A6.3.5. It should noted that following selection of the Preferred Corridor, a review of the drainage and flooding strategy shall be undertaken to ensure that the most appropriate and reasonable road drainage measures can be introduced. This assessment has estimated a 10l/s/hectare green-field run-off rate by considering the contributing factors set out in DMRB Volume 3 Section 2 Part 1: Drainage Run-off from Natural Catchments. Unmitigated carriageway surface water run-off discharge rates have also been provided and the subsequent attenuation proposals and quantities given to illustrate the volumes required for source control.

A6.3.6. The SFRA upon its classification of the surrounding sub-catchments characteristics has also provided an outline drainage strategy for sustainable drainage systems, in particular that of attenuation. Standard Percentage Runoff (SPR) is one of the critical catchment parameters in flood generation. Catchments with low SPR values will, as a general rule, generate low response to rainfall and as a result tends to possess suitable infiltration parameters. This cannot be confirmed until site specific tests are completed at the proposed locations. The SFRA outlines that '78% of the SFRA area (Herefordshire County) has a soil type potentially highly or moderately unsuitable for source control techniques'. The catchments specific to the study area and the corresponding lengths of proposed corridors that are most likely to be suitable for infiltration type site control of surface run-off are;

- Lower Wye (Southern Corridor & Western Corridors to approximately Ch1000m)

A6.3.7. The remaining corridors and their respective corridor links are predominantly within catchment areas where the SPR class is between 30 – 40%. These catchments include;

- Yazor Brook (remaining Western Corridors and part of Northern Corridor)
- Lower Lugg (remaining Northern Corridor and the Eastern Corridors)

A6.3.8. Following on from the engineering assumptions stated, a drainage and hydrology summary has been conducted with the view to assigning the proposed discharge at preliminary locations along the vertical profile of the proposed corridor links as detailed in Appendix A. An unmitigated discharge rate and the corresponding green-field run-off rate based on each corridor link's hard surface footprint are also detailed in the sections overleaf. The new impermeable catchment areas (carriageway and footway) have been used to compile the associated storage capacity required to maintain the green-field run-off as recommended by the Environment Agency and PPS25.

A6.4. Drainage & Hydrology Summary

SUDS Selection Process

A6.4.1. Drainage options for this stage of the project, including storage options for volumetric run-off control, have been assessed following the selection process for the provision of SUDS using the guidance set out in CIRIA C697. The proposal to use footways on each side of the carriageway constrains the allocation of source control due to the provisions of kerb and gully systems. Due to the rural nature of the scheme and speed limits proposed, it should be noted that the safety aspect of providing footways along or near the carriageway without kerbs to allow for localised site control creates a high risk for non-motorised users. The drainage options have therefore been allocated using the following design criteria;

- Carriageway design
- Edge of carriageway type proposed
- Embankment or cutting locations
- Surrounding topography
- Surrounding ecology and wildlife constraints data
- Location of receiving waters
- Floodplain levels

A6.4.2. Adoption of these various criteria is likely to lead to alternative drainage arrangements and techniques to further achieve the hydraulic, water quality and amenity performances for the various locations set out below. It should be noted that the storage and treatment volumes in the following tables reflect a conservative summary and do not consider the effects of the time of entry and time of flow for the carriageway run-off to reach the discharge location. Certain limitations on the selection process have been set and only until these site investigation / survey results or historical data is obtained shall the adequacy of the proposals be accurately measured. The limitations include the lack of;

- Complete site walkover inspection
- Visual survey of exact locality for proposed discharge
- Known locality of other minor streams not registered at this stage
- Underlying soil strata and hydrogeology information
- Final mitigated discharge quantity
- Water quality requirements
- Public amenity requirement
- Environment Agency feedback
- Detailed Flood Risk Assessment

A6.4.3. The attenuation strategy shall follow that of the SFRA whereby attenuation measures upstream of the main flooding waters and floodplains are to be implemented. The retention of run-off at all locations is not the preferred approach as this strategy could extent the flooding event after the storm duration has passed. A sequenced approach shall be proposed, mainly retention measures proposed at locations upstream of the historical flooding areas, and a controlled and treated direct discharge via hydro-breaks and treatment units, shall be proposed in the higher and lower regions respectively.

A6.5. Southern Corridor

A6.5.1. This Corridor contains 2 alternative links which are separated by the proposal to either avoid or impact upon Haywood Forest Park and Newton Coppice. The existing hydrology consists of a steady flowing stream along the C1227 Grafton Lane and a small stream located between Grafton Lane and the Hereford to Newport railway line. The Stage 1 Assessment found an issue or small spring near the proposed railway crossing at Merry Hill which also leads to the aforementioned small stream. Newton Brook commences from Haywood Forest which eventually terminates at its conveyance with the River Wye.

A6.5.2. As mentioned in section A6.2.6, the underlying soil may be considered for infiltration into the ground. To this effect, and for both Corridor Links SC1 and SC2, the drainage outfall at Ch250m will require further analysis for its proposal to use a detention basin to infiltrate, or to revise the long section profile to direct the flow back toward the B4399 Rotherwas Access Road and outfall towards Norton Brook (Map A0.05). Further eastwards to Ch920m and the proposed culvert for the unnamed stream at C1227 Grafton Lane can provide the required receptor function for the proposed discharge. Not until further site specific information is obtained can the extent of a retention pond be proposed. Based on evidence statements and the strategic drainage strategy for the area it is likely that some for of retention or storage will be required to alleviate the additional run-off that will inevitably come with the potential construction. This will ensure that the upstream run-off is initially contained at source before discharge into the stream beyond the duration of the storm.

Fig A6.3 Steady flow of stream at C1227 Grafton Lane

A6.5.3. The two corridor links proceeding to cross the railway lines will inevitably break the drainage line across the bridge as it is not proposed that any drainage network will traverse the bridge deck. An existing stream to the south (Ch1450m) and spring / small issue to the north (Ch1750m) of the new crossing can provide adequate receptors to the proposed discharge. Further on site analysis will be required however, the raised height of the railway crossing will be a favourable factor for the provision of retention ponds or detention basins as the discharge location shall be elevated above the existing level of the receptors mentioned.

Table A6.1: Outline Drainage: Southern Corridor Links SC1 – SC2

Scheme Corridor Link	Outfall Location (OFL) ID	Outfall Chainage (m)	Pathway / Receptor	Unmitigated Design Discharge (l/s)	Greenfield Run-Off Rate at 10l/s/ha (l/s)	Potential Site Control	Estimated Attenuation Volumes (m^3)
SC 1	SC1.1	250	Existing Ground / Soak Away	378	27.5	Infiltration	1149 – 1604
	SC1.2	920	Unnamed Stream	218	15.5	Ponds	648 – 904
	SC1.3	1450	Unnamed Stream	123	9.0	Ponds	376 – 525
	SC1.4	1750	Existing Ground / Soak Away	215	15.5	Infiltration	648 - 904
	SC1.5	2750	Newton Brook	195	14.0	Ponds	585 - 817
	SC1.6	3000	Newton Brook	164	12.0	Ponds	501 - 700
SC 2	SC2.1	250	Existing Ground / Soak Away	378	27.5	Infiltration	1149 - 1604
	SC2.2	920	Unnamed Stream	218	9.0	Ponds	376 – 525
	SC2.3	1450	Unnamed Stream	123	15.5	Ponds	648 - 904

Table A6.1: Outline Drainage: Southern Corridor Links SC1 – SC2							
Scheme Corridor Link	Outfall Location (OFL) ID	Outfall Chainage (m)	Pathway / Receptor	Unmitigated Design Discharge (l/s)	Greenfield Run-Off Rate at 10l/s/ha (l/s)	Potential Site Control	Estimated Attenuation Volumes (m^3)
	SC2.4	1750	Existing Ground / Soak Away	225	16.5	Infiltration	689 - 963
	SC2.5	2750	Newton Brook	328	23.5	Ponds	982 - 1371

A6.5.4. The two corridor links are then separated (Map A0.05) by the option to either adjoin to the existing road junction of A465 Belmont Road / B4349 through Haywood Forest (Fig A6.3) and over the Newton Brook or avoid this environmentally sensitive area and join the A465 Belmont Road further south and avoid the provision of the required structure. In either case, it will be necessary to discharge into the Newton Brook, and with a similar drainage strategy as detailed in section A6.3.2.

Fig A6.4 A465 looking south at possible crossing point within Haywood Forest

A6.5.5. The Southern Corridor and its preferred corridor link will have subsequent leverage on the selection of the adjoining corridor links and hence the final selection of the preferred corridor. At this stage, it should be noted that Corridor Link SC1 would be the preferred alignment option due to the elimination of the costs for the proposed structure across the Newton Brook and subsequent impact on the local amenity and environmental characteristics. The discharge point from SC1 is also further upstream from Newton Brook and the underlying soil, based on the catchment SPR, could be used to further reduce impact of the carriageway run-off by way of infiltration as site specific parameters may dictate.

A6.6. Western Inner Corridor

A6.6.1. This Western Inner Corridor comprises of Western Corridor Links WL1 to WL7 connecting the A465 Belmont Road to A4103 Roman Road through various routes close to the outskirts of Hereford City. All Western Inner Corridor Links cross the stream near Ruckhall Lane and the elevated position of the new carriageway may allow the provision of ponds on the south side of the crossing. This stream is a tributary to the Wye and in conveyance with the Newton Brook just before the River Wye, a residential area is modelled as being affected by the 1% Flood Risk. This location and potential construction measures can provide an opportunity to reduce this risk by implementing simple weirs to control the flow of the existing stream. This measure may not be suitable for the Newton Brook due to the crossing points and features being located near the source of the stream.

Fig A6.5 Steady flow of stream under at Ruckhall Lane

A6.6.2. All the links also cross the River Wye a different locations to provide a range of crossing options. The 1% Flood Risk flood levels have been traversed with the required 600mm free board to soffit level. Each crossing has significantly different impacts upon the surrounding landscape due to the varying steepness of side slopes and extent of floodplain on each side of the River Wye. The north side of the river crossing possesses the greater potential for ponding and the existing National Park & Garden and the Special Wildlife Site may induce the requirement to develop this area further as an amenity for residents and host for natural habitat. The sole purpose of the ponds is to protect the River Wye during floods and in so, should be located outside of the flood zone.

A6.6.3. The alternative corridor links approach to the south bank of the River Wye from Ruckhall Lane offer similar constraints for drainage proposals. The steep embankments and the proposal not to carry any carrier drain system within the proposed structure will result in the requirement to discharge on the flood zones with very limited space. Table A6.2 outlines the various outfall points of Western Corridor Links WL1 to WL4 between the A465 Belmont Road and the A438 Kings Acre Road.

Table A6.2: Outline Drainage: Western Inner Corridor Links WL1 – WL4

Scheme Corridor Link	Outfall Location (OFL) ID	Outfall Chainage (m)	Pathway / Receptor	Unmitigated Design Discharge (l/s)	Greenfield Run-Off Rate at 10l/s/ha (l/s)	Potential Site Control	Estimated Attenuation Volumes (m^3)
WL 1	WL1.1	0	A465 Existing Drainage	103	7.4	Existing Network	N/A
	WL1.2	600	Tributary to River Wye	143	10.4	Ponds	435 – 607
	WL1.3	1025	River Wye South Bank	287	20.5	Ponds	857 – 1196
	WL1.4	1300	River Wye North Bank	267	19.0	Ponds	794 – 1108
	WL1.5	1950	Existing Ground / Soak Away	389	28.1	Infiltration	1174 – 1639

Table A6.2: Outline Drainage: Western Inner Corridor Links WL1 – WL4							
Scheme Corridor Link	**Outfall Location (OFL) ID**	**Outfall Chainage (m)**	**Pathway / Receptor**	**Unmitigated Design Discharge (l/s)**	**Greenfield Run-Off Rate at 10l/s/ha (l/s)**	**Potential Site Control**	**Estimated Attenuation Volumes (m^3)**
	WL1.6	3150	Existing Ground / Soak Away	276	19.9	Infiltration	831 - 1161
WL 2	WL2.1	0	A465 Existing Drainage	103	7.4	Existing Network	N/A
	WL2.2	600	Tributary to River Wye	143	10.4	Ponds	435 - 607
	WL2.3	1025	River Wye South Bank	287	20.5	Ponds	857 - 1196
	WL2.4	1300	River Wye North Bank	267	19.0	Ponds	794 - 1108
	WL2.5	1950	Existing Ground / Soak Away	594	42.9	Infiltration	1792 - 2503
	WL2.6	4346	A438 Existing Drainage	388	28.0	Existing Network	1170 - 1634
WL 3	WL3.1	0	A465 Existing Drainage	103	7.4	Existing Network	N/A
	WL3.2	560	Tributary to River Wye	123	8.9	Ponds	372 - 519
	WL3.3	950	River Wye South Bank	164	11.8	Ponds	493 - 688
	WL3.4	1300	River Wye North Bank	657	47.4	Ponds	1980 - 2765
	WL3.5	3350	A438 Existing Drainage	328	23.7	Existing Network	990 - 1383
WL 4	WL4.1	950	Tributary to River Wye	390	28.1	Ponds	N/A

Table A6.2: Outline Drainage: Western Inner Corridor Links WL1 – WL4							
Scheme Corridor Link	Outfall Location (OFL) ID	Outfall Chainage (m)	Pathway / Receptor	Unmitigated Design Discharge (l/s)	Greenfield Run-Off Rate at 10l/s/ha (l/s)	Potential Site Control	Estimated Attenuation Volumes (m^3)
	WL4.2	1500	River Wye South Bank	226	16.3	Ponds	681 - 951
	WL4.3	1850	River Wye North Bank	677	48.8	Ponds	2039 - 2847
	WL4.4	3887	A438 Existing Drainage	302	21.8	Existing Network	911 - 1272 m^3

A6.6.4. The hydraulic performance of the River Wye should be given careful and detailed consideration to analyse the impact of supporting piers and abutments should this particular structure feature be proposed. Critical factors should be adhered to when considering the location of piers and abutments. Some of these include;

- No structural element shall be placed within the main river
- No abutment or retaining structure shall be located in the floodplain
- Upstream effects of the impact of the new structure should be assessed as part of a flood risk assessment

Table A6.3: Outline Drainage: Western Inner Corridor Links WL5 – WL7							
Scheme Corridor Link	Outfall Location (OFL) ID	Outfall Chainage (m)	Pathway / Receptor	Unmitigated Design Discharge (l/s)	Greenfield Run-Off Rate at 10l/s/ha (l/s)	Potential Site Control	Estimated Attenuation Volumes (m^3)
WL 5	WL5.1	560	Tributary to River Wye	123	8.9	Ponds	372 - 519
	WL5.2	950	River Wye South Bank	164	11.8	Ponds	493 - 688
	WL5.3	1300	River Wye North Bank	882	63.6	Ponds	2657 - 3711

Table A6.3: Outline Drainage: Western Inner Corridor Links WL5 – WL7							
Scheme Corridor Link	**Outfall Location (OFL) ID**	**Outfall Chainage (m)**	**Pathway / Receptor**	**Unmitigated Design Discharge (l/s)**	**Greenfield Run-Off Rate at 10l/s/ha (l/s)**	**Potential Site Control**	**Estimated Attenuation Volumes (m^3)**
	WL5.4	3350	A438 Existing Drainage	390	28.1	Existing Network	1174 - 1639
WL 6	WL6.1	950	Tributary to River Wye	287	20.7	Ponds	865 - 1208
	WL6.2	1500	River Wye South Bank	225	16.3	Ponds	681 - 951
	WL6.3	1850	River Wye North Bank	841	60.7	Ponds	2536 - 3541
	WL6.4	4596	A438 Existing Drainage	429	30.9	Existing Network	1291 - 1803
WL 7	WL7.1	650	Land adjacent to Yazor Brook Flooplain	441	31.8	Interceptor Discharge / Hydrobrake	1329 - 1855
	WL7.2	1075	Yazor Brook Crossing	66	4.7	Interceptor Discharge / Hydrobrake	196 – 274

A6.6.5. These River Wye crossing locations (e.g. Fig A6.6 & Fig A6.7) will be the focus of the Western Corridors when selecting the preferred corridor links. From a hydrology and drainage viewpoint, the fundamental aspects to be considered are;

- Total length of road (extent of new development / hard surface)
- Impact on current and predicted flood levels
- Feasibility of retention ponds to protect the main rivers during flooding
- Amenity opportunities

Fig A6.6 Steep embankments on south bank of the River Wye

Fig A6.7 Extent of floodplain on north bank of the River Wye

A6.6.6. On the basis of assessing the Western Inner Corridor Links between the A465 Belmont Road and the A438 Kings Acre Road the preferred corridor link based on the criteria set out in the previous paragraph is WL4 due to its short length and the feasibility of the discharge locations set out in Tables A6.2 and A6.3. This link is the choice corridor link to take for the Western Inner Corridor as this also ties in with the preferred link SC2 of the Southern Corridor.

