span foundations to comprise 18No. 900mm diameter bored piles of length 20-25m supporting 8m x 15m x 2.0m pile caps.

Table 21 - West River Mersey Crossing Indicative Sizes

1.10.7 Ditton Goods Line Option 1 – Steel Composite with 4No. Constant Depth Steel Plate Girders

1.10.7.1 Indicative Sizes for Scheme 2 Cost Appraisal

For the purposes of the Scheme 2 cost appraisal, the parameters in Table 22 can be assumed for this structure. At this stage in the design process it is only possible to provide indicative quantities based upon the high-level design work carried out thus far. The values presented below are not final and will change during the subsequent design phases as more information becomes available.

Construction Type	Steel Composite – 4No. Plate Girders
Total Bridge Length	40.0m
Number of Spans	1
Span Lengths	40.0m
Member Sizes	Top Flange – 650mm x 40mm Web – 25mm x 1910mm Bottom Flange – 800mm x 50mm
Number of Piers	0
Pier Dimensions	N/A
Total Reinforced Earthwork Lengths	Included in River Mersey Crossing Lengths
Deck Width	15.0m
Deck Thickness	250mm Reinforced Concrete Deck 2000mm Constant Plate Girder Depth
Foundation Type	12m x 3m x 9m high abutment walls on Piled Foundations
Indicative Foundation Sizes	12No. 20-25m long 900mm diameter piles per 15m x 4m x 1.5m abutment pile cap

Table 22 - Ditton Goods / Arpley Rail Bridge Option 1 Indicative Sizes

1.10.8 Ditton Goods Line Option 2 – Integral Concrete Deck Beams – 4No. W-Beams

1.10.8.1 Indicative Sizes for Scheme 2 Cost Appraisal

For the purposes of the Scheme 2 cost appraisal, the parameters in Table 23 can be assumed for this structure. At this stage in the design process it is only possible to provide indicative quantities based upon the high-level design work carried out thus far. The values presented below are not final and will change during the subsequent design phases as more information becomes available.

Construction Type	Reinforced Concrete – 4No. W-Beams
Total Bridge Length	40.0m
Number of Spans	1
Span Lengths	40.0m
Member Sizes	4No. W19 Beams 2300mm Depth
Number of Piers	0
Pier Dimensions	N/A
Total Reinforced Earthwork Lengths	Included in River Mersey Crossing Lengths
Deck Width	15.0m
Deck Thickness	200mm
Approximate Steel Tonnage	Concrete Structure
Foundation Type	14m x 3m x 9m high abutment walls on Piled Foundations
Indicative Foundation Sizes	14No. 20-25m long 900mm diameter piles per 18m x 4m x 1.5m abutment pile cap

Table 23 - Ditton Goods / Arpley Rail Bridge Option 2 Indicative Sizes

1.11 East River Mersey Crossing

1.11.1 Introduction

The East Mersey Crossing is required for the Pink and Green routes in the route option plan. The proposed alignment for this structure is shown in Figure 18 below:

