White Young Green

West Southall
Yeading Brook

Flood Risk Assessment
For

National Grid Property

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DOCUMENT VERIFICATION

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FOREWORD

The Planning Applications

Proposals have been prepared for the "West Southall" redevelopment of the former Southall Gas Works site in the London Borough of Ealing for National Grid Property Holdings Ltd.

The proposed development comprises five elements including: The Main Site, Springfield Road Foot/Cycle Bridge, Minet Country Park Foot/Cycle Bridge, Pump Lane Link Road and the South Road Eastern Access. The Main Site and the Eastern Access fall wholly within the London Borough of Ealing. The three remaining accesses fall within both Ealing and the London Borough of Hillingdon, so separate applications are being made to both Councils.

The elements of the planning applications are described as:

- Main Site (site area 34ha) – Outline approval is sought for the redevelopment of the former Southall Gas Works site comprising Access, Siting, Design, External Appearance and Landscaping reserved for future consideration but within the parameters described in the Environmental Statement.

- Springfield Road Foot/Cycle Bridge (site area 0.6ha) – The construction of a proposed foot/cycle bridge between Beaconsfield Road, Hayes and the Southall Gas Works with associated embankment and spans over the Yeading Brook and Grand Union Canal.

- Minet Park Foot/Cycle Bridge (site area 0.6ha) – Proposed new foot/cycle bridge over the Yeading Brook and Grand Union Canal to link the Minet Country Park with proposed development on the former Southall Gas Works.

- Pump Lane Link Road (site area 5.5ha) – Proposed new link road between Pump Lane on the Hayes bypass (A312) and the former Southall Gas Works with associated embankment, enhancement and diversion of the flood relief channel and bridges over the combined flood relief channel/Yeading Brook and the Grand Union Canal.

- Eastern Access (site area 1.3ha) – Proposed new link road connecting to South Road. Improvements to South Road.

A number of documents accompany the planning applications as listed below. This list identifies which documents form part of the planning applications and which are submitted for illustrative purposes only.

The application area of the main site extends to 34 hectares (c.84 acres) of land currently used for surface vehicle parking only, previously a major Gas Works of industrial and employment uses. This excludes approximately 2 hectares of land around one active waterless gas holder and infrastructure that is to be retained for operational use by National Grid. The proposed access routes collectively occupy 8 hectares of land (c.20 acres). Therefore the total area of the planning applications is 42 hectares (104 acres).

In addition to the Parameter Plans and the proposed development schedule, the application is also accompanied by the following principal reports:

- Environmental Statement
- Transport Assessment
- Retail Impact Assessment
- Remediation Strategy
- Flood Risk Assessments

Other reports have been prepared to support the application and to provide further elaboration and detail of the development proposals, but these are not in themselves, nor need to be, documents that would be assessed in the Environmental Statement. These reports include:

- Design Statement
- Housing Strategy
- Landscape Strategy
- Regeneration Strategy
- Consultation Report
- Access and Mobility Report
- Utilities and Drainage
- Sustainability Report

These reports provide additional information on the proposals, from which the London Boroughs of Ealing and Hillingdon can draw conclusions and, where appropriate, formulate planning conditions or clauses for the S106 Agreement.

The Parameter Plans

The redevelopment of the Main Site is made in 'outline' to establish the main parameters that would govern the detailed design. Full planning is sought for the siting and design of the two principal accesses alongside the Minet Park and Springfield Road foot/cycle bridges, including horizontal and vertical alignment, structures, materials and landscape, thus fixing the access details.

For the Main Site, remediation and redevelopment would be conducted over a number of years. As such, some flexibility would be required to respond to market demand and other influences upon the disposition and phasing of the proposals. Various legal cases have acknowledged the need for flexibility where long-term developments are proposed.

A number of plans, drawings and descriptions, which collectively define the proposed development, include the Application Boundaries (red-line plan), Parameters Plan (1: Land Use, 2: Access and Circulation, 3: Open Space, 4: Building Heights and 5: Composite Parameters), Highway Layout Plans and Highway Landscape Plans. Collectively these plans identify and provide sufficient information to define the parameters of the scheme and determine how it would evolve over a number of years.

The Parameter Plans show the main components of the scheme, and provide sufficient information as to siting, design and size.

The Proposals

The development would accommodate a high density mix of residential, commercial, leisure, retail and hotel facilities together with community facilities, open space and landscaping. This will deliver a first class setting for the area. The new link roads, to be provided in phases, are essential for the development of this site, as is extensive ground contamination remediation. The component parts of the application are as follows, with areas expressed as maximum Gross Floor Areas (GFA):

- For up to 3,750 new homes (up to 320,000m^2)
- Up to 200,150m^2 of retail floor space
- Up to 9,450m^2 of leisure uses
- Up to 2,550m^2 of community and health facilities
- a hotel of up to 9,650m^2
- A nursery and primary school of up to 3,450m^2
- Up to 3,500m^2 of office/studio space

There would also be:

- New green public open spaces and communal amenity spaces
- Landscaping and;
- New spine roads (boulevards) and secondary roads through the site linking to the public highways principally to the east and west and north.

1.0 INTRODUCTION

National Grid Property is proposing to redevelop the former Gas Works site at Southall, which lies adjacent to the Yeading Brook. The site itself does not fall within the flood plain of this river. However, to provide access to the site a link road in the west to Pump Lane and a pedestrian footpath/cycleway (Springfield Road Bridge) and a pedestrian footpath/cycleway (Minet Country Park Foot/Cycle Bridge) are to be constructed across the Yeading Brook. This report addresses the Flood Risk Assessment (FRA) relating to hydrological and hydraulic implications of these identified access proposals.

An FRA report in 2002 considered an alternative alignment for the Pump Lane Link Road. Planning permission was granted for this link road route in the western corner of the former Gas Works site, subject only to certain reserved matters which have been addressed in a separate Environmental Statement (Pump Lane Link Road Reserved Matters Application Environmental Statement, May 2005).

A further enhanced FRA report in July 2006 addressed the Pump Lane Link Road alignment, a vehicular link road to Springfield Road and a foot/cycle bridge (Minet Foot/Cycle Bridge), each of which were then proposed to cross the Yeading Brook as part of the former Southall Gas Works redevelopment. The FRA was subject to detailed consultation with the Environment Agency.

The Environment Agency advised in their letter dated 14 November 2006 that they would not object to applications for the crossings on flood risk grounds if they complied with the recommendation of the FRA (reference Appendix FRA 2). Objections to the principle of Minet Foot/Cycle Bridge and Springfield Road Link Road, however, were maintained on the basis that the Environment Agency considered that the Pump Lane Link Road provided adequate access from the site to the Minet County Park and wished to avoid multi-river crossings.

The Environment Agency provided an updated hydrological model of the River Crane catchment, but has advised that the physical data for the study area section of the model had not been changed since the 2000 FRA report.

This latest Environment Agency model data was used as a base for a new model to assess the effect of the proposed structures. The new model also incorporated additional topographic data available for the site.

The results of the model runs were extracted from the July 2006 report for use within the Version 2 assessment, issued March 2008. Local hydraulic modelling using the HECRAS programme was used to assess the effects of revised arrangements of the watercourse.

The Environment Agency has since advised that new mapping and modelling has been carried out for the River Crane. These latest flow and level details have been obtained and are used within this report.

Associated but integral issues (such as ecology, landscaping and ground conditions) have been considered holistically and are reported within complementary documents submitted with the planning applications, including the Environmental Statement.

2.0 LOCATION AND WATERCOURSES

The proposed works are located between Hayes and Southall, approximately 1.5km north of Junction 3 of the M4. Refer to Figure 630.

The Pump Lane Link, Springfield Road Foot/Cycle Bridge, and the Minet Park Foot/Cycle Bridge would all cross the Yeading Brook flood plain.

The Yeading Brook rises in Harrow approximately 11km north of the site. It then flows south into the River Crane and then eastwards to join the River Thames at Isleworth.

The River Crane was the subject of a flood alleviation scheme in the early 1990s. This scheme included two flood storage reservoirs in the upper part of the catchment and channel works at five locations. One of the River Crane's flood relief channels is located just east and parallel to the Hayes bypass and joins the Yeading Brook immediately upstream of the railway bridge.

North of the study area, the Yeading Brook flows in a confined channel between an industrial estate and a housing area.

It then enters a wide, flat valley and meanders to the western edge of the study area, where it outfalls through a bridge under the main railway line (which runs from London to the southwest).

Towards the northern edge of the study area the Brook receives flow from an overflow weir on the Grand Union Canal and a Thames Water surface water drainage discharge which crosses the study area.

The Paddington Branch of the Grand Union Canal follows a course along the south east side of the valley and adjacent to the site. It is an artificial waterway located at a higher elevation than the predicted flood levels. The proposed accesses would also cross this Canal. This will require clear span bridges, with clearance for barges and space on the banks for towpaths, maintenance, etc. As such, the canal crossings have a major effect on the vertical alignment of the access routes.

2.1 Hydrology and Existing Hydraulic Performance

The River Crane catchment, had been, historically, the subject of an area flood study by Peter Brett Associates (PBA) on behalf of the Environment Agency.

The report by PBA identified the critical storm duration to be 15.5 hours for this reach.

Further studies had been carried out by the Environment Agency. The resulting model was utilised in conjunction with updated topographic survey data to more accurately assess potential flood levels and the effect of construction bridges across the brook.

(Reference Southall Gas Works, Flood Risk Assessment, Yeading Brook, WYG – Version 6 – July 2006 and Version 2 of this assessment, March 2008).

The Environment Agency flood plain map as published on the internet is shown in Fig 643.

Subsequently, the catchment has been remodelled as part of a strategic Flood risk Assessment. Outputs from this study have been provided and are contained in Appendix FRA 2.

This latest information has been overlaid on the topographic survey to identify the functional flood plain and the 1:100 year flood outline.

It is understood that the new model was based on Liddar Ground Level data. Some adjustments have been made to the plots in areas where high ground levels have been missed from the Liddar data due to interpolatation across wooded areas.

Figure 632/B shows the 1:100 year flood outline i.e Flood Zone 3 and Figure 643/A shows the 1:20 year flood outline.

Downstream of the confluence the railway line is carried over the river by a brick arched bridge (Photo 1). The bridge has a limited effect on the flow, with a head loss of 90mm for 1:100 year flood flows.

It can be seen that the flood plain is contained within an undeveloped valley upstream of the railway bridge. This extends north for approximately 1km as far as Beaconfield Road and Yeading Football Club. Any works proposed would limit any hydraulic effects to within this area.

3.0 PROPOSED STRUCTURES

There are three proposed structures over the Yeading Brook (reference Figure 644). These comprise:

a) Pump Lane Link Road Crossing
b) Minet Park Foot/Cycle Bridge
c) Springfield Road Foot/Cycle Bridge

In addition, all the structures would need to cross the Grand Union Canal, and Pump Lane Link Road would also cross the Yeading Brook flood relief channel.

3.1 Pump Lane Link Road Crossing

This crossing is required to carry a three-lane road across both the Yeading Brook and the flood relief channel (a short distance from their confluence), as well as over the Canal and forms essential access infrastructure for the overall development.

No suitable alternative sites for the link road have been identified.

Alternative alignments of this crossing were the subject of flood risk assessments, which were carried out by White Young Green in November 2002 and 2006.

The Environment Agency's previously approved solution comprised a highway embankment with a 17.5m span bridge over the Brook, a 5.5m span culvert over the flood relief channel, a diversion of the flood relief channel to minimise the length of culvert required, compensation storage formed by excavating within the bank of the flood relief channel north of the crossing, and flow attenuation provided for the peak run off from the new highway.

A similar strategy of approach has been adopted for the new crossing. However, with the revision of the route to the north the opportunity has been taken to provide enhancement to the diversion of the flood relief channel and a corresponding greater span over the combined Brook and channel, thereby avoiding culverting, which was not an Environment Agency favoured solution in our previous application.

3.1.1 SEQUENTIAL AND EXCEPTION TESTS

The floor of the valley is predominantly Flood Zone 3b, functional flood plain. PPS 25 Table D.1 states:

Zone 3b the Functional Flood Plain

Definition
This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).

Appropriate Uses
Only the water-compatible uses and the essential infrastructure listed in Table D.2 that has to be there should be permitted in this zone. It should be designed and constructed to:-

- Remain operational and safe for users in times of flood.
- Result in no net low of flood plain storage.
- Not impede water flows and
- Not increase flood risk elsewhere.

Essential infrastructure in this zone should pass the Exception test.

FRA Requirements
All development proposals in this zone should be accompanied by an FRA. See Annex E for minimum requirements.

Policy Aims
In this zone, developers and local authorities should seek opportunities to:-

- Reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage techniques and
- Relocate existing development to land with a lower probability of flooding.

PPS 25 Table D.3 requires that the exception test be passed for essential infrastructure to be constructed in Flood Zone 3b and states:-

D9. For the exception test to be passed:-

a) It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by an SFRA where one has been prepared. If the DPD has reached the 'submission' stage – see Figure 4 of PPS 12: *Local Development Frameworks* – the benefits of the development should contribute to the Core Strategy's Sustainability Appraisal.

b) the development should be on developable[23] previously developed land or, if it is not on previously developed land[24], that there are no reasonable alternative sites on developable previously developed land, and

c) An FRA must demonstrate that the development still be safe, without increasing flood risk elsewhere, and where possible, will reduce flood risk overall.

In respect of (a) above the benefits to the community conveyed by the overall development are presented in other reports submitted with the application.

In respect of (b), the section of the link road crossing the flood zone is on undeveloped land. A road link from the development into the town of Hayes and linking into the area network is essential and must cross the Yeading Brook. The only other possible location was a link to Springfield Road at the north of the subject site. This was less suitable in terms of highway capacity and community impact and, during the previous application, received consistent objections from the Environment Agency on the basis that they did not consider it to be necessary.

The approximate location of the crossing is thus fixed. However, the new alignment has now been adjusted to minimise impact on the flood plain whilst avoiding construction in close proximity to Network rail land.

Item (c), flood risk and hydraulic design are discussed below.

3.1.2 FLOOD RELIEF CHANNEL DIVERSION

This involves the abandonment of around 225m of highly engineered U-shaped concrete channel.

The realignment of the link road has presented the opportunity to create an enhanced diversion, in a more natural channel, provide a larger full span bridge for the crossing and avoid culverting.

The proposal is for the flood relief channel to be directed to the left and join the existing brook just upstream of the link road.

An enlarged, combined channel then follows the route of the Yeading Brook until it reaches the existing hard engineered section just upstream of the existing railway bridge confluence.

The channel will be a 2 stage channel and have a trapezoidal low flow channel with a circa 2.0m bed width with a high flow section of approximately 2m ledge width. Bank slopes will be an average of 1:3. Hydraulic calculations (Appendix FRA 6) show that as a result water levels upstream of the bridge will increase by between 20mm and 40mm for the flows analysed.

This is negligible within the context of the valley and the back water effect will result in unchanged water levels within a short distance upstream.

The Brook at this location is in close proximity to major infrastructure; the Ealing by-pass, the proposed link road and the main London to the West of England railway line. It is therefore necessary to ensure that the channel does not change course. Whilst flow velocities are predicted to be relatively low, constant flow and wavelets can cause significant erosion over time.

It is therefore intended that the low flow channel banks shall be protected by sensitively detailed rock armour at bends and junctions. This form of protection naturalises rapidly above the water surface, particularly if the surface is topsoiled, and provides a variation in habitat below the water surface, essentially providing an area of large gravel. Other forms of protection may be considered during the detailed design phase e.g. pre-planted coir rolls (Photos 3 & 4 show typical uses of rock armour elsewhere).

The establishment of mature vegetation on the higher levels of the banks will provide protection during the shorter duration of flood flows.

The proposed route of the diversion is shown on Figure 646 and typical construction details on Figure 647.

Land drainage consent will be required for these proposals.

3.1.3 YEADING BROOK/FLOOD RELIEF CHANNEL BRIDGE

As a result of combining the channels, the bridge will be required to pass a $Q_{100+20\%}$ flow of 25.95m^3/s without affecting other properties. A clear span of 23m would achieve these objectives.

In order to maintain a wildlife corridor along the watercourse, a clear width of 4m will be provided between the main channel bank top and any abutment.

The soffit of the bridge would be a minimum of 600mm above the $Q_{100+20\%}$ flood level. The bridge levels are constrained by the existing road levels at Pump Lane and the need to pass over the Grand Union Canal. It is anticipated that the soffit will be around 1.5m above bank level at the west end and 2.5m above bank level at the east.

The local hydraulic model (Appendix FRA 6.1) indicates a 10 mm increase in the upstream water level compared to the proposed channel configuration without the bridge.

The total predicted increase in water level is thus between 30mm and 50 mm immediately upstream of the bridge for all the flows analysed. This rise is too small to affect the plotted extent of the flood plain.

The global model used in the previous FRA indicated that a 12mm increase in backwater had reduced to zero within 200m upstream.

3.1.4 ROAD SUPPORT EMBANKMENT

The new link road would be constructed on an embankment across the flood plain. The embankment's footprint will reduce the potential volume of flood storage by approximately 3,400m^3. This volume is too small to have any impact on flood flows as assessed by the river model.

Notwithstanding the above, the effects of loss of storage are cumulative and so it is proposed to excavate an equivalent volume upstream of the crossing outside of the existing flood plain as agreed previously with the Environment Agency.

In discussions with the Environment Agency and Hillingdon Council's Conservation Officer, an area adjacent to the flood relief channel was identified as being a suitable location for a compensatory storage site.

The storage would be formed by excavating a layer from the channel bank which is already an artificially formed surface.

Embankment volumes within the flood plain and excavation volumes in the proposed storage area were obtained from the design drawings using MX 3D software. The results are presented in Appendix FRA 6.3 and demonstrate that a close correlation in volumes can be achieved.

It should be noted that in order to achieve the match, a large volume of material (approximately 8,000m^3) will have to be excavated from above the predicted $Q_{100+20\%}$ flood level for Pump Lane.

This may be of consideration in assessing other development proposals in the valley e.g the possible expansion of Yeading Football Club.

It is anticipated that, subject to geotechnical assessment, the excavated material will be utilised to form the Pump Lane embankment.

Typical details of the compensatory storage area are given in Figure 648.

In addition a tunnel would be provided through the embankment in the form previously agreed with the Environment Agency to mitigate any obstruction to wildlife movement.

3.2 Minet Country Park Foot/Cycle Bridge

A new bridge is required to provide pedestrian and cycle access for the new development, across the Canal and Brook into the Minet Country Park area.

This is presented as both desirable and essential infrastructure as evidenced by the other supporting documents in the planning application and responses to requests of the planning authorities. PPS 25 requires the exception test to be passed if the structure is within Flood Zone 3.

Parts (a) and (b) of the exception test are covered in other supporting documents. Flood risk is considered below.

The bridge would be formed from a series of three interlocking hyperbolic paraboloids providing a span of around 60m across the flood plain, with a central foundation between the Canal and the Yeading Brook, and end supports. The soffit would be a minimum of 600mm above the $Q_{100+20\%}$ level (Appendix FRA 4). The footings for the bridge are all in Flood Zone 1, low risk.

Analysis of the latest Environment Agency flood model results show that the ground outside the bank tops is above the functional flood plain and that the Flood Zone 3a area to the west of the brook is actually protected. It is noted however, that there is a gap in the defence embankment, around 200m upstream of the bridge. At this point the top of bank level is approximately 77.45m AOD. The predicted Q_{100} level at this location is approximately 27.3m AOD and the predicted $Q_{100+20\%}$ is approximately 27.44m AOD.

As the western end of the bridge gives access to the parkland, it is intended that the landing from the abutment will follow the top of the existing flood defence embankment. This alignment keeps the pedestrian access outside the 1:100 year flood plain and also avoids the Yeading Football Club pitch (and a proposed relocation of the pitch).

The landing also crosses a drainage ditch which serves the lower lying area behind the river bund. A pipe culvert will be provided so as to maintain a drainage connection to the football pitch area.

The proposed layout of the paths and ditches in this location are subject to amendment as proposed improvements to Yeading Football Club facilities may also impact this area.

Passages for wildlife would be available both sides of the ramp until the entire area is inundated. At the closest point, the abutment would be at least 4m from the top of the bank.

3.3 Springfield Road Foot/Cycle Bridge

A new bridge is required to provide cycle and pedestrian access from the north west of the development to Springfield Road.

This is presented as both desirable and essential infrastructure as evidenced by the other supporting documents in the planning application and responds to requests of the planning authorities. PPS 25 requires the exception test to be passed if the structure is within Flood Zone 3.

Its route is dictated by the connection point to the site development as developed in the masterplan and the requirement to connect to Beaconfield Road.

The bridge would comprise a two span structure from the northwest of the Gas Works site to Beaconsfield Road north of Yeading Football Club ground. The alignment utilizes space provided by Yeading Football Club, which is relocating approximately 30m to the south as part of planned improvement works for the football pitch.

The spans average 49m over the Brook and 56m over the canal.

There will be an intermediate support founded on buried pile caps. This is outside Flood Zone 3 and is approximately 11m from the Yeading Brook bank top at its closest point.

An approach embankment is required at the northern end of the bridge. This will be based on ground above the 1:100 year flood plain and would be a minimum of 4m from the bank top of the conveyance channel.

3.4 Construction Stage Flood Risks

In parallel with consideration of the impact of the completed crossings, it is also critically important to establish a Construction Management Plan (CMP), which considers the potential flood risks during the construction stage. This would seek support through a pre-works consultation with the Environment Agency.

Such risks are most likely to arise through major activities and short-term storage within the flood plain area. Therefore, the principle would apply within the CMP that all activities and storage would be planned outside the flood plain area where practical. However, when access is needed, this would be within a framework of minimization and monitoring of weather conditions to allow withdrawal or cancellation of such works during high risk periods.

In addition, the area required for construction would be minimized so as to limit the impact on ecology and the environment as discussed in complementary reports submitted in support of the planning application.

This aspect is covered in more detail in the construction impact chapter of the ES.

The construction works will require temporary bridges over the watercourses. These together with any works within 8 m of the bank top will require temporary land drainage consents from the Environment Agency

4.0 SURFACE WATER DRAINAGE

The proposed crossings would increase the impermeable area of the Yeading Brook valley by around 4,800m^2. The Environment Agency requires that discharges from land being developed should match greenfield flow rates for 1:100 year peak flows.

Using the IOH 124 method (reference 3), the greenfield runoff rates for this area are estimated to be Q_{bar} = 8/l/s/ha and Q_{100} = 24 l/ls/ha. This value is very conservative when compared to runoff figures obtained by the ADAS 345 method.

Calculations in respect of greenfield runoff rates and attenuation volumes are presented in Appendix FRA 6.2.

The detailed design would ensure that runoff from the roads would initially pass through Class 1 bypass interceptors and then be held in underground retention tanks or open ponds before being discharged to the Brook or flood relief channel via a controlled outlet.

4.1 Pump Lane Link Road Crossing

This crossing creates the majority of new impermeable area of around 4,800m^2.

This can be considered in three sections:-

- The extreme western section has an existing drainage system discharging into the Yeading Brook. This will be maintained as far as possible. Some relocation of gullies will be required.

- From the edge of the existing Pump Lane carriageway to the Grand Union Canal. It is intended to drain this area to the low point in the region of the existing by-pass channel.

  The discharge flow will need to be reduced to a peak of 11.5l/s for flows generated by rainfall of up to 1:100 year return period together with a 30% increase to allow for climate change.

  This will require around 260m^3 of storage. It is anticipated that this will be contained within the modified upper section of the abandoned flood relief channel. The calculations show that for the volume of storage assessed the peak can be restricted to a maximum of 11.5 l/s using a Hydrobrake control. If a throttle pipe is used the predicted discharge increases to 12.8 l/s for the 100 year plus 30% climate change event. However, the storage volume used excludes the volume available north of the embankment and as a throttle pipe is hydraulically inefficient a closer match to lower return period greenfield run-off rates will be achieved. Therefore it is recommended that the outflow should be controlled by a throttle pipe. An overflow weir would be provided to protect the bank of the Brook.

- East of the Grand Union Canal – this will discharge in to the main site drainage system.

A schematic layout of the Link Road drainage system is depicted in Figure 649.

4.2 Springfield Road Foot/Cycle Bridge

The main spans of this bridge will have no effect on the impermeable area of the flood plain, as runoff will be directed over the sides to fall in close proximity to its natural landfall.

The ramp from the bridge to Springfield Road will create around 200m^2 of impermeable surface. This is too small an area to allow practical methods of flow attenuation and so it is anticipated that drainage will utilise existing facilities in the area. Additionally, it is likely that most of the ramp length will simply drain over the edge into adjacent landscaped areas.

4.3 Minet Park Foot/Cycle Bridge

The main spans of this bridge will have no effect on the impermeable area of the flood plain, as it is proposed to form the deck from perforated steel plate allowing run-off to fall in close proximity to its natural landfall.

There will be a short ramp at the western end. A ramp length of around 55m will be needed to bring the footway down to existing ground level. It is anticipated that this will be formed from permeable or semi-permeable material. The runoff volumes will be too small to permit any practical methods of attenuation.

5.0 SUMMARY

The Yeading Brook and its flood plain are proposed to be crossed by a new road and two pedestrian/cycle bridges.