A6.6.7. The knock-on effect of the selection of the above corridor links brings about the selection of WL7 by default. This corridor link alignment is directed through the Yazor Brook and the surrounding floodplain. Fig A6.8 shows the Yazor Brook at Huntington Lane with the surrounding terrain which is generally flat. Table A6.3 for WL7 outlines the proposal to allow the run-off to be treated for pollutants and the flow regulated for direct discharge into the Yazor Brook.

A6.6.8. The location for this corridor link will impact upon the Groundwater Source Protection Zone 2 (outer zone) and is also approximately 100m from the extent of the inner zone (Zone 1). Some sites within Source Protection Zones are overlying either a major or minor aquifers of high, intermediate or low vulnerability, as defined by the Environment Agency's Groundwater Protection Policy. As WL7 is within the locality of Source Protection Zone 1 of the Environment Agency's groundwater protection policy it is worth noting that any pollutants entering the groundwater below this site could contaminate the public water drinking supply and be abstracted within 50 days. Discharge from impermeable areas and industrial sites would not be acceptable within Zone 1.

A6.6.9. Corridor Link WL7 should be classified as being within Source Protection Zone 2 of the Environment Agency's groundwater protection policy. This means that any pollutants entering the groundwater below this site could contaminate the public water drinking supply and be abstracted within 400 days. In this zone there is a presumption against surface water from major roads and industrial sites draining to a soakaway. An interceptor should be installed for all discharges within Zone 2.

Fig A6.8 Yazor Brook at Huntington Lane view towards outbuldings

A6.6.10. The Yazor Brook is second to the River Wye for severity of impact on flooding of residential areas and businesses within the city and surrounding landscape as shown on Map A3.09 in Appendix A and . A flood alleviation scheme for the Yazor Brook near Credenhill in the northwest of Hereford, is currently undergoing the statutory orders process and compilation of contract documentation for the provision of a 2m diameter diversion approximately 1km upstream of the proposed crossing for the new carriageway. This scheme should reduce greatly impact on the floodplain and watercourse at the new crossing. It will be important to gauge from the assessment already completed for this scheme, the extent of direct discharge to be allocated into the alleviated Yazor Brook.

A6.6.11. Further to a more detailed analyses of flood risk on the natural catchments and rivers and streams, knowledge of the existing storm drainage within the existing highway network on the A465 Belmont Road, A438 Kings Acre Road and the A4103 Roman Road should be gained and a full understanding of current capacity shall be advised by the water company to support the multi-organisational approach to surface water management as highlighted earlier in the report.

A6.7. Western Outer Corridor

A6.7.1. Corridor Link WL8 (Map A3.10) provides a connecting link between A438 Kings Acre Road and the A4103 Roman Road. This link avoids significantly impacting upon the Yazor Brook and Floodplain and is situated entirely within the Groundwater Source Protection Zone 3. WL8 should therefore be classified as being within Source Protection Zone 3 of the Environment Agency's groundwater protection policy. This means that any pollutants entering the groundwater below this site could contaminate the public water drinking supply. The time taken for contamination in the water to be abstracted is estimated to be more than 400 days. In this zone soakaways are generally considered appropriate with an interceptor. For industrial proposals and major roads, soakaways may be appropriate but investigations must be undertaken to determine the risk of contamination. Advice from the Environment Agency shall be sought as part of the consultation process using this Engineering Assessment as the basis for requesting specific feedback on this issue for an links affected.

Table A6.4: Outline Drainage: Western Outer Corridor Links WL8 – WL10							
Scheme Corridor Link	Outfall Location (OFL) ID	Outfall Chainage (m)	Pathway / Receptor	Unmitigated Design Discharge (l/s)	Greenfield Run-Off Rate at 10l/s/ha (l/s)	Potential Site Control	Estimated Attenuation Volumes (m^3)
WL 8	WL8.1	1093	Existing Ground / Soak Away	448	32.4	Interceptor / Soakaway	1354 - 1890
WL 9	WL9.1	1010	Tributary to River Wye	595	42.9	Ponds	1792 - 2503
	WL9.2	2050	River Wye South Bank	246	17.8	Ponds	744 - 1038
	WL9.3	2700	Tributary at River Wye North Bank	574	41.4	Ponds	1730 - 2415
	WL9.4	4360	A438 Existing Drainage	373	26.9	Existing Network	1124 - 1569
WL 10	WL10.1	1010	Tributary to River Wye	414	29.9	Ponds	1249 - 1744
	WL10.2	2050	River Wye South Bank	427	30.8	Ponds	1287 - 1797
	WL10.3	2700	Tributary at River Wye North Bank	471	34.0	Ponds	1421 - 1984
	WL10.4	3550	Existing Ground / Soak Away	400	28.9	Infiltration	1208 - 1686
	WL10.5	4175	Existing Stream	92	6.7	Ponds	280 - 391
	WL10.6	4900	A438 Existing Drainage	205	14.8	Existing Network Upgrade	618 - 863

A6.7.2. Corridor Links WL9 and WL10 represent the provision for crossing the River Wye further upstream and allows for an alternative approach from the south, avoiding direct impact on the Belmont Golf Course. Due to the surrounding topography and the location of a small tributary on the north side of the River Wye, a 550m long bridge structure, 16m above ground level has been established as the necessary outline dimensional requirements to avoid excessive earthworks to the south and traverse across the River Wye and the small tributary while tying into the existing topography of the steep north bank.

A6.7.3. Contrary to the Western Inner Corridor, this corridor offers a more suitable terrain for ponds on both sides of the River Wye and avoids impacting on Special Wildlife Sites. The corridor link alignment at this location is common to both WL9 and WL10 and represents a longer alternative to the inner corridor. To this effect the Western Inner Corridor is generally 450m shorter than the Western Outer Corridor in assessing the shorter links contained within.

A6.7.4. WL9 is the shorter of the two alternative options for the outer corridor and terminates at its proposed junction with the A438 Kings Acre Road. Due to the vertical profile of the design the existing drainage of Kings Acre Road should be investigated through communication with the Herefordshire Council, Highways Agency and the water company, Welsh Water.

A6.7.5. Corridor Link WL10 generates an additional 540m of carriageway compared to WL9 and approximately 1km additional hard surface of carriageway compared to the inner corridor links. This outer corridor link ties in with Kings Acre Road approximately 1km further west of WL9 and traverses only one stream over the course of 2.2km beyond the north side of the River Wye. Although on closer, on site inspections, other undesignated streams may be sourced. The potentially large area of impermeable surface which this option generates will require detailed information on soil types and hydrogeology for the feasibility of infiltration and soakaway proposals along its route.

A6.7.6. Corridor Links WL11 and WL12 connect the two outer corridors links previously mentioned to the A4103 Roman Road. WL11 and WL12 are both entirely within Groundwater Source Protection Zone 3 and the same conditions and constraints apply as detailed in section A6.6.1. Corridor Link WL11 utilises the existing minor road connecting the same roads. As with WL10 a closer inspection of the surrounding water features and soil type should inform the design process as to the most appropriate form of drainage proposal and infiltration techniques applicable to this location.

A6.7.7. On balance the widening of the A480 from Kings Acre Road to the existing roundabout shall offer no more of a suitable measure than a new alignment as set out further west at WL12. WL11 is 250m longer than WL12 but the associated impact of additional hard surface is countered by the existing road pavement of the A480 already discharging into the surrounding features.

A6.7.8. Table A6.5 illustrates, as discussed earlier in the report, a basic approach to discharge estimation for comparison purposes. The final discharge will probably be within the lower limit of the range if not less. The highway cross section with kerb footways may not allow for immediate road edge drainage site controls however, on the basis of such high volumes predicted, further assessment may require alternative cross sections at relevant areas where footfall numbers are insignificant and the provision of alternative road edge and drainage proposals can be investigated to increase the time of entry / time of flow to the agreed discharge point.

Table A6.5: Outline Drainage: Western Outer Corridor Links WL11 – WL14

Scheme Corridor Link	Outfall Location (OFL) ID	Outfall Chainage (m)	Pathway / Receptor	Unmitigated Design Discharge (l/s)	Greenfield Run-Off Rate at 10l/s/ha (l/s)	Potential Site Control	Estimated Attenuation Volumes (m^3)
WL 11	WL11.1	0	A438 Existing Drainage	205	14.8	Existing Network Upgrade	618 - 863
	WL11.2	800	Existing Ground / Soak Away	220	15.9	Ponds	664 - 928
WL 12	WL12.1	760	Yazor Brook & Floodplain	312	22.5	Soakaway	940 - 1313
WL 13	WL13.1	800	Yazor Brook & Floodplain	328	23.7	Interceptor Discharge / Hydrobrake	990 - 1383
WL 14	WL14.1	760	Yazor Brook & Floodplain	312	22.5	Interceptor Discharge / Hydrobrake	940 - 1313

A6.7.9. The A4103 Roman Road as shown in Appendix A Map A3.15 and A3.16 presents an opportunity to use an existing road to provide the necessary carriageway for the new relief road. The location of the Yazor Brook and its floodplain creates significant engineering problems. Widening on either side of the existing road will impact on the floodplain and its behaviour upstream and the ground conditions will be unlikely to favourable for potential new road construction. Fig A6.9 highlights the extent of flooding experienced in March 2007 on the north side of the A4103 Roman Road (approx Ch700m on WL11) while Fig A6.10 shows the existing culverts under full capacity located at approximate Ch300m on W12.

Fig A6.9 Yazor Brook flooding on north side of A4103 Roman Road

Fig A6.10 Yazor Brook flooding on south side of A4103 Roman Road

A6.7.10. The drainage proposals for the Yazor Brook Flood Alleviation Scheme upstream from this potential road widening scheme may have such a positive impact on the hydraulic capacity of the existing side streams. Further flood analysis and historical modelling data should be sought to gain a better perspective of allowable discharge quantities to inform the process of selecting drainage mitigation proposals to reduce the amount discharging waters at any given time at the culverts and streams within the flood zone.

A6.7.11. Corridor Links WL11 and WL12 are also within the Groundwater Protection Zone 2 and so should address the same environmental constraints as previously mentioned for Corridor Link WL8.

Western Corridor Recommendation

A6.7.12. Drainage options for this stage of the scheme design, including storage options for volumetric run-off control, have been assessed following the selection process for the provision of sustainable drainage systems using the guidance set out in CIRIA C697. The proposal to use footways on each side of the carriageway constrains the allocation of immediate site control due to the provisions of kerb and gully systems. It is advised that following consultations with Herefordshire Council and the confirmation on the extent of the allocation of housing for Hereford, a revision of the necessity to provide footways in the new relief road highway section at high speed rural locations be undertaken to allow for a greater choice of drainage solutions and reduction of discharge quantities.

A6.7.13. The discharge drainage options have been allocated using the design criteria set out in section A6.2.4. The predominant factor in new road schemes with regards to drainage and flood risk is to reduce the area of hard surface and mitigate flow as much as possible closer to the source. Based on the above conclusion this Engineering Assessment would advise that Corridor Links SC1, WL4 and WL7 combine to provide the optimum solution at this interim stage for basis of the Western Corridor. Further analyses in the Stage 3 process such as the requisite level of Flood Risk Assessment and historical flooding, flood model and geotechnical data will provide the necessary supporting information to inform of changes to the alignments currently set out in Appendix A.

A6.8. Northern Corridor

A6.8.1. The Northern Corridor overlies an elevated region to the north of Hereford with the surrounding topography generally sloping downwards towards the city. There are few streams within the footprint of the corridor which aims to connect the A4103 Roman Road across the A49 Holmer Road to the A465 Aylestone Hill roundabout. The A49 and other minor roads along the corridor generally follow the topography and fall from north to south towards the city, all connecting to the existing A4103 Roman Road which follows a west / east alignment.

A6.8.2. Northern Corridor Links NC1 and NC2 require an under-bridge and over-bridge to facilitate the existing roads C1095 Tillington Road and the A4110 Canon Pyon Road respectively. The under-bridge at C1095 Tillington Road provides the first break of any proposed road drainage system. The relief road at this location will require surface run-off from on average the first 500m to be controlled before discharging into the Yazor Brook under the same conditions as detailed in section A6.6.10.

A6.8.3. The area surrounding this under-bridge is low lying and an existing tributary to the Yazor flood zones flows beneath the C1095 Tillington Road as shown by the tree line in Fig A6.12 below.

Fig A6.11 Tree line of Yazor tributary crossing C1095 Tillington Road

A6.8.4. The area surrounding this stream naturally falls towards it. The elevated position of the relief road, for the two corridor links at this location, would be suitable to provide retention ponds receiving up to 1km of surface water on the north east side of the new bridge structure before discharging into the stream.

A6.8.5. The lack of flowing receptors in this region and the high SPR value (35-40%) will result in large areas to facilitate any proposed ponding. A general rule for ponding is to plan / provide for 4% - 7% of the total impermeable catchment area. This would result in the allocation of between 984m^2 and 1722 m^2 of land to be acquired at this location, equating to a maximum 42m x 42m of ponding. This ponding could also blend into the National Park and Garden located on Tillington Road as a natural feature and amenity.

Table A6.6: Outline Drainage: Northern Corridor Links NC1 – NC4

Scheme Corridor Link	Outfall Location (OFL) ID	Outfall Chainage (m)	Pathway / Receptor	Unmitigated Design Discharge (l/s)	Greenfield Run-Off Rate at 10l/s/ha (l/s)	Potential Site Control	Estimated Attenuation Volumes (m^3)
NC 1	NC1.1	0	Yazor Brook	193	14.0	Interceptor Discharge / Hydrobrake	585 - 817
	NC1.2	600	Unnamed Stream	484	34.9	Ponds	1458 - 2036
	NC1.3	1900	Unnamed Stream	267	19.2	Ponds	802 - 1120
	NC1.4	2425	Existing Ground / Soak Away	83	6.0	Infiltration	251 - 350
NC 2	NC2.1	0	Existing Ground / Soak Away	225.7	16.3	Infiltration	681 - 951
	NC2.2	750	Unnamed Stream	472	34	Ponds	1421 - 1984
	NC2.3	2025	Unnamed Stream	349	25.2	Ponds	1053 - 1470
	NC2.4	2550	Existing Ground / Soak Away	84	6.0	Infiltration	251 - 350

Table A6.6: Outline Drainage: Northern Corridor Links NC1 – NC4							
Scheme Corridor Link	**Outfall Location (OFL) ID**	**Outfall Chainage (m)**	**Pathway / Receptor**	**Unmitigated Design Discharge (l/s)**	**Greenfield Run-Off Rate at 10l/s/ha (l/s)**	**Potential Site Control**	**Estimated Attenuation Volumes (m^3)**
NC 3	NC3.1	120	Existing Stream	147	10.4	Ponds	435 - 607
	NC3.2	550	Existing Ground / Soak Away	82	5.9	Infiltration	247 - 344
	NC3.3	940	Existing Stream	160	11.5	Ponds	480 - 671
	NC3.4	1450	Existing Ground / Soak Away	209	15.1	Infiltration	631 - 881
	NC3.5	2227	Existing Stream near Aylestone Hill	319	23.0	Ponds	961 - 1342
NC 4	NC4.1	120	Existing Stream	147	10.4	Ponds	435 - 607
	NC4.2	550	Existing Ground / Soak Away	82	5.9	Infiltration	247 - 344
	NC4.3	1350	Existing Ground / Soak Away	513	37.0	Infiltration	1546 - 2159
	NC4.4	2331	Existing Ground / Soak Away	218	15.7	Infiltration	656 - 916

A6.8.6. All Northern Corridor Links have been allocated the same tie-in location on the A49 Holmer Road. The location of small undesignated streams on both sides of the A49 Holmer Road could be used to carry drainage off this strategic junction. These small streams (450m west and 15m east of Holmer Road) may eventually connect to a flood zone just south-east of the proposed junction as shown in Map A3.17 in Appendix A. The flood zones are mostly pluvial in nature by assessment of the surrounding topography and the lack of any major watercourses. Any additional run-off should be carefully designed to ensure areas such as the Hereford Racecourse and the surrounding properties and highways are not put at risk.