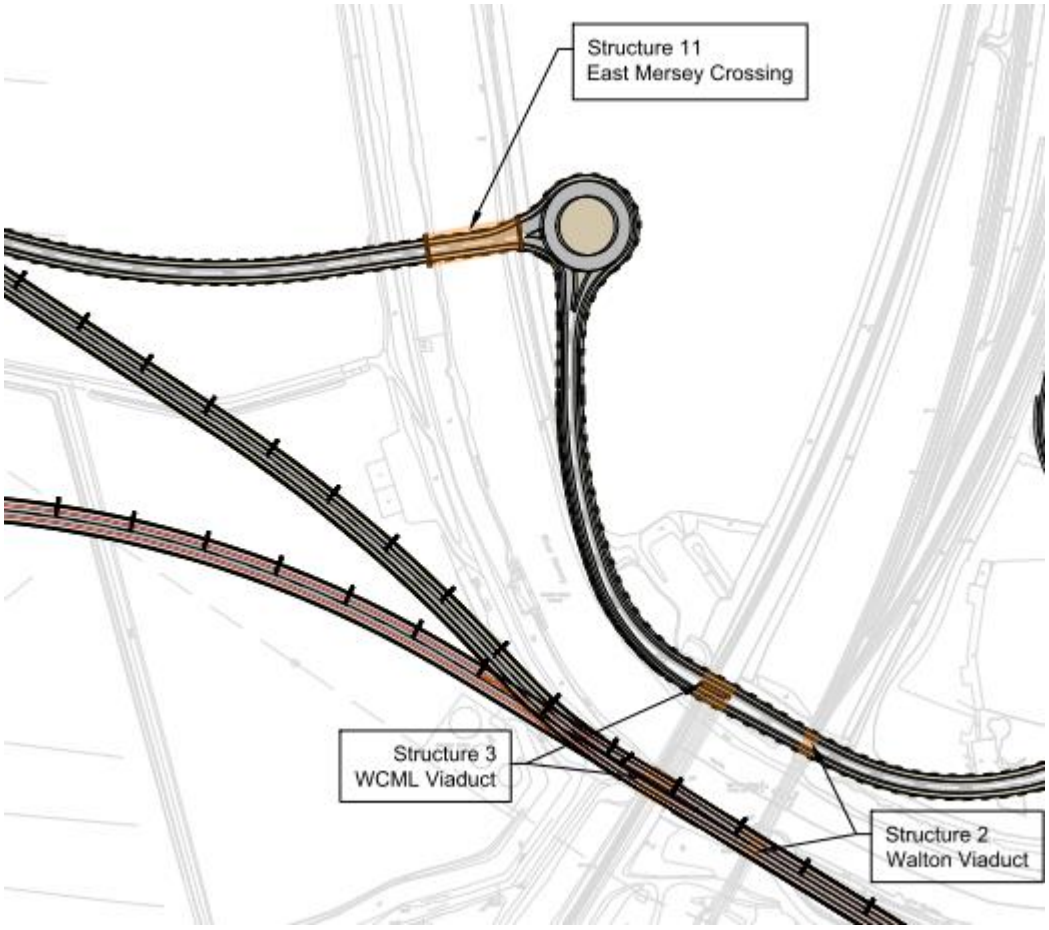

Figure 18 - East River Mersey Crossing Location Plan

The bridge crosses the River Mersey approximately 200m downstream of the West Coast Main Line Rail viaduct. The southern approach to the structure follows the north bank of the Mersey under the West Coast Main Line and Walton viaducts and connects with the proposed Centre Park Link and Chester Road.

1.11.2 Data

Bridge Ref	11
Routes Comprised	Pink and Green
OS Ref	SJ 59671 86850
Status	New Overbridge

Spans	River Mersey
Skew	0º
Minimum Soffit Level	Assumed 10.54mAOD matching Chester Road New Bridge (To be confirmed by Peel Ports)

Table 24 - East River Mersey Crossing Data

1.11.3 Site Appraisal

1.11.3.1 Site Overview

The topography of the site on both banks of the River Mersey typically comprises open undeveloped arable farmland. An existing single track highway Eastford Road runs across the site on the south bank of the river providing access to industrial works situated to the west of the site.

1.11.3.2 Ground Conditions

Maps available from the British Geological Survey show that superficial deposits at the site should be Tidal Flat Deposits comprising clay, silt and sand overlying Helsby Sandstone Formation which is part of the Sherwood Sandstone Group. From the available BGS boreholes in the vicinity of the structure, the ground conditions typically comprise a layer of soft alluvial clay overlying sands and gravels. Bore holes at the West Coast Main Line viaduct indicate rock-head at around -3.5m AOD to -5.0m AOD, suggesting that piled foundations socketed into the sandstone bedrock will be required.

