MOTT MACDONALD

Western Link Warrington

Stage 2 - Outline Drainage Strategy

October 2017

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Contents

Executive summary

Drainage for each of the six route options is feasible.

Sections of carriageway passing beneath the railway viaduct are assumed to require pumped drainage. The drainage lies at or below river tidal trough level. Flood protection walls will be required in these areas.

Sections of carriageway on the Yellow route lie on the Arpley landfill site and within an area subject to flooding. The carriageway lies above the 200 year flood level but it may be preferable to raise the carriageway slightly to aid the provision of a gravity drainage system.

Sections of carriageway on the Orange, Red, Purple, Pink and Green routes cross the area north of Gatewarth Treatment works. This is shown to flood on Environment Agency flood mapping.

The area appears to be protected by flood bunds but these are potentially, subject to a breach according to the JBA report (Warrington Waterfront Strategic Site Flood Risk Assessment). We have assumed that the area will flood but that no compensatory storage would be required.

Details of the proposed drainage systems are shown on drawing No 382900-MMD-07-XX-CD-D-1024 (Issued as a separate document).

No detailed agreements with Environment Agency or with Warrington Borough Council have yet been finalised in respect of drainage design parameters and the effects on rivers or watercourses. This shall be progressed in the design process for the preferred route.

1 Introduction

1.1 General

As part of the ongoing options review for the Western Link Scheme, the options examined at Stage 1 have now been reduced. Further detail of the Stage 1 drainage strategy can be found within the 'Stage 1 – Drainage Strategy Report' (Ref: WL-MMD-07-XX-RP-D-0002). In Stage 2, six route options proceeded for further analysis (See Figure 1).