A6.8.7. Northern Corridor Links NC3 and NC4 traverses sloping downhill topography through the residential areas of Holmer and Shelwick where existing and proposed housing developments are interconnected by the minor roads Munstone Road and Codwells Road. The steady decline from the proposed roundabout junction at the A49 Holmer Road requires a number of outfalls at the under-bridge crossing at Codwells Road and an existing stream at Ch950m. The common sag location at (Ch1450m / 1350m) will also require an outfall to ponding should this stream be found to impact on the Lugg floodplain.

A6.8.8. The proposed railway bridge over the Hereford to Shrewsbury line shall require surface water run-off outfalls on each side. The western side of the NC3 crossing can outfall into the pond mentioned previously. The run-off from the eastern side can be conveyed towards the Lugg Meadow and discharge within Flood Zone 2 and 3 at Aylestone Hill. Northern Corridor NC3 will result in the widening of an existing disused canal bridge at Ch2050m. Part of the canal south of NC3 at Ch2000m was found to have a minor stream cross it and fall towards the Lugg floodplain. This minor stream will require on site inspection to confirm if this stream can carry additional run-off from the proposed carriageway discharge at Ch1450m (and Ch1350m at NC4).

A6.8.9. Northern Corridor NC4 will require similar drainage arrangements however due to the elevated approach of the carriageway from the proposed railway bridge to Aylestone Hill roundabout tie-in the area contained within the new relief road, the railway line and the existing A4103 Roman Road may also be suitable for run-off outfall and potential soakaway or channelled towards the Lugg floodplain.

Fig A6.12 West side of existing railway line north of A4103 Roman Road

A6.8.10. At this stage it should be noted that any proposed outfall to or any potential works affecting the Lugg floodplain will require the consent of the Internal Drainage Board as well as the Environment Agency.

A6.9. Eastern Inner Corridor

A6.9.1. Eastern Inner Corridor Link EL1 illustrates the engineering of a proposed carriageway around the extent of the Flood Zones 2 and 3 to reduce the vulnerability of the floodplain due to excessive footprint and loss of storage capacity. Proposed surface run-off from new impermeable catchment areas must be controlled as close a possible to the source. For Eastern Inner Corridor Link EL1 this is not the case

A6.9.2. The construction of any relief road within or near the floodplains shall not require retention but demand immediate discharge to the floodplain. This ensures that throughout the duration of the storm event, the catchment area closest to the floodplain is discharged almost completely before the upstream volumes are conveyed to the floodplain, allowing the initial surge to be conveyed downstream.

Fig A6.13 Hillside view of Lugg floodplain south of A465 Aylestone Hill

A6.9.3. Optimising the proposed road drainage system can ensure that the proposed drainage within the road can surcharge adequately, maintaining some storage itself during the storm event. In addition, the potential embankment construction envisaged for this link will also require compensatory storage. This will most likely be required on the eastern side of the floodplain to compensate on the existing storage removed by the relief road on the opposite side.

Table A6.7: Outline Drainage: Eastern Corridor Links EL1 – EL4

Scheme Corridor Link	Outfall Location (OFL) ID	Outfall Chainage (m)	Pathway / Receptor	Unmitigated Design Discharge (l/s)	Greenfield Run-Off Rate at 10l/s/ha (l/s)	Potential Site Control	Estimated Attenuation Volumes (m^3)
EL 1	EL1.1	220	Tributary to the Lugg / Floodplain Channel	349	25.2	Treated Discharge / Hydrobrake	1053 - 1470
	EL1.2	1050	Tributary to the Lugg / Floodplain Channel	287	20.7	Treated Discharge / Hydrobrake	865 - 1208

Table A6.7: Outline Drainage: Eastern Corridor Links EL1 – EL4							
Scheme Corridor Link	**Outfall Location (OFL) ID**	**Outfall Chainage (m)**	**Pathway / Receptor**	**Unmitigated Design Discharge (l/s)**	**Greenfield Run-Off Rate at 10l/s/ha (l/s)**	**Potential Site Control**	**Estimated Attenuation Volumes (m^3)**
	EL1.3	1450	Tributary to the Lugg / Floodplain Channel	218	15.7	Treated Discharge / Hydrobrake	656 - 916
EL 2	EL2.1	350	Tributary to the Lugg / Floodplain Channel	320	23.1	Ponds	965 - 1348
	EL2.2	780	Unnamed Stream	90	6.5	Ponds	272 - 379
	EL2.3	1296	Existing Network / Continue to EL3.1 to River Wye	121	8.8	Existing Network / Ponds	368 - 513
EL 3	EL3.1	150	River Wye Floodplain (incl EL 2.3)	164 (285)	11.8 (20.6)	Treated Discharge / Hydrobrake	493 - 688 (861 - 1202)
	EL3.2	625	Tributary to the Lugg / Floodplain Channel	366	26.4	Treated Discharge / Hydrobrake	1103 - 1540
EL 4	N/A	Various	Lugg Functional Floodplain Channels	366	26.4	Treated Discharge / Hydrobrake	1103 - 1540

A6.9.4. Eastern Inner Corridor Link EL2 is predominantly outside the Lugg floodplains however surface run-off from the potential carriageway construction is still immediate to the floodplain and should be treated in the same manner. For all links discharging into or near the floodplain, oil and particle interceptors should be provided and if necessary installed with radio alarms linked to a central unit within the managing agent or body to ensure the water quality is not at risk of becoming contaminated at any point throughout its life.

A6.9.5. Corridor Link EL3 contains the inner eastern River Wye crossing. The surrounding landscape is flat and is classified as Flood Zones 2 and 3. The proposed carriageway has been raised above the 1% Flood Risk level of 49.017m AOD, a result generated by an previous flood study (ref SFRA). This study did not include for climate change and in comparison to the River Wye Flood Gauge 6 at this location measuring a level of 48.705m during the floods of 2000, it was decided to design the crossing and carriageway over the floodplain at no less that 49.5m AOD.

Fig A6.14 Approach to River Wye and floodplain south of B4224

A6.9.6. The proposed tie-in and approximately 750m of new carriageway will be contained within the Rotherwas Industrial Estate. A flood management strategy for Rotherwas is in the process of being reviewed with Herefordshire Council which when complete will finalise design flood levels for the estate and options for surface water management. This document will become an important feature in the final proposals for the carriageway levels and drainage strategy.

A6.10. Eastern Outer Corridor

A6.10.1. The A465 Aylestone Hill Road provides a passage for the Eastern Inner Corridor Links EL4 and EL5 to connect the Northern Corridors to an outer eastern option without presenting a new alignment proposal traversing the Lugg floodplain. The major constraints presented to these corridor links are the various relief culverts (Fig A6.15) and the historic Lugg Bridge. The potential widening of the A4103 shall reduce the impact of the relief road compared to proposing new construction to traverse the Lugg floodplain in this area.

Fig A6.15 Relief culvert at A465 Aylestone Hill

A6.10.2. The new relief road would require having these relief culverts extended as well as the widening of the 14th Century Bridge, a fact which will take on historic and cultural constraints of its own. The Flood Zones 2 and 3 show this road to be within the vulnerable classification and hence any proposal to extend or widen this road will require an exception test through the means of a flood risk assessment. The new carriageway may be required to be elevated above the current road level, and in conjunction with the expected re-channelling of floodplain watercourses and extensions for 11 relief culverts and possible bridge replacement if accepted presents a challenging and expensive set of measures to allow for an outer eastern corridor.

A6.10.3. The Eastern Outer Corridor Link alignments EL6 – EL12 are predominantly derived from the variation of ties-ins to avoid the existing 3-arch masonry bridge at Lugwardine (Fig A6.16). The bridge is located at the end of the A438 Ledbury Road to the south of the village and bridges over the River Lugg. There are 3 potential roundabouts located near this location as indicated in the Corridor Summary Map A0.04 in Appendix A.

Fig A6.16 River Lugg crossing at Lugwardine

A6.10.4. Each roundabout is located on the south side of the A438 Ledbury Road which results a new river crossing across the Lugg. The Eastern Outer Corridor Link alignment EL6 connects a potential roundabout situated at Lugg Bridge on the A465 Aylestone Hill Road to one of the new roundabouts proposed at Lugwardine as part of the outer eastern corridor. Corridor Links EL7 and EL8 connect within the same locality at Lugwardine, however, the proposed linkage with the A465 Aylestone Hill Road is located 500m east of EL6 to avoid the constraints at the Lugg Bridge.

A6.10.5. Corridor Links EL6 – EL8 cross a tributary to the River Lugg where the Environment Agency has designated a Flood Zone 2 and 3 beyond its banks, although there is no historical flooding data for this tributary. It will be necessary to assess this location further as to the requirements to exceed the proposal to culvert the watercourse or to provide a bridge structure or a row of relief culverts. This proposal will be vital to ensuring that properties upstream from the potential crossing point are adequately protected from flooding which may occur outside of the flood zones due to the barrier effect this crossing may present. This potential culvert crossing provides a suitable location for discharge into the tributary before conveyance into the River Lugg.

A6.10.6. The new crossing locations to the south of Lugwardine are mostly located to avoid or reduce the impact of the approaching alignment on an area designated a Special Wildlife Site on the north side of the A438 Ledbury Road. The approaching alignments enter Flood Zones 2 and 3 before crossing a small stream and the River Lugg (Fig A6.17). Similarly to the previous watercourse crossing, the impact of the proposed alignment on the associated flood plain should be analysed for the extent of the bridge crossing required. For this report is has been assumed that a major bridge crossing is assigned to the extent of the River Lugg channel and a simple culvert will be sufficient for the small stream to the north.

Fig A6.17 River Lugg view west of existing Lugwardine Bridge

A6.10.7. An alternative option for the crossing along the north side approach to the A438 Ledbury Road could be to provide an extended and elevated bridge structure across the flood plain between the extents of Flood Zone 2 and 3 and over the River Lugg to the proposed roundabout.

A6.10.8. The River Lugg would be a suitable location for the discharge of road surface run-off however a more detailed analysis of the impact of these alignments on both run-off quantities and flood storage compensation measures will be required before detailed drainage measures can be adequately provided.

A6.10.9. All alignments and proposed roundabouts within this locality have been allocated an estimated finished road level based on a 2006 flood model which did not account for climate change. The 1% Flood Risk level was modelled at 48.147m AOD. The roundabout locations as detailed in Maps A3.26 – A3.28 in Appendix A at Lugwardine Bridge have been allocated a finished road level of 48.75m for this stage of the scheme assessment.

Table A6.8: Outline Drainage: Eastern Inner Corridor Links EL5 – EL8

Scheme Corridor Link	Outfall Location (OFL) ID	Outfall Chainage (m)	Pathway / Receptor	Unmitigated Design Discharge (l/s)	Greenfield Run-Off Rate at 10l/s/ha (l/s)	Potential Site Control	Estimated Attenuation Volumes (m^3)
EL 5	N/A	Various	Lugg Functional Floodplain Channels	510	36.8	Treated Discharge / Hydrobrake	1538 - 2147
EL 6	EL6.1	1025	Tributary to River Lugg	533	38.5	Treated Discharge / Hydrobrake	1609 - 2246
	EL6.2	1740	Tributary to River Lugg / Floodplain Channel	181	13	Treated Discharge / Hydrobrake	543 - 758
	EL6.3	1800 - 1900	Tributary to River Lugg / River Lugg	82	6	Treated Discharge / Hydrobrake	251 - 350
EL 7	EL7.1	650	Tributary to River Lugg	370	26.6	Treated Discharge / Hydrobrake	1111 - 1552

Table A6.8: Outline Drainage: Eastern Inner Corridor Links EL5 – EL8							
Scheme Corridor Link	Outfall Location (OFL) ID	Outfall Chainage (m)	Pathway / Receptor	Unmitigated Design Discharge (l/s)	Greenfield Run-Off Rate at 10l/s/ha (l/s)	Potential Site Control	Estimated Attenuation Volumes (m^3)
	EL7.2	1250	Tributary to River Lugg / Floodplain Channel	144	10.4	Treated Discharge / Hydrobrake	435 - 607
	EL7.3	1250 - 1450	Tributary to River Lugg / River Lugg	82	6	Treated Discharge / Hydrobrake	251 - 350
EL 8	EL 8.1	650	Tributary to River Lugg	390	28	Treated Discharge / Hydrobrake	1170 - 1634
	EL 8.2	1350	Tributary to River Lugg / Floodplain Channel	144	10.4	Treated Discharge / Hydrobrake	435 - 607
	EL 8.3	1578	Tributary to River Lugg / River Lugg	94	6.7	Treated Discharge / Hydrobrake	280 - 391

A6.10.10. The corridor links commencing at the various roundabout locations to the south of the A438 Ledbury Road and connecting to a common point on the B4224 Hampton Park Road present this scheme assessment with the largest impact on flood plains and subsequent flood risk to the surrounding area.

A6.10.11. The predominantly flat area of the Lugg floodplain (Fig A6.18) is severed by these proposals which are necessary to align back towards Rotherwas while avoiding an area designated under Ancient Monument as detailed in Maps A3.29 – A3.31. The proposals are to be elevated above the floodplain to a level that will adequately avoid flooding of the proposed carriageway. The levels modelled at Lugwardine Bridge (48.147m) and of those experienced and modelled at the River Wye, 48.705m and 49.017 respectively, illustrate the extent of embankment required over the Lugg floodplain, which currently lies at an approximate level of 46m, for the first 500m of each link.

Fig A6.18 Lugg floodplain view south of A438 Ledbury Road

A6.10.12. The crossing at the River Lugg (Rhea) can provide the necessary outfall receptor for road drainage. The proposed embankment and scheme footprint will require flood alleviation to the extent that extensive relief culverts and compensatory flood storage measures will be required within the proposed embankment and flood zone boundary respectively. The location of the Ancient Monument site along and across the extent of the Flood Zones 2 and 3 will lessen the effectiveness the compensatory measure as this area may not be permissible to be excavated for the required storage and subsequently eliminates 600m of floodplain embankment from being extended back from the corridor link.

A6.10.13. The corridor links enter an area benefiting from 'The Stank' flood defence embankment. This embankment generally runs parallel with the River Lugg (Rhea) and any proposed structure to cross this river will require the finished soffit level to be above the embankment ridge level. This will further elevate the proposed carriageway on the approach from Lugwardine which is currently set between 2.0m and 3.5m above the existing floodplain ground level.

Table A6.9: Outline Drainage: Eastern Inner Corridor Links EL9 – EL12							
Scheme Corridor Link	**Outfall Location (OFL) ID**	**Outfall Chainage (m)**	**Pathway / Receptor**	**Unmitigated Design Discharge (l/s)**	**Greenfield Run-Off Rate at 10l/s/ha (l/s)**	**Potential Site Control**	**Estimated Attenuation Volumes (m^3)**
EL 9	EL 9.1	600	Tributary to River Lugg / Floodplain Channel	246	17.8	Treated Discharge / Hydrobrake	744 - 1038
	EL 9.2	1150	Lugg Functional Floodplain Channels	431	31.1	Treated Discharge / Hydrobrake	1299 - 1814
	EL 9.3	1982	Existing Network / Continue to EL12.1 to River Wye	136	9.9	Treated Discharge / Hydrobrake	414 - 578
EL10	EL10.1	500	Tributary to River Lugg / Floodplain Channel	307	22.2	Treated Discharge / Hydrobrake	928 – 1295
	EL10.2	1050	Lugg Functional Floodplain Channels	328	23.7	Treated Discharge / Hydrobrake	990 – 1383
	EL10.3	1887	Existing Network / Continue to EL12.1 to River Wye	138	10	Treated Discharge / Hydrobrake	418 - 583
EL11	EL11.1	625	Tributary to River Lugg / Floodplain Channel	256	18.5	Treated Discharge / Hydrobrake	773 - 1079
	EL11.2	900	Lugg Functional Floodplain Channels	359	25.9	Treated Discharge / Hydrobrake	1082 - 1511

	EL11.3	2012	Existing Network / Continue to EL12.1 to River Wye	210	15.2	Treated Discharge / Hydrobrake	635 - 887
EL 12	EL12.1	225	Existing Ground / Soak Away	185	13.3	Treated Discharge / Hydrobrake	556 - 776
	EL12.2	750	Unnamed Stream	382	27.6	Treated Discharge / Hydrobrake	1153 - 1610

A6.10.14. Corridor Links EL9 – EL11 tie in to a common location on the B4224 Hampton Park Road before its link with Corridor Link EL12 brings the complete Eastern Outer Corridor to its termination at or continuation through, the B4399 Rotherwas Access Road roundabout and further towards the Southern Corridors. At this stage it is assumed that there is insufficient road drainage within the B4224 to deal with the additional run-off and that the approaching carriageway drainage will continue through to the adjoining Corridor Link EL12 and into Rotherwas Industrial Estate. This area represents one of the highest priority surface water flood risk areas in Hereford. The corridor link drainage will be directed straight back into the River Wye.