1.11.3.3 Clearances

The clearance requirement for a crossing at this location is not currently known and will be determined at the next stage following consultation with the various relevant bodies should the crossing be adopted. For the purposes of Stage 2a assessment, the minimum soffit level has been taken as equal to that of the existing Chester Road Fixed bridge situated several hundred meters upstream. This soffit level is approximately 10.54mAOD and would be required over a clear width of about 46m.

1.11.4 Implications of Site Constraints

1.11.4.1 Eastford Road Junction

The proposed crossing will be required to tie in with the existing Eastford Road as the road currently provides vital access to the industrial works situated to the west of the site. It is expected that this will necessitate significant highway works including the construction of new roundabouts on both banks. The width of the flood plain at 1:200 year flood level is approximately 76m. It is possible that the Environment Agency could require maintenance of the same water way area, which would require either a long single span or a more moderate span over the navigation channel with flood relief spans to make up the required area. The base price should allow for this, but since flood levels are driven by tide rather than river flows, it may be possible to demonstrate that a reduced water way area would reduce upstream water levels, providing a flood alleviation benefit. This would provide an opportunity to reduce cost by omitting the flood relief culverts.

1.11.5 Bridge Proposal - Integral Steel Composite with 4No. Plate Girders

The bridge proposal presented below is provided as a robust feasible solution for consideration in a future detailed design. Other feasible structural forms and span arrangements exist and advantages may become apparent when full ground investigation data is available.

1.11.5.1 Construction Type

For the proposed span arrangement listed above, it is proposed that an integral steel composite structure is used with a reinforced concrete deck. This is likely to comprise 4No. constant depth plate girders.

1.11.5.2 Review of Potential Crossing Locations

The current proposed alignment has not been finalised and it is possible that the location of the crossing may vary by up to 20m south east of the location shown in Figure 18. As the width of the River Mersey is fairly constant at the proposed crossing location, it is not expected that altering the location of the crossing will have a significant impact on the required span lengths.

1.11.5.3 Review of Proposed Span Arrangements

The clear span over the River Mersey is approximately 50m. It is proposed that a 62m single span crossing is adopted with abutments set at the top of the river banks similar to the proposed Chester Road crossing.

1.11.5.4 Indicative Sizes for Scheme 2 Cost Appraisal

For the purposes of the Scheme 2 cost appraisal, the parameters in Table 25 can be assumed for this structure. At this stage in the design process it is only possible to provide indicative quantities based upon the high-level design work carried out thus far. The values presented below are not final and will change during the subsequent design phases as more information becomes available.

Construction Type	Steel Composite – 4No. Constant Depth Plate Girders
Total Bridge Length	62m
Number of Spans	1
Span Lengths	62m
Main Girder Sizes	Top Flange – 900mm x 55mm Web – 30mm x 2880mm Bottom Flange – 1000mm x 65mm
Number of Piers	0
Pier Dimensions	N/A
Total Reinforced Earthwork Lengths	Approx. 40m supported on precast concrete driven piles
Deck Width	15.0m
Deck Thickness	250mm Reinforced Concrete Deck 3000mm Steel Plate Girder

Approximate Steel Tonnage	510 tonnes structural steel, 60 tonnes permanent steel pile casings
Foundation Type	12 No 900mm diameter steel cased bored piles at each end socketed into end beams. Casings 15-20m long Bored piles 20-25m long
Indicative Foundation Sizes	Integral 3m deep 14m wide by 4m high reinforced concrete end beams.