The **Pump Lane Link Road Crossing** would be constructed to create:

a) The diversion of 225m of concrete lined channel into 120m of new open channel and 170m of combined, improved channel, with the Yeading Brook.

b) A 23m clear span bridge over the combined Yeading Brook/flood relief channel with 600mm freeboard to the soffit above the $Q_{100+20\%}$ flows and 4m clearance from the channel top of bank edge to each abutment.

c) A mammal tunnel along the line of the abandoned flood relief channel formed from 1.0m diameter pipes with the invert filled with natural ground.

Surface water discharges would be limited to a peak flow of 11.5l/s for 1:100 year return period rainfall events, with a 30% allowance for climate change. This will require a volume of around 260m^3 which can be contained within the upper section of the abandoned flood relief channel.

The **Springfield Road** foot/cycle bridge would pass over the flood plain on two spans totalling 105m.

The western abutment will be sited in Flood Zone 1, a minimum of 4m from the bank top.

The central support will be located between the Brook and the Grand Union Canal in Flood Zone 1, in an area not used for conveyance of flood flows and a minimum of 4m from the Yeading Brook bank top.

The main structure of the support will be a buried pile cap with only the supports required for the bridge bearings protruding above existing ground levels.

The bridge structure will not affect surface water runoff. However, the access ramp will create a small increase in impermeable area that will drain via the existing facilities.

Interference with river flow would be negligible and the narrow deck and relatively high clearance would minimise impact on the ecology of the flood plain below.

The **Minet Park Foot/Cycle Bridge** will comprise two spans totalling 129m over the flood plain with a minimum freeboard of 600mm above the $Q_{100\ +\ 20\%}$ level.

Interference with river flow would be negligible and the narrow permeable deck and relatively high clearance would minimise impact on the ecology of the flood plain below.

Compensatory Storage

The construction of the embankment for the Pump Lane crossing will reduce the flood plain storage available. An area has been identified adjacent to the flood by-pass channel that could be excavated to provide level for level compensatory storage. The total volume required will be approximately 3,400m^3 for $Q_{100+20\%}$ levels.

6.0 CONCLUSIONS

The proposed structures are essential for the development of the Southall Gas Works site and there are no locations available away from the river corridor. They thus pass the sequential test and parts A and B of the exception test required under PPS 25.

The proposed structures would have a negligible effect on the hydraulic regime of the flood plain. An increase in flood level of up to 50mm is predicted immediately upstream of the Pump Lane Link Road Crossing. This backwater will reduce rapidly once the river is confined to channel and is expected to be negligible by the Minet Foot/Cycle Bridge with no appreciable increase in flood levels upstream of the foot/cycle bridge.

Compensatory storage would be provided for flood plain volume removed by embankments. Therefore, there would be no additional adverse flooding effect on properties either upstream of downstream from the study area in this context.

The structures therefore also pass part C of the exception test according to PPS 25.

Surface water runoff from the new roads would be attenuated and treated prior to discharge, which would primarily be into the Yeading Brook.

All the structures would require land drainage consent from the Environment Agency and may be subject to certain changes as required by the detail design process which naturally follows planning approval to comply with such consents.

Location	Existing Conditions				With New Crossings					
	Q_{20}		Q_{100}		Q_{20}		Q_{100}		$Q_{100 + 20\%}$	
	Flow	Level	Flow m^3/s	Level m AOD	Flow	Level	Flow m^3/s	Level m AOD	Flow m^3/s	Level m AOD
Springfield Road Bridge	8.69	27.15	9.94	27.34	8.69	27.15	9.94	27.34	10.77	27.47
Footbridge	9.53	27.01	11.22	27.23	9.53	27.01	11.22	27.23	12.18	27.38
Pump Lane Bridge	12.5	26.72	14.90	27.01	18.67	**26.73**	23.10	**27.06**	25.96	**27.27**
Upstream of Railway Bridge	18.66	26.58	23.10	26.89	18.66	26.58	23.10	26.89	25.95	27.09
Downstream of Railway Bridge	18.66	26.51	23.10	26.8	18.66	26.51	23.10	26.8	25.95	26.99

Notes: Halcrow 2008 modelling

YEADING BROOK

FLOOD LEVELS

TABLE 1

PHOTOGRAPHS

Photo 1
Flood Relief Channel

Photo 2
Railway Bridge

Photo 3
River Stour, Kidderminster
Naturalised Rock Armour

Photo 4
River Wye, High Wycombe
150 mm Rock Armour to Q_{100} Level After Naturalisation

REFERENCES

1. Planning Policy Statement 25 (PPS 25) Development and Flood Risk, Communities and Local Government, December 2006

2. Southall Gas Works, Flood Risk Assessment, Yeading Brook, White Young Green (Version 6), July 2006

3. Institute of Hydrology Report 124 – Flood Estimation on Small Catchments

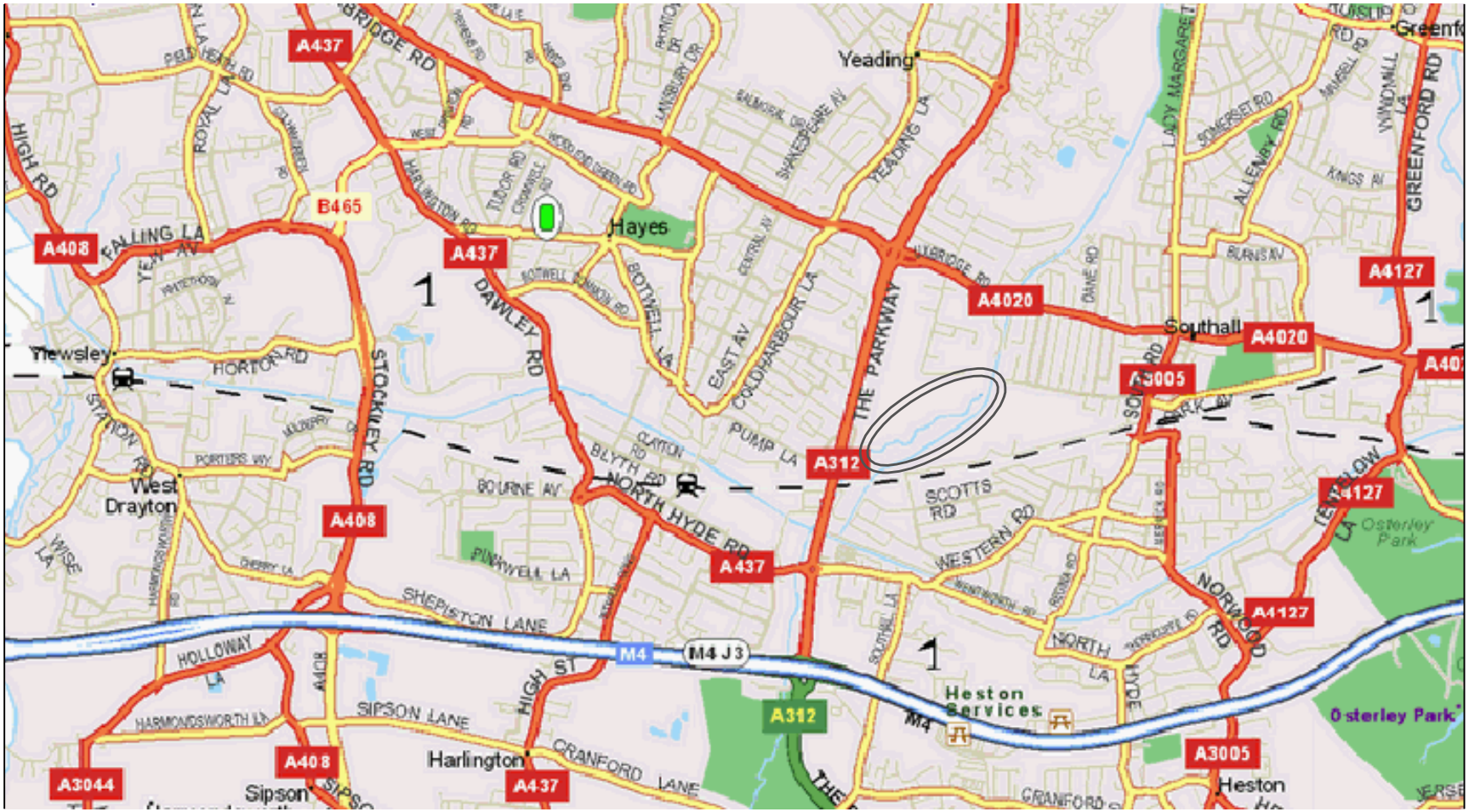
4. The Design of Field Drainage Systems, Ministry of Agriculture, Fisheries and Flood Reference Book 345 (ADAS 345), 1982

FIGURES

N

INDICATIVE ONLY

DO NOT SCALE: Contractor to check all dimensions and report any omissions or errors



Rev	Description	By	Chk	App	Date
A	New Map Used in Background	AB	RB	RB	26/07/06

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White Young Green

Consulting Engineers

Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:

WEST SOUTHALL
YEADING BROOK
FLOOD RISK ASSESSMENT

Drawing Title:

LOCATION PLAN

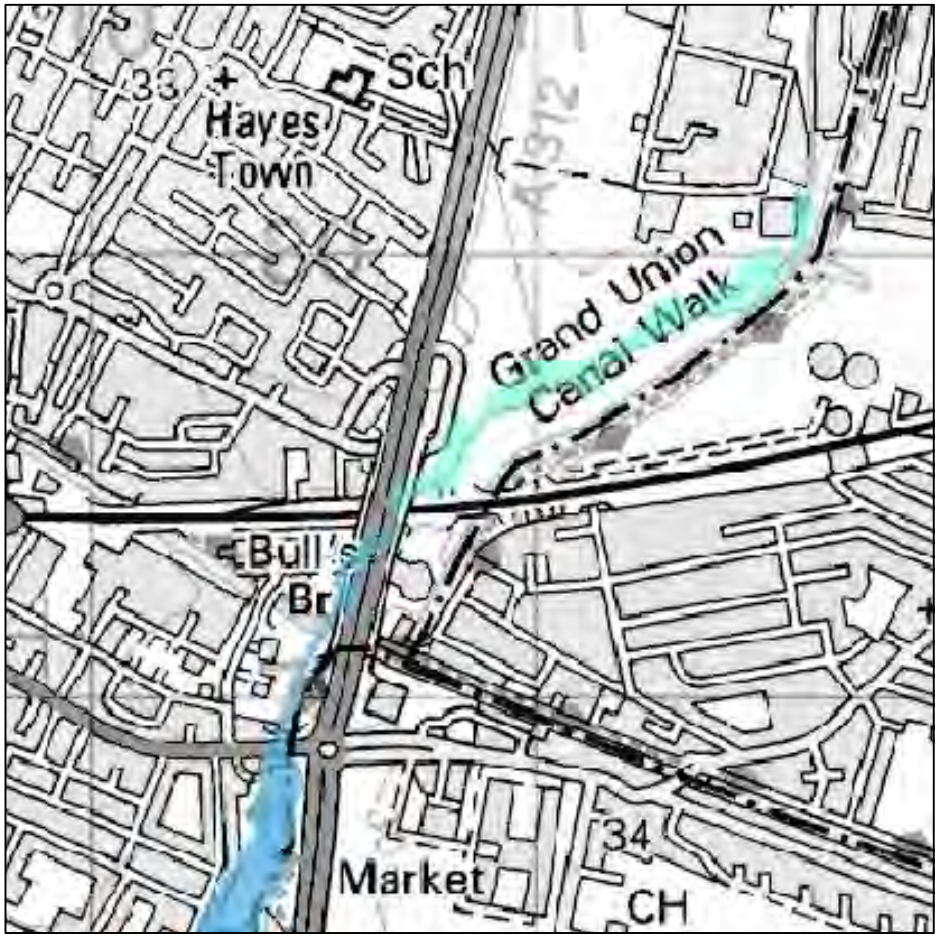
Scale at A4	Drawn By	Date	Checked By	Date	Approved By	Date
N.T.S.	B.C.E.	23.03.05				

Project No.	Office	Discipline	Drawing No.	Revision
A012564	28	C	630	A

N

INDICATIVE ONLY

DO NOT SCALE: Contractor to check all dimensions and report any omissions or errors



Rev	Description	By	Chk	App	Date
A	Flood zone map updated	DW	RB	RB	12/02/08

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Project:

WEST SOUTHALL
YEADING BROOK
FLOOD RISK ASSESSMENT

Drawing Title:

EA FLOOD ZONE MAP (CURRENTLY PUBLISHED)
(SEE DWG. No. 632)

Scale at A4	Drawn By	Date	Checked By	Date	Approved By	Date
N.T.S.	DW	12/02/08	RB	12/02/08	RB	12/02/08

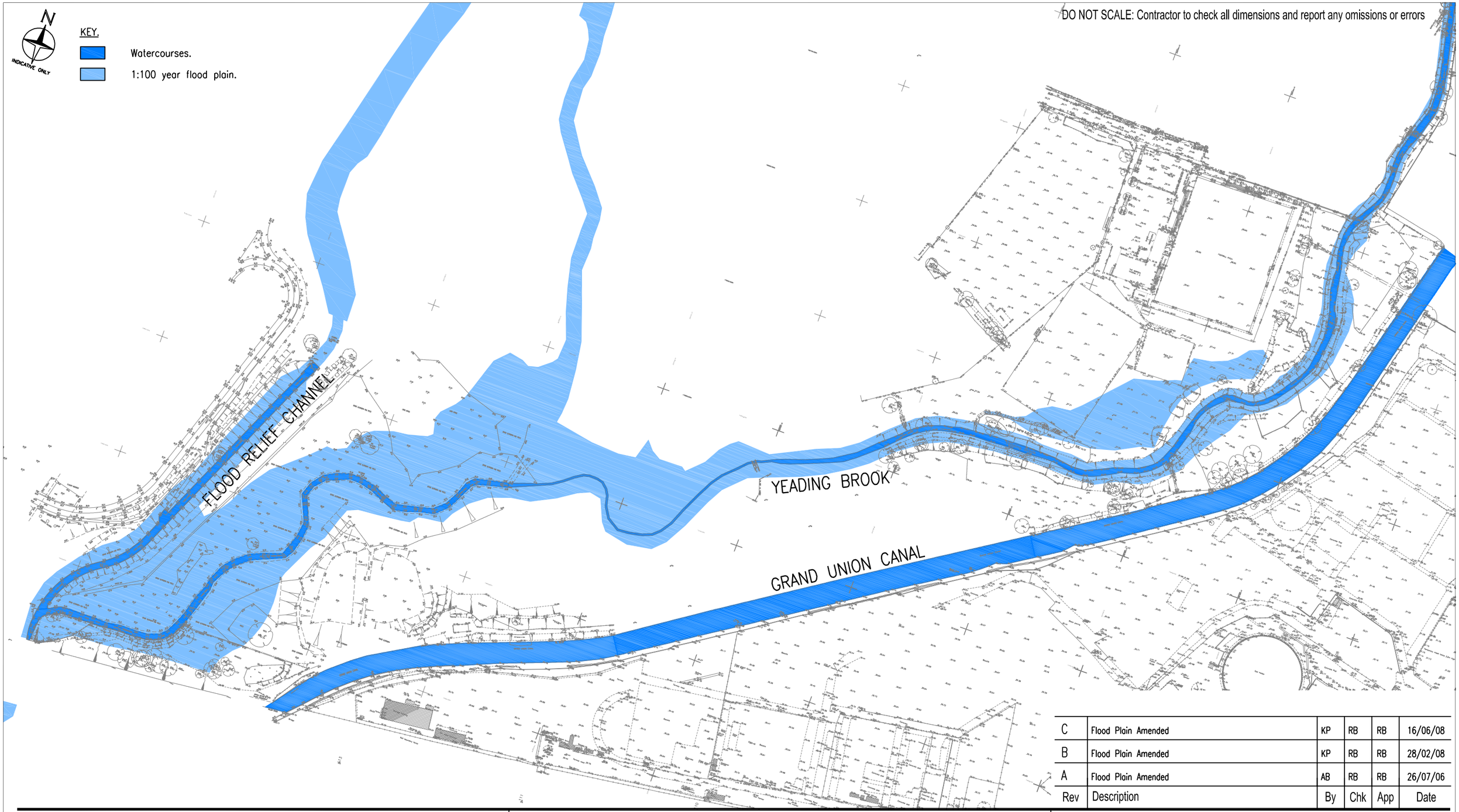
Project No.	Office	Discipline	Drawing No.	Revision
A012564	28	C	631	A

DO NOT SCALE: Contractor to check all dimensions and report any omissions or errors

KEY.

Watercourses.

1:100 year flood plain.



Rev	Description	By	Chk	App	Date
C	Flood Plain Amended	KP	RB	RB	16/06/08
B	Flood Plain Amended	KP	RB	RB	28/02/08
A	Flood Plain Amended	AB	RB	RB	26/07/06

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Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:

WEST SOUTHALL
YEADING BROOK
FLOOD RISK ASSESSMENT

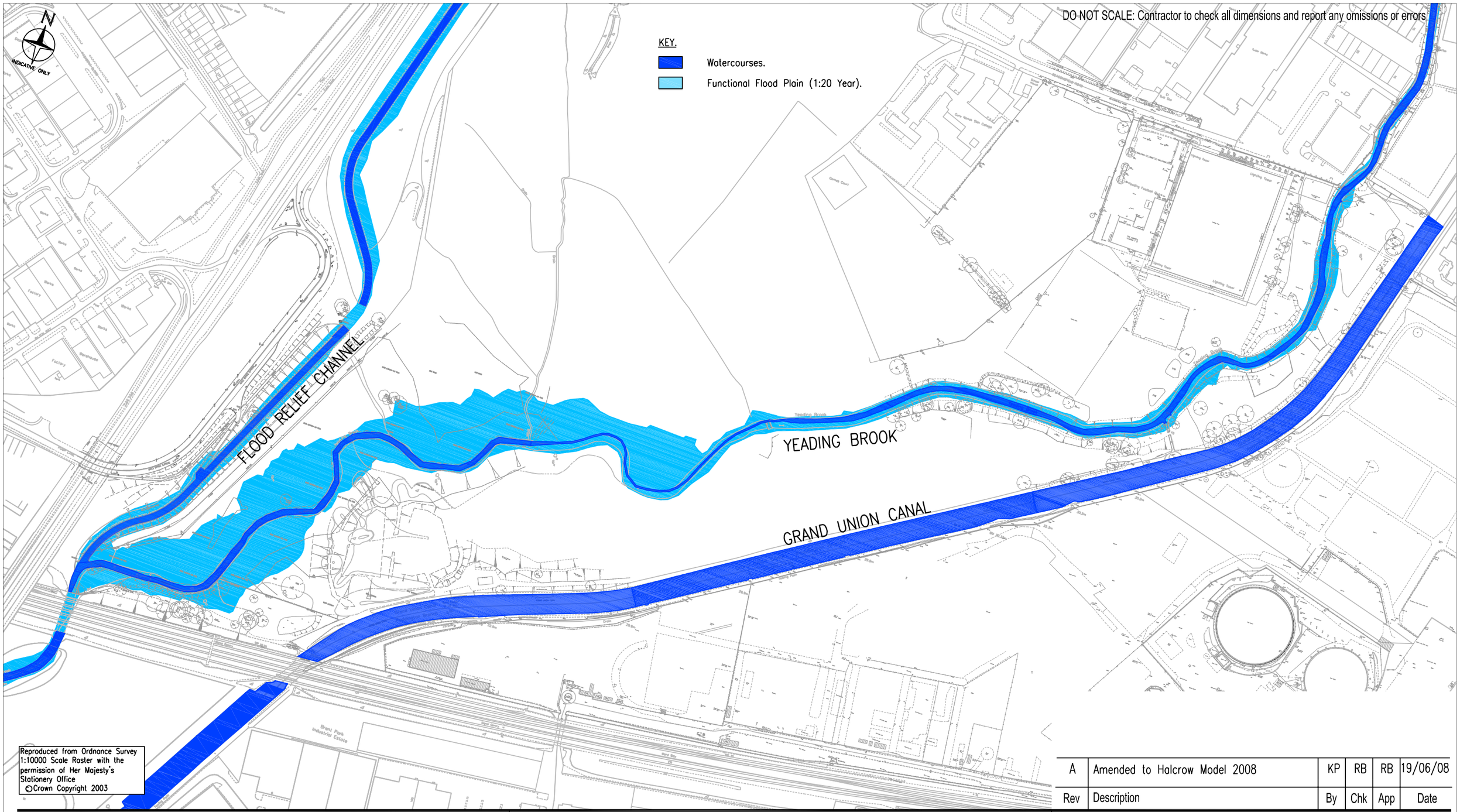
Drawing Title:

FLOOD PLAIN MAP (ENHANCED TO REFLECT LATEST EA DATA AVAILABLE)

Scale at A3	Drawn By	Date	Checked By	Date	Approved By	Date
N.T.S.	B.C.E.	23.03.05	R.H.	01.04.05	R.H.	01.04.05

Project No.	Office	Discipline	Drawing No.	Revision
A012564	28	C	632	C

DO NOT SCALE: Contractor to check all dimensions and report any omissions or errors



Rev	Description	By	Chk	App	Date
A	Amended to Halcrow Model 2008	KP	RB	RB	19/06/08

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White Young Green

Consulting Engineers

Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:

WEST SOUTHALL
YEADING BROOK
FLOOD RISK ASSESSMENT

Drawing Title:

FUNCTIONAL FLOOD PLAIN

Scale at A3	Drawn By	Date	Checked By	Date	Approved By	Date
N.T.S.	D.W	12/02/08	R.C.B.	12/02/08	R.C.B.	12/02/08

Project No.	Office	Discipline	Drawing No.	Revision
A012564	28	C	643	A

DO NOT SCALE: Contractor to check all dimensions and report any omissions or errors

KEY.

Watercourses.

1:100 year flood plain.