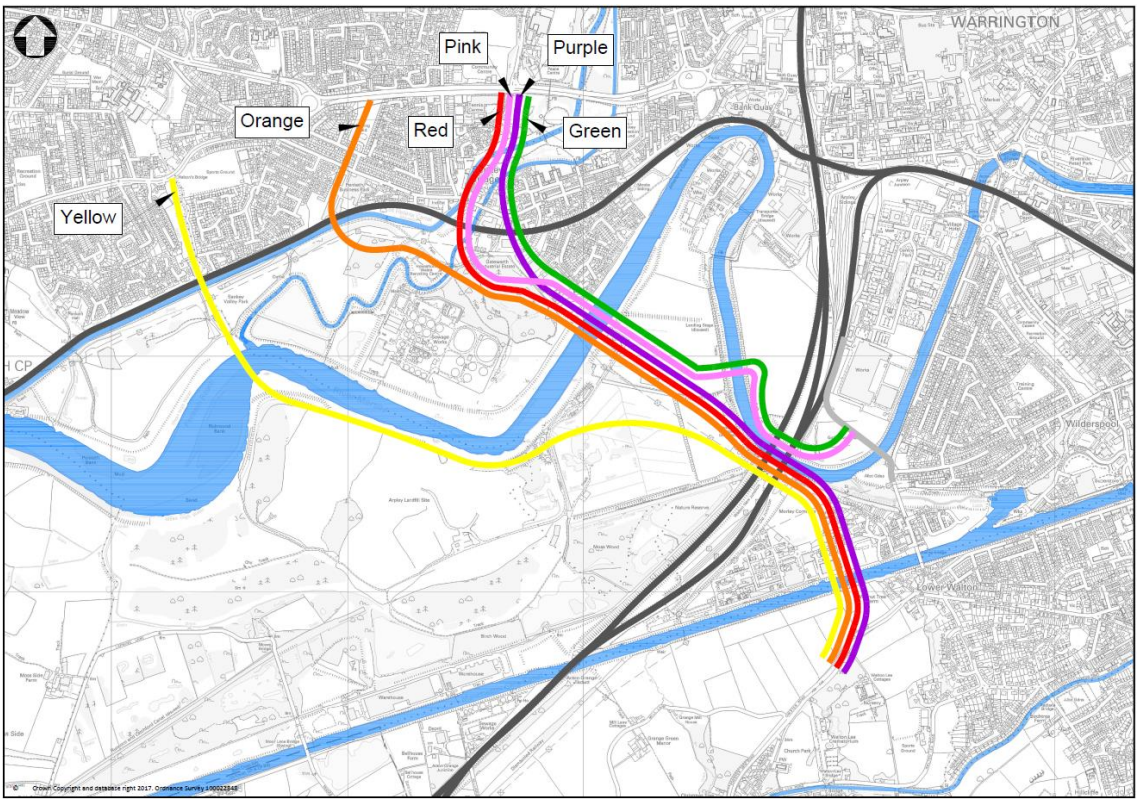

Figure 1: Stage 2 Route Options

The main aim for this report is to determine a drainage strategy for each of the six route options. This report shall also highlight the feasibility of proposed drainage strategies. The six routes reviewed within this report are referred to as:

- The Yellow Route
- The Orange Route
- The Red Route
- The Purple Route
- The Pink Route
- The Green Route

The nature of each route option is described within Section 2 as is the approach to drainage. Flood risk is also briefly discussed but this would be examined in more detail in the project specific Flood Risk Assessment (FRA) to be produced.

The drainage strategy features mentioned within this report are shown in Appendix A.

1.2 Future Design Criteria

No detailed parameters have yet been agreed but those which would be discussed will refer to/take account of the criteria used for the Centre Park Link Road (in the same vicinity). The criteria adopted for that Scheme are set down within the “Centre Park Link Road Drainage Strategy” prepared by Ramboll in August 2016.

The road will be designed to ensure no flooding from a 30year rainfall event plus climate change considering a river trough level of 3.4m AOD and a river tidal peak of 6.7m. (From the Ramboll Strategy). A combination of a 1 in 30-year return on the road would be tested against a 2 year tidal level (6.6m AOD or 6.7 in accord with the above) as an initial conservative approach

The general outfall level will be above the tidal trough level (set at 4m or above) and if practicable may be above the 2- year peak tide level (6.6m approx.). Setting the discharge at this higher level to provide (subject to agreement) a semi free discharge may allow reduced or no storage.

For any outfall set at 4.0m an overflow would be provided at a high level (above river tidal peak return to be agreed) accompanied by storage. For this report, (as free discharges have not yet been agreed) attenuation back to green field flow has been assumed. At more detailed design stages storage will be modelled and hopefully reduced.

In low areas of the carriageway (passing beneath the railway viaducts) a pumped section of carriageway drainage will be required.

It will be assumed that a constant rather than varying water level is present when drainage modelling is carried out.

2 Route Options – Drainage Approach

This section outlines the proposed drainage strategy for six of the route options under consideration. It must be mentioned that several of the route options share sections of carriageway. At this stage, it is assumed these sections would have the same drainage strategy. The drainage features described for each route option are shown in Appendix A.

2.1 The Yellow Route

2.1.1 Chainage 0.00 to 400.00 – A56 Chester Road to Manchester Ship Canal (MSC) bridge High Point

Approximately 120m lies on embankment (reinforced earth) with the remainder being on structure. The alignment falls toward Chester Road at gradients ranging from 1 in 80 to 1 in 20. The section of carriageway on structure would be drained by Kerbdrain. These would discharge to a carrier pipe suspended beneath the viaduct or within the embankment.

The section on embankment would be drained by gullies at approximately 15m spacing.

The outfall for this section is envisaged as being to the MSC as the existing ground falls toward that feature (as shown on drainage features plan). An alternative option is connecting to the existing highway drainage system serving A56 Chester Road. The former assumes that permissions can be obtained and the latter assumes that some capacity is available in the existing highway drainage or public sewers.

A headwall possibly pre-cast would be needed at the outfall.

In both cases it is anticipated that flow would be restricted to green field flow (5 l/sec). and that storage in the form of modular tanks would be provided with an approximate volume of 800 cu m

Pipe sizes vary between 225mm and 375mm with manholes of 1200mm and 1800mm at the outfall (hydrobrake manhole restricting discharges to 5 l/sec if required).

An interceptor of nominal size NSB 18 would be required.