A6.10.15. As discussed earlier in this chapter, the strategic approach of discharging immediately into the downstream area of a flooding river is being proposed at this stage on the recommendation of Hereford's SFRA. It will be the responsibility of the relevant statutory organisations to work and plan together to find the optimum surface water management measures for each specific site or area. The Rotherwas Industrial Estate surface management plan is likely to be a pivotal process when identifying and agreeing consent for road surface run-off to the adjacent River Wye from this area and any potential development.

A7. Utilities

A7.1. Summary of Stage 1 Assessment

Overview

A7.1.1. Following consultation with relevant statutory authorities, information regarding underground and overhead service locations was collated.

A7.1.2. Ordnance Survey maps, together with service information provided by the relevant statutory authorities has been used to identify the location of the utilities that may be affected by each proposed route corridor. At Stage 1, utilities which would experience the greatest conflict with the proposed route corridors, and incur the greatest cost to relocate or divert, were identified.

A7.1.3. Within the study, the following statutory authorities consulted were found to have existing apparatus within the study boundary:

- Welsh Water
- British Telecoms
- E-on (Electricity)
- National Grid Gas
- Envoy (Awaiting apparatus information)

A7.1.4. As advised by all statutory authorities, information provided by the statutory authorities may only be taken as a guideline, and service location accuracy cannot be guaranteed.

A7.2. Consultations

Information Requirements

A7.2.1. Additional consultation was undertaken with each of the statutory authorities for this engineering report, to collect information regarding:

- Additional areas outside extents of Stage 1 western corridors
- Information on pylon heights and clearances below existing power lines.

Outstanding Information

A7.2.2. To date, some of the information requested regarding public utilities remains outstanding, this includes:

- Electricity – additional info requested regarding pylon heights and clearances below existing power lines.
- Envoy (Awaiting apparatus information).

Public Utility Strategy

A7.2.3. Information regarding the location of apparatus has been received showing the location in plan, however further information regarding cable heights and required clearances remain outstanding. With this in mind it has been assumed that anywhere an overhead utility crosses the corridor and the proposed levels at that point are above existing ground level, some form of diversionary works should be required. In most other locations where the road is at or below existing ground level, there is still the potential that the clearance under the cabling, may not meet the clearance requirements for a dual carriageway road, and again some form of diversionary works may be required.

A7.2.4. In a similar manner, underground services have been considered to require diversionary works if the proposed levels of the carriageway are below existing ground level, or the service is in close proximity to a proposed structure or roundabout. In some cases, such as high pressure gas mains crossed in existing agricultural land may need improvements to the backfill and cover over the pipeline due to the change in stresses arising from the increased loading on the pipeline. In many other locations the existing utilities can remain intact.

A7.2.5. It should be noted that this strategy provides a preliminary guide to how utilities may be dealt with along each corridor, and the final decision to undertake diversionary works will be made after further detailed consultation with the public utility supplier involved.

A7.3. Impact on Utilities: Southern Corridor Links

Southern Corridor Link 1

A7.3.1. Southern Corridor Link 1 has a medium impact on public utilities. It crosses 66kV overhead transmission lines twice however proposed levels are very close to existing ground levels or in cutting and sufficient vertical clearance should be able to be maintained. A minimum of two sets of portal poles should require to be relocated. An 11kV overhead line is also crossed in cutting.

A7.3.2. The route crosses a 250mm diameter medium pressure gas main at the location of a proposed roundabout on the A465 Belmont Road. This may require diversionary works to facilitate the construction of the roundabout.

A7.3.3. The route also crosses several water distribution mains (up to 150mm Dia.) and both underground and overhead BT cabling which may require minor diversionary works during construction.

Southern Corridor Link 2

A7.3.4. Southern Corridor Link 2 has a similar impact on public utilities as that of Southern Corridor Link 1, although there are fewer utilities present on the A465 Belmont Road where Southern Corridor Link 2 terminates with a proposed roundabout, thus reducing the amount of diversions required and related costs.

Table A7.1: Corridor Links Assessment - Southern Corridor Links

Link Name	Chainage	Supply Network	Details
SC 1	**A49 Ross Road**		
	0	Telecommunication	BT Underground within verge on either side of carriageway and existing lay-by.
	790	Electricity	66kV Overhead Line.
	C1227 Grafton Lane		
	872	Water	Water Main
	C1226 Haywood Lane		
	2090	Water	Water Trunk Main. Ø = 130mm, Cover = 0.9m.
	2090	Telecommunication	BT Underground on C1226
	2223	Electricity	66kV Overhead Line
	2277	Electricity	11kV Overhead Line
	A465 Belmont Road		
	3123	Water	Watermain. Southern Verge. Ø = 150mm, Cover = 0.9m.
	3123	Gas	250mm PE Medium Pressure Gas Main. Southern verge.
	3123	Tele-communication	BT Underground on south verge of carriageway at A465
SC 2	**A49 Ross Road**		
	0	Tele-communication	BT Underground within verge on either side of carriageway and existing lay-by.
	790	Electricity	66kV Overhead Line.
	C1227 Grafton Road		
	872	Water	Water Main

Table A7.1: Corridor Links Assessment - Southern Corridor Links			
Link Name	**Chainage**	**Supply Network**	**Details**
	C1226 Haywood Lane		
	2062	Water	Water Trunk Main. Ø = 130mm, Cover = 0.9m.
	2062	Telecommunication	BT Underground on C1226
	2564	Electricity	66kV Overhead Line
	2874	Electricity	11kV Overhead Line
	A465 Belmont Road		
	3093	Telecommunication	BT Underground and overhead on south verge of carriageway at A465

A7.4. Impact on Utilities: Western Inner Links

Western Link 1

A7.4.1. Western Link 1 starts with a proposed roundabout on the A465 Belmont Road, where gas, water and telecommunication networks are present. Diversionary works may be required to enable the construction of the roundabout. The link then crosses over an 11kV underground line on an embankment.

A7.4.2. At C1199 Ruckhall Lane, existing services should be unaffected as the proposed alignment crosses on an overpass structure.

A7.4.3. There are several services present on the approach to Lower Breinton Road, including overhead BT and E-on services which will require suitable diversionary works, as the proposed alignment is rising on embankments at this point in order to overpass Lower Breinton Road.

A7.4.4. At Upper Breinton Road, existing services may be affected as the proposed alignment passes under the existing road and diversionary works may be required to enable construction of the proposed structure.

A7.4.5. As the alignment approaches the A438 Kings Acre Road, a gravity foul sewer, pumping station and pumped foul sewer are encountered. The pumping station is situated within the proposed alignment, so should require relocation approximately 10m to the west of its current location. This is not anticipated to have a significant impact on the hydraulic design of the existing pipelines, which should be unaffected by the proposed alignment.

A7.4.6. On the A438 Kings Acre Road, several utilities are present in the verges which may need diversion or protection depending upon depth of cover.

Western Link 2

A7.4.7. Western Link 2 folllows the same alignment as Western Link 1 for the first 2km, and therefore encounters the same utilities. The two routes diverge after Lower Breinton Road, however the 11kV overhead electricity line at Upper Breinton Road is still crossed in cutting. The location of existing poles may dictate the need for modifications to the existing poles and alignment of this line.

A7.4.8. The land between Upper Breinton Road and A438 Kings Acre Road is relatively clear of services, with only one 11 kV electricity line being crossed. Again depending upon clearances below the existing line, this may require diversionary works.

A7.4.9. At the proposed junction with the A438 Kings Acre Road, equipment is present from each of the main public utilities. Gas, water and BT are all underground. There is one 11kV overhead electricity line present.

Western Link 3

A7.4.10. Western Link 3 starts and finishes at the same locations as Western Link 1, but takes a shorter, more direct route. As a result the utilities encountered over the initial and final 500m are identical.

A7.4.11. This more direct route enables many of the utilities encountered by Western Link 1 to be avoided, with only one water main and two crossings of an 11kV electricity line.

Western Link 4

A7.4.12. Western Link 4 starts with a proposed roundabout on the A465 Belmont Road following on from Southern Corridor Link 2. At this location as noted in Southern Corridor Link 2, the only utility present is both underground and overhead BT cabling, which may require diversion to facilitate the construction of the roundabout.

A7.4.13. Heading towards the B4349, an 11 kV overhead electricity line is encountered, while gas, water and underground BT services are all present on the B4349. As the alignment is in cutting, up to 2.9m deep, each of these services should require minor diversionary works.

A7.4.14. As the alignment crosses C1199 Ruckhall Lane water and BT services are encountered. At this location the proposed alignment underpasses the existing road, with minor works necessary to incorporate the services within the proposed structure.

A7.4.15. As the alignment nears the River Wye, it turns to follow the alignment of Western Link 3.

Western Link 5

A7.4.16. Western Link 5 starts at the same location as Western Link 3 and follows the same alignment for the first 2km before turning in a north-westerly direction and follows the alignment of Western Link 2.

Western Link 6

A7.4.17. Western Link 6 starts at the same location as Western Link 4 and follows the same alignment for the first 2.5km before turning in a north-westerly direction and follows the alignment of Western Link 2.

Western Link 7

A7.4.18. Western Link 7 starts on the A438 Kings Acre Road at the end of Western Links 1, 3 and 4. On the A438 Kings Acre Road, several utilities are present in the verges which may need diversion or protection depending upon depth of cover.

A7.4.19. Between the A438 Kings Acre Road and A4103 Roman Road, the only utility present is a foul sewer, which is crossed on an embankment of 1.9m, and so should not be affected by the proposed carriageway.

A7.4.20. On the A4103 Roman Road, Gas mains, water mains and overhead BT cables are present. Each utility may require diversionary works in order to facilitate the construction of the proposed roundabout.

Table 7.2: Corridor Links Assessment - Western Inner Links

Link Name	Chainage	Supply Network	Details
WL 1	**A465 Belmont Road**		
	0	Gas	250mm PE Medium Pressure Gas Main. Southern Verge.
	0	Water	Water Main
	0	Telecommunication	BT Underground. Northern Verge.
	234	Electricity	11kV Underground Line
	C1199 Ruckhall Lane		
	485	Water	Water Main
	485	Telecommunication	BT Underground
	1240-1300	Electricity	LV Underground Line

Table 7.2: Corridor Links Assessment - Western Inner Links			
Link Name	**Chainage**	**Supply Network**	**Details**
	1702	Electricity	11kV Overhead Line
	1845	Electricity	11kV Overhead Line
	1854	Telecommunication	BT Overhead
	1873	Water	Water Main
	Lower Breinton Road		
	1922	Water	Water Main
	Upper Breinton Road		
	2624	Telecommunication	BT Underground. Southern Verge.
	2633	Water	Water Main
	2740	Electricity	11kV Overhead Line
	3503	Water	Gravity Sewer Sewage Pumping Station Pumped Foul Sewage
	A438 Kings Acre Road		
	3573	Gas	150mm DI Low Pressure Gas Main. Southern verge.
	3573	Water	Water Main
	3573	Telecommunication	BT Underground. Southern Verge.
	3573	Electricity	11kV Overhead Line. Southern verge.
	3573	Electricity	LV Overhead Line. Northern verge.
WL 2	**A465 Belmont Road**		
	0	Gas	250mm PE Medium Pressure Gas Main. Southern Verge.
	0	Water	Water Main
	0	Telecommunication	BT Underground. Northern verge.
	234	Electricity	11kV Overhead Line
	C1199 Ruckhall Lane		
	485	Water	Water Main
	485	Telecommunication	BT Underground
	1240-1300	Electricity	LV Overhead Line

Table 7.2: Corridor Links Assessment - Western Inner Links			
Link Name	**Chainage**	**Supply Network**	**Details**
	1702	Electricity	11kV Overhead Line
	1845	Electricity	11kV Overhead Line
	1854	Telecommunication	BT Overhead.
	1873	Water	Water Main
	Lower Breinton Road		
	1922	Water	Water Main
	Upper Breinton Road		
	2708	Telecommunication	BT Underground. Southern verge.
	2717	Water	Water Main
	2748	Electricity	11kV Overhead Line
	3632	Electricity	11kV Overhead Line
	A438 Kings Acre Road		
	4346	Gas	3" ST Low Pressure Gas Main. Northern Verge.
	4346	Water	Water Main Foul Sewage
	4346	Telecommunication	BT Underground. Southern verge.
	4346	Electricity	LV Overhead Line. Northern Verge.
WL 3	**A465 Belmont Road**		
	0	Gas	250mm PE Medium Pressure Gas Main. Southern Verge.
	0	Water	Water Main
	0	Telecommunication	BT Underground
	210	Electricity	LV Overhead Line
	220	Electricity	11kV Overhead Line
	C1199 Ruckhall Lane		
	500	Water	Water Main
	500	Telecommunication	BT Underground
	Lower Breinton Road		
	1701	Water	Water Main
	2130	Electricity	11kV Overhead Line

Table 7.2: Corridor Links Assessment - Western Inner Links			
Link Name	**Chainage**	**Supply Network**	**Details**
	Upper Breinton Road		
	2416	Telecommunication	BT Underground. Southern verge.
	2420	Water	Water Main
	2520	Electricity	11kV Overhead Line
	3283	Water	Gravity Sewer Sewage Pumping Station Pumped Foul Sewage
	A438 Kings Acre Road		
	3353	Water	Water Main
	3353	Telecommunication	BT Underground. Southern verge.
	3353	Electricity	11kV Overhead Line. Southern Verge.
	3353	Electricity	LV Overhead Line. Northern Verge.
WL 4	**A465 Belmont Road**		
	0	Telecommunication	BT Underground and Overhead. Southern verge.
	260	Electricity	11kV Overhead Line
	B4349		
	275	Gas	250mm PE Medium Pressure Gas Main. Southern Verge.
	275	Water	Water Main
	285	Telecommunication	BT Underground. Northern verge.
	C1199 Ruckhall Lane		
	1100	Water	Water Main
	1103	Telecommunication	BT Underground. Northern Verge.
	Lower Breinton Road		
	2236	Water	Water Main
	2665	Electricity	11kV Overhead Line
	Upper Breinton Road		
	2949	Water	Water Main
	2950	Telecommunication	BT Underground. Southern verge.

Table 7.2: Corridor Links Assessment - Western Inner Links			
Link Name	**Chainage**	**Supply Network**	**Details**
	3053	Electricity	11kV Overhead Line
	3817	Water	Gravity Sewer Sewage Pumping Station Pumped Foul Sewage
	A438 Kings Acre Road		
	3887	Water	Water Main
	3887	Telecommunication	BT Underground. Southern verge.
	3887	Electricity	11kV Overhead Line. Southern Verge.
	3887	Electricity	LV Overhead Line. Northern Verge.
WL 5	**A465 Belmont Road**		
	0	Gas	250mm PE Medium Pressure Gas Main. Southern Verge.
	0	Water	Water Main
	0	Telecommunication	BT Underground.
	210	Electricity	LV Overhead Line.
	220	Electricity	11kV Overhead Line
	C1199 Ruckhall Lane		
	500	Telecommunication	BT Underground.
	Lower Breinton Road		
	1701		
	2130	Electricity	11kV Overhead Line.
	Upper Breinton Road		
	2425	Water	Water Main
	2430	Telecommunication	BT Underground. Southern verge.
	2465	Electricity	11kV Overhead Line
	3348	Electricity	11kV Overhead Line
	A438 Kings Acre Road		
	4058	Gas	3” ST Low Pressure Gas Main. Northern Verge.
	4058	Water	Water Main Foul Sewage

Table 7.2: Corridor Links Assessment - Western Inner Links			
Link Name	**Chainage**	**Supply Network**	**Details**
	4058	Electricity	11kV Overhead Line. Northern Verge.
	4058	Telecommunication	BT Underground. Southern verge.
WL 6	**A465 Belmont Road**		
	0	Telecommunication	BT Underground and Overhead. Southern verge.
	260	Electricity	11kV Overhead Line
	B4349		
	275	Gas	250mm PE Medium Pressure Gas Main. Southern Verge.
	275	Water	Water Main
	285	Telecommunication	BT Underground. Northern verge.
	C1199 Ruckhall Lane		
	1100	Water	Water Main
	1103	Telecommunication	BT Underground. Northern verge.
	Lower Breinton Road		
	2236	Water	Water Main
	2682	Electricity	11kV Overhead Line
	Upper Breinton Road		
	2950	Water	Water Main
	2964	Telecommunication	BT Underground. Southern verge.
	3000	Electricity	11kV Overhead Line
	A438 Kings Acre Road		
	4596	Gas	3” ST Low Pressure Gas Main. Northern Verge.
	4596	Water	Water Main Foul Sewage
	4596	Telecommunication	BT Underground. Southern verge.
	4596	Electricity	11kV Overhead Line. Northern Verge.
WL 7	**A438 Kings Acre Road**		
	0	Water	Water Main
	0	Telecommunication	BT Underground. Southern verge.