INDICATIVE ONLY

Compensatory storage area

Springfield Footbridge

FLOOD RELIEF CHANNEL

Flood Relief Channel Diversion

YEADING BROOK

GRAND UNION CANAL

Minet Footbrige

Rev	Description	By	Chk	App	Date
A	Extent of Flood Plain amended (Halcrow Model 2008). Compensation Area Design amended to suit. Flood relief channel diversion added.	AB	RB	RB	20/06/08

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Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:

WEST SOUTHALL
YEADING BROOK
FLOOD RISK ASSESSMENT

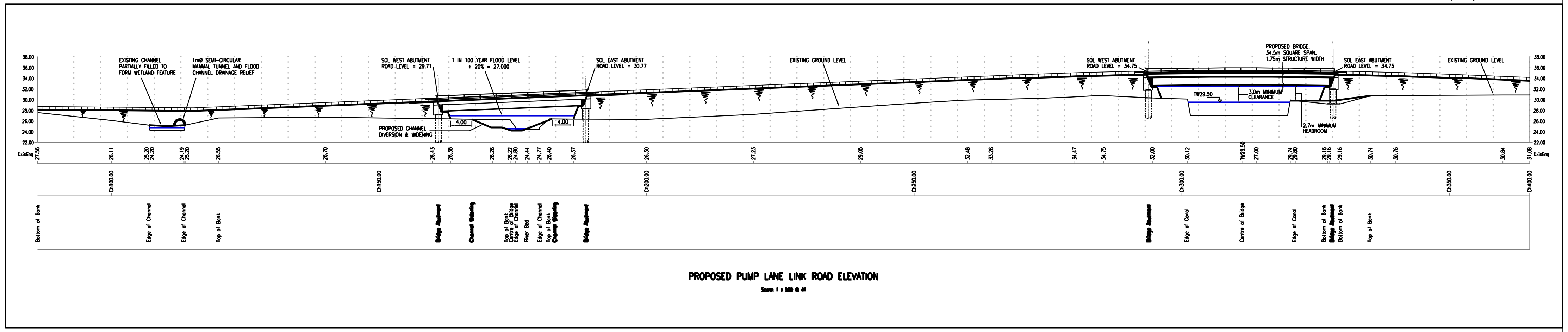
Drawing Title:

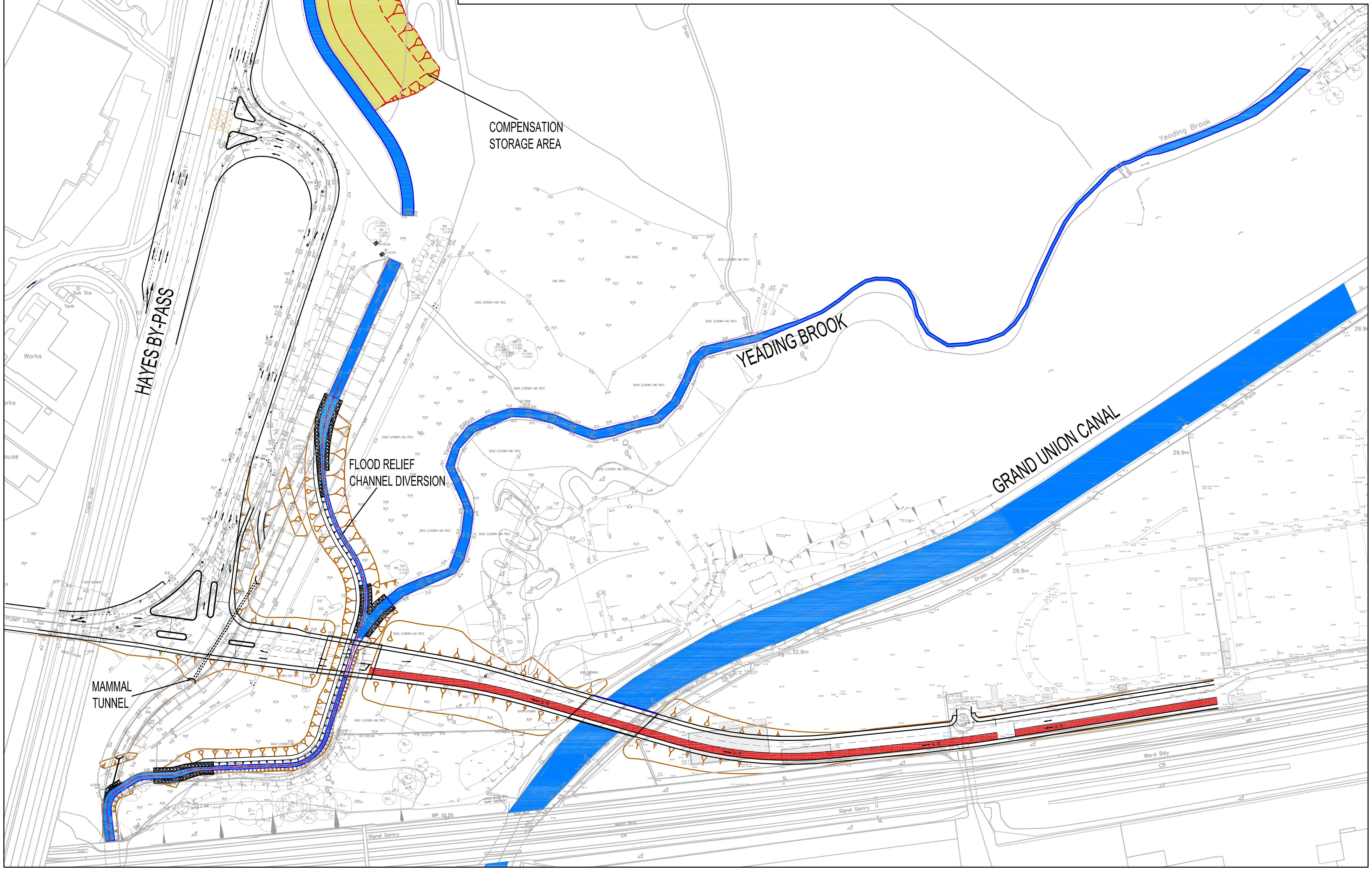
BRIDGE AND COMPENSATORY STORAGE LOCATIONS

Scale at A3	Drawn By	Date	Checked By	Date	Approved By	Date
N.T.S.	DW	13/02/08	RB	13/02/08	RB	13/02/08

Project No.	Office	Discipline	Drawing No.	Revision
A012564	28	C	644	A

DO NOT SCALE: Contractor to check all dimensions and report any omissions or errors





Rev	Description	By	Chk	App	Date
A	Compensation Area Design revised. Flood relief channel design amended.	KP	RB	RB	20/06/08

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Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:

WEST SOUTHALL
YEADING BROOK
FLOOD RISK ASSESSMENT

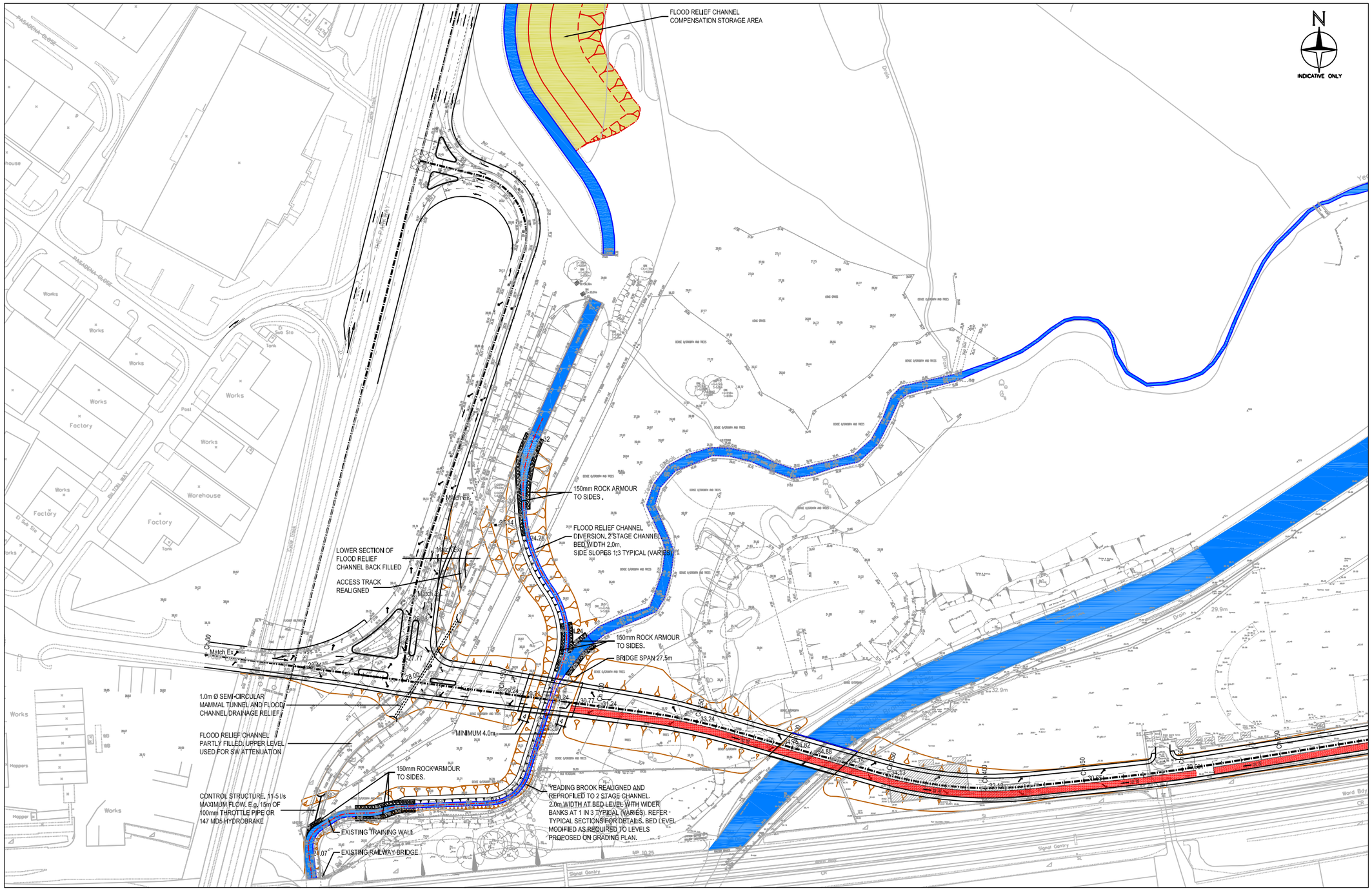
Drawing Title:

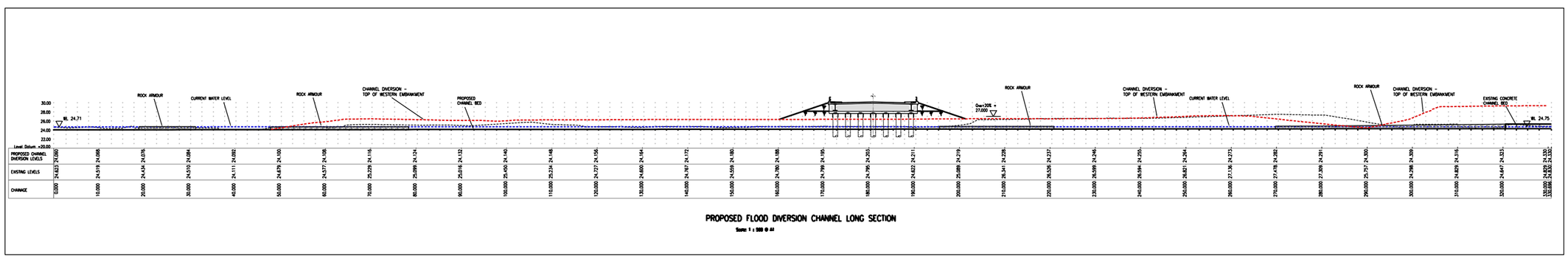
PUMP LANE LINK ROAD
GENERAL ARRANGEMENT
AND ELEVATION

Scale at A1	Drawn By	Date	Checked By	Date	Approved By	Date
1:1000	DW	13/02/08	RB	13/02/08	RB	13/02/08

Project No.	Office	Discipline	Drawing No.	Revision
A012564	28	C	645	A

DO NOT SCALE: Contractor to check all dimensions and report any omissions or errors





PROPOSED FLOOD DIVERSION CHANNEL LONG SECTION

Scale: 1 : 500 @ A1

A	Compensation Area Design revised. Flood Relief Channel Diversion amended to 2 Stage channel.	KP	RB	RB	20/06/08
Rev	Description	By	Chk	App	Date

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White Young Green

Consulting Engineers

Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

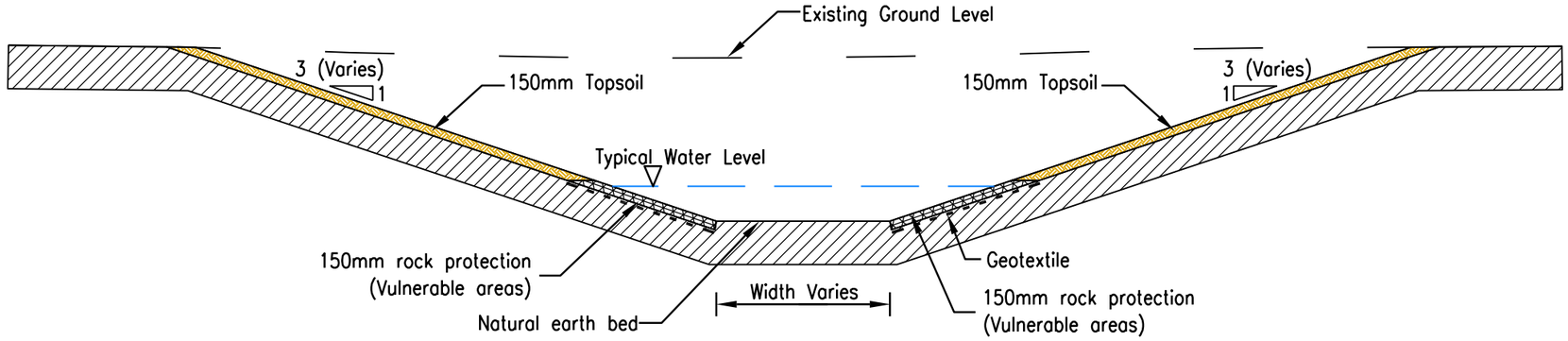
Project:
WEST SOUTHALL
YEADING BROOK
FLOOD RISK ASSESSMENT

Drawing Title:
PUMP LANE LINK ROAD
FLOOD RELIEF CHANNEL DIVERSION

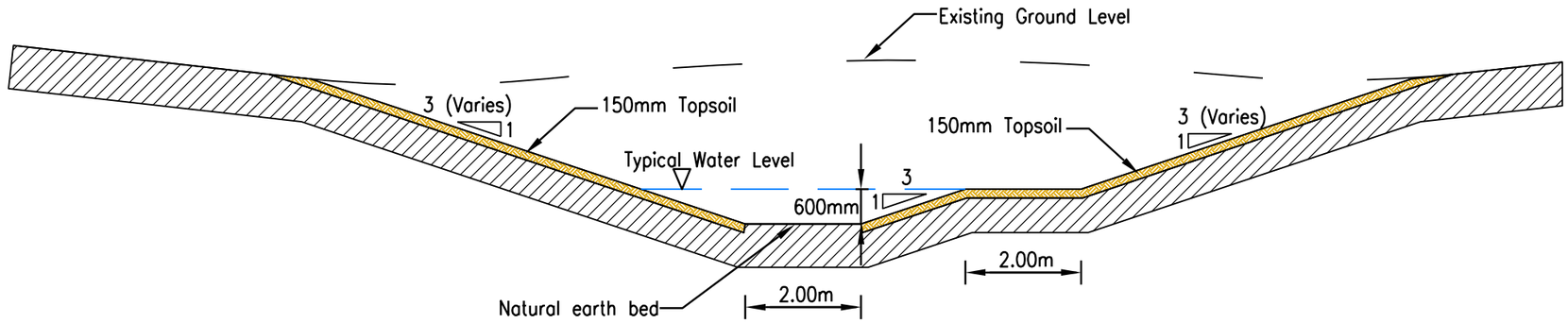
Scale at A1	Drawn By	Date	Checked By	Date	Approved By	Date
1:1000	DW	13/02/08	R.C.B	13/02/08	R.C.B	13/02/08

Project No.	Office	Discipline	Drawing No.	Revision
A012564	28	C	646	A

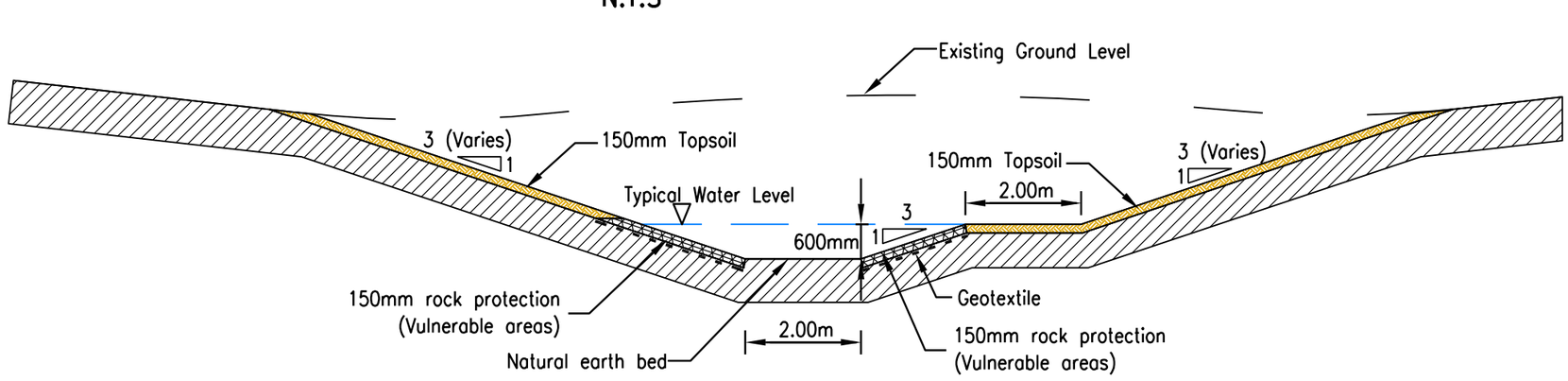
DO NOT SCALE: Contractor to check all dimensions and report any omissions or errors



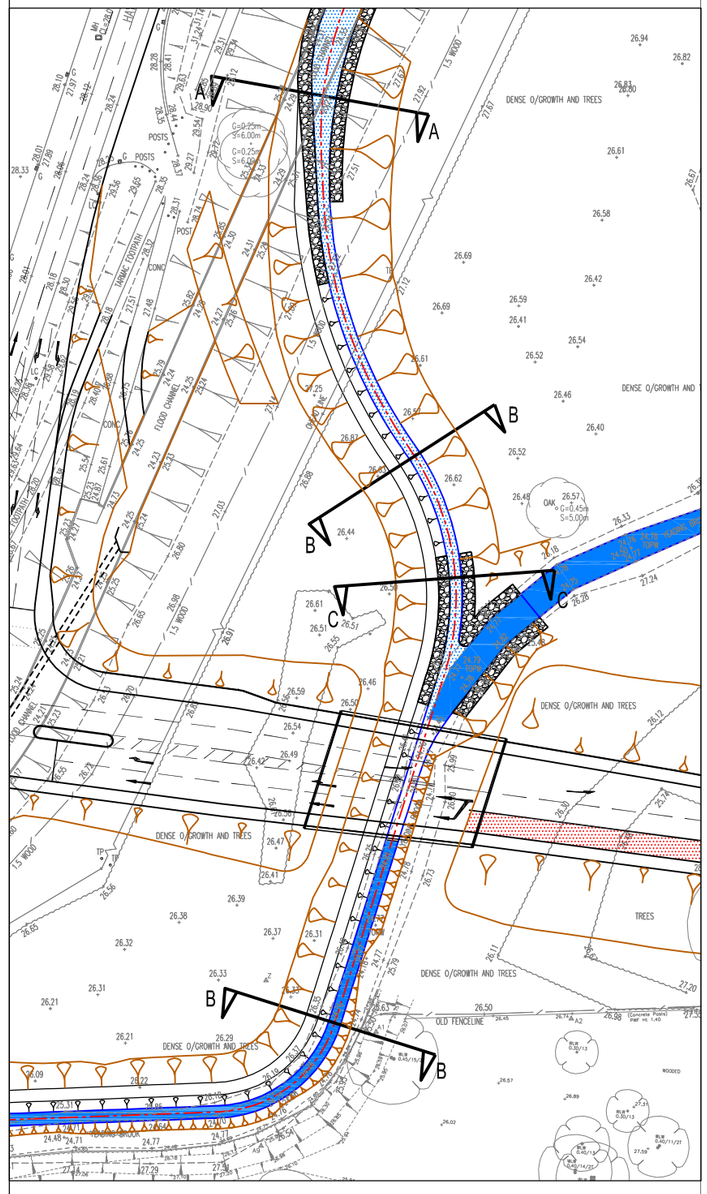
PROPOSED TYPICAL SECTION A-A
N.T.S



PROPOSED TYPICAL SECTION B-B
N.T.S



PROPOSED TYPICAL SECTION C-C
N.T.S



Rev	Description	By	Chk	App	Date
A	Typical Cross Sections amended to reflect New Flood Relief Channel Design.	KP	RB	RB	20/06/08

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Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:
WEST SOUTHALL
YEADING BROOK
FLOOD RISK ASSESSMENT

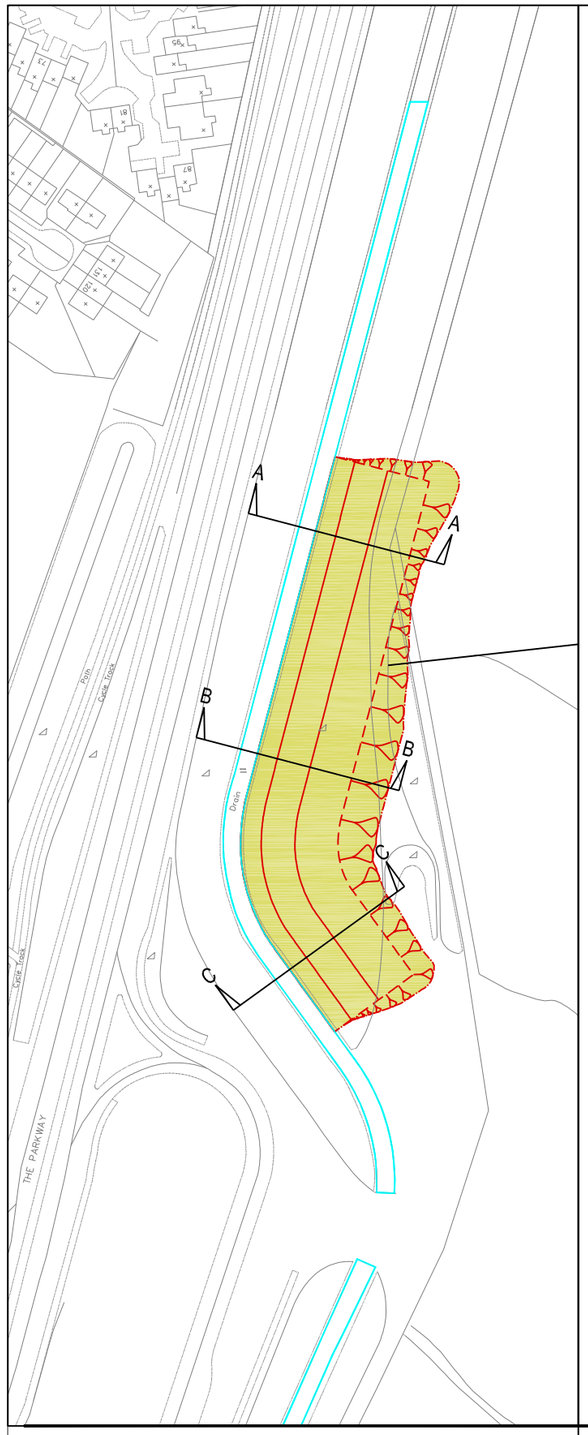
Client:

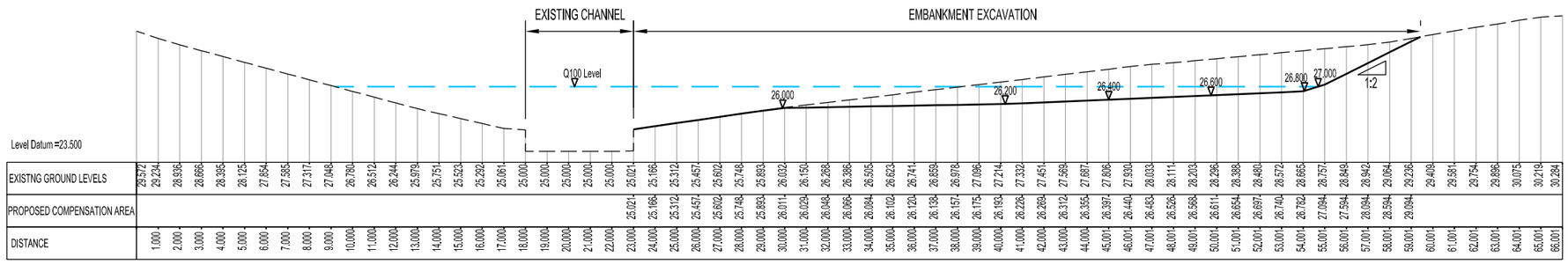
Drawing Title:
FLOOD RELIEF DIVERSION CHANNEL
TYPICAL SECTIONS

Scale at A3	Drawn By	Date	Checked By	Date	Approved By	Date
N.T.S.	DW	17/01/08	R.C.B.	17/01/08	R.C.B.	17/01/08

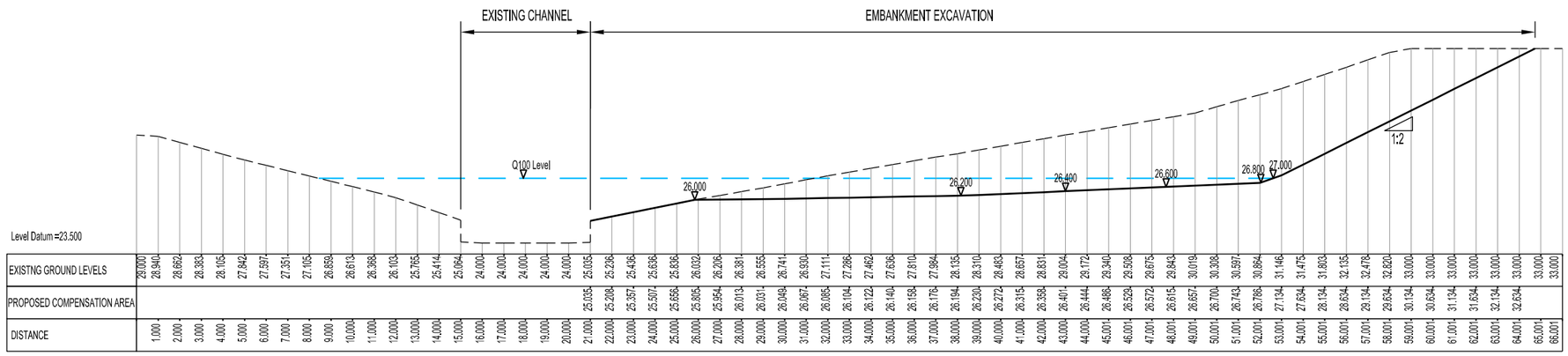
Project No.	Office	Discipline	Drawing No.	Revision
A012564	28	C	647	A

DO NOT SCALE: Contractor to check all dimensions and report any omissions or errors

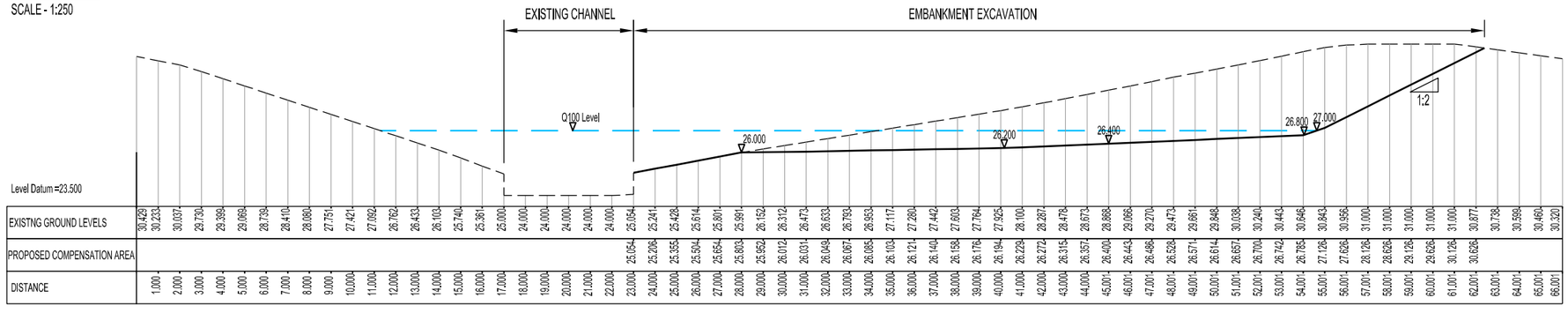




SECTION A-A
SCALE - 1:250



SECTION B-B
SCALE - 1:250



SECTION C-C
SCALE - 1:250

Rev	Description	By	Chk	App	Date
A	Compensation Area amended to suit Flood Levels (Halcrow Model 2008).	KP	RB	RB	20/06/08