2.1.2 Chainage 400.00 to Chainage 830.00 (Low point for discharge)

This section mainly lies on structure and on reinforced earth embankments. The intention is to discharge at approximately chainage 830.00 above the 2 year tidal river level of 6.6m. This may be refined during more detailed design phases. Storage of approximately 600 cu m in modular units would be needed

Drainage of the structure would be by Kerbdrain and carrier pipe as above with the carrier pipe continuing beneath the reinforced earth embankment. Cover of approximately 1.2m would be maintained for pipes varying in diameter meter from 225mm to 300mm. Manholes would be of 1200mm diameter with the hydrobrake manhole being 1800mm (hydrobrake to pass green field flow set at 5 l/sec). A headwall would be required (possibly precast) at the outfall.

Gullies would be provided at 15 m spacing on the reinforced earth embankment.

An interceptor of nominal size NSB 6 would be required.

2.1.3 Chainage 830.00 to 1120.00 with low point at Chainage 980

The low point of the alignment is at chainage 980 and a pumped system is proposed.

A pumped section of carriageway 320m long is assumed and based on a flat rate rainfall of 75mm/hour the peak discharge would be 96 l/sec. Pumping at this rate is feasible without storage. Kerbdrain plus a carrier drain would be provided to collect flows.

Flood protection walls would extend to at least this length and would be set at 200- year flood level (tidal) plus 300mm freeboard (approximately 7.8m). The section is susceptible to flooding under short return tidal or pluvial events.

Bearing in mind ground levels the pumping station should be sited in an area with a surface level of 7.8m to avoid inundation at extreme events (when flood protection walls plus freeboard are breached). The pumping station would remove flood flows back to the river in those circumstances.

Pipe sizes in this section would be 225mm to 300mm in trench with 1200mm diameter manholes. The rising main would be 150mm diameter extending from the pumping station to and over the flood walls discharging above the 2 year tidal event (6.6m).

An interceptor of nominal size NSB 6 would be required

2.1.4 Chainage 1120.00 to Chainage 1462.00 (High Point)

The section falls from the High point at chainage 1462.00 to discharge above the 2 year tidal level if practicable.

Pipe sizes would be 225mm to 300mm and manholes would be 1200mm diameter except for the hydrobrake manhole which would be 1800mm diameter. The hydrobrake would limit flows to 5 l/sec (green field flow) if necessary. If a free discharge was accepted no storage would be needed.

A headwall possibly pre-cast would be provided at the outfall.

Storage would be of the order of 340 cu m in modular units

Gradient varies between 1 in 150 and 1 in 20 and gully spacing would be of the order of 15m would be used.

An interceptor class NSB 6 would be required.

2.1.5 Chainage 1462.00 to Chainage 2027.00 (Low Point) to Chainage 2140 (High Point)

The section gradient remains constant at approximately 1 in 150 from chainage 1462.00 to chainage 2140.00 and from chainage 2140.00 to the low point the gradient increases to 1 in 47 and traditional gullies at 15 m spacing could be used.

Pipe sizes would be of the order of 225mm to 450mm with an outfall from the low point to the river Mersey. Road levels at the low point are of the order of 11.71 with drainage set approximately 1,5m below (to invert) a direct discharge to the Mersey should be possible. Manholes would be 1200mm diameter with the hydrobrake manhole being 1800mm. The hydrobrake would be set to discharge greenfield flow assumed at 5 l/sec.

Storage of approximately 660 cu m in modular units would be needed as would a headwall at the outfall.

Interceptors would be needed on each section with nominal sizes of NSB 8 and NSB 3 respectively.

The area appears to lie outside the flood risk extents shown on Environment Agency mapping.

2.1.6 Chainage 2140.00 (High Point) to Chainage 3067.00 (Low Point) to Chainage 3470.00 (High Point Mersey Crossing)

The carriageway falls at approximately 1 in 150 to the low point and rises at gradients ranging from 1 in 18 to 1 in 160 along the vertical curve to reach the peak at the Mersey Crossing.