Table 7.2: Corridor Links Assessment - Western Inner Links			
Link Name	**Chainage**	**Supply Network**	**Details**
	0	Electricity	11kV Overhead Line. Southern verge.
	0	Electricity	LV Overhead Line. Northern verge
	543	Water	Abandoned Water Main
	1025	Water	Foul Sewage
	A4103 Roman Road		
	1234	Gas	150mm DI Low Pressure Gas Main. Southern verge.
	1234	Water	Two Water Mains
	1234	Telecommunication	BT Underground. Northern verge.

A7.5. Impact on Utilities: Western Outer Links

Western Link 8

A7.5.1. Western Link 8 starts on the A438 Kings Acre Road at the end of Western Links 2, 5, 6 and 9. As per Western Link 2, numerous underground utilities are present at this location. These may require additional protection, or diversion in order to cope with the increased loading due to the proposed dual carriageway. Overhead electricity is also present which may require diversion depending upon clearance under exiting cables.

A7.5.2. Further along the alignment, on the A480, BT underground cabling and a water main are present. As the road level is to remain at the present level, there should be no impact on the services present.

A7.5.3. The link ends on the A4103 Roman Road where there is a water main and 11kV overhead line present. Both services may require diversionary works in order to facilitate the construction of the proposed roundabout.

Western Link 9

A7.5.4. Western Link 9 starts on the A465 Belmont Road at the end of Southern Corrridor Link 2. At this location as noted in Southern Corridor Link 2, the only utility present is both underground and overhead BT cabling, which may require diversion to facilitate the construction of the roundabout.

A7.5.5. Heading towards the B4349, an 11 kV overhead electricity line is encountered, while gas, water and underground BT services are all present on the B4349. As the alignment is in cutting, up to 2.9m deep, each of these services should require minor diversionary works.

A7.5.6. As the alignment crosses C1199 Ruckhall Lane a water main is encountered. At this location the proposed alignment crosses the existing road at grade. Beyond this an 11kV overhead electricity line is crossed in cutting of 3.5m deep. Repositioning of existing poles may be required in order to span the proposed carriageway.

A7.5.7. Underground BT cabling and a water main are present on the Upper Breinton Road, which may require diversionary works to facilitate the construction of the proposed structure to allow the proposed carriageway to underpass the existing carriageway.

A7.5.8. The link passes under a further two 11kV overhead electricity lines after it crosses Green Lane. Again, subject to assessment, these may require to be raised or diverted underground.

A7.5.9. At the proposed junction with the A438 Kings Acre Road, equipment is present from each of the main public utilities. Gas, water and BT are all underground. There is one 11kV overhead electricity line present.

Western Link 10

A7.5.10. Western Link 10 starts at the same location as WL 9 and follows the same alignment for the first 2500m. WL 10 crosses Upper Breinton Road to the west of WL 9, but the same utilities are encountered.

A7.5.11. This alignment avoids crossing several 11kV overhead electricity lines. There is a water main present on Breinton Lane.

A7.5.12. Western Link 10 ends at a proposed signalised junction on the A438 Kings Acre Road. All four major utilities have plant in this vicinity. As the levels are to remain as existing, underground plant should be unaffected. Overhead plant will require assessment to ensure adequate vertical clearance.

Western Link 11

A7.5.13. Western Link 11 starts on the A438 Kings Acre Road at the end of Western Links 2, 5, 6 and 9. As per Western Link 2, numerous underground utilities are present at this location. These may require additional protection or diversion in order to cope with the increased loading due to the proposed dual carriageway. Overhead electricity is also present which may require diversion depending upon clearance under exiting cables.

A7.5.14. A foul sewer is present for the first 70m approximately and may require diversion as the proposed levels are lower than existing ground level.

A7.5.15. Along the A480 services are quite congested with a water main on the southern side and pumped foul sewer on the northern side. Underground BT cabling and both LV and 11kV overhead electricity lines are present in close proximity to the exiting carriageway, and may require diversionary works.

Western Link 12

A7.5.16. Western Link 12 starts on the A438 Kings Acre Road at the end of Western Link 10. All four major utilities have plant in this vicinity. As the levels are to remain as existing, underground plant should be unaffected. Overhead plant will require assessment to ensure adequate vertical clearance.

A7.5.17. Two 11kV overhead electricity lines are crossed on low embankments of approximately 1m high, and so should require to either be raised or diverted underground.

A7.5.18. On the approach to the roundabout, the utilities are quite congested, with each of the major utilities having apparatus running along the original alignment of the A480, before the current roundabout junction with the A4103 Roman Road was constructed. The proposed levels are as existing, so underground services should be unaffected. Overhead services will require assessment to decide on suitable approach.

Western Link 13

A7.5.19. Western Link 13 starts at the existing roundabout at the western end of the A4103 Roman Road and heads in an eastern direction. A medium pressure gas main and a water main are present along the length of the link. As this road is being widened, utilities which were originally installed in the grass verge, may now be located within a live traffic lane. If cover depth is insufficient, diversion of this service may be required to locate within the proposed verge.

A7.5.20. An overhead LV electricity line is also present near the end of the link which may need to be raised to provide sufficient vertical clearance.

Western Link 14

A7.5.21. Western Link 14 is a continuation of Western Link 13 along the A4103 Roman Road. Gas and water mains continue along the carriageway as per Western Link 13. There are also some overhead cables crossing the alignment at various locations which may need assessed to ensure that they provide adequate vertical clearance in line with the requirements of the proposed dual carriageway standard.

Table 7.3: Corridor Links Assessment - Western Outer Links

Link Name	Chainage	Supply Network	Details
WL 8	**A438 Kings Acre Road**		
	0	Gas	3” ST Low Pressure Gas Main. Northern verge.
	0	Water	Water Main Foul Sewage
	0	Telecommunication	BT Underground. Southern verge.
	0	Electricity	11kV Overhead Line. Southern verge.
	0	Electricity	LV Underground Line. Northern Verge.
	A480		
	100	Water	Water Main

Table 7.3: Corridor Links Assessment - Western Outer Links			
Link Name	**Chainage**	**Supply Network**	**Details**
	115	Telecommunication	BT Underground. Eastern verge.
	600	Water	Abandoned Water Main
	A4103 Roman Road		
	1093	Water	Abandoned Water Main Water Main
WL 9	**A465 Belmont Road**		
	0	Telecommunication	BT Underground and Overhead. Southern verge.
	260	Electricity	11kV Overhead Line.
	B4349		
	293	Gas	250mm PE Medium Pressure Gas Main. Southern Verge.
	293	Water	Water Main
	298	Telecommunication	BT Underground
	C1199 Ruckhall Lane		
	1302	Water	Water Main
	1685	Electricity	11kV Overhead Line.
	Upper Breinton Road		
	3015	Water	Abandoned Water Main.
	3020	Water	Water Main.
	3020	Telecommunication	BT Underground. Northern verge.
	3080	Electricity	11kV Overhead Line.
	3668	Electricity	11kV Overhead Line.
	3784	Electricity	11kV Overhead Line.
	A438 Kings Acre Road		
	4360	Gas	3” ST Low Pressure Gas Main. Northern verge.
	4360	Water	Water Main Foul Sewage
	4360	Electricity	11kV Overhead Line. Northern verge.
	4360	Telecommunication	BT Underground. Southern verge.

Table 7.3: Corridor Links Assessment - Western Outer Links			
Link Name	**Chainage**	**Supply Network**	**Details**
WL 10	**A465 Belmont Road**		
	0	Telecommunication	BT Underground and Overhead. Southern verge.
	260	Electricity	1kV Overhead Line
	B4349		
	293	Gas	250mm PE Medium Pressure Gas Main. Southern Verge.
	293	Water	Water Main
	298	Telecommunication	BT Underground. Northern verge.
	C1199 Ruckhall Lane		
	1302	Water	Water Main
	1685	Electricity	11kV Overhead Line
	Upper Breinton Road		
	3015	Water	Abandoned Water Main Water Main
	3024	Telecommunication	BT Underground. Northern verge.
	3034	Electricity	11kV Overhead Line
	Green Lane		
	3765	Water	Abandoned Water Main Water Main
	A438 Kings Acre Road		
	4900	Gas	3” ST Low Pressure Gas Main. Northern Verge.
	4900	Water	Water Main Foul Sewage
	4900	Telecommunication	BT Underground and Overhead. Southern verge.
	4900	Electricity	LV Overhead Line. Northern Verge.
WL 11	**A438 Kings Acre Road**		
	0	Gas	3” ST Low Pressure Gas Main. Northern Verge.
	0	Water	Water Main

Table 7.3: Corridor Links Assessment - Western Outer Links			
Link Name	**Chainage**	**Supply Network**	**Details**
	0-70		Foul Sewage
	0	Telecommunication	BT Underground. Southern verge.
	0	Electricity	11kV Overhead Line. Southern Verge.
	0	Electricity	LV Underground Line. Northern Verge
	A480		
	200-500	Water	Water Main (LHS Carriageway)
	230-875	Telecommunication	BT Underground. North eastern verge
	250	Electricity	LV Overhead Line. North-eastern Verge.
	310	Electricity	11kV Overhead Line
	420-1000	Water	Pumped Foul Sewage (RHS Carriageway). Diameter = 125mm.
WL 12	**A438 Kings Acre Road**		
	0	Gas	3" ST Low Pressure Gas Main. Northern Verge.
	0	Water	Water Main Foul Sewage. Diameter = 110mm. Cover = 0.9m.
	0	Telecommunication	BT Underground and Overhead. Southern verge.
	0	Electricity	LV Overhead Line. Northern Verge.
	270	Electricity	11kV Overhead Line
	416	Water	Abandoned Water Main
	500-530	Electricity	11kV Overhead Line
	A480		
	661	Electricity	LV Overhead Line
	667	Water	Water Main. Diameter = 160mm.
	667	Telecommunication	BT Underground. Crossing at 90°.
	668	Gas	Low Pressure Gas Main. Crossing at 90°.
	671	Water	Foul Sewage. Diameter = 125mm.
	676	Telecommunication	BT Overhead. Crossing at 90°.
	701	Water	Pumped Foul Sewer. Diameter = 125mm. Pumped Foul Sewer. Diameter = 150mm.

Table 7.3: Corridor Links Assessment - Western Outer Links			
Link Name	**Chainage**	**Supply Network**	**Details**
WL 13	**A4103 Roman Road**		
	0-867	Gas	180mm PE Medium Pressure Gas Main. Northern Verge.
	0-867	Water	Abandoned Water Main Water Main
	805	Electricity	LV Overhead Line
WL 14	**A4103 Roman Road**		
	0-758	Gas	180mm PE Medium Pressure Gas Main. Northern Verge.
	0-758	Water	Abandoned Water Main Water Main
	367	Electricity	LV Overhead Line
	370	Telecommunication	BT Underground
	579	Water	Foul Sewage. Diameter = 450mm, Invert = 60.117m AOD.
	660-758	Telecommunication	BT Overhead

A7.6. Impact on Utilities: Northern Corridor Links

North Corridor Link 1

A7.6.1. North Corridor Link 1 starts with a proposed roundabout on the A4103 Roman Road at the end of the Western Corridors. The exiting water mains and overhead BT cabling may require diversion to facilitate the construction of the proposed roundabout.

A7.6.2. Prior to Tillington Road, an 11 kV overhead electricity line is crossed on an embankment approximately 7m high. This service should require to be diverted underground. Numerous services are present along Tillington Road, but as the proposed alignment overpasses this road, existing services should be unaffected.

A7.6.3. Beyond Tillington Road, the alignment crosses a combined sewer on an embankment, and four 11kV overhead electricity lines meet in the middle of the proposed alignment, and so will require diversionary works.

A7.6.4. At A4110 Canon Pyon Road a water main and underground BT cabling are present which will be incorporated into the proposed structure to carry the existing road over the proposed alignment.

A7.6.5. One further 11kV electricity line is crossed prior to the A49 Holmer Road on an embankment of approximately 1.5m and so may require to be diverted underground. On the A49 Holmer Road itself, two underground BT services are present which may require diversionary works to facilitate the construction of the proposed roundabout.

North Corridor Link 2

A7.6.6. North Corridor Link 2 starts and ends at the same locations as North Corridor Link 1, however it has an improved horizontal alignment over the first 1500m. This means that its impact on utilities in the area is very similar to that of North Corridor Link 1, even though it crosses some of the utilities at a different location to that in Northern Corridor Link 1.

North Corridor Link 3

A7.6.7. North Corridor Link 3 starts on the A49 Holmer Road at the end of North Corridors 1 and 2. Two underground BT services are present which may require diversionary works to facilitate the construction of the proposed roundabout. Close by there is also a water main, which may also require diversion.

A7.6.8. Approaching Coldwells Road, the proposed alignment begins to rise to pass over this road. As a result the existing water main should be unaffected but the overhead BT cabling may need to be diverted underground.

A7.6.9. Beyond this the route crosses five electricity line, two carrying 11kV and three 66kV, all of which are on embankments of varying heights. Each line would need to be assessed individually to determine proposed vertical clearance and whether this is permissible.

A7.6.10. As the alignment meets the A4103 Roman Road again, a 12” high pressure gas main is encountered, with the proposed carriageway level approximately 2m above existing throughout. A LV overhead line is also present which will require approximately 210m of diversionary works required.

North Corridor Link 4

A7.6.11. North Corridor Link 4 starts and ends at the same location as Northern Corridor Link 3, and follows the same alignment for the first 900m, before changing course to cross the railway further to the north. Over this distance, many of the same major utility are encountered with a similar extent of diversionary works required, although fewer utilities are encountered on the approach to the proposed roundabout as the land is currently used for agriculture.