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Consulting Engineers

Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:
WEST SOUTHALL
YEADING BROOK
FLOOD RISK ASSESSMENT

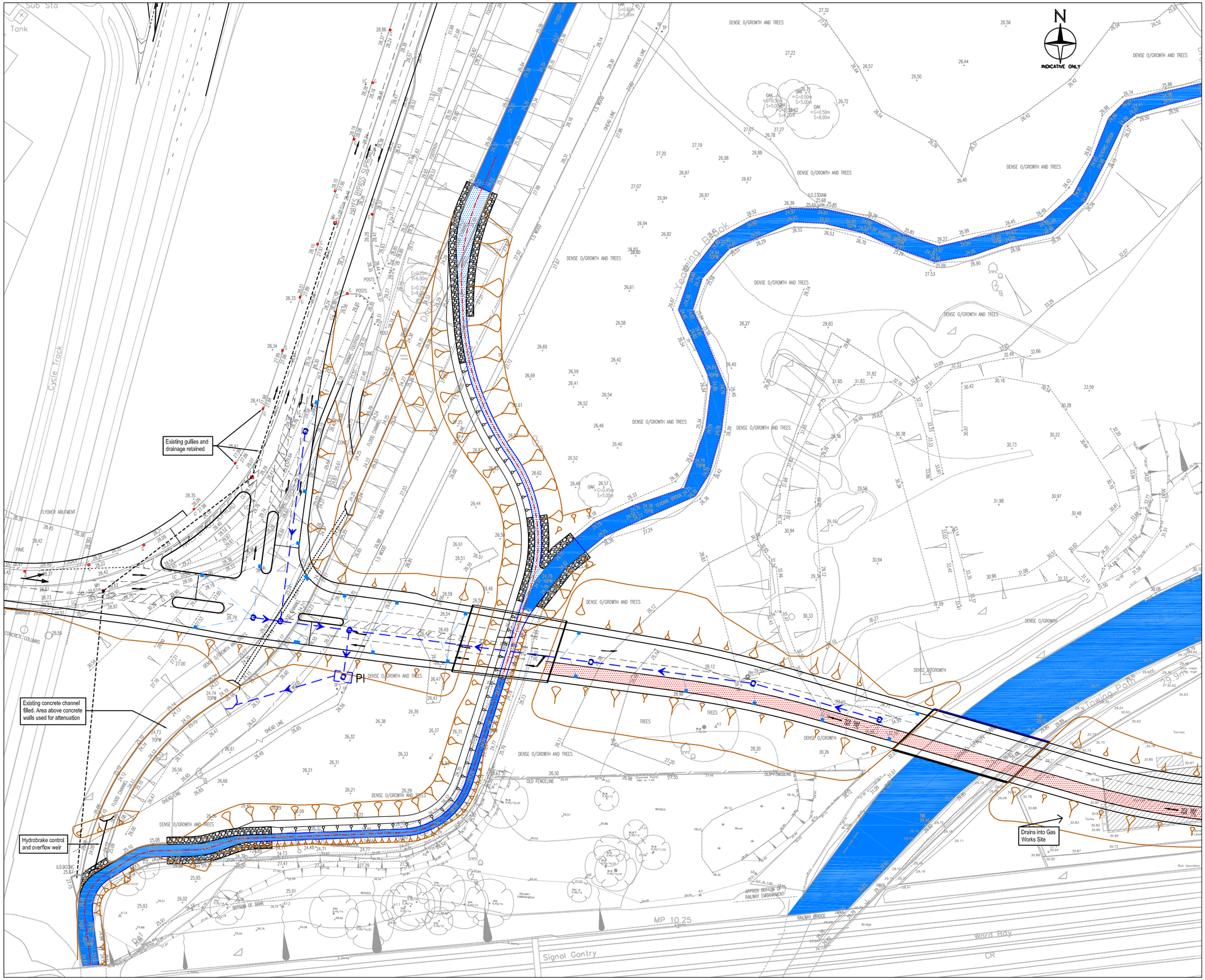
Drawing Title:
FLOOD RELIEF CHANNEL
COMPENSATION AREA

Scale	Drawn By	Date	Checked By	Date	Approved By	Date
1:2000	KP	28/02/08	RB	28/02/08	RB	28/02/08

Project No.	Office	Type	Drawing No.	Revision
A012564	28	C	648	A

APPROVAL ☐ INFORMATION ☐ TENDER ☐ CONTRACT ☐ CONSTRUCTION ☐

DO NOT SCALE: Contractor to check all dimensions and report any omissions or errors



Rev	Description	By	Chk	App	Date
A	Flood Relief Channel Diversion amended to 2 Stage Channel.	KP	RB	RB	20/06/08

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Consulting Engineers

Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:

WEST SOUTHALL
YEADING BROOK
FLOOD RISK ASSESSMENT

Drawing Title:

PUMP LANE LINK ROAD
ROAD DRAINAGE PLAN

Scale at A1	Drawn By	Date	Checked By	Date	Approved By	Date
1:500	DW	17/01/08	R.C.B	17/01/08	R.C.B	17/01/08

Project No.	Office	Discipline	Drawing No.	Revision
A012564	28	C	649	A

APPENDIX FRA 1

Topographic Survey

APPENDIX FRA 2

Environment Agency Correspondence

FRA 2.1 **May 2008 Flood Data**

FRA 2.2 **Response to FRA version 3**

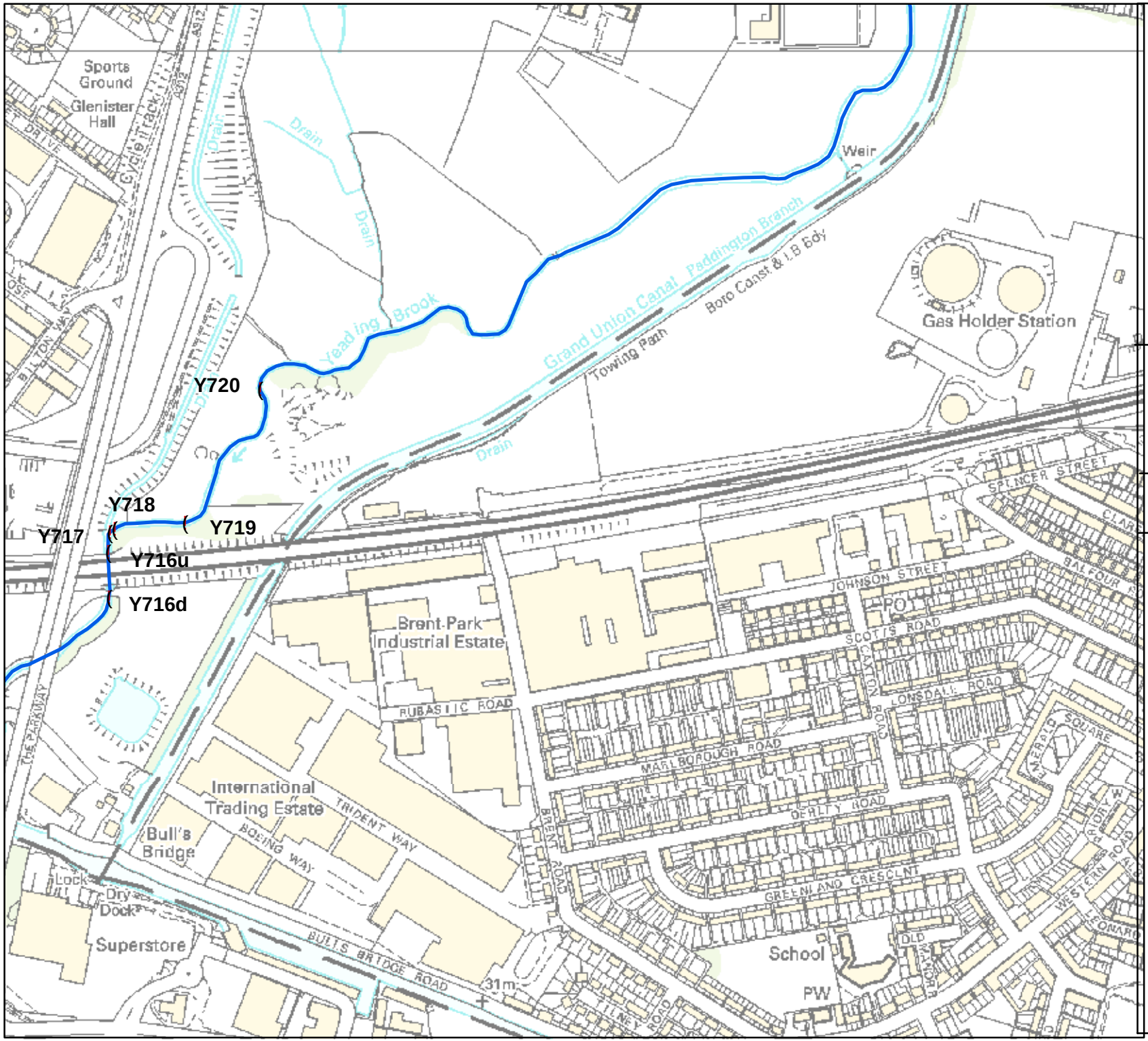
FRA 2.3 **Response to FRA version 2**

FRA 2.4 **Original Correspondence**

APPENDIX FRA 2.1

Environment Agency Correspondence 2.1

May 2008 Flood Data



Environment Agency

Environment Agency
2 Bishops Square Business Park
St Albans Road West
Hatfield
Hertfordshire
AL10 9EX

Crane Modelled Outlines 2 (Yeading Brook) TQ1127579812

Our ref: NE16962JM
228May 2008

Main River

Crane Nodes

0 25 50 100 150 200 Meters

Produced by:
Flood Risk Mapping & Data Management
Thames Region (North East Area)

Environment Agency ref: NE16962JM

The following information has been extracted from the River Crane Mapping Study (Halcrow 2008)

Caution:
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites across the entire catchment.

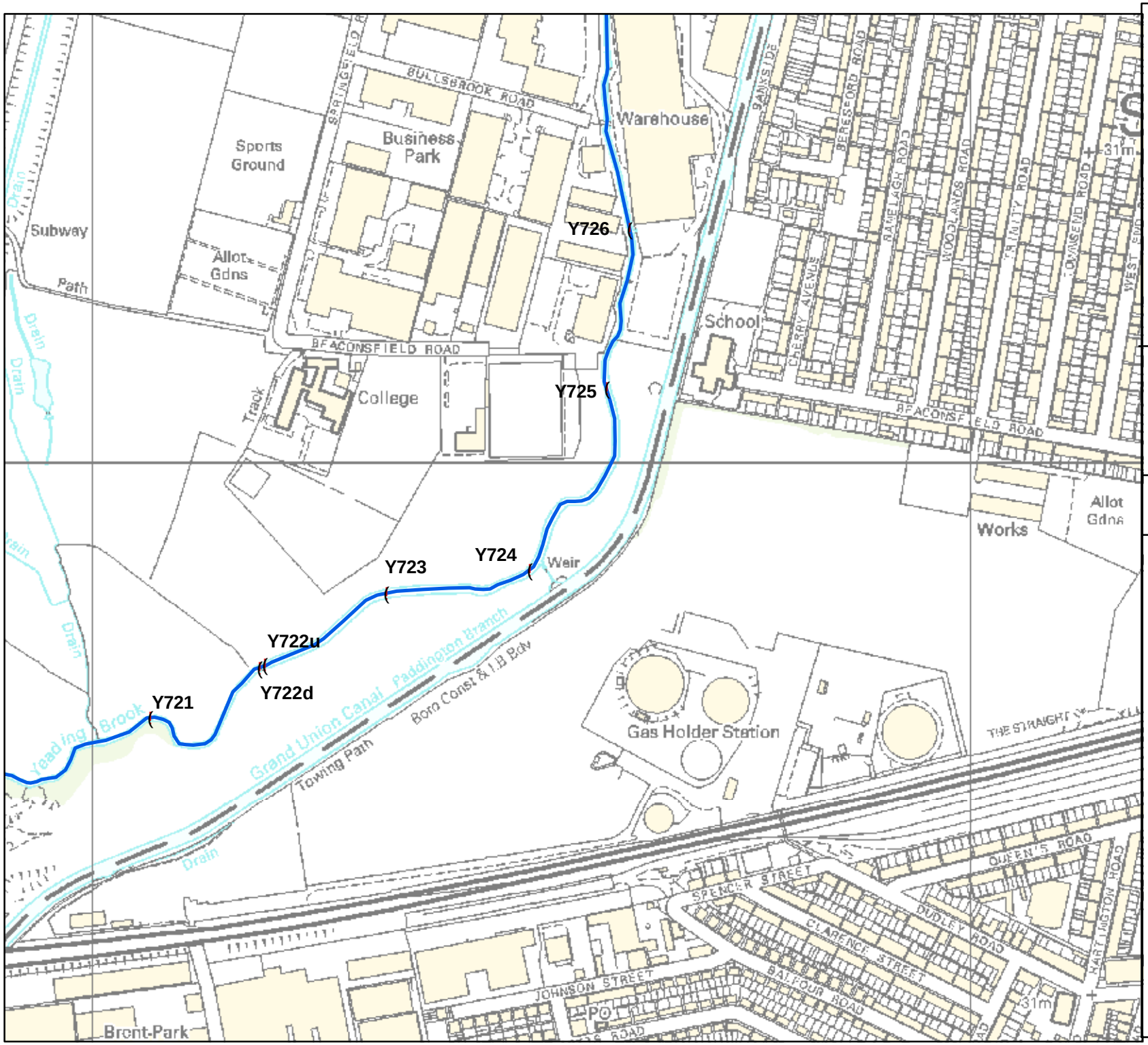
All flood levels are given in metres Above Ordnance Datum (mAOD)
All flows are given in cubic metres per second (cumecs)

MODELLED FLOOD LEVEL

			Return Period						
Node Label	**Easting**	**Northing**	**5 yr**	**10yr**	**20 yr**	**50 yr**	**100 yr**	**100yr + 20%**	**1000yr**
Y720	510870	179619	26.56	26.65	26.74	26.91	27.03	27.22	29.06
Y719	510771	179465	26.48	26.58	26.68	26.87	26.99	27.20	29.05
Y718	510691	179457	26.43	26.53	26.65	26.85	26.97	27.18	29.05
Y717	510684	179455	26.43	26.53	26.65	26.85	26.97	27.18	29.05
Y716u	510687	179430	26.37	26.47	26.58	26.77	26.89	27.09	28.98
Y716d	510684	179380	26.31	26.40	26.51	26.68	26.80	26.99	28.83

MODELLED FLOWS

			Return Period						
Node Label	**Easting**	**Northing**	**5 yr**	**10yr**	**20 yr**	**50 yr**	**100 yr**	**100yr + 20%**	**1000yr**
Y720	510870	179619	10.85	11.58	12.34	13.79	14.78	16.12	24.54
Y719	510771	179465	11.21	11.93	12.65	14.05	15.02	16.58	25.11
Y718	510691	179457	11.78	12.58	13.37	14.92	15.98	17.71	25.90
Y717	510684	179455	15.90	17.22	18.67	21.34	23.10	25.96	42.47
Y716u	510687	179430	15.90	17.22	18.66	21.34	23.10	25.95	42.47
Y716d	510684	179380	15.90	17.22	18.66	21.34	23.10	25.95	42.47



Environment Agency

Environment Agency
2 Bishops Square Business Park
St Albans Road West
Hatfield
Hertfordshire
AL10 9EX

Crane Node Map (Yeading Brook) TQ1127579812

Our ref: NE16962JM
22 May 2008

Main River

Crane Nodes

0 25 50 100 150 200 Meters

Produced by:
Flood Risk Mapping & Data Management
Thames Region (North East Area)

Environment Agency ref: NE16962JM

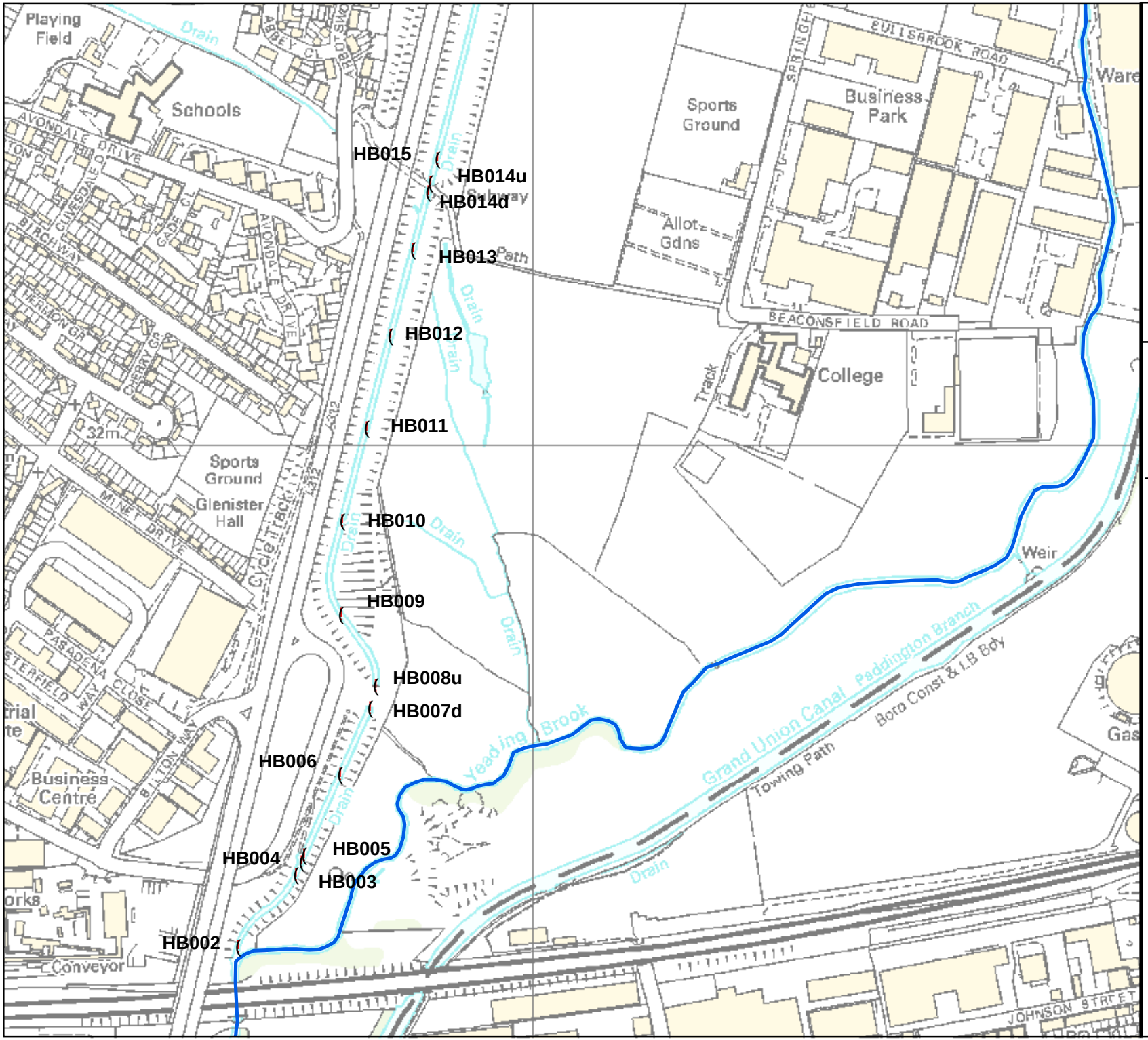
The following information has been extracted from the River Crane Mapping Study (Halcrow 2008)

Caution:
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites across the entire catchment.

All flood levels are given in metres Above Ordnance Datum (mAOD)
All flows are given in cubic metres per second (cumecs)

MODELLED FLOOD LEVEL

			Return Period						
Node Label	**Easting**	**Northing**	**5 yr**	**10yr**	**20 yr**	**50 yr**	**100 yr**	**100yr + 20%**	**1000yr**
Y726	511612	180266	27.21	27.26	27.32	27.42	27.48	27.59	29.09
Y725	511584	180082	27.03	27.09	27.15	27.26	27.34	27.47	29.08
Y724	511498	179877	26.90	26.96	27.03	27.16	27.25	27.40	29.08
Y723	511335	179849	26.85	26.92	26.99	27.12	27.21	27.36	29.07
Y722u	511196	179767	26.78	26.84	26.92	27.05	27.14	27.31	29.06
Y722d	511192	179765	26.76	26.83	26.90	27.03	27.12	27.28	29.06
Y721	511065	179708	26.70	26.77	26.85	26.99	27.09	27.27	29.06



Environment Agency

Environment Agency
2 Bishops Square Business Park
St Albans Road West
Hatfield
Hertfordshire
AL10 9EX

Hayes Bypass Channel (Crane)
Node Map
TQ1099979900

Our ref: NE17148SS
11 June 2008

(Hayes Bypass Channel Nodes

Main River

0 50 100 200 Meters

Produced by:
Flood Risk Mapping & Data Management
Thames Region (North East Area)

Environment Agency ref: NE17148SS

The following information has been extracted from the River Crane Mapping Study (Halcrow 2008)

Caution:
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites across the entire catchment.