A Kerbdrain solution is suggested for the section on structure with gullies at 15m spacing being provided on the bridge approaches.

Manholes would be 1200mm diameter with a hydrobrake manhole of 1800mm.

Storage would be of the order of 1100 cu m in modular units. A headwall would be required at the outfall.

Interceptors would be required of nominal size NSB 15 and NSB 6.

The low point on this section of drainage network is at approximately 6.5m, just below the two-year level. This point lies close to the river bank and a gravity outfall is proposed.

It may be prudent to lift the carriageway to raise the drainage above two- year flood levels. This would aid drainage and avoid, as far as is practicable, excavation within the landfill area. Further investigation of flood extents but this would need further investigation and modelling. This may show that raising the carriageway can be avoided

This length of carriageway is shown to lie within an area of high flood risk and whilst the carriageway lies above the 200-year flood level (tidal) The embankments/carriageway may interfere with flood storage capability within the area.

The matter of compensatory storage would need further discussion with Environment Agency.

2.1.7 Chainage 3470.00 (High Point) to Chainage 4108.00 (Low Point) to Chainage 4246.00 (High Point),

The section falls at a gradient varying between 1 in 160 and 1 in 25 to the low point and rises at 1 in 94 to the high point (lies within the Whittle Brook corridor).

It crosses the Mersey, Sankey Brook, the St Helens Canal and the railway at high level. Before falling to meet existing ground level adjacent to Whittle Brook.

The Whittle Brook corridor is shown to lie within an area designated as medium to high risk of flooding.

Design of embankments within the corridor would need discussion with Environment Agency as the brook is designated Main River. Discharges to the brook will require their agreement.

Compensation storage may be required in this section.

Drainage would consist of gullies at 15m spacing plus carrier drains varying in size from 225mm to 375mmand carrier pipes.

Drainage would outfall to Whittle Brook and 750 cu m of storage in modular units would be required. A headwall would be required at the outfall.

Manholes would be 1200mm diameter with an 1800mm diameter manhole at the outfall accommodating a hydrobrake set to green field flow (assumed 5 l/sec).

Interceptors of nominal size NSB10 and NSB 3 would be required.

2.1.8 Chainage 4246.00 (High Point) to Chainage 4325.00 (Penketh Road)

This short section of carriageway falls from the high point to meet Penketh Road at grade.

It is assumed that drainage from this point would outfall to Whittle Brook and agreements with Environment Agency will be needed with respect to discharge limits and any compensatory storage needed.

Pipe sizes would be of the order of 225mm and storage of 100 cu m would be required as would a headwall at the outfall. Gullies at 15m spacing would be used.

Manhole diameter would be as for previous sections.

An interceptor of nominal size NSB 8 an allowance for additional area at the junction has been included when sizing the interceptor.

2.1.9 The Proposed Junction at Penketh Road

No assessment of drainage needs has yet been carried out it is assumed that traditional gullies at say 15m spacing would be provided with outfalls to existing highway drains or to the system described above.

Storage would be needed as may interceptors.

2.2 The Orange Route

The alignment proposed is identical to that for the yellow route from chainage 0.00 to chainage 1120 (See Section 2.1).

Beyond chainage 1120 the route deviates northward from the yellow route crossing the Mersey at the Forrest way bridge location and continuing westward to cross Sankey Brook, the St Helens Canal, and the railway before turning north to meet Sankey Way.

2.2.1 Chainage 1120 (low point) to Chainage 1360 High Point

The carriageway rises in cutting reaching the high point on fill.

Pipe sizes would be 225mm to 300mm and manholes would be 1200mm diameter except for the hydrobrake manhole which would be 1800mm diameter. The hydrobrake would limit flows to 5 l/sec (green field flow) if necessary. If a free discharge was accepted no storage would be needed.

A headwall possibly pre-cast would be provided at the outfall.

Storage would be of the order of 340 cu m in modular units

Gradient varies between 1 in 25 to 1 in 75 a gully solution would be provided with spacing would of approximately 15m.

An interceptor of nominal size NSB 6 would be needed.