Table 7.4: Corridor Links Assessment - Northern Corridor Links

Link Name	Chainage	Supply Network	Details
NC 1	**A4103 Roman Road**		
	0	Water	Two Water Mains
	0	Telecommunication	BT Overhead. Northern verge.
	400	Electricity	11kV Overhead Line
	Tillington Road		
	460	Water	Abandoned Trunk Water Main
	466	Telecommunication	BT Underground. Western verge.
	466	Gas	(Size see Pg 21) Medium Pressure Gas Main. Western Verge.
	477	Water	Water Main
	633	Water	Combined Sewage. Diameter = 150mm.
	645-734	Water	Trunk Water Main. Diameter = 500mm.
	650-710	Electricity	11kV Overhead Lines. 2No. Crossing.
	A4110 Canon Pyon Road		
	1098	Water	Trunk Water Main. Diameter = 500mm.
	1100	Telecommunication	BT Underground. Western verge.
	1109	Water	Water Main
	2545	Electricity	11kV Overhead Line
	A49 Holmer Road		
	2642	Telecommunication	BT Underground (2No.) Both verges.
NC 2	**A4103 Roman Road**		
	0	Water	

Table 7.4: Corridor Links Assessment - Northern Corridor Links			
Link Name	**Chainage**	**Supply Network**	**Details**
	0	Telecommunication	BT Overhead. Northern verge.
	360	Electricity	11kV Overhead Line
	490	Electricity	11kV Overhead Line
	Tillington Road		
	553	Water	Abandoned Water Main
	563	Telecommunication	BT Underground. Western verge.
	565	Gas	(Size see Pg 21) Medium Pressure Gas Main
	788	Electricity	11kV Overhead Line
	817	Water	Combined Sewage
	A4110 Canon Pyon Road		
	1213	Water	Trunk Water Main. Diameter = 500mm.
	1215	Telecommunication	BT Underground. Western verge.
	1223	Water	Water Main
	2656	Electricity	11kV Overhead Line
	A49 Holmer Road		
	2753	Telecommunication	BT Underground (2No.) Both Verges.
NC 3	**A49 Holmer Road**		
	0	Telecommunication	BT Underground (2No.) Both Verges.
	17-115	Water	Existing Trunk Water Main
	Coldwells Road		
	576	Telecommunication	BT Overhead. Northern verge.
	584	Water	Water Main
	900	Electricity	11kV Overhead Line
	1105	Electricity	11kV Overhead Line
	1195	Electricity	66kV Overhead Line
	1245	Electricity	66kV Overhead Line
	1270	Electricity	66kV Overhead Line
	1700	Telecommunication	BT Overhead.
	1807	Electricity	11kV Overhead Line

Table 7.4: Corridor Links Assessment - Northern Corridor Links			
Link Name	**Chainage**	**Supply Network**	**Details**
	1930-2100	Gas	12” ST High Pressure Gas Main. Crossing at shallow angle.
	1985-2150	Electricity	LV Overhead Line
	2000-2331	Water	Water Main
	Aylestone Hill Road		
NC 4	**A49 Holmer Road**		
	17-115	Water	Existing Trunk Water Main. Diameter = 450mm, Cover = 0.9m.
	Coldwells Road		
	576	Telecommunication	BT Overhead. Northern verge
	584	Water	Water Main
	940	Electricity	11kV Overhead Line
	1072	Electricity	11kV Overhead Line
	1480	Electricity	66kV Overhead Line
	1833	Electricity	11kV Overhead Line
	1938	Electricity	66kV Overhead Line
	1969	Electricity	66kV Overhead Line
	2064	Gas	12” ST High Pressure Gas Main.
	Aylestone Hill Road		
	2331	Water	Water Main

A7.7. Impact on Utilities: Eastern Inner Links

Eastern Link 1

A7.7.1. Eastern Link 1 starts at the junction of the A465 Roman Road and A465 Aylestone Hill. Two water mains are present at this location and may require diversionary works to facilitate construction of the proposed roundabout.

A7.7.2. An 11kV overhead electricity line then intersects the proposed alignment several times over a distance of approximately 500m. As the alignment is in a flood plain, it is raised above existing ground levels on an embankment. Diversion of his line should be required.

A7.7.3. As the alignment approaches the A438 Ledbury Road, it crosses several additional underground services including BT, combined sewer and medium pressure gas main. Levels are to be kept as existing however, some diversionary works may be required to facilitate the construction of the proposed roundabout.

Eastern Link 2

A7.7.4. Eastern Link 2 follows on from Eastern Link 1 and encounters the same utilities initially at the proposed roundabout. An 11kV electricity line is also crossed, with the proposed carriageway level close to existing levels.

A7.7.5. On the B4224 Hampton Park Road a water main and medium pressure gas main are present at the location of the proposed roundabout.

Eastern Link 3

A7.7.6. On the B4224 Hampton Road, a water main and medium pressure gas main are present which may require diversion to facilitate construction of the proposed roundabout. A low voltage overhead electricity line also intersects the proposed alignment close by, and may require to be diverted underground.

A7.7.7. After crossing the River Wye, several water mains and a foul sewer are present, however the proposed levels at this point are close to existing ground level, and so it is not anticipated that diversionary works will be required.

A7.7.8. Overhead BT cabling is also present, which may require the cables to be raised or diverted underground.

A7.7.9. At the end of the link several utilities are present, including water, medium pressure gas and underground BT which may need to be diverted to facilitate construction of the proposed roundabout.

Table 7.5: Corridor Links Assessment - Eastern Inner Links			
Link Name	**Chainage**	**Supply network**	**Details**
EL 1	**A465 Aylestone Hill**		
	0	Water	Water Main
	25	Water	Water Main
	362-580	Electricity	11kV Overhead Line
	848	Electricity	11kV Overhead Line
	2072	Telecommunication	BT Underground. Northern Verge
	A438 Ledbury Road		
	2114	Gas	10" ST Medium Pressure Gas Main. In eastbound lane.
	2114	Water	Water Main.
	2114	Telecommunication	BT Underground. Northern Verge
EL 2	**A438 Ledbury Road**		
	0	Water	Combined Sewage. Diameter = 200mm, Invert = 65.253m AOD.
	0	Telecommunication	BT Underground. Northern verge
	1013	Electricity	11kV Overhead Line
	B4224 Hampton Park Road		
	1296	Gas	10" ST Medium Pressure Gas Main. Southern Verge.
	1296	Water	Water Main
EL 3	**B4224 Hampton Park Road**		
	0	Water	Water Main
	10	Gas	125mm PE Medium Pressure Gas Main. Southern Verge.
	25	Electricity	LV Overhead Line
	River Wye		
	732	Water	Water Main
	888	Water	Water Main
	914	Water	Water Main
	930	Telecommunication	BT Overhead

Table 7.5: Corridor Links Assessment - Eastern Inner Links			
Link Name	**Chainage**	**Supply network**	**Details**
	1133	Water	Foul Sewage. Diameter = 250mm.
	1164-1293	Telecommunication	BT Underground
	1194-1293	Water	Water Main Foul Sewage Surface Water
	1250	Water	Water Main
	B4399 The Straight Mile Road		
	1290	Water	Water Main
	1293	Gas	180mm PE Medium Pressure Gas Main. Northern Verge changing to Southern Verge after junction.
	1293	Telecommunication	BT Underground. Southern verge

A7.8. Impact on Utilities: Eastern Outer Links

Eastern Link 4

A7.8.1. Eastern Link 4 crossing under three 66kV electricity lines with the proposed levels close to existing. This maintains the vertical clearance under the apparatus, but further consultation with the electricity service provider would be required to confirm that this clearance is sufficient for the proposed carriageway. A medium pressure gas main is also present in the southern verge, which may need to be diverted to enable the widening of the existing carriageway.

Eastern Link 5

A7.8.2. Eastern Link 5 follows along the same route as Eastern Link 4 for the first 730m, encountering the same utilities. Beyond this, several gas pipelines are present, including a 10” high pressure main, along the existing carriageway and cross over to connect with pipe work on the A465. As the road is being widened, and the profile is to remain as current, it is not anticipated that diversionary works will be required along the length of the carriageway, however some diversionary works may be required to facilitate the construction of the proposed roundabout.

Eastern Link 6

A7.8.3. Eastern Link 6 starts with a proposed roundabout at the end of Eastern Link 4, encountering BT, Gas and a water main at this location with potential diversionary works required. Beyond this two overhead electricity lines are present which may need to be diverted underground. The proposed alignment crosses two 10" medium pressure gas mains, a combined sewer and a 10" high pressure gas main. The proposed levels at this point are close to existing ground level, and so diversionary works are not anticipated.

A7.8.4. On the A438 Ledbury Road, underground BT is present which may require diversionary works.

Eastern Link 7

A7.8.5. Eastern Link 7 starts at the end of Western Link 5 and heads south. Its impact on utilities is low with only an 11kV electricity cable potentially needing to be diverted underground.

Eastern Link 8

A7.8.6. Eastern Link 8 follows a similar route to Eastern Link 7 and encounters the same utilities with the same impacts.

Eastern Link 9

A7.8.7. The major impacts of Eastern Link 9 upon existing public utilities are crossing under three 66kV electricity lines on an embankment up to 1.3m high. This reduces the vertical clearance under the apparatus and as a result may necessitate, pending further investigation, that the cables either be raised or diverted underground. A 10" high pressure gas main is also crossed by the alignment, which may need improved protection due to the change in loading conditions.

Eastern Link 10

A7.8.8. Eastern Link 10 encounters exactly the same utilities as those of Eastern Link 9 and the vertical alignments are matching, thus the impact upon public utilities is broadly similar.

Eastern Link 11

A7.8.9. Eastern Link 11 is similar to Eastern Links 9 and 10 with the addition of a 125mm medium pressure gas main, which may require diversionary works to facilitate the construction of the proposed roundabout.

Eastern Link 12

A7.8.10. Eastern Link 12 starts at the end of Eastern Links 9, 10 and 11 on the B4224 Hampton Park Road at a proposed roundabout. At this location there is a medium pressure gas main and water main present. After crossing the River Wye, several underground services are encountered, with the proposed level being above the existing ground level, and so this should not present a problem. A BT overhead cable is present and may require diversion underground.

A7.8.11. The link ends on the B4399 The Straight Mile with a proposed roundabout. Underground BT and a medium pressure gas main are present within the existing road cross section and may require diversionary works to facilitate the construction of the proposed roundabout.

Table 7.6: Corridor Links Assessment - Eastern Outer Links

Link Name	Chainage	Supply Network	Details
EL 4	**A465 Aylestone Hill**		
	0-729	Water	Water Main
	250	Electricity	66kV Overhead Line
	277	Electricity	66kV Overhead Line
	340	Electricity	66kV Overhead Line
	385-729	Telecommunication	BT Underground. Both verges
	729	Gas	63mm PE Medium Pressure Gas Main. Southern verge of Roman Road.
EL 5	**A465 Aylestone Hill**		
	0-1242	Water	Water Main
	250	Electricity	66kV Overhead Line
	277	Electricity	66kV Overhead Line
	340	Electricity	66kV Overhead Line
	385-950	Telecommunication	BT Underground. Both verges
	720-920	Gas	63mm PE Medium Pressure Gas Main. Southern verge of Roman Road
	920-1242	Gas	10” ST Medium Pressure Gas Main. Crossing onto A465 and northern verge of Roman Road.
	1015	Gas	10” ST High Pressure Gas Main. Crossing at

Table 7.6: Corridor Links Assessment - Eastern Outer Links			
Link Name	**Chainage**	**Supply Network**	**Details**
			90°.
	1052	Electricity	11kV Overhead Line
EL 6	**A465 Aylestone Hill**		
	0	Gas	63mm PE Medium Pressure Gas Main. Southern Verge of Roman Road.
	0	Water	Water Main
	0	Telecommunication	BT Underground (2No.)
	100	Electricity	11kV Overhead Line
	557	Electricity	11kV Overhead Line
	707	Gas	10” ST Medium Pressure Gas Main. Crossing at 45°.
	720-1940	Gas	10” ST Medium Pressure Gas Main. Southern verge of Roman Road.
	1140	Water	Combined Sewage. Diameter = 150mm.
	1175	Gas	10” ST High Pressure Gas Main. 1.2m Cover. Crossing at 45°.
	A438 Ledbury Road		
	1910	Telecommunication	BT Underground.
EL 7	**A465 Aylestone Hill**		
	486	Electricity	11kV Overhead Line
	625	Water	Combined Sewage. Diameter = 150mm.
	A438 Ledbury Road		
	1452	Telecommunication	BT Underground. Northern verge
EL 8	**A465 Aylestone Hill**		
	486	Electricity	11kV Overhead Line
	625	Water	Combined Sewage. Diameter = 150mm.
	A438 Ledbury Road		
	1488	Telecommunication	BT Underground. Northern verge
EL 9	**A438 Ledbury Road**		
	0	Telecommunication	BT Underground.

Table 7.6: Corridor Links Assessment - Eastern Outer Links			
Link Name	**Chainage**	**Supply Network**	**Details**
			Northern verge
	876	Electricity	66kV Overhead Line
	950	Electricity	66kV Overhead Line
	975	Electricity	66kV Overhead Line
	1180	Gas	10” St High Pressure Gas Main. Crossing at 30°.
	1948	Electricity	11kV Overhead Line
	B4224 Hampton Park Road		
	1982	Water	Water Main
EL 10	**A438 Ledbury Road**		
	794	Electricity	66kV Overhead Line
	872	Electricity	66kV Overhead Line
	895	Electricity	66kV Overhead Line
	1113	Gas	10” ST High Pressure Gas Main. Crossing at 30°.
	1853	Electricity	11kV Overhead Line
	B4224 Hampton Park Road		
	1887	Water	Water Main
EL 11	**A438 Ledbury Road**		
	794	Electricity	66kV Overhead Line
	872	Electricity	66kV Overhead Line
	895	Electricity	66kV Overhead Line
	1268	Gas	10” ST High Pressure Gas Main. Crossing at 30°.
	1853	Electricity	11kV Overhead Line
	B4224 Hampton Park Road		
	2012	Gas	125mm PE Medium Pressure Gas Main. Southern Verge B4224.
	2012	Water	Water Main
EL 12	**B4224 Hampton Park Road**		

Table 7.6: Corridor Links Assessment - Eastern Outer Links			
Link Name	**Chainage**	**Supply Network**	**Details**
	0	Gas	125mm PE Medium Pressure Gas Main. Southern verge.
	0	Water	Water Main
	River Wye		
	520-1381	Water	Surface Water
	900-950	Water	Water Main
	975-1037	Telecommunication	BT Overhead
	1024-1250	Telecommunication	BT Underground (3No.)
	1025	Water	Water Main
	1030	Water	Water Main
	1120-1381	Water	Water Main Surface Water
	1260-1381	Water	Foul Sewage. Diameter = 250mm.
	1335	Water	Water Main
	B4399 The Straight Mile		
	1381	Water	180mm PE Medium Pressure Gas Main. Northern Verge changing to Southern Verge after junction.
	1381	Telecommunication	BT Underground. Southern verge

A7.9. Future Public Utility Requirements

A7.9.1. Consultations with public utility providers was commenced as part of this Engineering Report, but due to the constrained timescale for completion, has not been able to produce the required feedback in order to plan for future public utility requirements.

A7.9.2. As a result an indicative road cross section and preliminary proposals for utilities to be installed as part of the relief road works package, has been drawn up and can be seen in Figure A3.1 in section A3. It is anticipated that this proposal should be refined in the future when input from public utility providers becomes available, but that the assumptions made should be sufficient to enable a cost estimate for the works to be completed.

A8. Preliminary Assessment of Structures

A8.1. Structural Assessment Criteria

A8.1.1. Each of the proposed corridor links will involve the construction of a number of major and minor structures, including, bridges, underpasses and culverts. Some proposals will also include modifying existing structures in order to accommodate a wider cross section of carriageway associated with the relief road.

A8.1.2. Proposals for the modification of existing structures to accommodate the wider carriageway section have been based on visual assessment. Some corridor links involve potential modification of listed structures and any such proposal should be predicated by consultation with Environment Agency and other relevant statutory and non-statutory bodies. Detailed inspection and assessment of any existing bridges or structures would have to be conducted before any proposal for modification is considered to support the preferred alignment (Stage 3).

A8.1.3. New proposals for structures have been made on the basis of site visits and assessment of the topography of the area. Proposed structures have been assessed for clearance based on information from the vertical alignment of the individual corridor links. In the case of overpasses/underpasses the span of the bridge required has often been dictated by the width of route passing over/under it. Clearance has largely been specified in accordance with DMRB Standard TD27/05 “Cross Sections and Headrooms.” For river bridges and viaducts crossing floodplains the span and height of the bridge has been dictated by the size of the floodplain over which it spans.

A8.1.4. Any additional requirements for pedestrian crossing by way of footbridges or subways will bring with them additional associated costs. The magnitude and cost impact of any such works shall be studied in greater detail following consultations with the relevant statutory and non-statutory bodies.

A8.1.5. Additional requirements for cattle creeps will be dependent on a number of criteria including daily movement of stock, herd size and proportion of land either side of the carriageway. Such criteria have yet to be confirmed and as such the number of cattle creeps is unknown at this stage. When more details are available, the overall dimension and location of such underpasses can be confirmed to inform the selection process of Stage 3.

A8.1.6. Sections A9.2 to A9.7 cover each corridor in turn assessing the requirements for and the scale of any structures required. Recommendations made should be carried forward to the Stage 3 "Structures Required" section as per the requirements of DMRB standard TD37/93. The final choice of a particular structure will depend on many factors such as the availability of land, cost of the structure and the phasing of the project.

A8.1.7. At this stage, it is proposed that the Hereford Relief Road will take the form of a dual all purpose road (D2AP). Therefore when considering the range of structures that will be required, Figure A8.1 below shows a typical cross section of an overbridge and an underbridge in accordance with TD27/05: Cross Sections and Headrooms. However, should the relief road take the form of a wide single carriageway (WS2), Figure A8.2 shows the typical cross section of an overbridge and underbridge associated with this road type.