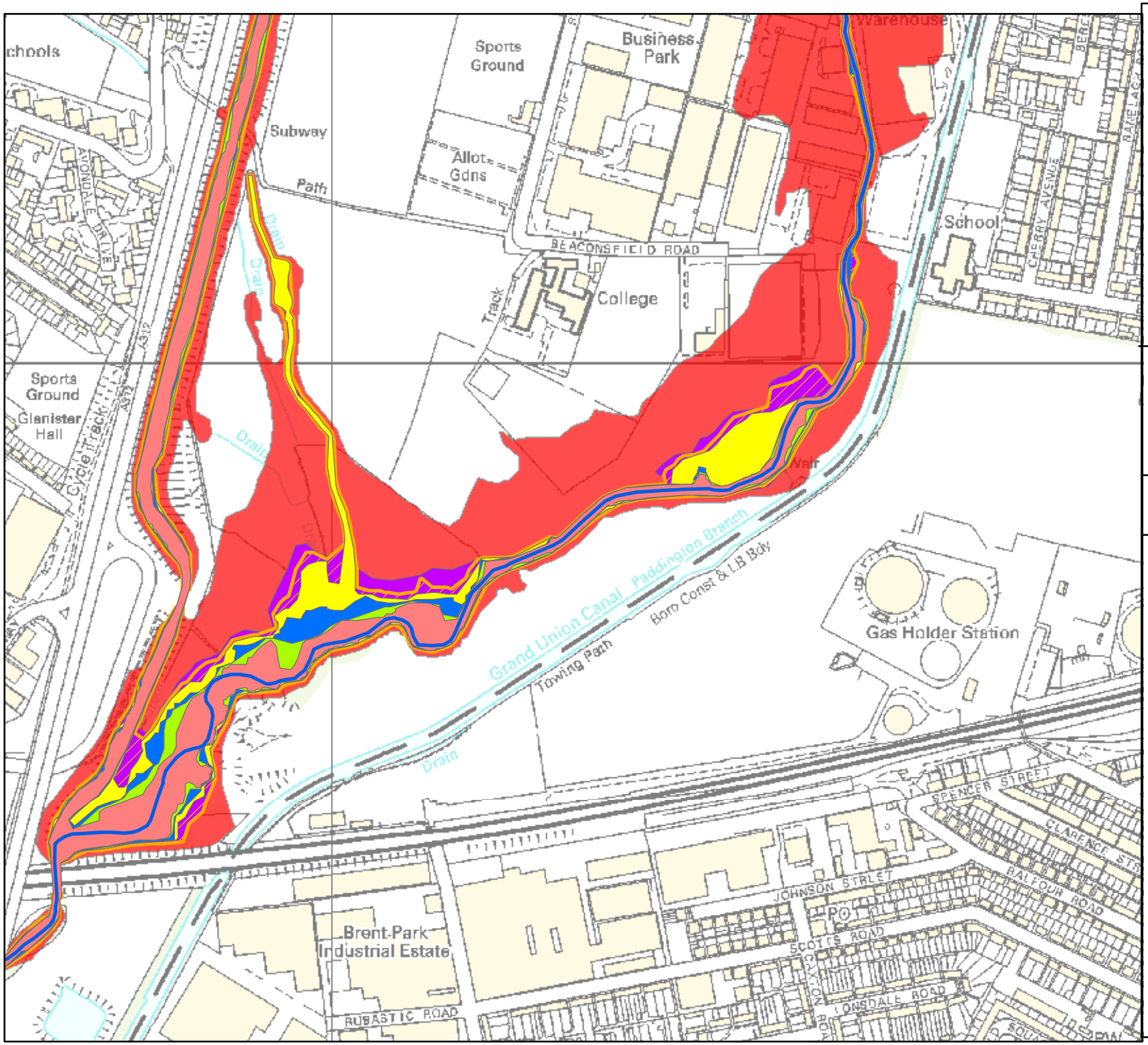
All flood levels are given in metres Above Ordnance Datum (mAOD)
All flows are given in cubic metres per second (cumecs)

MODELLED FLOOD LEVEL

			Return Period					
Node Label	**Easting**	**Northing**	**5 yr**	**20 yr**	**50 yr**	**100 yr**	**100yr + 20%**	**1000yr**
HB015	510900	180304	26.50	26.72	26.91	27.04	27.24	29.18
HB014u	510893	180276	26.50	26.72	26.91	27.03	27.24	29.18
HB014d	510893	180276	26.50	26.71	26.91	27.03	27.24	29.17
HB013	510870	180208	26.49	26.71	26.90	27.03	27.24	29.16
HB012	510846	180116	26.48	26.70	26.90	27.02	27.23	29.16
HB011	510820	180020	26.47	26.69	26.89	27.01	27.22	29.16
HB010	510799	179919	26.47	26.69	26.89	27.01	27.22	29.16
HB009	510796	179820	26.46	26.68	26.88	27.00	27.21	29.16
HB008u	510832	179745	26.44	26.66	26.86	26.98	27.19	29.13
HB007d	510829	179720	26.44	26.66	26.86	26.98	27.19	29.05
HB006	510797	179650	26.44	26.66	26.86	26.98	27.19	29.06
HB005	510756	179565	26.44	26.65	26.85	26.98	27.19	29.06
HB004	510756	179557	26.44	26.65	26.85	26.98	27.19	29.06
HB003	510750	179543	26.43	26.65	26.85	26.98	27.19	29.05
HB002	510684	179469	26.43	26.65	26.85	26.97	27.18	29.05

MODELLED FLOWS

			Return Period					
Node Label	**Easting**	**Northing**	**5 yr**	**20 yr**	**50 yr**	**100 yr**	**100yr + 20%**	**1000yr**
HB015	510900	180304	4.77	5.98	6.96	7.59	8.75	19.74
HB014u	510893	180276	4.77	5.98	6.96	7.58	8.74	19.72
HB014d	510893	180276	4.77	5.98	6.96	7.58	8.74	19.72
HB013	510870	180208	4.78	5.99	6.95	7.56	8.72	19.66
HB012	510846	180116	4.79	6.00	6.95	7.56	8.70	19.58
HB011	510820	180020	4.81	6.02	6.96	7.57	8.71	19.50
HB010	510799	179919	4.83	6.05	6.98	7.60	8.74	19.41
HB009	510796	179820	4.87	6.11	7.05	7.68	8.86	19.24
HB008u	510832	179745	4.88	6.13	7.07	7.71	8.90	19.20
HB007d	510829	179720	4.88	6.13	7.07	7.71	8.90	19.20
HB006	510797	179650	4.90	6.15	7.10	7.74	8.94	19.16
HB005	510756	179565	4.91	6.18	7.14	7.79	9.00	19.10
HB004	510756	179557	4.92	6.19	7.14	7.79	9.00	19.10
HB003	510750	179543	4.92	6.19	7.15	7.80	9.01	19.09
HB002	510684	179469	4.94	6.22	7.19	7.85	9.07	19.05



Environment Agency

Environment Agency
2 Bishops Square Business Park
St Albans Road West
Hatfield
Hertfordshire
AL10 9EX

Crane Modelled Outlines (Yeading Brook) TQ1127579812

Our ref: NE16962JM
22 May 2008

- 5yr Defended
- 10yr Defended
- 20yr Defended
- 50yr Defended
- 100yr Defended
- 100yr 20% Defended
- Main River
- 1000yr Defended

0 2550 100 150 200 Meters

Produced by:
Flood Risk Mapping & Data Management
Thames Region (North East Area)

APPENDIX FRA 2.2

Environment Agency Correspondence

Response to FRA version 3

[redacted]
White Young Green Environmental Ltd
[redacted]@wyg.com

Our ref: TL/2008/100682/04-L01
Your ref: West Southall

Date: 22 July 2008

Dear [redacted]

SUBMISSION OF REVISED FLOOD RISK ASSESSMENT FOR THE YEADING BROOK CROSSINGS AND THE EASTERN ACCESS.
FORMER SOUTHALL GAS WORKS SITE, SOUTHALL.

Thank you for the revised Flood Risk Assessment (FRA) for the bridge works and eastern access at Southall Gas works.

Bridge works

The revised FRA for the bridge works has dealt with most of the outstanding issues, there are however a couple of points which need to be addressed prior to submission:

- Flood storage compensation should be provide accounting for climate change, this must be demonstrated ad part of you plans and cross sections. Due to the stability works being undertaken, this volume may already be provided at the correct levels but this must be shown in the FRA.
- Please confirm the run-off rates from the surface water attenuation. It is stated in the report that this will be to Greenfield rates as agreed, but the calculations for the detention basin show run-off rates in excess of this, will this remaining run-off be catered for in the drainage system?
- Please provide a topographic site survey suitably sized so it is legible as part of the planning application, and include the surveys of the river and other channels.
- Please confirm that the channel on the bridge design sections is indicative as this does not meet with our discussions regarding a two-stage channel approach.

We will condition the details of the bridges, river diversion and channel design as part of the planning application. Further discussion with us will be required at discharge of condition stage to ensure the appropriate design is used.

Flood Defence Consent will be required from us for works in, over, under or within 8m of the Yeading Brook. Works to ordinary watercourses such as the flood relief

channel will require consent for any works will affect the flow of the watercourse, such as diversions.

Eastern Access

At the planning application stage we would object to the planning application for the Eastern Access as the FRA has failed to provide the information we previously requested as follows:

- It must be confirmed that SUDS will be used on site, this is part of the drainage strategy and the attenuation volume and method must be confirmed at this stage. This is the developers responsibility, the requirements of Thames Water are separate to our requirements and Planning Policy Statement 25, as Thames Water deal with the sewer capacity and not on site attenuation.
- The run-off has not been restricted to the Greenfield rate as agreed and as required by the Development Control policy messages in Ealing's SFRA and our requirements.
- Calculations must be provided to demonstrate the volume of attenuation provided.

Please note we have not provided comments on the surface water strategy for the main site as the revised version has not yet been received.

Please contact me if you have any questions to the above.

Yours sincerely

[redacted]
Major Projects Officer

Direct dial [redacted]

End

APPENDIX FRA 2.3

Environment Agency Correspondence

Response to FRA version 2

[redacted] Green Environmental Ltd
Sunley House Bedford Park
[redacted]@wyg.com

Our ref: TL/2008/100682/01-L01
Your ref: West Southall

Date: 29 April 2008

Dear [redacted]

SUBMISSION OF BRIDGE CROSSING DETAILS, ECOLOGICAL MITIGATION PLAN AND GAS HOLDER WEST FACTUAL REPORT AND INITIAL INTERPRETATION REPORT.
FORMER SOUTHALL GAS WORKS SITE, SOUTHALL.

Thank you for submitting the above documents for our consideration. We are happy to meet with you to discuss the below comments in relation to the reports. We suggest a meeting be held on 16 May 2008 in our offices in Hatfield from 2pm to 4pm.

Flood Risk Assessment for bridges

New mapping and modelling is now available on the Crane which may assist you in your calculations. If you wish to use this information please contact our External Relations team by emailing thnortheast@environment-agency.gov.uk.

Bridge Design

1. Springfield road bridge and Minet Park Bridge

In terms of the two footbridges, we understand that the height of the bridges relative to the water levels has been maximised, of which we approve. However, both pedestrian bridges are proposed to cross the Yeading brook diagonally, which is likely to impact on the river and its corridor more than if they were to cross at 90 degrees to the watercourse.

We would like confirmation of why they have been proposed to cross at this angle and would like to question if they can be changed?

In relation to the Spring field road bridge (which we assume is a pedestrian bridge) the abutment on the land between the GUC and the Yeading Brook is a large structure that seems to impinge in terms of space into the 4m buffer zone to the Yeading Brook. Can you please confirm why this distance is required.

In relation to the Minet Park Bridge, does the access ramp on the Minet Country Park side have to run parallel with the riverbank? The design should minimise impacts on the river corridor which includes disturbance, and in this case is there any reason why the ramp could not be at 90 degrees to the Yeading Brook.

2. Link Road Crossing

Is there any opportunity for the embankments to be replaced with abutments and piers, to reduce the amount of flood storage compensation required? Having an embankment would also have a much greater impact on the wildlife site than would abutments and piers.

We would also like to question if the road bridge been designed so that the height of the bridge relative to the water level has been maximised? Road bridges are wide and we need to see more details of the shading study to know the extent of shading.

While the bridge must be designed so that there is minimal shading, it should be recognised that there is still a negative impact on the river, even if it is considered to be reasonably low, and such an effect should be put on balance sheet of negatives against which appropriate positives through mitigation and enhancement should be weighed up against.

The mitigation report does not comment on the scale of impact of this bridge in terms of the severing of the wildlife site. We recognise that mammal tunnels have been proposed, but in terms of the current cohesive and relatively undisturbed nature of the site for example, nesting birds have not been considered in terms of impact. There is also the impact in terms of loss of area of the wildlife site, i.e. the physical footprint. This has not been addressed in the mitigation report.

Trying to weigh up all impacts is a difficult task, but following guidelines set out by IEEM (Institute of Ecology and Environmental Management) for Ecological Impact Assessments (EcIA) would be of much use here, especially considering the scale of the works. In fact, the mitigation plan refers to an EcIA, but this has not been sent to us. We are aware from previous consultations that this southern area of the site is the most valuable for wildlife, and we do not consider that the impacts have been fully considered, and therefore cannot be sure that full appropriate mitigation is proposed.

Please note that once we are satisfied with the proposed bridge designs we are likely to condition the details of the bridge design at the planning application stage and the works would require Flood Defence Consent from us.

Flood Storage Compensation

Insufficient information has been provided regarding the compensation. The volumes lost at each level must be demonstrated and the replacements shown in a similar manner for comparison.

The area designated for compensation appears to be constrained by its situation in relation to the existing floodplain. It must be demonstrated that this area is hydraulically connected to the existing floodplain to ensure that floodwaters will reach the compensation area and not be forced elsewhere.

Channel diversion

Insufficient information has been submitted regarding the channel diversion. It must be demonstrated that the new channel has sufficient hydraulic capacity, not just increased channel width for the combined flows. The channel should be two stage to accommodate low and high flows and set at the existing invert levels.

FRA for Eastern Access

The flood risk information submitted is not acceptable to us for the following reasons:

- Inadequate information has been submitted regarding the assessment of surface water as existing and likely to be generated as a result of the development
- Calculations regarding the volume of storage required, including an allowance for climate change, up to the 1 in 100 year critical storm duration have not been provided.
- Surface water run-off has not been restricted as far as possible to the greenfield rate.
- Sustainable Drainage systems have not been employed.

Please note that is not acceptable to rely on a reduction in hardstanding to create improvements. There is ample space as part of the Eastern Access to include Sustainable Drainage Systems to act as attenuation including ponds, detention basins and swales. The FRA must comply with the requirements of PPS25 and the London Plan. See further surface water advice below.

Surface Water FRA for masterplan site

The greenfield run-off rate proposed is acceptable to us. However, the surface water FRA has failed to meet the requirements of PPS25 and the London Plan for the reasons outlined above. The previous FRA was written under old legislation which has now been superseded.

Calculations must be submitted to demonstrate the surface water system as existing and as a result of the proposed development, including 30% rainfall intensity as an allowance for climate change, outlined in PPS25.

Plans to illustrate the SUDS features proposed on site must be included at outline stage to ensure that adequate space is left in the design phase to include these. Plans of SUDS on site and the levels of attenuation provided by these must be submitted. The most sustainable methods possible on site must be used, with any barriers to the use of SUDS clearly justified as part of the FRA.

Phased Application

Where phased development of the site is proposed, the surface water FRA should demonstrate each phase of the development to ensure that adequate surface water facilities are provided as part of each stage. Only if this is demonstrated are we able to provide conditions which would be discharged at each phase of the development, otherwise the detailed design of the entire site will be required prior to discharge of conditions.

Surface water information:

Planning applications under PPS25 should be 'reducing flood risk to and from new development through location, layout and design, incorporating sustainable drainage systems (SUDS)'.

The London Plan states in Policy 4A.3 The Mayor will, and boroughs should, ensure future developments meet the highest standards of sustainable design and construction and reflect this principle in DPD policies. These will include measures to:

- Manage flood risk, including through sustainable drainage systems (SUDS) and flood resilient design for infrastructure and property
- Encourage major developments to incorporate living roofs and walls where feasible (Policy 4A.11)

Further policies, Policy 4A.9 Adaptation to Climate Change, Policy 4A.11 Living Roofs and Walls, Policy 4A.14 Sustainable drainage, Policy 4C.3 The natural value of the Blue Ribbon Network and Policy 4A.17 Water quality are relevant to this application.

For the Surface Water Flood Risk Assessment to be acceptable to us the drainage system shall be designed as follows:

- Surface water discharge from the site shall be restricted to the greenfield rate.
- 1 in 100 year on-site attenuation shall be provided, including an allowance for climate change as outlined in PPS25.
- Sustainable Urban Drainage solutions shall be employed.

Any barriers to providing the above criteria must be clearly justified.

Sustainable drainage is the practice of controlling surface water runoff as close to its origin as possible, before it is discharged to a watercourse or to ground. This involves moving away from traditional piped drainage systems towards softer engineering solutions which seeks to mimic natural drainage regimes. For a drainage scheme to be termed 'sustainable' it must meet the following three criteria:

- Reduce flood risk
- Improve water quality
- Improve the environment

When designing a site's drainage scheme the type(s) of SUDS techniques selected should aim to meet all three criteria. The most sustainable techniques should be included your drainage design. Traditional piped/tanked systems are the least sustainable of all SUDS techniques and should be avoided, they will only be accepted if it has been demonstrated that they are the only viable technique. A site's drainage design can be made up of a range of SUDS techniques.

Flood Channel Enhancements

The documents refer to works in regards the flood channel, and the proposals for this indicate that there will be ecological benefit here. We look forward to discussing the details on these proposals.

Proposed Wetland

There is a wetland proposed within the central park area, but at this stage no details have been submitted. Although this is an outline application we would need to be sure that a wetland was viable in a area with the availability/water levels having been investigated and known to be able to support a wetland.

The park is currently managed by Hillingdon Council and they have to balance many different park user needs. We need to be satisfied that there is sufficient and appropriate space for a fully functioning wetland.

Yeading Brook

No enhancement has been proposed to the Yeading Brook itself through the site. It is an wide and deep channel that has poor flow diversity and there is good scope to improve in-channel habitat. This has not been explored at all in the reports. In addition, there is some bank rock cladding proposed about which we have great concern.

In channel enhancements could be a way of mitigating the impact of the bridges on the Yeading Brook and its corridor.

There is the additional argument of increased numbers of people to the park from the development and if these pedestrian bridges are to be put in to encourage people to use the park, extra funds should be made available to enhance the park given the size of this new development, and the number of people likely to use the park. The Yeading Brook is such a feature of this park that there should be more consideration to its enhancement.

Balance Sheet

In order to be satisfied with a mitigation plan we will need more details than currently provided. To re-iterate, a balance of negatives and positives should be produced in order to satisfy us that all impacts have been addressed. Impacts should be given appropriate weight in terms of scale of impact, and that appropriate mitigation and compensation has been proposed. Currently this has not been provided. We are happy to discuss these comments in more detail at the meeting.

Consents

Under the terms of the Water Resources Act 1991, our prior written consent is required for dewatering from any excavation or development to a surface watercourse. Contact Consent Department on 08708 506506 for further details.

Under the terms of the Water Resources Act 1991, our prior written consent of the is required for any discharge of sewage or trade effluent into controlled waters (e.g. watercourses and underground waters), and may be required for any discharge of surface water to such controlled waters or for any discharge of sewage or trade effluent from buildings or fixed plant into or onto ground or into waters which are not controlled waters. Such consent may be withheld. Contact Consent Department on 08708 506506 for further details.

Under the terms of the Water Resources Act 1991 our prior written consent is required for any works within 8 metres of the Yeading Brook.

Cont/d..

Ground Contamination

Due to current resourcing issues we have been unable to provide detailed comments on the Gas Holder Factual Reports submitted. However, we will try to submit comments to you as soon as we are able.

Please contact me if you wish to discuss the following.

Yours sincerely

[redacted]
Major Projects Officer

[redacted]

End

APPENDIX FRA 2.4

Environment Agency Correspondence

Original Correspondence

[redacted]

From: [redacted]@environment-agency.gov.uk]
Sent: 10 December 2007 17:42
To: [redacted]
Subject: RE: West Southall, Yeading brook crossings

[redacted]

Following on from our recent discussions regarding the functional floodplain, having reviewed the outlines and plans submitted by yourself, it is my consideration that in this instance the approach you have used is satisfactory.

I am happy for you to use the functional outlines submitted. For clarity, this is the area covered by both the light blue and the hatched blue in your plan SK100.

I trust the above is of use to you, please do not hesitate to contact me should you require any further guidance. I am aware that there are still comments outstanding regarding the revised bridge design, you will receive these from our Planning Liaison team shortly.

Kind regards,

[redacted]

Development Control Engineer
For the Brent and Crane catchments
Environment Agency, NE Thames

[redacted]

From: [redacted]@wyg.com]
Sent: 06 December 2007 14:49
To: [redacted]
Subject: RE: West Southall, Yeading brook crossings

[redacted]

The colours on SK 100 are as follows:

Dark blue – normal extent of the Yeading Brook and the canal

Light blue – functional flood plain

Speckled blue - Functional flood plain - estimated extent due to limited topographic data.

Green - Location of attenuation/compensatory storage.

The functional flood plain will extend further up the flood relief channel than shown, but will be tightly constrained.

SK's 101 &103 only show watercourse and diversion routes. Flood plains are omitted.

Hope the above helps

Regards

[redacted]

From: [redacted]@environment-agency.gov.uk]
Sent: 06 December 2007 13:56
To: [redacted]
Subject: RE: West Southall, Yeading brook crossings

[redacted]

I will send this drawing onto our Planning liaison team for consultation as it is not solely myself who would need to comment.

I am currently still trying to resolve the issues about the functional floodplain. Could you possibly confirm what the differing coloured zones relate to, i.e. dark blue, light blue, hatched blue? The outline of all of these areas appears similar to the functional floodplain outline, but not the dark blue or light blue outlines. If you could clarify I would be grateful.

Kind regards,

[redacted]

Development Control Engineer
For the Brent and Crane catchments
Environment Agency, NE Thames

[redacted]

From: [redacted]wyg.com]
Sent: 05 December 2007 14:39
To: [redacted]
Subject: West Southall, Yeading brook crossings

[redacted]

Further to our discussion on Monday please find attached our sketch no SK103. This indicates our current thinking in respect of the road alignment and diversion of the Flood relief channel. Please note that these are very much first drafts

The main changes from the layout applicable to the previous FRA are:

The road alignment has been moved north to avoid network rail land.

The diversion of the flood relief channel has been extended so as to pass under the Yeading Brook bridge.

The 5.5 m wide flood relief channel culvert is omitted.

The bridge span has been widened by 5.5 m to accommodate both channels.

I would appreciate your confirmation that you are, in principle, in agreement with this arrangement. Following which we can discuss and firm up the details these would include:

Treatment of the junction of the Flood relief channel and the brook

The extent, and details of, the widening of the Yeading brook

The extent of the embankment base

Compensatory storage provisions

Attenuation storage provisions

Mammal pass provision

I will be posting you a CD containing most of the previous FRA for your information. This includes the BPA modelling report.

The disk also includes .pdf's of the previous two sketches sent.

Please call me if you need to discuss any of the above

Regards

[redacted]
Associate

WHITE YOUNG GREEN
Brigantine House, 27-31 Cumberland Street, Bristol, BS2 8NL
[redacted]

[redacted]

From: [redacted]
Sent: 20 November 2007 15:28
To: [redacted]@environment-agency.gov.uk'
Cc: [redacted]@environment-agency.gov.uk'
Subject: West Southall redevelopment

Dear [redacted]

I refer to [redacted] letter dated15 Nov 2007. After Speaking to [redacted] I understand that the technical discussion is best held directly between ourselves.

You have advised that our functional flood plain outline differs from that produced by [redacted] as part of Hillingdon's SFRA. I have spoken to Hillingdon and Scott Wilson in this respect.
I understand that the SFRA is not yet available for public issue. Also, Scott Wilson are very reluctant to release their results until, at least, their modelling have been accepted by yourselves. I understand that this is due this week.

As a result I am unable to comment on any differences between the predicted flood extents. Although as the results were produced using different methods it is not surprising that there are some differences.

[redacted] have advised that their results were obtained by overlaying EA flood level figures over a Liddar survey of the area.

The PBA figures used in our previous report were obtained by running the latest EA model of the River Crane/Yeading Brook catchment (as of December 2005, I was given understand that there have been no significant changes since then). The model was updated to include topographic survey data of the watercourse in this valley. The FRA report included comments on the reduction in flood level for the base condition and it was accepted by the EA in November last year.

The PBA model should thus be a more accurate representation of the Brook than a simple overlay of flood levels.

Not withstanding the above is important that we agree on the values to use and I would appreciate the opportunity to discuss the appropriate approach (and confirmation that you would be happy for Hillingdon/Scott Wilson to release their flood zone plans)

I anticipate that the overall principles of our proposals will remain unchanged i.e.

Foot bridges : Min 600 mm clear above 1:100 year +20% level
Abutments/piers 4 m min set back from bank
Abutments/piers ; preferably outside but otherwise with minimum impact on the flood plain

Pump Lane crossing: Bridge 17 .5 m min span, abutments 4 m back from embankments
Min 600 mm clear above 1:100 year +20% level
The embankment will be in the flood plain Therefore compensatory storage to be provided

Culvert As short as possible
As much freeboard as possible
Provision for mammal ledge

I will try to call you later this week to discuss the above or, alternatively you may prefer to contact me when you are free.

Regards

[redacted]
Associate

WHITE YOUNG GREEN
Brigantine House, 27-31 Cumberland Street, Bristol, BS2 8NL
[redacted]
www.wyg.com

Our Ref: RB/A012564/fc-01

Date: 29 October 2007

[redacted]

The Environment Agency
Apollo Court
2 Bishop's Square Business Park
St. Albans Road West
HATFIELD
Herts AL10 9EZ

Dear [redacted]

WEST SOUTHALL REDEVELOPMENT
YEADING BROOK – FLOOD RISK ASSESSMENT
FLOOD ZONE 2

I refer to our telephone conversation on 17 October 2007 and [redacted] email to [redacted] dated 11 October 2007.

I enclose a copy of our sketch A012564/SK100 which depicts my interpretation of Flood Zone 2, the functional flood plain.

The outline is based on the 1:50 year flood levels predicted by the latest PBA modelling exercise.

The model for this return period produces a combined flow downstream of the confluence of the Yeading Brook and the Hayes Bypass channel of 17.02m^3/s.

The Hiflow-UK website contains details of gauging station reference 39057 which is located a short distance further downstream. This station has recorded 5 annual maximum flows greater than 17m^3/s in the 28 years between 1974 and 2002.

The station does serve a larger catchment than the reach we are considering and the flow figures are not considered sufficiently reliable to be included in the FEH database. However, I consider that this figure can be deemed to provide a reasonably conservative estimate of the functional flood plain.

I would be grateful if you would confirm that you are happy for this approach to be used within the Flood Risk Assessment that is being prepared for the crossings of the brook.

Yours sincerely

[redacted]
Associate

Enc.

c.c. [redacted] - White Young Green Environmental
- White Young Green, Norwich

creating a better place

Environment Agency

[redacted]
White Young Green
29-31 Cumberland Street
Bristol
Avon
BS2 8NL

Our ref: NE/2007/104791/01-L01
Your ref: RB/A012564/fc-01

Date: 15 November 2007

Dear [redacted]

WEST SOUTHALL REDEVELOPMENT. YEALDING BROOK FLOOD RISK ASSESSMENT.
WEST SOUTHALL.

Thank your for your letter dated 29 October 2007 that we received on 31 October 2007. In places the proposed functional floodplain outline is smaller than that mapped by Scott Wilson as part of Hillingdon's Strategic Flood Risk Assessment (SFRA) which has recently been signed off.

You are advised to contact Hillingdon to obtain their modelled shapefile for the functional floodplain which is being mapped as part of their SFRA and establish why your flood outlines are different to theirs.

This exercise should also be undertaken for the 1 in 100 year, 1 in 100 year climate change outlines, it should also be checked that you have our most recent flood zone 2 shapefiles.

Scott Wilson are using our data to create their shapefiles for this SFRA and this data is more up to date than the PBA data you refer to in your letter.

The most accurate and up to date data should always be used to represent all of the flood zones identified in line with Planning Policy Statement 25 (PPS25) to ensure that the Flood Risk Assessment for this site is fully updated.

Lastly, It is unclear why you refer to the functional floodplain as Flood Zone 2 in your letter, as in accordance with PPS25, the functional floodplain is called as Flood Zone 3b.