2.2.2 Chainage 1360.00 (High Point) to Chainage 1752.00 (low point close to the River Mersey) to Chainage 2000 High Point at Mersey Crossing

The initial section to the low point is shown as falling at a consistent gradient of 1 in 150 and a gully solution is proposed with gullies at 15m spacing combined with a carrier drain.

The second section rises at gradients varying between 1 in 75 and 1 in 20 as the carriageway rises to cross the Mersey on structure. For this section Kerbdrain is proposed along with a carrier drain on the structure gullies would be used on the approach embankments.

The outfall would be to the Mersey with a hydrobrake set to discharge green field flow (5 l/sec) and approximately 620 cu m of modular storage. A headwall would be required. A free outfall may be feasible.

Pipe sizes would vary between 225mm diameter and 375mm diameter and 1200mm diameter manholes except for the 1800mm diameter manhole containing the hydrobrake.

Interceptors of nominal size NSB 6 and NSB 4 would be needed.

The area is indicated to lie in an area outside the limits of flood risk as indicated on Environment Agency Flood Mapping for Planning.

2.2.3 Chainage 2000.00 (High Point) to Chainage 2220.00 (Limit of Gravity Drainage)

This section falls from its peak above the River Mersey to a point beyond which gravity drainage is not currently deemed feasible. The drainage low point (beyond this section is at an invert level of approximately 4.4m just above the tidal tough level). It may be practicable to provide a high-level overflow but this may be dependent on preventing backflow from the river into an area where the ground/road lies below the 200-year flood level.

Gradients in this section are between 1 in 20 and 1 in 30 but as much of it lies on structure a Kerbdrain solution is recommended with gullies on sections of embankment.

Pipe sizes would vary between 225mm diameter and 300mm diameter with 1200mm dia manholes and an 1800mm diameter manhole containing a hydrobrake. Outfall pipe would be 225mm diameter and a headwall would be needed.

An interceptor of nominal size NSB 4 would be needed.

2.2.4 Chainage 2220.00 to 2670.00 (Limits of Pumped Section)

A significant section of this route (between the Mersey and Sankey Brook is shown on Environment Agency Flood Mapping as forming part of the flood plain (Mersey To Sankey Brook approximately).

Examination of Lidar data and of Google mapping suggests that the area is protected by flood banks and these are shown in part on certain Environment Agency maps.

The Flood Risk Assessment for Warrington Waterfront contains a section which describes the potential for breaching of flood defences for Forrest Way Business Park stating “On review of these locations (potential breach locations) with Warrington Borough Council and Environment Agency that the defences protecting the Treatment Works at Forrest Way Business Park would be breached and there is a need to assess the residual risk associated with the proposed Forrest Hall Business Park identified within the Council’s SHLAA.”

As we are not aware of the results deriving from the comments for this review we have assumed that the road lies within the floodplain and that this short section of carriageway could be inundated.

It may be feasible to improve the general flood defences in the area to protect the carriageway or it may be feasible to lift the carriageway above Flood Level. (Maximum increase in level of the order of 1.5m at the low point (Chainage 2350.00).

It is considered and assumed that no flood compensatory areas would be needed but this will need to be agreed at a later design stage.

Because of the above a pumped system has been assumed.

Feeder pipes would be 225mm to 375mm and the pumping station would deliver 135 l/sec (peak flow). Three pumps would be provided for failure and redundancy each capable of dealing with the incoming peak flow. The flow values may be adjusted (reduced)and balanced by storage at later design stages.

A 150mm diameter rising main would discharge to a reception manhole close to the Mersey and a headwall would be provided on the discharge pipe (375mm dia).

Carriageway gradients in this section vary between 1 in 60 and 1 in 150 a Kerbdrain solution is proposed to assist in removing water quickly from the carriageway.

2.2.5 Chainage 2670.00 to Chainage 3160.00 (St Helens Canal)

The proposed carriageway falls from the high point (on structure) to the point at which a gravity drainage discharge is feasible. Sankey brook crossing may be on structure or may be in box culverts the details need to be agreed with Environment Agency as the vertical alignment shows little headroom above the 20 year flood level. Raising the carriageway would increase the headroom.