Table 25 - East River Mersey Crossing Indicative Sizes

1.12 Centre Park Link Chester Road Bridge

1.12.1 Introduction

Centre Park Link Chester Road Bridge is currently under development by Balfour Beatty for Warrington Borough Council and comprises a new single span structure over the River Mersey. The proposed structure over the River Mersey is required for the Pink and Green routes in the route option plan. As the number of lanes required to facilitate the Chester Road junction for Western Link is greater than those currently proposed for the Centre Park Link scheme, it will be necessary to widen the proposed bridge deck from 16.95m currently to 26.93m to accommodate the additional lanes. The proposed alignment for this structure is shown in Figure 19 below:

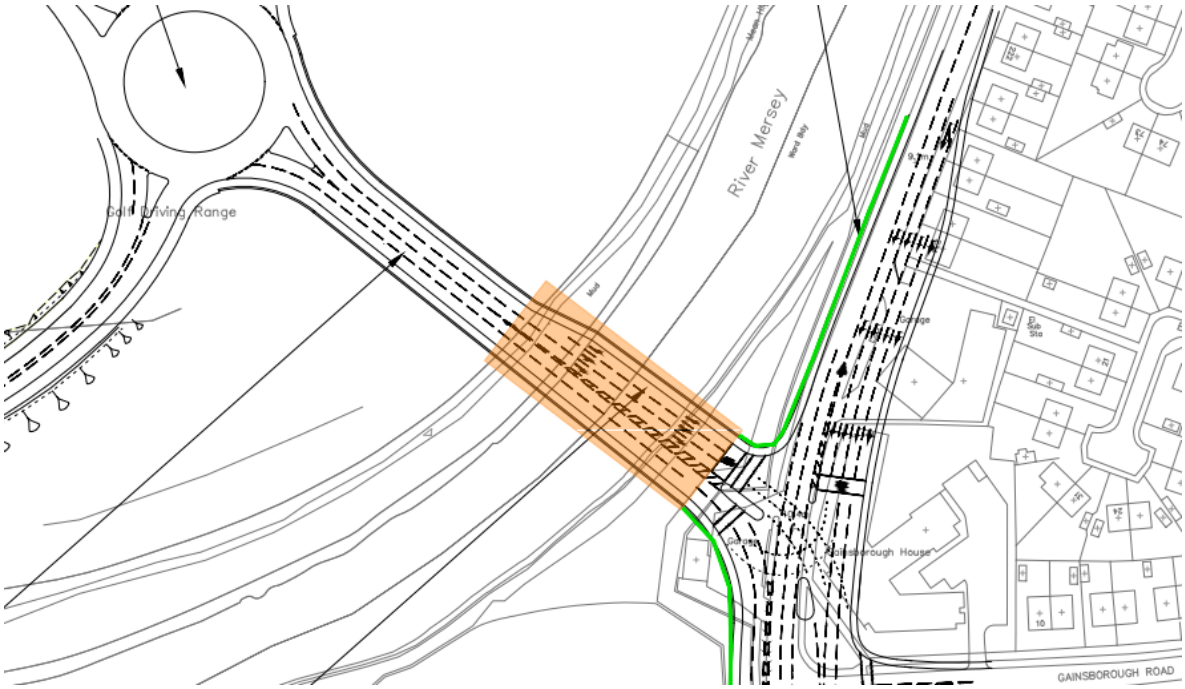

Figure 19 - Centre Park Link Location Plan

The bridge crosses the River Mersey west of Gainsborough Road, approximately 400m upstream of Walton Viaduct.

1.12.2 Data

Bridge Ref	12
Routes Comprised	Pink and Green
OS Ref	SJ 60265 86598
Status	New Overbridge (Widening of currently proposed structure)
Spans	River Mersey
Skew	0º

Minimum Soffit Level	8.664mAOD

Table 26 - Centre Park Link Data

1.12.3 Existing Structure Proposal

1.12.3.1 Overview

The existing proposal for Centre Park Link Chester Road Bridge is an integral single span structure. The superstructure comprises constant depth steel longitudinal girders acting compositely with a transverse spanning reinforced concrete deck slab supporting the highway. The substructure comprises piled foundations supporting a reinforced concrete abutment. The approach embankment is a reinforced earth structure which is to be incorporated into the bridge abutment.

1.12.3.2 Clearances

The proposed soffit level for this structure would not change as a result of the widening scheme and would remain at 8.664m.