Please contact me if you have any questions to the above.

Environment Agency
Apollo Court, 2 Bishops Square Bussines Park, St Albans Rd West, Hatfield, Herts, AL10 9EX.
Customer services line: 08708 506 506
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk

Cont/d..

Yours sincerely

[redacted]

Major Projects Officer

[redacted]

Please note that the North East London Planning Team are moving office on 19 November 2007. My direct dial will be changing to [redacted] *Email and postal addresses will remain unchanged.*

End

From: [redacted]@environment-agency.gov.uk]
Sent: 11 October 2007 10:33
To: [redacted]
Cc: [redacted]
Subject: RE: SOUTHALL GAS WORKS REDEVELOPMENT

[redacted]

I have received some preliminary comments back fo[redacted](Development Control Engineer). These are as follows.

The impact of the new structures cannot be adequately assessed with respect to flood risk because an updated Flood Risk Assessment has not been submitted. We require an FRA to be submitted which is inline with PPS25 and not PPG25 as with the previous submission.

We would require the following information:

1) The FRA needs to establish Flood Zone 3b, 3a and 2. The FRA should include the impact of the bridges and details, plans, cross sections and calculations on flood storage compensation. If the site is found to fall within Flood Zone 3b, the Exception test would need to be passed and the applicant would need to demonstrate that all the structures within the functional floodplain were "essential". Climate change of +20% should be accounted for as outlined in Table B2 of PPS25.

2) The drainage FRA for the site should be updated in line with PPS25. As stated previously, the drainage strategy should restrict the run-off to between 2-8l/s/ha, up to and including the 1 in 100 year + 30% climate change as outlined in Table B2 of PPS25. The use of SUDS on site should be maximised. The Environment Agency has previously agreed the restriction of 7l/s to the Flood Relief channel and 16l/s to the Yeading Brook for the site run-off.

3) The bridge designs should meet with the parameters previously set: bridges should be clear span with soffit levels 600mm above the 1 in 100 year inc climate change flood level, with abutments set a minimum of 4m from bank top. **We are unable to agree to the bridge designs and principles until the FRA has been updated.**

4) A 5m undeveloped green buffer strip measured from canalside should be included in the development. The masterplan submitted conflicts with this agreement by showing hardstanding to canalside.

Please feel free to contact me on the number below or [redacted]

Kind regards

[redacted]
Planning Liaison Officer
Environment Agency

Tel [redacted]
Fax

Apollo Court, 2 Bishops Square Business Park, St Albans Road West, Hatfield, Hertfordshire, AL10 9EX

A01254

White Young Green Environmental Ltd
Yeoman House
Croydon Road
London
SE20 7TS

Our ref: NE/2005/013231/04-L01 (Springfield Road)
NE/2005/013227/04-L01 (Pump Lane)
NE/2005/013229/04-L01 (Minet Park)

Your ref: 54814/APP/2005/1775
54814/APP/2005/1773
54814/APP/2005/1781

Date: 14 November 2006

FAO [redacted]

Dear [redacted]

PROPOSED NEW LINK ROAD BETWEEN SPRINGFIELD ROAD/BEACONSFIELD ROAD, HAYES AND THE FORMER SOUTHALL GAS WORKS WITH ASSOCIATED EMBANKMENT AND BRIDGES OVER THE YEADING BROOK AND GRAND UNION CANAL.
LAND TO SOUTH EAST OF BEACONSFIELD ROAD, HAYES, AND TO THE WEST OF FORMER SOUTHALL GAS WORKS, HAYES.

Thank you for your letter dated 6 October 2006, which was received on 12 October 2006. You are asked to quote our reference in any correspondence. We have the following comments:

- **Pump Lane Bridge and Culvert**

Biodiversity
We are happy with the detail and basis of the Ecological Mitigation proposals. If these proposals were submitted as part of a planning application to the London Borough of Hillingdon, we would remove/not object to the application on the grounds of loss of species habitat.

Flood Risk
If the flood risk details were submitted to us as part of a planning application to the London Borough of Hillingdon, we would remove/not object in detail to the application because the following elements now meet our requirements:

- flood risk assessment,
- surface water drainage design,

- bridge design,
- culvert design,
- level for level floodplain compensation and
- design of the new channel.

We would require the following conditions be attached to any planning permission that was granted:

- No development approved by this permission shall be commenced until the detailed drawings of the bridge crossing has been approved in writing by the Local Planning Authority.
  - To prevent the increased risk of flooding and to protect the river corridor.

- No development approved by this permission shall be commenced until the detailed design of the culvert has been approved by the Local Planning Authority.
  - To prevent the increased risk of flooding and to protect the river corridor.

- The detailed design of the diversion channel shall have been submitted to and agreed in writing by the Local Planning Authority before development commences.
  - To alleviate the increased risk of flooding that would otherwise be caused by a reduction in flood storage capacity.

- Level for level compensatory flood storage works shall be carried out in accordance with details which shall have been submitted to and approved in writing by the Local Planning Authority before the development commences.
  - To alleviate the increased risk of flooding that would otherwise be caused by a reduction in flood storage capacity.

- There shall be no building or raising of existing ground levels, nor deposition of spoil/material on that part of the site lying within land liable to flood.
  - To prevent the increased risk of flooding due to impedance of flood flows and reduction of flood storage capacity.

- Surface water drainage works shall be carried out in accordance with details which shall have been submitted to and approved in writing by the Local Planning Authority before development commences.
  - To prevent the increased risk of flooding, to improve water quality and to provide improved amenity and wildlife habitat.

Under the terms of the Water Resources Act 1991 and the Land Drainage Byelaws 1981, the prior written consent of the Environment Agency is required for certain proposed works or structures in, under, over or within 8 metres of the brink of the Yeading Brook and the Hayes By-Pass Channel. Land Drainage Consent is required irrespective of any planning permission granted.

- **Springfield Road Bridge (DPS 13231)**

Biodiversity
As detailed in the Introduction of the Ecological Mitigation Plan (V3A August 2006), we would maintain our objection to the principle of development at Springfield Road.

Regarding the mitigation proposals in the case of the Local Authority granting permission on the Springfield Road, we do not consider the current proposals sufficiently compensate for the residual impacts of the bridges (those impacts that remain after mitigation). If these were to be granted planning permission we would consider ecological enhancements to the Yeading Brook within Minet Country Park to be appropriate compensation. This could include removal of invasive species, bank reprofiling and selective scrub clearance. The plans would have to be agreed by ourselves.

Flood Risk
The following elements now meet our requirements:

- flood risk assessment,
- surface water drainage design,
- bridge design,
- level for level floodplain compensation.

If these flood risk details were submitted to us as part of a planning application to the London Borough of Hillingdon, we would remove/not object in detail to the planning application.

However, we would object to the principle of this bridge crossing because we do not believe it to be necessary given the fact that access to the park could be achieved by the Pump Lane Bridge.

We also wish to see and comment on the detailed design proposals for the highways drainage attenuation wetland feature (drawing number Appendix C revision C).

- **Minet Footbridge (DPS 13229)**

Biodiversity
As detailed in the Introduction of the Ecological Mitigation Plan (V3A August 2006), we would maintain our objection to the principle of development at Minet Park.

Regarding the mitigation proposals in the case of the Local Authority granting permission on the Minet Park, we do not consider the current proposals sufficiently compensate for the residual impacts of the bridges (those impacts that remain after mitigation). If these were to be granted planning permission we would consider ecological enhancements to the Yeading Brook within Minet Country Park to be appropriate compensation. This could include removal of invasive species, bank reprofiling and selective scrub clearance. The plans would have to be agreed by ourselves.

Flood Risk
The following elements now meet our requirements:

- flood risk assessment,
- surface water drainage design,
- bridge design,
- level for level floodplain compensation.

If these flood risk details were submitted to us as part of a planning application to the London Borough of Hillingdon, we would remove/not object in detail to the planning application.

However, we would object to the principle of this bridge crossing because we do not believe it to be necessary given the fact that access to the park could be achieved by the Pump Lane Bridge.

We also wish to see and comment on the detailed design proposals for the highways drainage attenuation wetland feature (drawing number Appendix C revision C).

If you have any questions, please contact me directly on my number below.

Yours sincerely

[redacted]
Planning Liaison Officer

Direct dial [redacted]
Direct fax
Direct e-m[redacted]environment-agency.gov.uk

cc London Borough of Hillingdon

H:\Projects\E00001 - E01000\E00357\4004\E00357\DF02OCT06L EA.doc

6th October 2006

M [redacted]
Environment Agency
Apollo Court
2 Bishops Square Business Park
St Albans Road West
Hatfield
Herts AL10 9EX

Dear [redacted]

RE: SOUTHALL GAS WORKS REDEVELOPMENT

Further to our various correspondence and consultations to address the EA's comments following the planning application for the above which culminated in our concluding consultation meeting of 5th June 2006, please find attached a copy of our enhanced reports, drawings and documentation as listed below.

These documents have addressed all of the issues raised and discussed at the referenced meeting which has resulted in these clarified and developed solutions. The documents should be read together.

1. **Detailed Ecological Mitigation Plan (BOUND REPORT)**
(Ref: E0357/jaAug06ecolmitplan/V3A)

- **Included drawings:**

ECO100/101	- River Corridor Survey
A012564/AppC Rev C	- Pump Lane General Arrangement
RE01/RE02 Rev B	- Flood Relief Channel Diversion Plan and Section Detail
SK02 Rev A	- Ecological Impact Areas
4142-4-100 G	- Pump Lane Landscape Proposals
4142-3-100F	- Minet Footbridge Landscape Proposals
4142-2-100 G	- Springfield Road Landscape Proposals
Open Space Parameter Plan	

2. **Flood Risk Assessment (BOUND IN FOLDER)**
(Ref: SOUTHALL/RBFRA/24.July.06/V6A)

- **Included Drawings**

Figures:

Fig. 630 Rev A	- Location Plan
Fig. 631	- Environment Agency Flood Zone Map (currently published)
Fig. 632 Rev A	- Flood Plain Map (enhanced to latest data)
Fig. 633Rev B	- Bridging and Compensatory Structure Locations
Fig. 634 Rev D	- Springfield Road Link Road Bridge Area
Fig. 635	- Pump Lane Link Road

Yeoman House, 63 Croydon Road, London SE20 7TS
Tel: 020 8659 9959 Fax: 020 8676 9968 Email: enviro.london@wyg.com Website: www.wyg.com

White Young Green Environmental Ltd
Registered in England Number 3050297 Registered Office: Arndale Court, Headingley, Leeds LS6 2UJ

Drawings in Appendices:

App A Rev A	- E0357/800 Topographical Survey
App C(Rev C)	- Pump Lane Link Road Bridge – General Arrangement
App D(Rev A)	- Pump Lane Link Road Bridge – Drainage Strategy
App E	- 013 RevA Minet Footbridge – General Arrangement
App F Rev A	- Minet Footbridge – Drainage Strategy
App G	- 011 RevA Springfield Road Link Bridge – General Arrangement and 012 Details
App H	- SK05 RevD Springfield Road Link Road Bridge – Drainage Strategy
App J (Rev B)	- Flood Relief Channel Diversion Plan and RE01/RE02 Channel Details
App K(Rev A)	- Flood Compensatory Storage Area

3.A Structural Layout Drawings (IN WALLET)

001 Rev A / 002 Rev A	- Pump Lane Canal Bridge Crossing and Detail
003 Rev A / 004	- Pump Lane Yeading Brook River Crossing and Detail
005	- Pump Lane Flood Relief Channel Diversion Culvert
011 Rev A	- Springfield Road General Arrangement and Detail
013 Rev A	- Minet Footbridge General Arrangement and Detail

3.B Minet Country Park Plans (for information only) (IN WALLET)

Minet Country Park Suppport Text

4142-05-01	- Existing Landscape Plan
4142-05-02	- Landscape Character Zoning Plan
4142-05-03	- Character Images, Sheet 1/2
4142-05-04	- Character Images, Sheet 2/2
4142-05-05	- Public Access Zoning Diagram
4142-05-06	- Landscape Proposals

For ease of reference we also attach a further copy of the agreed minutes of our meeting of 5th June 2006, so that when you are reviewing the provided details you can assure yourselves that all points raised have been appropriately dealt with in line with our recorded discussions.

If, during your considerations of these details, any items require clarification then to avoid further correspondence may we request that such items can be discussed over the telephone, or by email, to the following contacts:

Ecology – [redacted]
Flood Risk and Structures [redacted]
Landscape – [redacted]
General Issues – [redacted]

We trust that you find these details comprehensive and appropriate to allow us to conclude our consultations in line with our meeting. At the appropriate time we would be grateful if you could issue correspondence to confirm this (noting your retained in principle objection to the three river crossings as minuted) such that the planning authorities and other stakeholders can be informed of our mutually agreed position.

Yours sincerely,
For **WHITE YOUNG GREEN ENVIRONMENTAL LTD**

[redacted]

Managing Director

Encs:

c.c. [redacted]
- EA (plus docs)
- EA (plus docs)
- Castlemore (plus docs)
- Salisbury Jones Planning for National Grid (plus docs)
- RPS (plus docs)
- Lovejoys
- WYG
- WYGE

BRISTOL

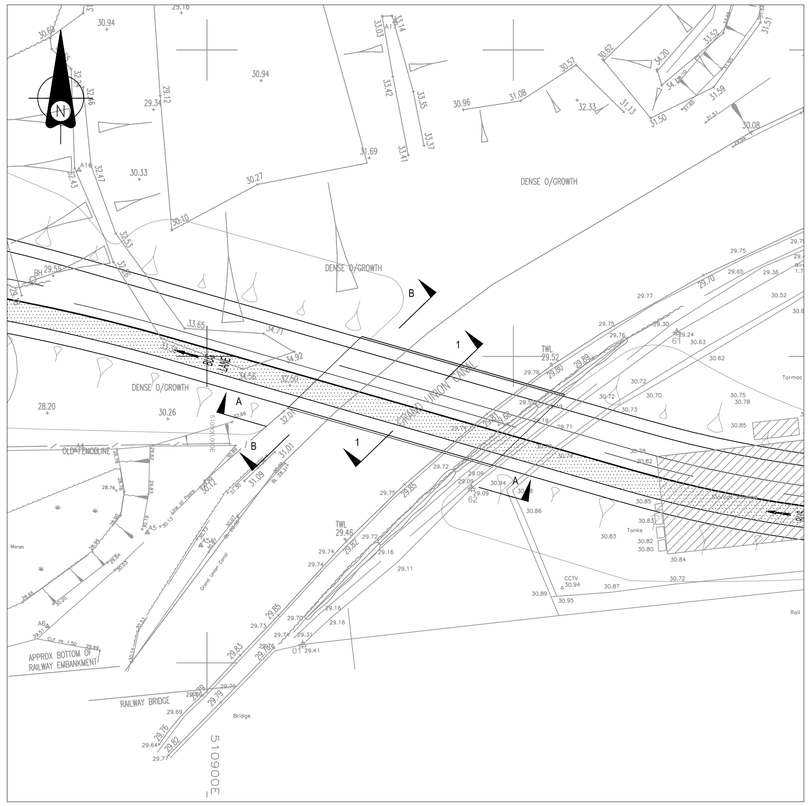
APPENDIX FRA 3

Pump Lane Link Road Bridge Details

DO NOT SCALE: Contractor to check all dimensions and report any omissions or errors

NOTES

1. ALL LEVELS IN METERS AND ARE BASED ON ORDINANCE DATUM
2. ALL DEMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED

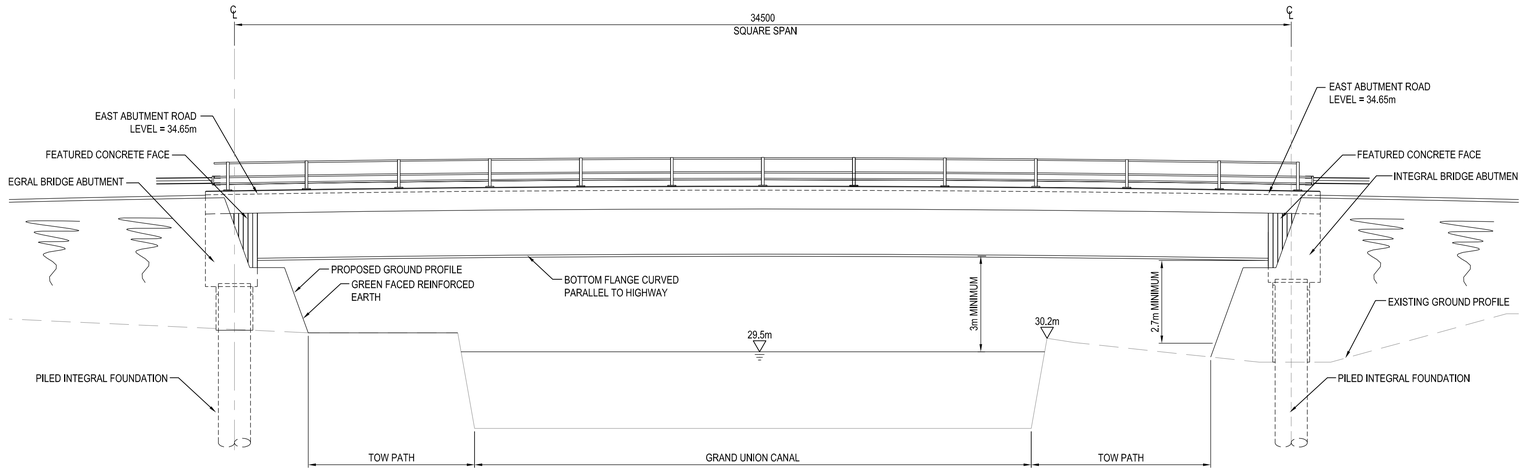


SITE PLAN

SCALE 1:500

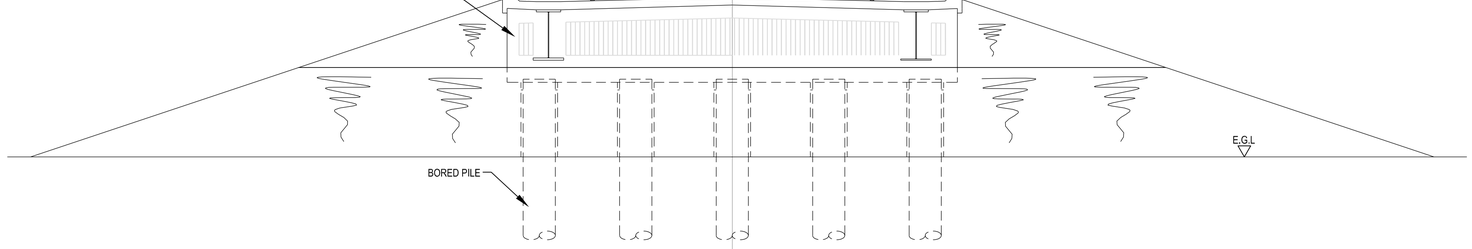
NOTE

CONFIGUATION IS INDICATIVE ONLY AND SUBJECT TO CHANGE DURING DETAILED DESIGN STAGE.



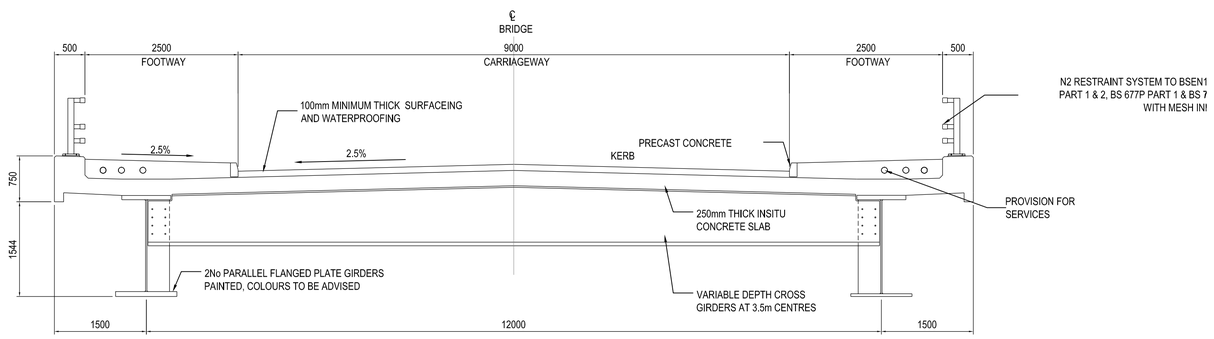
SOUTH ELEVATION A-A

SCALE 1:100



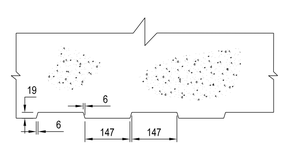
ELEVATION B-B

SCALE 1:50



SECTION 1-1

SCALE 1:50



DETAIL OF FEATURED CONCRETE FACE

SCALE 1:10

Rev	Description	By	Chk	App	Date
1	DRAFT	SLW	BS	DH	23.01.08
0	DRAFT	SLW	BS	DH	16.01.08

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Bristol
BS2 8NL

Tel: 0117 924 4144
Fax: 0117 924 4145
e-mail: bristol@wyg.com

White Young Green

Consulting Engineers

Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:

WEST SOUTHALL
GRAND UNION CANAL BRIDGE

Drawing Title:

PROPOSED COMPOSITE STEEL LADDER DECK AND INTEGRAL ABUTMENTS

Scale at A1	Drawn By	Date	Checked By	Date	Approved By	Date
	SLW	16/01/2008	BS	16/01/2008	DH	16/01/2008

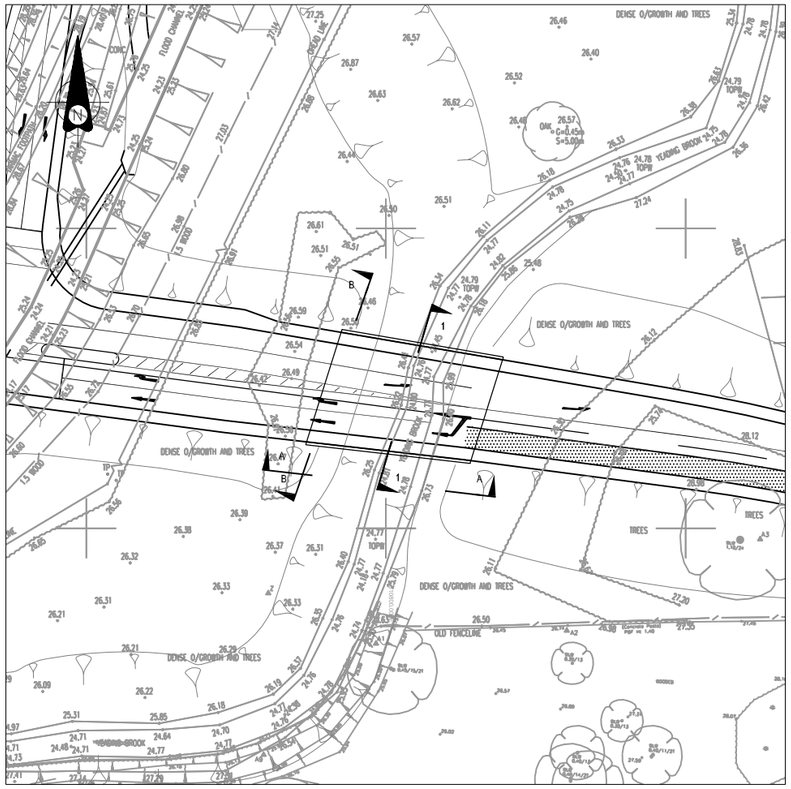
Project No.	Office	Type	Drawing No.	Revision
A012564-1	28	R	201	1

APPROVAL ☐ INFORMATION ☒ TENDER ☐ CONTRACT ☐ CONSTRUCTION ☐

DO NOT SCALE: Contractor to check all dimensions and report any omissions or errors

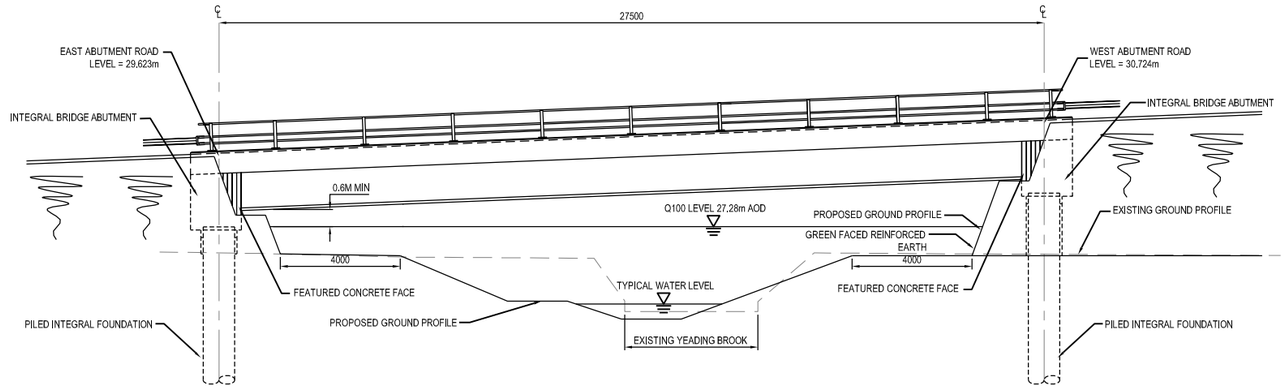
NOTES

1. ALL LEVELS IN METERS AND ARE BASED ON ORDINANCE DATUM
2. ALL DEMENSIONS IN MILLIMETERS UNLESS OTHERWISE STATED



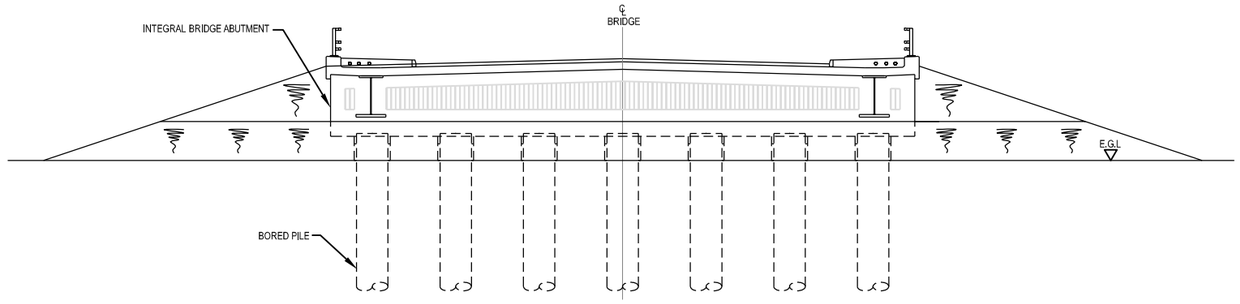
SITE PLAN

SCALE 1:500



SOUTH ELEVATION A-A

SCALE 1:100



ELEVATION B-B

SCALE 1:100

NOTE

CONFIGUATION IS INDICATIVE ONLY AND SUBJECT TO CHANGE DURING DETAILED DESIGN STAGE.