The outfall is envisaged as being to Sankey brook via 225mm to 450mm diameter pipes and a high-level overflow. Manholes would be as for previous sections, no storage would be provided.

Kerbdrain would be used on structure with gullies at 15m spacing elsewhere.

2.2.6 Chainage 3160.00 (St Helens Canal) to Chainage 3433.00 (Low Point) to Chainage 3757.00 (Connection to Sankey Way)

Section gradients vary between 1 in 40 and 1 in 133 and hence gullies at 15m spacing could be used for those sections off structure. Kerbdrain would be used on the structure.

Pipe sizes would vary between 225mm diameter and 375mm diameter and manholes would be as for previous sections. The hydrobrake would be set to green field flow/5 l/sec assumed.

Discharge would be to Sankey brook and the discharge limits would need agreement with Environment Agency. Interceptors of nominal size NSB 4 and NSB 6 would be required.

Outfall level would be set at /above the 2 year tidal return level if possible.

2.2.7 The proposed Junction with Sankey Way

It is assumed that traditional gullies at say 15m centres would be provided with pipes varying between 225mm and 300mm. Discharge would be to the system described above or to existing drainage within Sankey Way. Storage may be required. No assessment of drainage needs for the junction has been carried out at this stage.

2.3 Red Route

For the Red route, the alignment follows the Orange Route to an approximate chainage of 2220.00 from where it deviates curving sharply northward to meet Sankey Way at the modified Cromwell Avenue Junction.

Sections 2.2 above describe the southern section of this route and only the length beyond chainage 2220.00 is described below.

2.3.1 Chainage 2220.00 to Chainage 2450.00 Pumped Section

This section is almost identical to Section 2.2.4 excepting that the length of pumped section of carriageway is less. For this review the pumping station is assumed to be identical as are the comments regarding flood risk.

The feeder pipes would be 300mm diameter.

Manholes would be as described above with no hydrobrake manhole and a Kerbdrain collector system is suggested. This would clear standing water with more certainty than would gullies.

The rising main would be 150mm discharging to the Mersey via a reception Manhole and headwall.

2.3.2 Chainage 2450.00 to Chainage 2673.00 (High Point above Sankey Brook)

The carriageway falls from the high point to discharge above the 2 year tidal level as it affects Sankey Brook if practicable.

Gradients are of the order of 1 in 30 and gullies at 15m spacing would be used on the approaches to the structure with Kerbdrain on the structure.

225mm diameter pipes would be needed as would 190 cu m of modular storage.

An interceptor of nominal size NSB 4 would be needed as would a hydrobrake manhole limiting discharges to green field flow. A headwall would be provided at Sankey Brook.

2.3.3 Chainage 2673.00 to Chainage 2963.00 (Low Point) to Chainage 3142.00 (High Point)

The section falls from the peak of the alignment which crosses the railway to a low point before it rises to cross the St Helens Canal. Gradients are of the order of 1 in 40 on average and gullies at 15m centres would be provided on embankments whereas Kerbdrain/Beany Block would be used on the structure.

Manholes at the hydrobrake would be as for previous sections as would an headwall into the canal.

The section would outfall to the St Helens Canal and 225/300mm diameter pipes would be used.

Storage of approximately 400 cu m in modular units would be needed.

The area lies within the Sankey Brook corridor and agreement with Environment Agency would be required in terms of flood risk, compensation storage and any discharge rates to the brook. The flood risk plan indicates that the road may lie outside the areas of flood risk from Sankey Brook or the canal but checks in more detail would be required at more detailed design stages. an

2.3.4 Chainage 3142.00 to Chainage 3317.00 (Tie in to Sankey Way Junction)

The section falls to Sankey way at gradients of the order of 1 in 150 and gullies at 15m spacing would be used with a carrier pipe of 225mm.

The section would discharge to existing sewers in Sankey way via a hydrobrake combined with approximately 170 cu m of storage.

Manholes would be as previously described and an interceptor of nominal size NSB 4 would be needed.