1.12.4 Site Appraisal

1.12.4.1 Site Overview

The topography of the site on both banks of the River Mersey typically comprises light vegetation. On the northern side of the River Mersey is a golf driving range with a row of trees situated in front. On the southern side of the River Mersey, is Gainsborough House Healthcare centre and Chester Road Service Station. In order to facilitate the new junction as part of the Western Link scheme it will be necessary to obtain both plots with a compulsory purchase order.

1.12.4.2 Ground Conditions

Maps available from the British Geological Survey show that superficial deposits at the site should be Tidal Flat Deposits comprising clay, silt and sand overlying Helsby Sandstone Formation which is part of the Sherwood Sandstone Group. The existing design for the centre park link Chester Road bridge indicates that a single row of 900mm diameter 14m long piles will be used to support each abutment. For the proposed widening, it is simply proposed that the row of piles is continued to accommodate the increased width of abutment.

1.12.5 Bridge Proposal – Steel Composite – 10No. Plate Girders (Previously 6No.)

The bridge proposal presented below is provided as a robust feasible solution for consideration in a future detailed design. Other feasible structural forms and span arrangements exist and advantages may become apparent when full ground investigation data is available.

1.12.5.1 Construction Type

The proposed construction type for this structure would not change as a result of widening scheme and would remain as an integral steel composite structure with a reinforced concrete deck.

To facilitate the additional lanes the structure is required to carry, it is proposed to widen the existing proposed structure width from 16.95m to 26.93m. This will be provided by extending the width of the abutment and pile foundations to 27m. Two additional plate girders would then be constructed at 3m centres either side of the current abutment and the deck reconfigured to provide 5No. 3.65m wide lanes, a 2.68m maximum central reservation and a 2.5m wide combined footpath / cycleway either side of the carriageway.

1.12.5.2 Review of Proposed Span Arrangements

The proposed span arrangement for this structure would not change as a result of widening scheme and would remain as a single 45m clear span over the River Mersey with a 14m long southern approach and 24m long northern approach carried on reinforced earth.

1.12.5.3 Indicative Sizes for Scheme 2 Cost Appraisal

For the purposes of the Scheme 2 cost appraisal, the parameters in Table 27 can be assumed for this structure. At this stage in the design process it is only possible to provide indicative quantities based upon the high-level design work carried out thus far. The values presented below are not final and will change during the subsequent design phases as more information becomes available if going forward this structure comprises the preferred route.

Construction Type	Steel Composite – 10No. Constant Depth Plate Girder (Previously 6No. Girders)
Total Bridge Length	45m
Number of Spans	1
Span Lengths	45m
Main Girder Sizes	As per previous design
Number of Piers	0
Pier Dimensions	N/A
Total Reinforced Earthwork Lengths	Approx. 38m
Deck Width	Proposed - 26.93m
Deck Thickness	250mm Reinforced Concrete Deck 1900mm Steel Plate Girder
Foundation Type	900mm diameter bored piles at each end socketed into end beams. Bored piles approx. 14m long

Table 27 - Centre Park Link Indicative Sizes

1.13 Chester Road Fixed Bridge

1.13.1 Introduction

Chester Road Fixed Bridge is an existing highway structure that spans over a disused navigation channel that formerly linked the River Mersey with the Manchester Ship Canal. The proposed Pink and Green routes both utilise this structure; however, as the number of lanes required to facilitate the Chester Road junction for Western Link is greater than those currently accommodated by the structure, it will be necessary to widen the existing bridge deck from 12.8m to 27.3m to accommodate the additional lanes. The proposed alignment for this structure is shown in Figure 20 below:

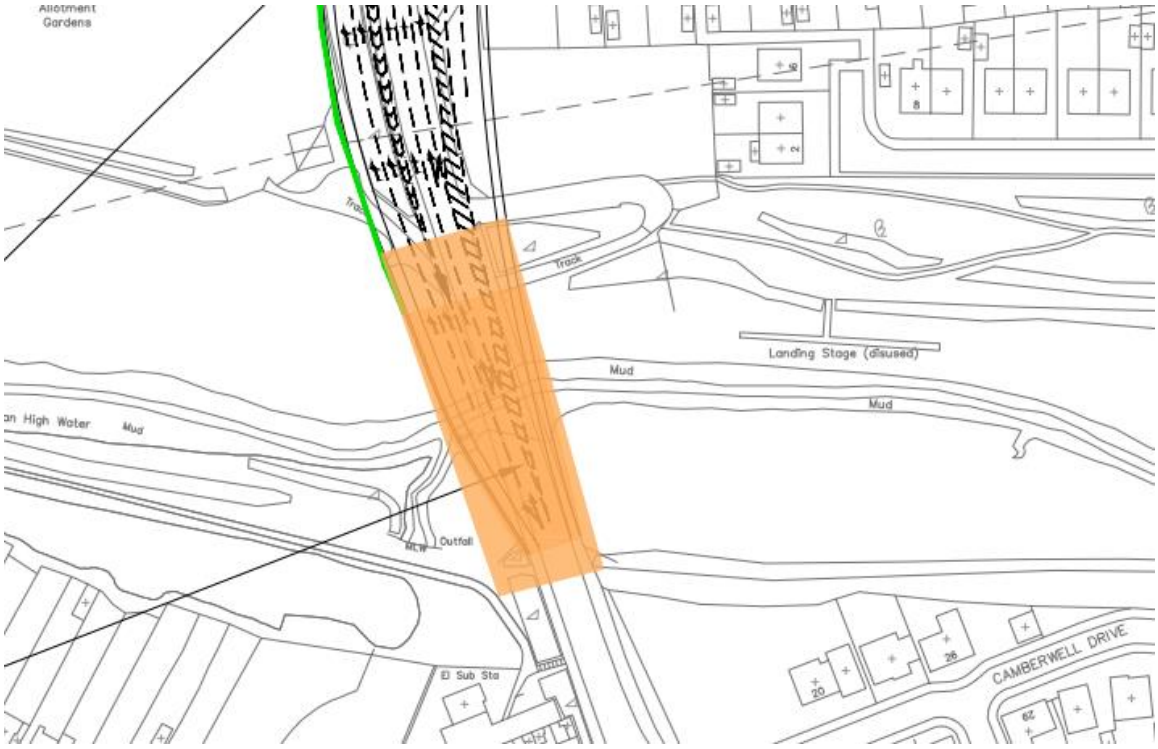

Figure 20 - Chester Road Fixed Bridge Location Plan

1.13.2 Data

Bridge Ref	13
Routes Comprised	Pink and Green
OS Ref	SJ 60265 86598
Status	Existing Overbridge (Widening of existing structure)
Spans	Disused navigation channel that formerly linked the River Mersey with the Manchester Ship Canal
Skew	20º
Minimum Soffit Level	10.54mAOD

Table 28 - Chester Road Fixed Bridge Data

1.13.3 Existing Structure Proposal

1.13.3.1 Overview

The existing Chester Road Fixed Bridge is a 3-span composite steel structure comprising 4No. Universal I-Beams encased in concrete and a reinforced concrete deck. The structure has two piers situated within the navigation channel and has a main span approximately 27.3m in length and two side spans both approximately 15.8m in length. The deck comprises a 2-lane carriageway of width 7.92m with a 2.44m footpath on either side of the carriageway. The bridge foundations comprise pile foundations.

1.13.3.2 Clearances

The proposed soffit level for this structure would not change as a result of widening scheme and would remain at 10.54m.

1.13.4 Site Appraisal

1.13.4.1 Ground Conditions

Maps available from the British Geological Survey show that superficial deposits at the site should be Tidal Flat Deposits comprising clay, silt and sand overlying Helsby Sandstone Formation which is part of the Sherwood Sandstone Group. The existing structure is supported on pile foundations. For the proposed widening, it is proposed that the widened abutments are supported on 600mm diameter piles.