Rev	Description	By	Chk	App	Date
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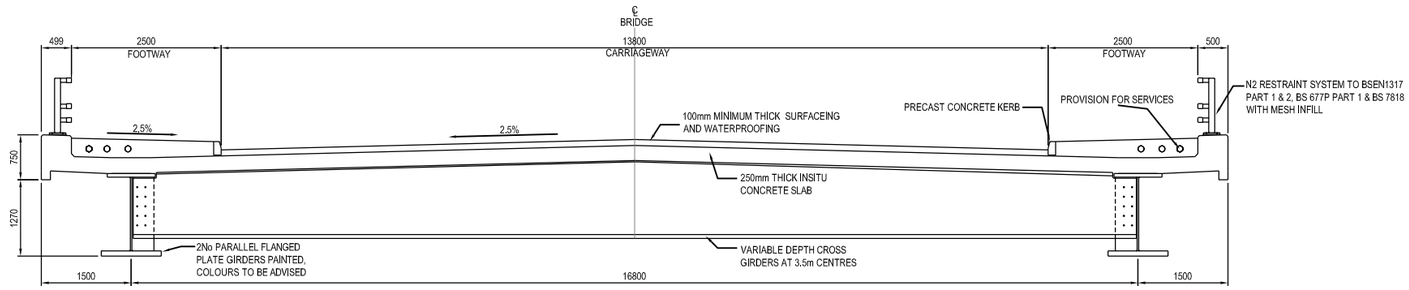
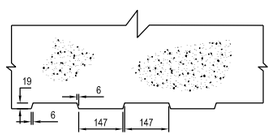
0	DRAFT	SLW	BS	DH	15.01.08



SECTION 1-1

SCALE 1:50



DETAIL OF FEATURED CONCRETE FACE

SCALE 1:10

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Bristol
BS2 8NL

Tel: 0117 924 4144
Fax: 0117 924 4145
e-mail: bristol@wyg.com

White Young Green

Consulting Engineers

Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:

WEST SOUTHALL
YEALDING BROOK BRIDGE

Drawing Title:

PROPOSED COMPOSITE STEEL LADDER DECK AND INTEGRAL ABUTMENTS

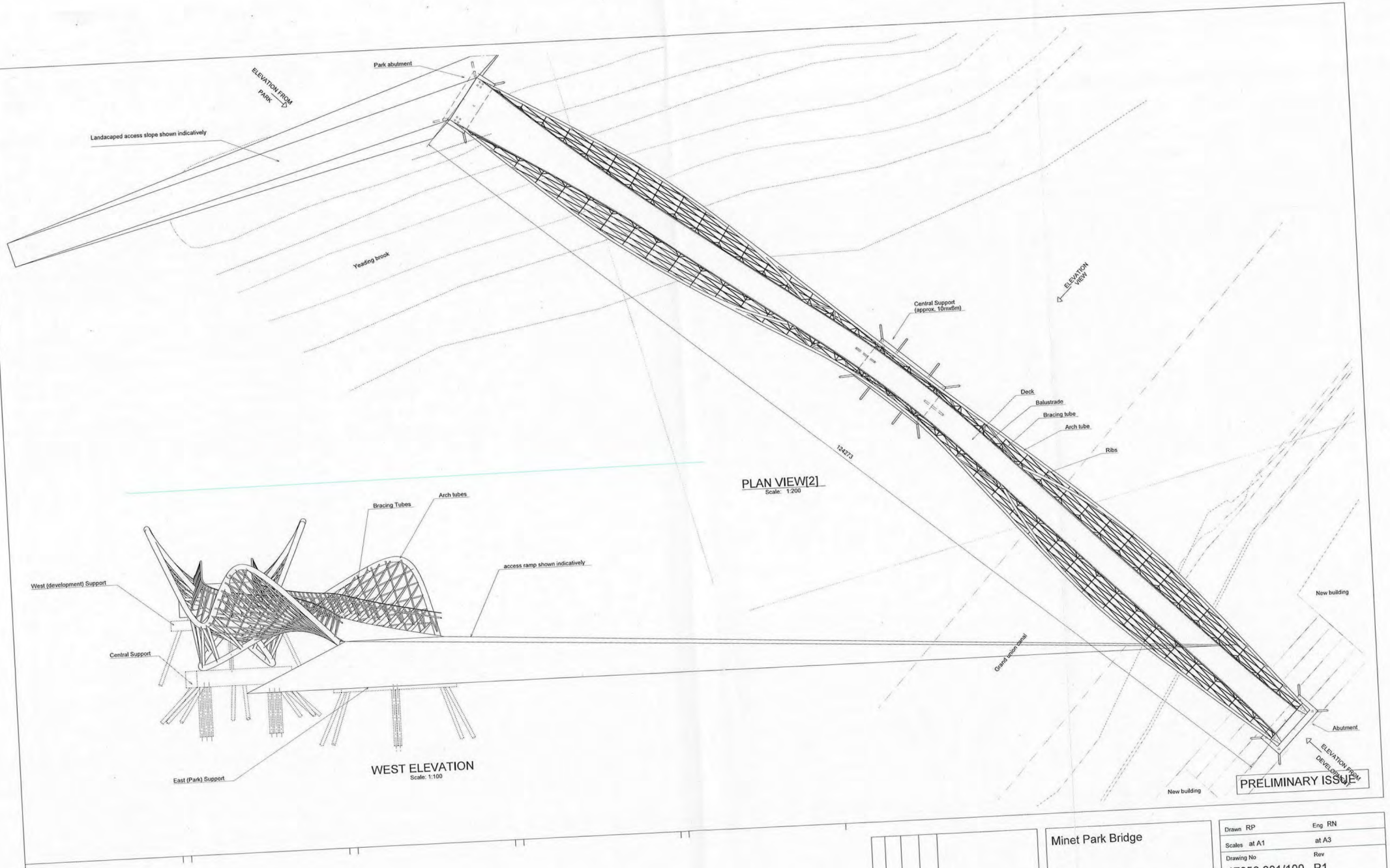
Scale at A1	Drawn By	Date	Checked By	Date	Approved By	Date
AS SHOWN	SLW	15.01.08	BS	15.01.02	DH	15.01.02

Project No.	Office	Type	Drawing No.	Revision
A012564-1	28	R	200	2

APPROVAL ☐ INFORMATION ☒ TENDER ☐ CONTRACT ☐ CONSTRUCTION ☐

APPENDIX FRA 4

Minet Park Foot/Cycle Bridge General Arrangement



PLAN VIEW[2]
Scale: 1:200

WEST ELEVATION
Scale: 1:100

Notes :

1. This Drawing is to be read in conjunction with all relevant Architect's Engineer's and specialists' drawings and specifications.
2. Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check drawing has been printed to the intended scale this bar should be 50mm long @ A1 or 25mm long @ A3.
3. Health & Safety : All specific drawing notes are to be read in conjunction with the project "Information Pack" and "Site Rules".
4. For general notes refer to Drawing No. 17056/100

Rev	Date	Drawn	Eng	Amendment
P1	07/03/08		RN	Issued for planning

Minet Park Bridge

Plans, Elevations

Drawn RP	Eng RN
Scales at A1	at A3
Drawing No	Rev
17056.001/100	P1

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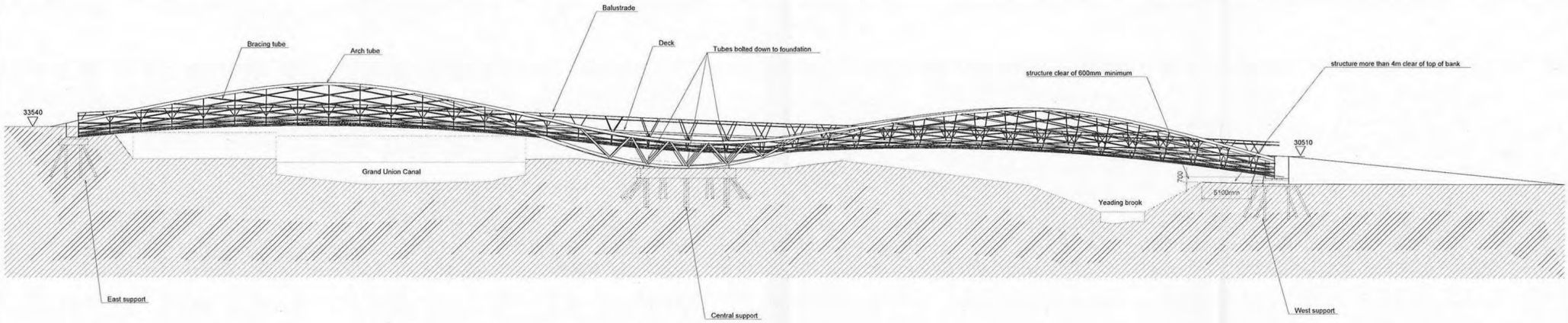
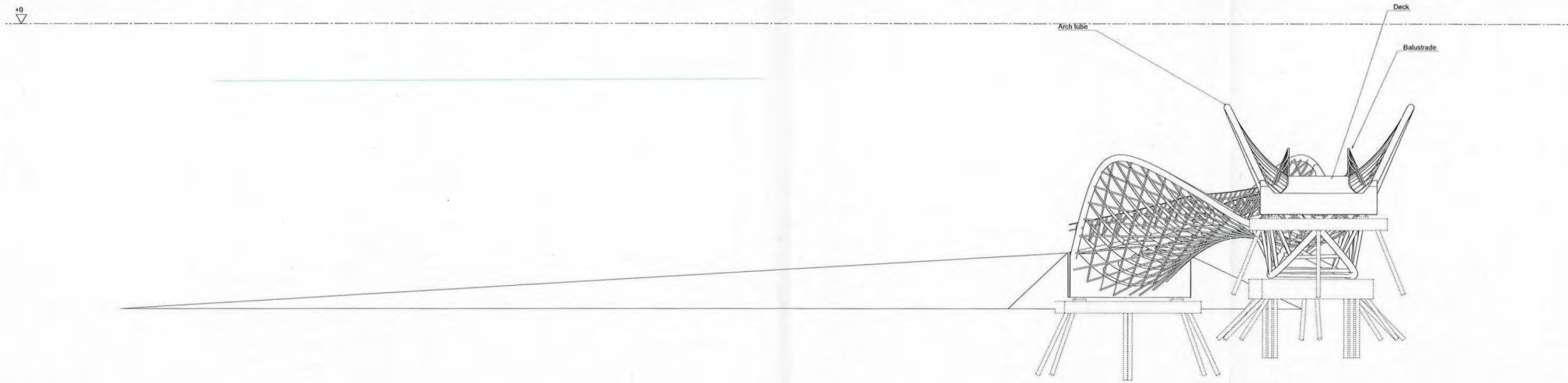
Consulting Engineers
30 Newman Street London W1T 1LT
T 020 7631 5128 F 020 7642 1390
E name@pricemyers.com www.pricemyers.com



NORTH ELEVATION
Scale: 1:200



EAST ELEVATION
Scale: 1:100

PRELIMINARY ISSUE

Notes :

1. This Drawing is to be read in conjunction with all relevant Architect's Engineer's and specialists' drawings and specifications.
2. Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check drawing has been printed to the intended scale this bar should be 50mm long @ A1 or 25mm long @ A3.
3. Health & Safety :
   All specific drawing notes are to be read in conjunction with the project "Information Pack" and "Site Rules".
4. For general notes refer to Drawing No. 17056/100

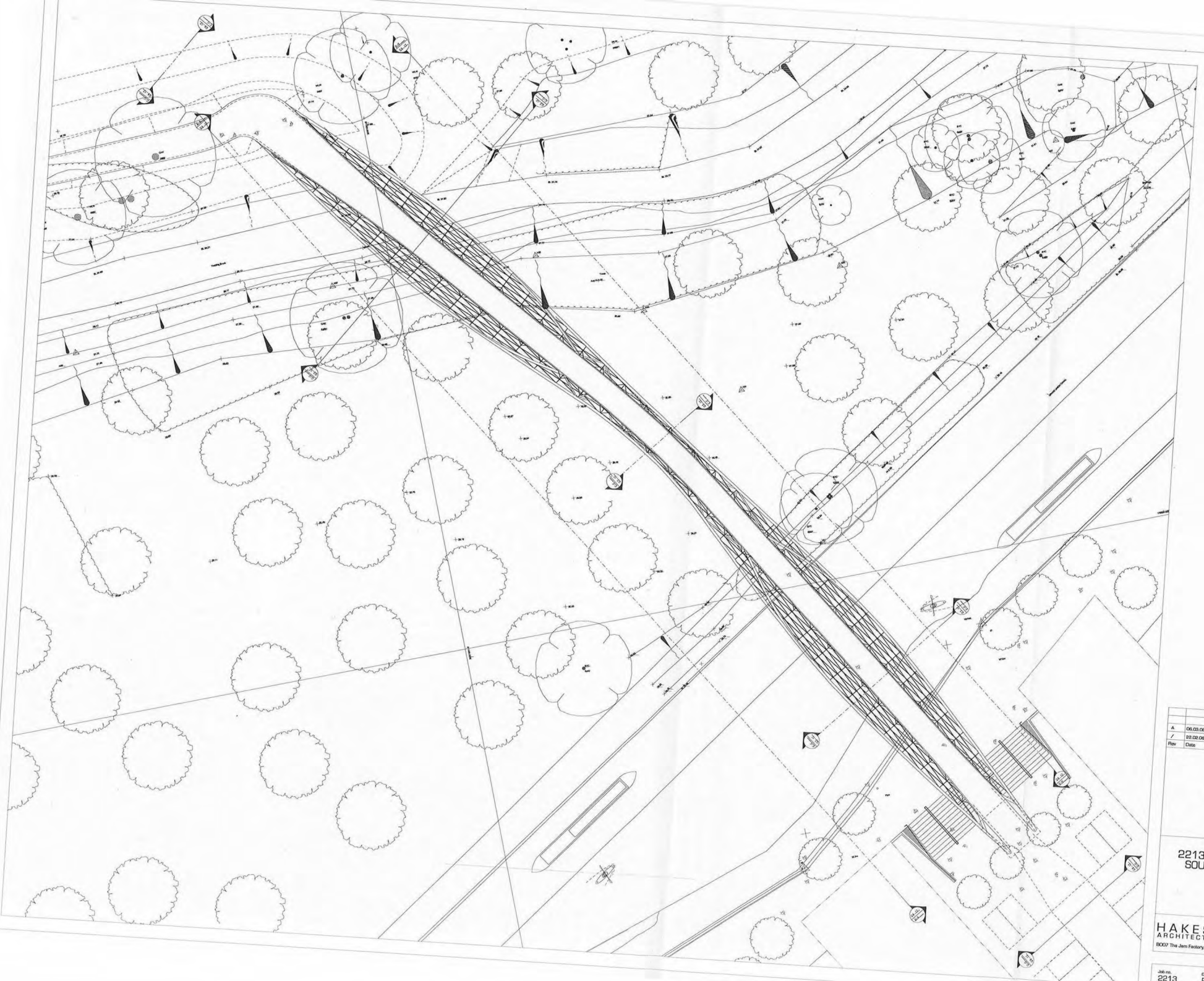
Rev	Date	Drawn	Eng	Amendment
P1	070306	RP	RN	Issued for planning

Minet Park Bridge

Elevations

Drawn RP	Eng RN
Scales at A1	at A3
Drawing No	Rev
17056.001/101	P1

PRICE&MYERS
Consulting Engineers
30 Newman Street London W1T 1LT
T 020 7631 5128 F 020 7642 1390
E name@pricemyers.com www.pricemyers.com



NOTES:
Do not scale from this drawing

All information is to be checked on site for accuracy and fit. Only drawings with WD status with the most recent revision are to be used for construction. Report any discrepancies and omissions to Hakes Associates

Status codes:
EX = existing
SK = preliminary sketch design drawings
PP = drawings for planning submission
DD = design drawings for stage E/F
SP = space planning options
TT= tender
WD = working drawings for construction

Rev	Date	Description
A	06.03.08	Ammended geometry and re-issued for draft planning review
/	22.02.08	Issued for draft planning review

PLANNING

2213 MINET PARK BRIDGE SOUTHALL GAS WORKS

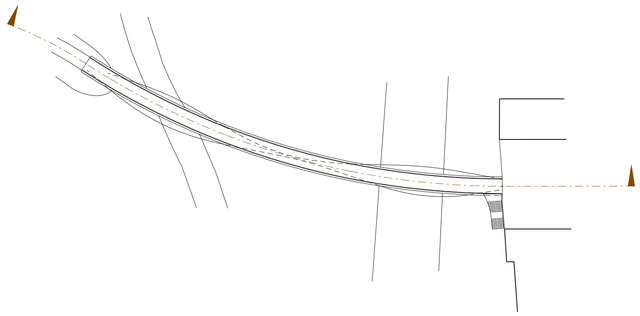
PLAN

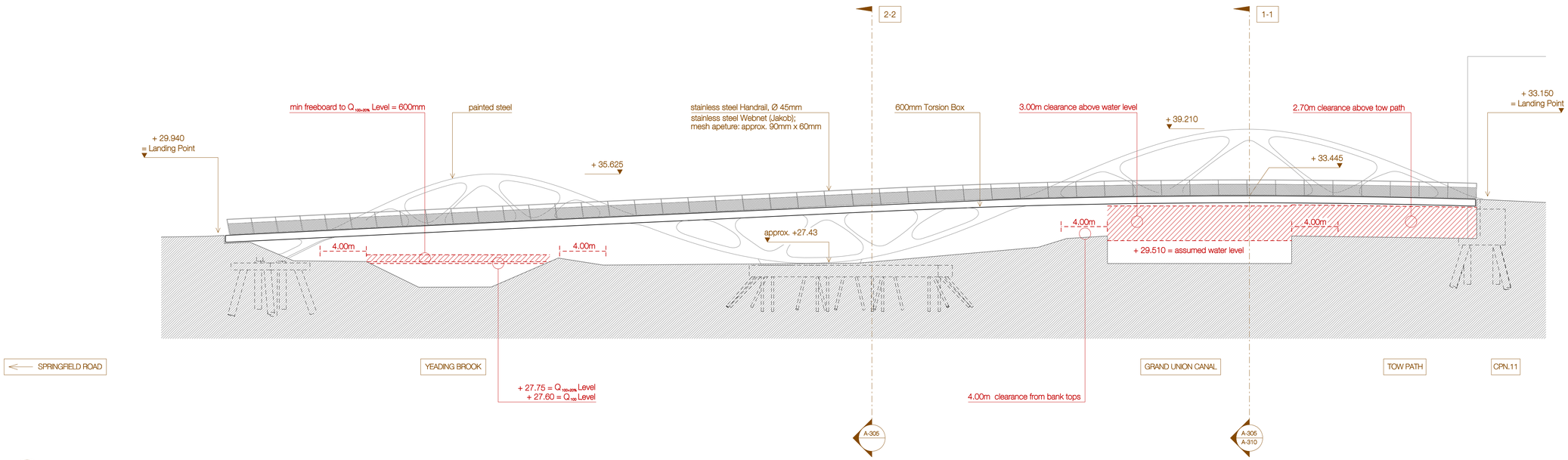
HAKES ASSOCIATES
ARCHITECTS AND BRIDGE DESIGNERS
B007 The Jam Factory, 27 Green Walk, London SE1 4TX. T: 020 7631 5330

Job no. 2213 | DWG NO PP-02 | REVISION: A | DRAWN: HH

APPENDIX FRA 5

Springfield Road Foot/Cycle Bridge





306 SECTION
SCALE 1:200

Rev	Date	By	Description

Notes:

Structural Engineer:
PRICE & MYERS LLP
30 Newman Street
London W1T 1LT

Client:
national grid properties
Priory Court
Pilgrim Street
London
EC4V 6DR
Tel: 020 7583 0146
Fax: 020 7329 7301

Architect:
marks barfield architects
60 Bromells Road
London SW4 0BG
Tel 020 7501 0180
Fax 020 7498 7103

Springfield Road Bridge

Drawing Title
Sections 02

Job No	Scale	Package No	Drawing No	Rev	Status
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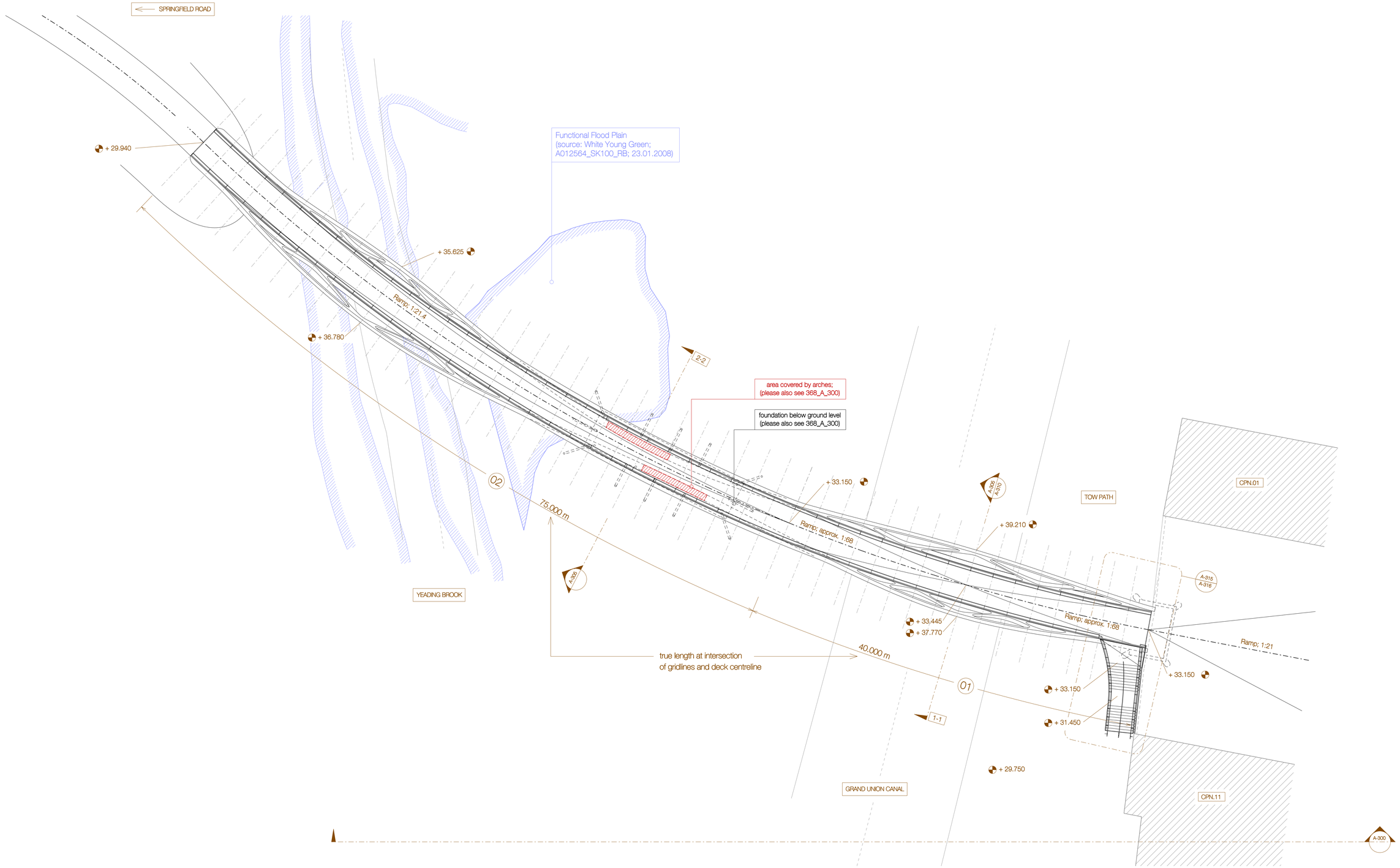
Date 21.02.2008	Checked SC				