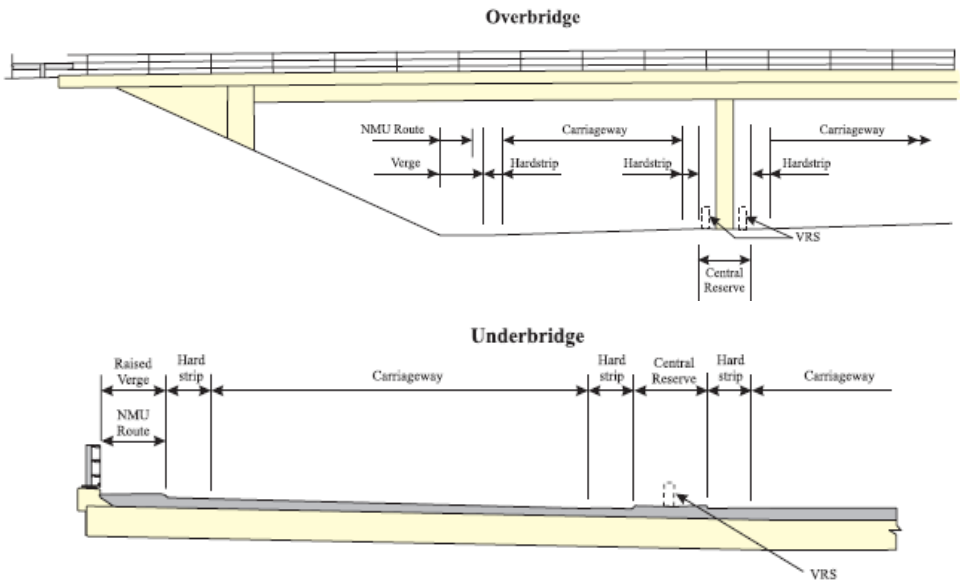


Fig A8.1: Rural All-purpose Dual Carriagway: Typical Overbridge and Underbridge

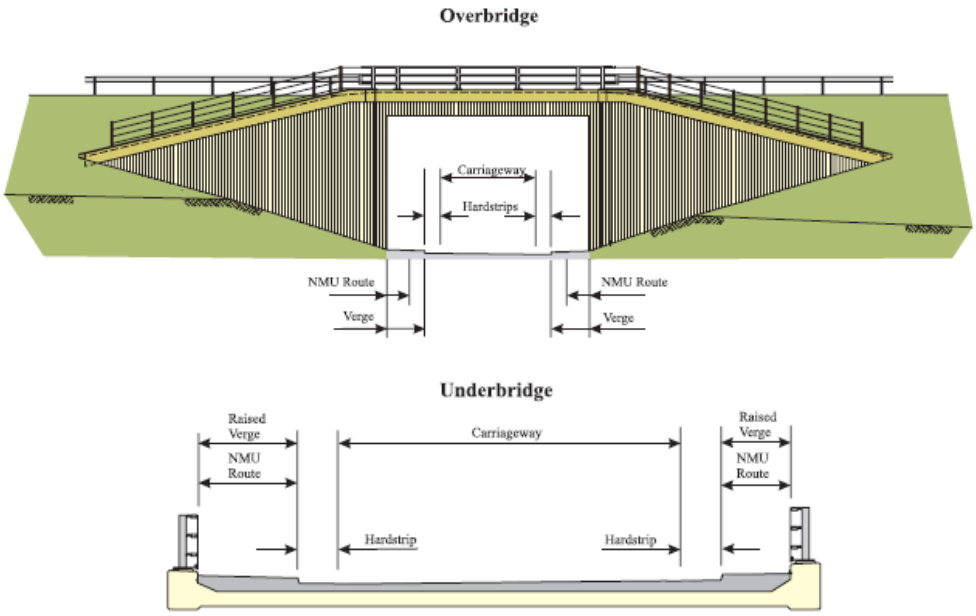


Fig A8.2: Rural All-purpose Single Carriageway: Typical Overbridge and Underbridge

A8.2. Southern Corridor

A8.2.1. The Southern Corridor consists of two links which are common to both the western and eastern alignments. The links associated with this corridor are shown on Map A0.03 in Appendix A. Table A8.1 summarises the structures required for the corridor.

Table A8.1: Structures Summary – Southern Corridor

Link	No	Structure Type (Cost Type)	Start Ch (m)	Span (m)	Clearance (m)	Skew (°)	Additional Information
SC1	1	Culvert (E)	915	TBC	TBC	50	Existing culvert to be extended
	2	Culvert (E)	1450	TBC	TBC	0	-
	3	Railway bridge (A)	1700	15	7.5	0	6.5m clearance maintained to railway lines
	4	Underpass (C)	2150	25	5.6	30	-

Table A8.1: Structures Summary – Southern Corridor							
Link	**No**	**Structure Type (Cost Type)**	**Start Ch (m)**	**Span (m)**	**Clearance (m)**	**Skew (°)**	**Additional Information**
	5	Bridge (C)	2750	100	8.0	0	Spanning Newton Brook at Newton Coppice Haywood Forest Park
SC2	1	Culvert (E)	915	TBC	TBC	50	Existing culvert to be extended
	2	Culvert (E)	1460	TBC	TBC	0	
	3	Railway Bridge (A)	1725	15	7.5	30	6.5m clearance maintained to railway lines
	4	Underpass (C)	2084	25	6.0	0	

Long Span/Complex Structures

A8.2.2. Railway Bridge at Merry Hill: For both Southern Corridor Links SC1 and SC2 a bridge structure with an approximate span of 15m will be required to cross the Hereford to Newport Railway line located near to an existing structure at Merry Hill. A clearance height of at least 6.5m will have to be maintained across the railway lines to comply with current railway group standards (RSSB).

A8.2.3. Bridge Structure at Haywood Forest Park: An additional structure will be required to cross the Newton Brook and associated flood plain located at Haywood Forest Park for Southern Corridor Link SC1. Newton Brook is located within a 10-12m deep gorged channel and the proposed structure has been identified as a mitigating solution to both span the low laying brook and to avoid unnecessary depletion of surrounding woodland and park amenities at Newton Coppice. This structure is likely to require a span of approximately 100m with a clearance height of approximately 8m. Any proposed structure would have to provide adequate clearance for the existing flood zones.

A8.3. Western Inner Corridor

A8.3.1. The Western Inner Corridor consists of seven links and will provide a link between the A4103 Roman Road before traversing the A49 and ending at the A4103 Roman Road Roundabout junction. The links associated with this corridor are shown on Map A0.03. Table A8.2 summarises the structures required for the corridor.

Table A8.2: Structures Summary – Western Inner Corridor

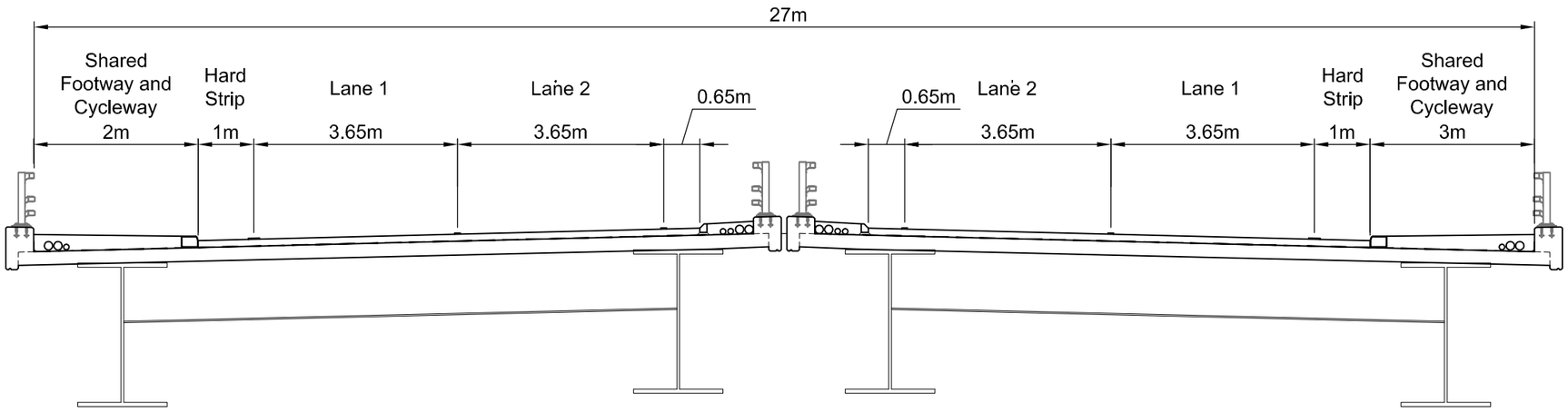
Link	No	Structure Type (Cost Type)	Start Ch (m)	Span (m)	Clearance (m)	Skew (°)	Additional Information
WL1	1	Overpass (C)	490	25	5.0	0	Spanning C1199 Ruckhall Lane
	2	Culvert (E)	605	TBC	TBC	40	
	3	Viaduct (D)	1050	200	9.0	0	Spanning extents of floodplain 3
	4	Overpass (C)	1960	25	5.0	50	Spanning Lower Brenton Road
	5	Underpass(C)	2625	15	7.9	0	Spanning Hill Road
WL2	1	Overpass (C)	480	25	5.0	0	Spanning C1199 Ruckhall Lane
	2	Culvert (E)	605	TBC	TBC	40	
	3	Viaduct (D)	1050	200	9.0	0	Spanning extents of floodplain 3
	4	Overpass (C)	1900	25	7.1	35	Spanning C1189 Lower Brenton Road
	5	Underpass(C)	2700	15	6.2	30	Spanning Hill Road
WL3	1	Overpass (C)	500	25	5.0	0	Spanning C1199 Ruckhall Lane
	2	Culvert (E)	560	TBC	TBC	40	
	3	Viaduct (D)	1000	300	9.0	0	Spanning extents of floodplain 3
	4	Underpass(C)	1700	15	5.0	0	Spanning C1189 Lower Brenton Road
	5	Underpass(C)	2420	15	6.9	0	Spanning U73022 Hill Road

Table A8.2: Structures Summary – Western Inner Corridor							
Link	**No**	**Structure Type (Cost Type)**	**Start Ch (m)**	**Span (m)**	**Clearance (m)**	**Skew (°)**	**Additional Information**
WL4	1	Culvert(E)	950	TBC	TBC	40	Spanning C1199 Ruckhall Lane
	2	Underpass(C)	1150	15	5.0	0	
	3	Viaduct(D)	1500	300	9.0	0	Spanning extents of floodplain 3
	4	Underpass(C)	2230	15	5.0	0	Spanning C1189 Lower Brenton Road
	5	Underpass(C)	2950	15	5.0	0	Spanning U730022 Hill Road
WL5	1	Overpass(C)	500	25	5.26	0	Spanning C1199 Ruckhall Lane
	2	Culvert(E)	560	TBC	TBC	40	
	3	Viaduct(D)	1000	300	9.0	0	Spanning extents of floodplain 3
	4	Underpass(C)	1700	15	5.0	0	Spanning C1189 Lower. Brenton Road
	5	Underpass(C)	2420	15	6.1	0	Spanning U730022 Hill Road
WL6	1	Culvert(E)	950	TBC	TBC	40	Spanning C1199 Ruckhall Lane
	2	Overpass(C)	1175	25	5.0	0	
	3	Viaduct(D)	1550	250	9.0	0	Spanning extents of floodplain 3
	4	Underpass(C)	2230	15	5.0	0	Spanning C1189 Lower Brenton Road
	5	Underpass(C)	2925	15	6.5	20	Spanning U730022 Hill Road
WL7	1	Culvert(E)	1650	TBC	TBC	35	Flood relief of Yazor Brook and Flood Plain

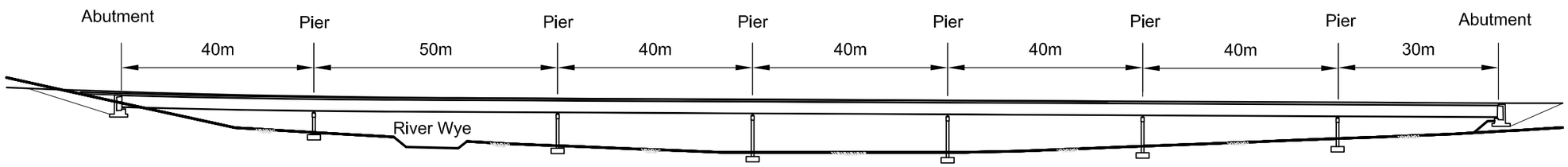
Long Span/Complex Structures

A8.3.2. River Wye Cross (Western Inner Corridors): Western inner corridor links WL1, WL2, WL3, WL4, WL5 and WL6 will all require the construction of a major viaduct structure to cross the River Wye and associated floodplain. Based on information provided by Environment Agency (EA) in relation to the size and extents of the existing floodplain, it is envisaged that a viaduct structure with span in the region of 300-350m will be required depending on the individual link. A multi-span composite steel bridge could be considered a possible option at this location. (Refer to Fig A8.3 for possible cross-section and span arrangement). A ladder deck or plate girder spaced at 3.0-3.5m centres could both be considered suitable cross-sections for such a structure. Haunched girders could also be used should a larger span between piers be required.

A8.3.3. Yazor Brook Cross (WL7 Western Inner Corridor Link 7): WL7 connecting the A938 King's Acre Road to the A4103 Roman Road will cross the Yazor Brook and associated floodplain. The proposed vertical alignment has been raised with the provision of a relief culvert at this location of the brook. The size, number and type of culverts to be provided shall be agreed with the EA following consultation and the implementation of a flood risk assessment at Stage 3.



Possible Viaduct Cross Section
(Scale 1:100)



Possible Span Arrangement
(Scale 1:1000)

NOTES
1. All dimensions are shown in metres.

Rev	Revision details	Chkd	Appd	Date

Drawn: DK	
Design: DK	
Chkd: SD	
Appd: RM	
Date: July 2010	

Preliminary	✓
For comment	
For tender	
For construction	
As constructed	
Other	

amey

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Project Name
Hereford Relief Road

Drawing Title
River Wye Crossing

Original Drawing Size :	A3
Scale : As Shown	Dimensions : Metres

Drawing No	Fig No	Rev
551497-H-P-A8.3	A8.3	-

A8.4. Western Outer Corridor

A8.4.1. The Western Outer Corridor consists of seven links and will provide a link between the A4103 Roman Road and the A4103 Roman Road Roundabout junction similar to the Western Inner Corridor. However, this corridor will avoid the existing Belmont Golf Club by bordering the western boundary of the golf club. The links associated with this corridor are shown on Map A0.03 in Appendix A. Table A8.3 summarises the structures required for the corridor.

Table A8.4: Structures Summary – Western Outer Corridor

Link	No	Structure Type (Cost Type)	Start Ch (m)	Span (m)	Clearance (m)	Skew (°)	Additional Information
WL8	1	N/A					
WL9	1	Culvert(E)	1010	TBC	10.0	20	
	2	Bridge(C)	2100	550	16.90	0	Spanning extents of floodplain 3 at River Wye
	3	Underpass(C)	3018	15	5.0	20	Spanning C1189 Upper Brenton Road
WL10	1	Culvert(E)	1010	TBC	TBC	20	
	2	Bridge (C)	2100	550	16.90	0	Spanning extents of floodplain 3
	3	Underpass(C)	3022	15	5.0	20	Spanning C1189 Upper Brenton Road
	4	Culvert(E)	4170	TBC	TBC	45	
WL 11	1	Culvert(E)	733	TBC	TBC	0	
WL 12	1	N/A					
WL 13	1	Culvert(E)	810	TBC	TBC	0	
WL 14	1	Culvert(E)	100	TBC	TBC	0	
	2	Culvert(E)	210	TBC	TBC	0	
	3	Culvert(E)	296	TBC	TBC	0	
	4	Culvert(E)	380	TBC	TBC	50	

Existing Structures

A8.4.2. Existing Culvert A4103 Roman Road: Western Corridor Link WL14 will require the extension of an existing culvert located on the A4103 Roman Road to accommodate the wider carriageway cross section on this section of the road. The extension of the culvert across the floodplain may cause obstruction to watercourse flows which could change the shape of the existing floodplain. Further analysis and consultation at Stage 3 should examine these effects and should implement appropriate measures to accommodate existing watercourses and floodplains as part of the scheme proposals.

Long Span/Complex Structures

A8.4.3. River Wye Cross (Western Outer Corridor): Western Outer Corridor links WL9 and WL10 will require the construction of a major viaduct structure to cross the River Wye and associated floodplain. Based on information provided by Environment Agency in relation to the size and extents of the existing floodplain, it is envisaged that a viaduct structure with a span of approximately 550m will be required depending on the individual link. A composite steel structure similar to that shown on Fig A8.3 could be used with an appropriate arrangement that will suit a larger span.