2.3.5 Junction with Sankey Way

A grade separated flyover junction is proposed and structures sections would be drained by Kerbdrain whilst at grade and embankment sections would utilise gullies at 15m spacing.

It is assumed that storage may be needed to allow discharges to the existing system but this has not been examined in any detail at this stage.

2.4 The Purple Route

This route follows the orange and red route to Chainage 2220.00 and then bends north on a tighter curve passing through industrial areas on Barnard Street and housing and industrial areas north of the railway and Liverpool Road. It then merges with the Red route to meet Sankey way at Cromwell avenue.

There is only a short section whose alignment differs to the Red Route.

In overall drainage terms, at this stage it can be considered identical to the Red Route.

2.5 The Pink Route

This route differs from all previous routes in that its start point is from the Centre Park Link Road.

It then passes beneath the railway viaducts on the north side of the River Mersey following its banks northward before crossing the river on a new bridge.

The route then merges with the Orange, Red and Purple routes. At this stage, the drainage strategy for the Pink Route can be considered identical to the Red Route from this merge point.

2.5.1 Chainage 0.00 to Chainage 530.00 with a low point at Chainage 350.00

A pumped section of carriageway 530m long is assumed. Based on a flat rate rainfall of 75mm/hour the peak discharge would be 165 l/sec. Pumping at this rate is feasible without storage. Kerbdrain plus a carrier drain would be provided to collect flows.

Flood protection walls would extend to at least this length and would be set at 200- year flood level (tidal) plus 300mm freeboard (approximately 7.8m). The section is susceptible to flooding under short return tidal or pluvial events.

Bearing in mind ground levels the pumping station should be sited in an area with a surface level of 7.8m to avoid inundation at extreme events (when flood protection walls plus freeboard are breached). The pumping station would remove flood flows back to the river in those circumstances. It would contain three pumps each capable of delivering peak flow.

Pipe sizes in this section would be 225mm to 300mm in trench with 1200mm diameter manholes. The rising main would be 150mm diameter extending from the pumping station to and over the flood walls discharging above the 2 year tidal event (6.6m).

An interceptor class NSB 8 would be needed.

2.5.2 Chainage 530.00 (Limit of Gravity Drainage) to Chainage 700.00 (High Point at Roundabout)

This section mainly lies on reinforced earth embankments. The intention is to discharge at approximately chainage 530.00 above the 2 year tidal river level of 6.6m. This may be refined during more detailed design phases. Storage of approximately 150 cu m in modular units would be needed

Drainage of the structure would be by Kerbdrain and carrier pipe as above with the carrier pipe continuing beneath the reinforced earth embankment. Cover of approximately 1.2m would be maintained for pipes varying in diameter meter from 225mm to 300mm. Manholes would be of 1200mm diameter with the hydrobrake manhole being 1800mm (hydrobrake to pass green field flow set at 5 l/sec). A headwall would be required (possibly precast) at the outfall.

Gullies would be provided at 15 m spacing on the embankment

An interceptor of nominal size NSB 4 would be required.

2.5.3 Roundabout approximate Chainage700.00 to the Intersection with Red Route at Forrest Gate.

This section falls to the intersection with the low point at approximately chainage 900.00.

Gradients are of the order of 1 in 150 hence gullies at 15m spacing would be utilised whilst elements on structure would be served by Kerbdrain where appropriate.

Pipe sizes would be of the order of 225mm diameter to 375mm diameter. Manholes would be as previously described and storage of approximately 650 cu m would be needed in modular units.

The remainder of the route (Beyond Chainage 900.00 follows the Red route which is described within Section 2.3.

2.6 The Green Route

This route commences vat the Centre Park Link road following the Pink route. It meets the Orange, Red, Purple, routes at approximately Chainage 900.00 and then follows the Purple route to Reach Sankey.

Therefore, its alignment and drainage strategy features are as the Pink and Purple Routes where appropriate.

A. Drainage Strategy Drawing

Refer to drawing Western Link – Stage 2 – Proposed Drainage Plan (Ref: 382900-MMD-07-XX-CD-D-1024)