1.13.5 Bridge Proposal – Steel Composite with 12No. Universal Beams (Previously 4No.)

The bridge proposal presented below is provided as a robust feasible solution for consideration in a future detailed design. Other feasible structural forms and span arrangements exist and advantages may become apparent when full ground investigation data is available.

1.13.5.1 Construction Type

The proposed construction type for this structure would not change as a result of the widening scheme and would remain as a steel composite structure with reinforced concrete deck.

To facilitate the additional lanes the structure is required to carry, it is proposed to widen the existing proposed structure width from 12.8m to 27.3m. This will be provided by extending the width of the abutment and pile foundations from 10.67m to 27m. It is proposed that the eastern portion of the widened deck is supported on three additional universal beams at 2500mm centres. It is proposed that the western portion of the deck is supported on five additional universal beams at 2350mm centres.

1.13.5.2 Review of Proposed Span Arrangements

The proposed span arrangement for this structure would not change as a result of widening scheme and would remain as a 27.3m clear span over the River Mersey with 15.8m long side spans and reinforced earthwork embankments forming the southern and northern approaches.

1.13.5.3 Indicative Sizes for Scheme 2 Cost Appraisal

For the purposes of the Scheme 2 cost appraisal, the parameters in Table 29 can be assumed for this structure. At this stage in the design process it is only possible to provide indicative quantities based upon the high-level design work carried out thus far. The values presented below are not final and will change during the subsequent design phases as more information becomes available if going forward this structure comprises the preferred route.

Construction Type	Steel Composite – 12No. Steel UB Girder (Previously 4No. Girders)
Total Bridge Length	57.9m
Number of Spans	3
Span Lengths	15.8m, 27.3m, 15.8m
Main Girder Sizes	4 Existing Girder comprise UB 838x292x226 encased in concrete 8 New Girders to comprise UB 914x305x253 not encased.
Number of Piers	2
Pier Dimensions	Existing - 10.67m x 1.7m Proposed - 25m x 1.7m
Deck Width	Existing – 12.8m Proposed – 27.3m
Deck Thickness	Approx. 227mm thick Reinforced Concrete Deck Existing – 850.9mm high UB 838x292x226 New – 918.4mm high UB 914x305x253
Foundation Type	For each pier and abutment; 12No. Additional 600mm bored RC piles approx. 10-15m long.

Table 29 - Chester Road Fixed Bridge Indicative Sizes

Appendix A - Drawings

- 382900-MMD-07-XX-CD-S-0009
- 382900-MMD-07-XX-CD-S-0100
- 382900-MMD-07-XX-CD-S-0200
- 382900-MMD-07-XX-CD-S-0201
- 382900-MMD-07-XX-CD-S-0202
- 382900-MMD-07-XX-CD-S-0203
- 382900-MMD-07-XX-CD-S-0204
- 382900-MMD-07-XX-CD-S-0205
- 382900-MMD-07-XX-CD-S-0300
- 382900-MMD-07-XX-CD-S-0400
- 382900-MMD-07-XX-CD-S-0401
- 382900-MMD-07-XX-CD-S-0500
- 382900-MMD-07-XX-CD-S-0501
- 382900-MMD-07-XX-CD-S-0600
- 382900-MMD-07-XX-CD-S-0601
- 382900-MMD-07-XX-CD-S-0700
- 382900-MMD-07-XX-CD-S-0800
- 382900-MMD-07-XX-CD-S-0900
- 382900-MMD-07-XX-CD-S-0901
- 382900-MMD-07-XX-CD-S-1000
- 382900-MMD-07-XX-CD-S-1001
- 382900-MMD-07-XX-CD-S-1100
- 382900-MMD-07-XX-CD-S-1200
- 382900-MMD-07-XX-CD-S-1201
- 382900-MMD-07-XX-CD-S-1300
- 382900-MMD-07-XX-CD-S-1301

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