A8.5. Northern Corridor

A8.5.1. The Northern Corridor consists of four links and is common to both the western and eastern alignments. The links associated with this corridor are shown on Map A0.03 in Appendix A. Table A8.4 summarises the structures required for the corridor.

Table A8.4: Structures Summary – Northern Corridor

Link	No	Structure Type (Cost Type)	Start Ch (m)	Span (m)	Clearance (m)	Skew (°)	Additional Information
NC1	1	Overpass(C)	470	25	7.90	20	Spanning C1095 Tillington Road
	2	Overpass(C)	1100	25	8.50	60	Spanning Canon Pyon Road
	3	Culvert (E)	2450	TBC	TBC	30	
NC2	1	Overpass(C)	570	25	7.90	90	Spanning C1095 Tillington Road
	2	Overpass(C)	1200	15	8.50	0	Spanning A4110 Canon Pyon Road
	3	Culvert (E)	2540	TBC	TBC	30	
NC3	1	Culvert (E)	120	TBC	TBC	45	
	2	Overpass(C)	580	25	7	0	Spanning Codwell Road
	3	Culvert(E)	900	TBC	TBC	45	
	4	Bridge(C)	1680	15	7	0	Spanning Existing Railway Line
	5	Bridge(C)	2060	15	5.0	0	Existing Bridge Spanning Disused Canal
NC4	1	Culvert (E)	120	TBC	TBC	45	
	2	Bridge(C)	580	15	7	0	Spanning Codwell Road
	3	Bridge(C)	1800	15	7	0	Spanning Railway Line
	4	Bridge(C)	2060	15	5.10	0	Spanning Disused Canal

Existing Structures

A8.5.2. Existing Bridge Spanning Disused Canal: Northern Corridor Link NC3 will require the existing bridge structure across the disused canal to be modified to accommodate a wider carriageway cross section required for the relief road.

Long Span/Complex Structures

A8.5.3. Railway Bridge at Burcott: Northern Corridor Links NC3 and NC4 will require a new crossing of existing railway lines. A bridge structure with a span of approximately 50m would be required. A clearance height of at least 6.5m will have to be required sbove the railway lines to comply with current railway group standards (RSSB).

A8.5.4. Bridge Spanning Disused Canal: Northern Corridor Link NC4 will require a new structure to cross the existing disused canal. A bridge structure with a span in the region of 15m would be required.

A8.6. Eastern Inner Corridor

A8.6.1. The Eastern Inner Corridor consists of three links and will provide a link between the A465 and the Rotherwas Access Road roundabout junction. The links associated with this corridor are shown on Map A0.03. Table A8.5 summarises the structures required for the corridor.

Table A8.5: Structures Summary – Eastern Inner Corridor

Link	No	Structure Type (Cost Type)	Start Ch (m)	Span (m)	Clearance (m)	Skew (°)	Additional Information
EL1	1	Culvert (E)	240	TBC	TBC	35	
EL2	1	Culvert (E)	775	TBC	TBC	45	
EL3	1	Bridge(C)	400	100	7	0	Spanning the River Wye

Long Span/Complex Structures

A8.6.2. River Wye (Eastern Inner Corridor): Eastern Inner Corridor Link EL3 will require a structure to span the River Wye. It is envisaged that a viaduct structure with an approximate span of 110m will be required to clear the existing floodplain. The extent of the floodplain has been defined by the information provided by Environment Agency. A composite steel structure similar to that shown on Fig A8.3 could be used but with an appropriate arrangement for a shorter span.

A8.7. Eastern Outer Corridor

A8.7.1. The Eastern Outer Corridor consists of nine links and similar to the Eastern Inner Corridor, will provide a link between the A465 and the Rotherwas Access Road roundabout junction. The main difference is that the outer corridor passes through the Rotherwas Industrial Estate providing an additional link to A465 Aylestone Hill Road, as shown in Map A0.03 in Appendix A. Table A8.6 summarises the structures required for the corridor.

Table A8.6: Structures Summary – Eastern Outer Corridor

Link	No	Structure Type	Start Ch (m)	Span (m)	Clearance (m)	Skew (°)	Additional Information
EL4	1	Culvert (E)	220	N/A	N/A	0	Existing Relief Culvert
	2	Culvert (E)	260	N/A	N/A	0	Existing Relief Culvert
	3	Culvert (E)	315	N/A	N/A	0	Existing Relief Culvert
	4	Culvert (E)	360	N/A	N/A	0	Existing Relief Culvert
	5	Culvert (E)	400	N/A	N/A	0	Existing Relief Culvert
	6	Culvert (E)	440	N/A	N/A	0	Existing Relief Culvert
	7	Culvert (E)	460	N/A	N/A	0	Existing Relief Culvert
	8	Culvert (E)	510	N/A	N/A	0	Existing Relief Culvert
	9	Culvert (E)	570	N/A	N/A	0	Existing Relief Culvert
	10	Culvert (E)	605	N/A	N/A	0	Existing Relief Culvert
	11	Culvert (E)	630	N/A	N/A	0	Existing Relief Culvert
	12	Bridge(D)	690	20	5.0	45	Spanning River Lugg
	13	Culvert(E)	740	N/A	N/A	0	Culvert for Little Lugg
EL5	1	Culvert (E)	220	N/A	N/A	0	Existing Relief Culvert
	2	Culvert (E)	260	N/A	N/A	0	Existing Relief Culvert
	3	Culvert(E)	315	N/A	N/A	0	Existing Relief Culvert
	4	Culvert (E)	360	N/A	N/A	0	Existing Relief Culvert
	5	Culvert (E)	400	N/A	N/A	0	Existing Relief Culvert
	6	Culvert (E)	440	N/A	N/A	0	Existing Relief Culvert
	7	Culvert (E)	460	N/A	N/A	0	Existing Relief Culvert
	8	Culvert (E)	510	N/A	N/A	0	Existing Relief Culvert

Table A8.6: Structures Summary – Eastern Outer Corridor							
Link	**No**	**Structure Type**	**Start Ch (m)**	**Span (m)**	**Clearance (m)**	**Skew (°)**	**Additional Information**
	9	Culvert (E)	570	N/A	N/A	0	Existing Relief Culvert
	10	Culvert (E)	605	N/A	N/A	0	Existing Relief Culvert
	11	Culvert (E)	630	N/A	N/A	0	Existing Relief Culvert
	12	Bridge(D)	690	25	5.0	45	Existing bridge spanning River Lugg (Listed)
	13	Culvert(E)	740	N/A	N/A	0	Culvert for Little Lugg
EL6	1	Culvert(E)	0	N/A	N/A	45	Culvert for Little Lugg
	2	Culvert (E)	1020	N/A	N/A	0	
	3	Culvert (E)	1740	N/A	N/A	45	
	3	Culvert (E)	1800	N/A	N/A	45	
	4	Bridge(E)	1895	25	5.0	0	Spanning River Lugg
EL7	1	Culvert(E)	650	N/A	N/A	45	
	2	Culvert (E)	1250	N/A	N/A	45	
	3	Bridge(C)	1380	25	5.0	0	Spanning River Lugg
EL8	1	Culvert (E)	650	N/A	N/A	45	
	2	Culvert (E)	1350	N/A	N/A	30	
	3	Bridge(C)	1475	25	5.0	0	Spanning River Lugg
EL9	1	Bridge(C)	600	15	5.0	0	Existing Stream
EL10	1	Bridge(C)	500	15	5.0	0	
EL11	1	Bridge(C)	630	15	5.0	0	
EL12	1	Bridge(C)	450	100	8.0	0	Spanning River Wye

Existing Structures

A8.7.2. Existing Flood Relief Culverts: Eleven existing flood relief culverts located along A465 Aylestone Hill Road will require extension to accommodate the wider carriageway cross section associated with corridor link EL4. The existing culverts have previously been widened with the addition of precast box culverts to the southern side. A detailed assessment would be required to assess suitability for future widening of the culverts. Any potential extension of the culverts could provide an obstruction to watercourse flow which could change the shape of the existing floodplain. These effects would need to be considered and accommodated within any proposal for a preferred corridor at this location.

A8.7.3. Lugg Bridge: Eastern Corridor Link EL4 will involve modification of the existing Lugg Bridge to accommodate the wider carriageway cross section. This bridge consists of three masonry arches with cutwaters facing both up and down stream as shown in Figures A8.4 and A8.5 respectively. Sheet piling retains the existing river bank to the east.

Fig A8.4 The Lugg Bridge masonry arch

Fig A8.5 The Lugg Bridge (Cutwaters on northern side)

A8.7.4. The bridge is a listed structure and consultation with Environment Agency and all other statutory bodies and non-statutory bodies will be required. A detailed assessment of the bridge would be required to assess the feasibility of any future widening or strengthening proposals.

A8.7.5. Lugwardine Bridge: Eastern Corridor Links EL6, EL7 and EL8 will involve crossing the River Lugg in the vicinity of the existing Lugwardine Bridge. This bridge has a similar construction to the Lugg Bridge and consists of three masonry arches with cutwaters facing both up and downstream as shown in Figure A8.6 below.

A8.7.6. This bridge is also a listed structure and consultation with Environment Agency and all other statutory bodies will be a required for any proposed works. The existing structure will be maintained and at this stage it is proposed that a new structure with a span in the region of 30m to 40m would be built upstream crossing the River Lugg. The road level of the new bridge is likely to be approximately 5m above the existing river bed. The size of opening that is required for the river flow at this point should be confirmed with Environment Agency, but is likely to be similar or larger than the existing structure.

Fig A8.6 The Lugwardine Bridge

Long Span/Complex Structures

A8.7.7. Floodplain Relief Culverts: Eastern outer corridor links EL4, EL5 and EL6 cross the existing floodplain of the River Lugg. As construction of the road embankments across the floodplain will provide an obstruction to the watercourse flows, it is envisaged that suitably sized flood relief culverts will be a requirement. It is possible that precast box culverts could be used as such features. The exact dimensions of the structure should be confirmed and agreed with Environment Agency.

A8.7.8. River Wye (Eastern Outer Corridor): Eastern corridor link EL12 will require a structure to span the River Wye to the East of Hereford. It is envisaged that a viaduct structure with a span in the region of 110m will be required to clear the existing floodplain. Any potential construction of embankments / structures on the flood plain could provide an obstruction to flow which could affect the shape of the existing floodplain. Further analysis and consultation at Stage 3 should examine these affects. A composite steel structure similar to that shown in Fig A8.3 could be used but with an appropriate arrangement for a shorter span.

A8.8. Structures Summary

A8.8.1. Following an initial review of potential new structures that would be required to construct the Hereford Relief Road within each of the corridors, Table 8.7 below summaries the number, type and size of structures required for the implementation of each link being considered.

Table A8.7: Overall Structures Summary

Corridor	Number of Structures				
	Existing to be modified	Underpass/ Overpass	Culverts	Long Span / Complex	Total
Southern Corridor Link SC 1	1	1	1	2	**5**
Southern Corridor Link SC 2	1	1	1	1	**4**
Western Inner WL 1	0	3	1	1	**5**
Western Inner WL 2	0	3	1	1	**5**
Western Inner WL 3	0	3	1	1	**5**
Western Inner WL 4	0	3	1	1	**5**
Western Inner WL 5	0	3	1	1	**5**
Western Inner WL 6	0	3	1	1	**5**
Western Inner WL 7	0	0	1	0	**1**
Western Outer WL 8	0	0	0	0	**0**
Western Outer WL 9	0	1	2	1	**4**
Western Outer WL 10	0	1	2	1	**4**
Western Outer WL 11	0	0	1	0	**1**
Western Outer WL 12	0	0	0	0	**0**
Western Outer WL 13	0	0	1	0	**1**
Western Outer WL 14	1	0	4	0	**5**
Northern Corridor Link NC 1	0	2	1	0	**3**
Northern Corridor Link NC 2	0	2	1	0	**3**
Northern Corridor Link NC 3	1	1	2	1	**5**
Northern Corridor Link NC 4	0	1	1	2	**4**

Table A8.7: Overall Structures Summary					
Corridor	Number of Structures				
	Existing to be modified	Underpass/ Overpass	Culverts	Long Span / Complex	Total
Eastern Inner EL 1	0	0	1	0	**1**
Eastern Inner EL 2	0	0	1	0	**1**
Eastern Inner EL 3	0	0	0	1	**1**
Eastern Outer EL 4	11	0	1	1	**13**
Eastern Outer EL 5	11	0	1	1	**13**
Eastern Outer EL 6	0	0	4	1	**5**
Eastern Outer EL 7	0	0	2	1	**3**
Eastern Outer EL 8	0	0	2	1	**3**
Eastern Outer EL 9	0	0	0	1	**1**
Eastern Outer EL 10	0	0	0	1	**1**
Eastern Outer EL 11	0	0	0	1	**1**
Eastern Outer EL 12	0	0	0	1	**1**

Structures Conclusions

A8.8.2. Southern Corridor: Southern Corridor Link 1 and Southern Corridor Link 2 require five and four structures respectively. Southern Corridor Link 1 would be the preferred link within the corridor as it avoids the need to construct a long span viaduct structure at Haywood Forest Park.

A8.8.3. Western Inner Corridor: Western Links WL1 to WL6 all require a similar number, type and scale of structures, with the major impacts being the crossing at the River Wye and three new overpasses / underpasses. Therefore, in terms of the number of required highway structures, there is no preference between these links. Western Inner Link 7 has minimal impact in terms of structures required although this link will require measures to accommodate the Yazor Brook and Yazor Brook Floodplain

A8.8.4. Western Outer Corridor: Western Links 9 and 10 require a similar number, type and scale of structures, with the river crossing at the River Wye being the one major structure. One new overpass is also a requirement for each of these links. Western Links 8, 11, 12 and 13 will require minimal structures and Western Outer Link 14 will require four minor structures. Overall the Western Outer Corridor requires fewer structures than the Western Inner Corridor and would be the preferred western corridor for this particular criterion.

A8.8.5. Northern Corridor: Northern Corridor Links NC1 and NC2 require a similar number, type and scale of structures and therefore there is no preference, in terms of the number of structures required, between these links. Northern Corridor Links NC3 and NC4 also require a similar number of structures, however, if feasible, the modification of the existing canal bridge in link NC3 would be preferred as it is likely to prove a more economic viable solution than the construction of a new crossing further north.

A8.8.6. Eastern Inner Corridor: Eastern Inner Corridor Links EL1 and EL2 are anticipated to have a relatively low impact with only one minor structure being required for each. Eastern Inner Link EL3 will require a major crossing of the River Wye (110m span viaduct). Overall however this corridor has a minimal requirement for structures.

A8.8.7. Eastern Outer Corridor: Eastern Outer Corridor Links EL4 and EL5 both have a high impact on existing structures with 12 to be modified, the most complex being the existing Lugg Bridge. Eastern Outer Links 6, 7, 8, 9, 10 and 11 all have a similar impact in terms of structures required with only one major crossing required of the River Lugg. Eastern Link 12 will require a second major crossing of the River Wye. Overall this corridor has a relatively high requirement for structures, with two major river crossings at the Wye and the Lugg as well as the modification and construction of a large number of complex structures which includes two listed bridges.

Recommendations for Stage 3

A8.8.8. Review of records data, on site inspections and assessment of all existing structures affected should be carried out.

A8.8.9. Consultations to be carried out with relevant statutory and non-statutory bodies as required regarding measures to be implemented for pedestrian subways/footways and potential footbridges.

A8.8.10. Flood risk assessment and consultation with Environment Agency to be carried out for floodplain associated with the River Wye, the Yazor Brook and the Lugg floodplian. Size and number of flood relief culverts to be confirmed following appropriate level of flood risk assessment.

A8.8.11. Further analysis and consultation at Stage 3 should examine the effects to the floodplain of extending the existing culvert and river diversion at the Yazor Brook on the A4103 Roman Road.

A8.8.12. The eleven existing flood relief culverts located on the A465 Aylestone Hill Road will need to be assessed to determine suitability for future widening. The effects to the existing floodplain should also be considered.

A8.8.13. An assessment of the existing Lugg Bridge for proposed widening/strengthening proposals should be carried out. This should include consultation with relevant statutory organisations.

Appendix A

A3 DESIGN DRAWING BOOKLET

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