200 DECK LEVEL
SCALE 1:200

Rev	Date	By	Description
A	21.02.08	TE	Stair + Arches updated
B	25.02.08	TE	Central footing added

Notes:

Structural Engineer:

PRICE & MYERS LLP
30 Newman Street
London W1T 1LT

Client:

national grid properties
Priory Court
Pilgrim Street
London
EC4V 6DR

Tel: 020 7583 0146
Fax: 020 7329 7301

Architect:

marks barfield architects
50 Bromells Road
London SW4 0BG

Tel 020 7501 0180
Fax 020 7498 7103

Springfield Road Bridge

Drawing Title
Deck Level

Job No	Scale
368	1:200 @ A1
Date	Checked
13.02.2008	SC

Package No	Drawing No	Rev	Status
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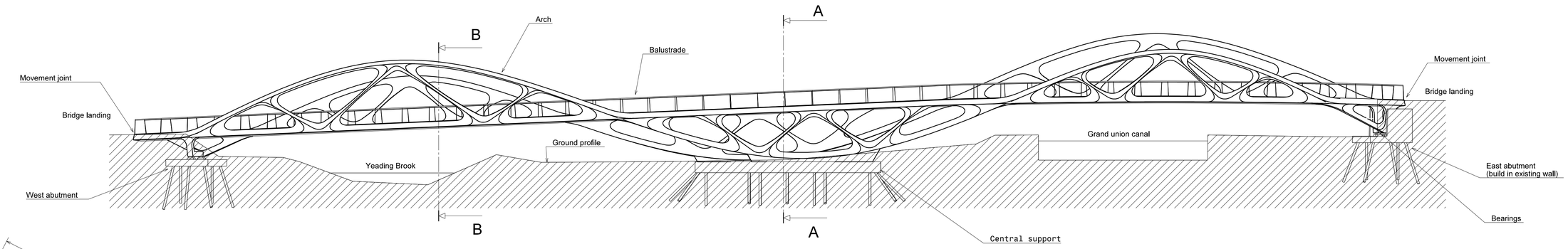

FRONT ELEVATION
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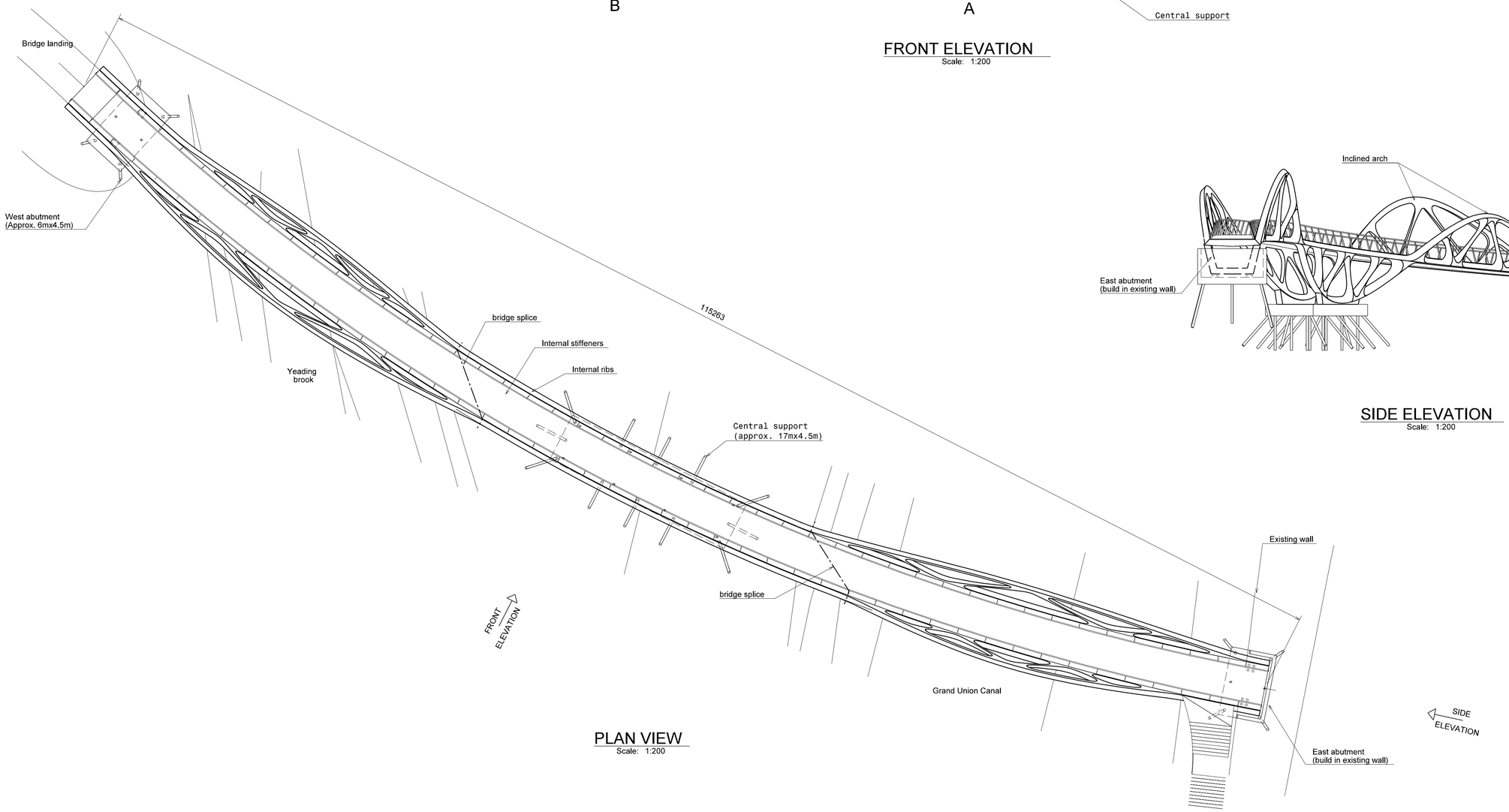

PLAN VIEW
Scale: 1:200

SIDE ELEVATION
Scale: 1:200

PRELIMINARY ISSUE

Notes :

1. This Drawing is to be read in conjunction with all relevant Architect's Engineer's and specialists' drawings and specifications.
2. Do not scale from this drawing in either paper or digital form. Use written dimensions only. To check drawing has been printed to the intended scale this bar should be 50mm long @ A1 or 25mm long @ A3.
3. Health & Safety : All specific drawing notes are to be read in conjunction with the project "Information Pack" and "Site Rules".
4.

Rev	Date	Drawn	Eng	Amendment
P1	270208	EV	BG	Issued for planning

SPRINGFIELD ROAD BRIDGE

PLAN AND ELEVATIONS

Drawn EV	Eng BG
Scales at A1	at A3
Drawing No 17056/100	Rev P1

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APPENDIX FRA 6

Calculations

APPENDIX FRA 6.1

Flood Relief Channel Diversion

White Young Green

White Young Green

Project No A012564

Calculation Sheet No 1 A

Office

Division

Project Title WEST SOUTHALL

Prepared by RCB

Work Section FLOOD RELIEF CHANNEL DIVERSION

Date JUNE 2008

1 The new pumping station access entails crossings of the Yeading Brook & Flood Relief Channel (FRC)

2 The EA have requested that the length of culvert for the FRC be kept to a minimum

3 The previous approved solution entailed

1) FRC Diversion mainly open channel 3.5 bed width, 1:3 Ave side slopes

2) 25 m long culvert on FRC 5.5 m wide x 3.7 m High

3) Bridge over Yeading Brook span = 17.5 m.

4 The access road has now been re-aligned. This gives an opportunity to combine the FRC channel with the Brook and provide a larger clear span bridge.

White Young Green

Project No	A012564
Calculation Sheet No	2A
Office	
Division	
Prepared by	
Date	

Project Title WEST SOUTHALL

Work Section FRC DIVERSION

5 EA have indicated general principle to be acceptable but require a 2 stage channel. also EA have new Flood data.

6 New proposal

a) Diversion channel
- main channel 2.0 m bed 1:3 slopes
- high flow shelf approx 2 m wide 0.6 m above main invert.

b) Wider span Bridge

b) Widen Yeading Brook downstream of confluence. as (a) above.

c) reduce back to existing section at hard banked area by Railway Bridge.

7 Hecras

a) Local reach modelled using top survey data. Flows Taken from EA data (Halcrow 2004)

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Calculation Sheet No	3A
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Project Title: WEST SOUTHALL

Work Section: FRC DIVERSION

b) channel roughness = n = 0.027
Out of bank n = 0.125
gave good fit to EA DATA — sht 4A

c) Diversion added (no Bridge)
⇒ 0.02 m increase for Q_{20}
0.05 m increase for $Q_{100+20\%}$ — sht 5A

D) Bridge added to model.
Further increase of 0.01 m. — sht 6A

4 For cross section locations
see sht 9

HEC-RAS Plan: P1YB River: yeading Reach: yupper

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	from EA model W.S elev m	
yupper	90	PF 1	12.58	24.05	26.73		26.76	0.000349	0.84	26.6	33.06	0.19	**26.74**	Q_{20}
yupper	90	PF 2	15.98	24.05	27.02		27.06	0.000312	0.87	38.28	45.15	0.19	**27.03**	Q_{100}
yupper	90	PF 3	17.71	24.05	27.21		27.24	0.000269	0.85	47.2	50.17	0.18	**27.22**	$Q_{100+20\%}$
yupper	80	PF 1	12.58	24.51	26.69		26.73	0.000446	0.87	22.34	53.11	0.22		
yupper	80	PF 2	15.98	24.51	26.99		27.03	0.000345	0.84	39.43	57.98	0.2		
yupper	80	PF 3	17.71	24.51	27.19		27.22	0.000276	0.79	50.93	59.94	0.18		
yupper	70	PF 1	12.58	24.45	26.67		26.71	0.000406	0.86	33.63	68.16	0.21		
yupper	70	PF 2	15.98	24.45	26.99		27.01	0.000284	0.8	60.07	98.43	0.18		
yupper	70	PF 3	17.71	24.45	27.18		27.2	0.00021	0.73	79.77	101.04	0.16		
yupper	60	PF 1	12.58	24.3	26.67		26.7	0.000308	0.76	30.25	78.92	0.19		
yupper	60	PF 2	15.98	24.3	26.98		27	0.000217	0.72	57.09	87.72	0.16		
yupper	60	PF 3	17.71	24.3	27.18		27.2	0.000166	0.67	74.7	90.43	0.14		
yupper	50	PF 1	12.58	24.62	26.66		26.69	0.000302	0.75	35.69	61.5	0.18		
yupper	50	PF 2	15.98	24.62	26.98		27	0.000222	0.72	55.1	61.5	0.16		
yupper	50	PF 3	17.71	24.62	27.18		27.19	0.000177	0.68	67.29	61.5	0.15		
yupper	40	PF 1	12.58	24.69	26.62		26.66	0.000446	0.89	20.68	27.55	0.22		
yupper	40	PF 2	15.98	24.69	26.94		26.98	0.000358	0.9	29.48	27.92	0.21		
yupper	40	PF 3	17.71	24.69	27.14		27.18	0.000299	0.88	35.11	28.16	0.19		
yupper	30	PF 1	12.58	24.08	26.62		26.64	0.000135	0.62	33.79	26.38	0.13	**26.65**	Q_{20}
yupper	30	PF 2	15.98	24.08	26.94		26.96	0.000134	0.67	42.21	26.87	0.13	**26.97**	Q_{100}
yupper	30	PF 3	17.71	24.08	27.14		27.16	0.000125	0.68	47.63	27.18	0.13	**27.18**	$Q_{100+20\%}$
yupper	20	PF 1	12.58	24.1	26.62		26.63	0.000101	0.43	37.33	31.54	0.11		
yupper	20	PF 2	15.98	24.1	26.94		26.95	0.000084	0.44	47.51	32.43	0.1		
yupper	20	PF 3	17.71	24.1	27.14		27.15	0.000072	0.44	54.1	33	0.1		
yupper	10	PF 1	12.58	24.57	26.58	25.34	26.62	0.000392	0.94	15.55	10	0.22	**26.58**	Q_{20}
yupper	10	PF 2	15.98	24.57	26.89	25.47	26.94	0.0004	1.03	18.75	10.66	0.22	**26.89**	Q_{100}
yupper	10	PF 3	17.71	24.57	27.09	25.52	27.14	0.000378	1.04	20.92	11.1	0.21	**27.09**	$Q_{100+20\%}$

WEST SOUTHALL
YEADING BROOK AT PUMP LANE
HECRAS CALIBRATION

HEC-RAS Plan: two stage

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
yupper	90	Q20	12.58	24.05	26.75		26.78	0.000337	0.83	27.15	33.84	0.19
yupper	90	Q100	15.98	24.05	27.06		27.09	0.000289	0.85	39.89	43.55	0.18
yupper	90	Q100+20%	17.71	24.05	27.26		27.29	0.000244	0.83	48.74	44.58	0.17
yupper	80	Q20	12.58	24.51	26.71		26.74	0.000426	0.86	23.34	53.61	0.22
yupper	80	Q100	15.98	24.51	27.04		27.07	0.000315	0.81	41.84	58.61	0.19
yupper	80	Q100+20%	17.71	24.51	27.24		27.27	0.000246	0.76	54.23	59.99	0.17
yupper	70	Q20	12.58	24.22	26.72		26.73	0.000054	0.34	49.23	71.92	0.08
yupper	70	Q100	15.98	24.22	27.05		27.05	0.000032	0.29	78.58	99.29	0.07
yupper	70	Q100+20%	17.71	24.22	27.26		27.26	0.000022	0.26	99.24	101.99	0.06
floodchan	130	Q20	12.58	24.32	26.71		26.75	0.000256	0.87	20.15	15.48	0.18
floodchan	130	Q100	15.98	24.32	27.03		27.07	0.000253	0.95	25.5	21.75	0.18
floodchan	130	Q100+20%	17.71	24.32	27.24		27.28	0.000234	0.96	29.27	27.22	0.18
floodchan	120	Q20	12.58	24.3	26.72		26.74	0.000109	0.54	27.66	18.49	0.13
floodchan	120	Q100	15.98	24.3	27.05		27.06	0.000103	0.57	33.92	25.1	0.13
floodchan	120	Q100+20%	17.71	24.3	27.25		27.27	0.000094	0.56	38.11	30.86	0.12
floodchan	110	Q20	6.15	24.28	26.73		26.73	0.000022	0.23	45.27	59.85	0.06
floodchan	110	Q100	7.74	24.28	27.05		27.06	0.000017	0.22	66.52	70.47	0.05
floodchan	110	Q100+20%	8.94	24.28	27.26		27.26	0.000015	0.22	81.32	73.03	0.05
floodchan	100	Q20	6.15	24.25	26.73		26.73	0.00002	0.22	35.73	52.39	0.06
floodchan	100	Q100	7.74	24.25	27.05		27.06	0.000015	0.22	55.29	69.8	0.05
floodchan	100	Q100+20%	8.94	24.25	27.26		27.26	0.000013	0.22	69.57	69.8	0.05
floodchan	70	Q20	6.15	24.22	26.73		26.73	0.000012	0.16	52.88	72.21	0.04
floodchan	70	Q100	7.74	24.22	27.05		27.05	0.000007	0.14	82.2	99.32	0.03
floodchan	70	Q100+20%	8.94	24.22	27.26		27.26	0.000005	0.13	102.8	102.02	0.03
ylower	70	Q20	12.58	24.22	26.72		26.73	0.000049	0.32	52.63	71.95	0.08
ylower	70	Q100	15.98	24.22	27.05		27.05	0.00003	0.28	81.96	99.29	0.06
ylower	70	Q100+20%	17.71	24.22	27.26		27.26	0.00002	0.25	102.63	102	0.05
ylower	60	Q20	12.58	24.2	26.72		26.73	0.000081	0.4	42.39	84.11	0.1
ylower	60	Q100	15.98	24.2	27.05		27.05	0.000042	0.33	70.93	88.63	0.07
ylower	60	Q100+20%	17.71	24.2	27.26		27.26	0.000028	0.29	89.47	91.45	0.06
ylower	50	Q20	12.58	24.17	26.71		26.72	0.000085	0.44	49.63	61.5	0.1
ylower	50	Q100	15.98	24.17	27.04		27.05	0.000069	0.44	69.8	61.5	0.1
ylower	50	Q100+20%	17.71	24.17	27.25		27.26	0.000059	0.44	82.46	61.5	0.09

WEST SOUTHALL
YEADING BROOK AT PUMP LANE
TWO STAGE DIVERSION CHANNEL

HEC-RAS Plan: two stage

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
ylower	40	Q20	12.58	24.15	26.71		26.72	0.000091	0.45	32.83	27.65	0.11
ylower	40	Q100	15.98	24.15	27.04		27.05	0.000081	0.48	41.94	28.04	0.11
ylower	40	Q100+20%	17.71	24.15	27.24		27.25	0.000071	0.48	47.72	28.28	0.1
ylower	35	Q20	12.58	24.06	26.71		26.71	0.000069	0.36	37.68	33.79	0.09
ylower	35	Q100	15.98	24.06	27.04		27.04	0.000057	0.38	49.02	35.27	0.09
ylower	35	Q100+20%	17.71	24.06	27.24		27.25	0.000049	0.37	56.39	36.2	0.08
ylower	30	Q20	18.73	24.08	26.67		26.71	0.000276	0.9	35.1	26.46	0.18
ylower	30	Q100	23.72	24.08	27		27.04	0.000272	0.97	43.75	26.96	0.19
ylower	30	Q100+20%	26.65	24.08	27.2		27.24	0.00026	0.99	49.3	27.27	0.18
ylower	20	Q20	18.73	24.1	26.67		26.69	0.0002	0.61	38.91	31.68	0.16
ylower	20	Q100	23.72	24.1	27		27.02	0.000165	0.63	49.44	32.6	0.15
ylower	20	Q100+20%	26.65	24.1	27.21		27.23	0.000146	0.64	56.24	33.18	0.14
ylower	10	Q20	18.73	24.57	26.58	25.56	26.68	0.000234	1.4	15.55	10	0.32
ylower	10	Q100	23.72	24.57	26.89	25.72	27.01	0.000237	1.52	18.75	10.66	0.32
ylower	10	Q100+20%	26.65	24.57	27.09	25.8	27.21	0.00023	1.57	20.92	11.1	0.32

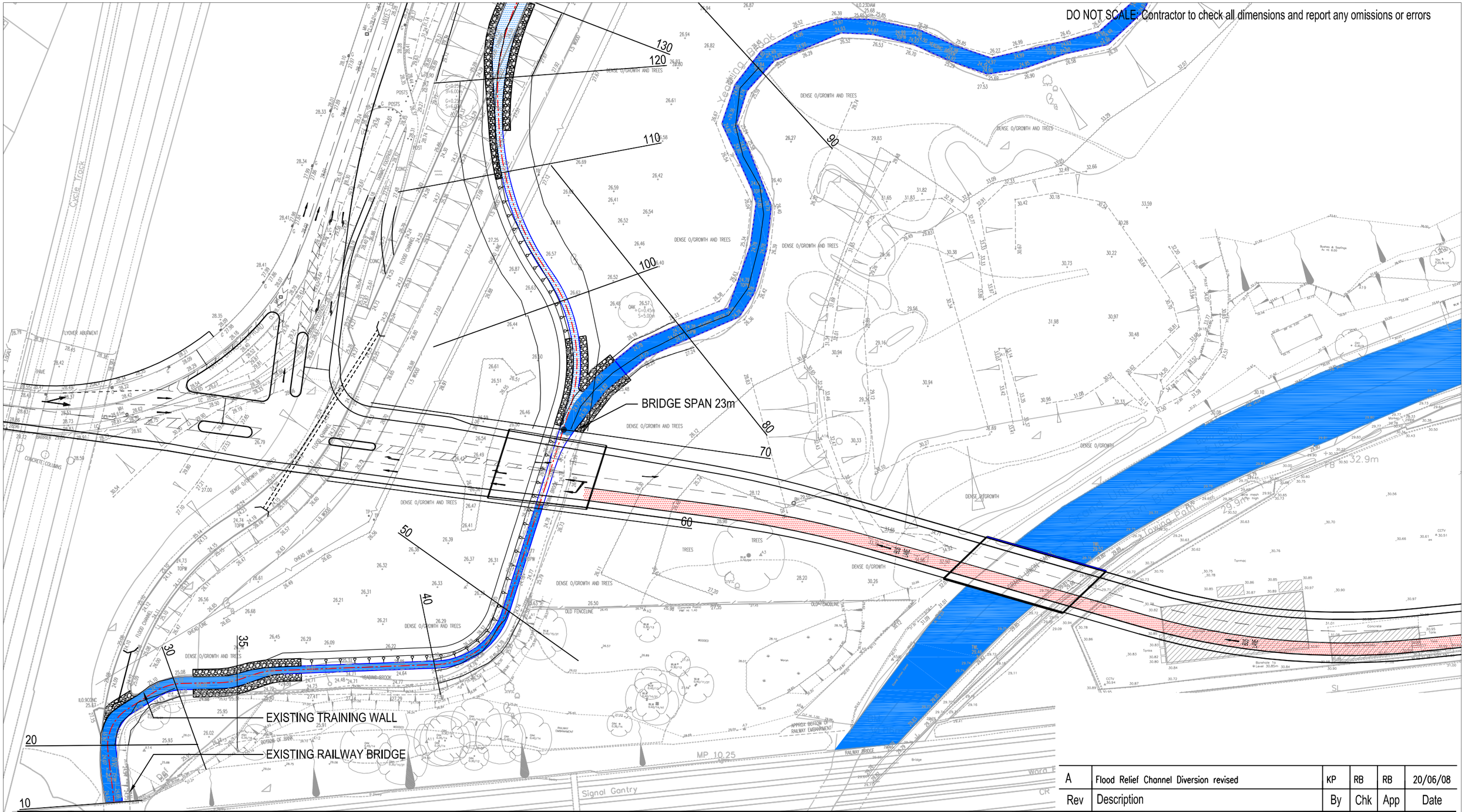
HEC-RAS Plan: Plan 01

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
yupper	90	Q20	12.58	24.05	26.75		26.78	0.00033	0.82	27.47	34.27	0.19
yupper	90	Q100	15.98	24.05	27.07		27.1	0.000283	0.84	40.59	46.5	0.18
yupper	90	Q100+20%	17.71	24.05	27.27		27.3	0.000239	0.82	50.49	51.89	0.17
yupper	80	Q20	12.58	24.51	26.72		26.75	0.000415	0.85	23.89	53.76	0.21
yupper	80	Q100	15.98	24.51	27.05		27.08	0.000306	0.8	42.58	58.8	0.19
yupper	80	Q100+20%	17.71	24.51	27.26		27.28	0.000239	0.75	54.99	60.01	0.17
yupper	70	Q20	12.58	24.22	26.73		26.74	0.000053	0.33	49.95	72.68	0.08
yupper	70	Q100	15.98	24.22	27.06		27.07	0.000031	0.29	79.79	99.45	0.06
yupper	70	Q100+20%	17.71	24.22	27.27		27.27	0.000021	0.26	100.51	102.16	0.05
floodchan	130	Q20	12.58	24.32	26.72		26.76	0.000252	0.87	20.31	15.55	0.18
floodchan	130	Q100	15.98	24.32	27.04		27.09	0.000248	0.94	26.19	22.1	0.18
floodchan	130	Q100+20%	17.71	24.32	27.25		27.29	0.000228	0.95	31.26	27.59	0.18
floodchan	120	Q20	12.58	24.3	26.73		26.75	0.000107	0.54	27.86	18.54	0.13
floodchan	120	Q100	15.98	24.3	27.06		27.07	0.000101	0.56	34.18	25.46	0.13
floodchan	120	Q100+20%	17.71	24.3	27.26		27.28	0.000092	0.56	38.38	31.23	0.12
floodchan	110	Q20	6.15	24.28	26.74		26.74	0.000033	0.28	29.21	42.3	0.07
floodchan	110	Q100	7.74	24.28	27.07		27.07	0.000028	0.28	44.69	51.99	0.07
floodchan	110	Q100+20%	8.94	24.28	27.27		27.27	0.000026	0.29	55.61	53.6	0.07
floodchan	100	Q20	6.15	24.25	26.74		26.74	0.000021	0.22	32.17	37.47	0.06
floodchan	100	Q100	7.74	24.25	27.07		27.07	0.000018	0.23	44.48	37.47	0.05
floodchan	100	Q100+20%	8.94	24.25	27.27		27.27	0.000017	0.23	52.14	37.47	0.05
floodchan	70	Q20	6.15	24.22	26.74		26.74	0.000011	0.16	53.24	68.33	0.04
floodchan	70	Q100	7.74	24.22	27.07		27.07	0.000007	0.14	77.76	78.08	0.03
floodchan	70	Q100+20%	8.94	24.22	27.27		27.27	0.000005	0.13	94.02	80.78	0.03
ylower	70	Q20	12.58	24.22	26.73	25.06	26.74	0.000053	0.33	49.95	72.68	0.08
ylower	70	Q100	15.98	24.22	27.06	25.18	27.07	0.000031	0.29	79.79	99.45	0.06
ylower	70	Q100+20%	17.71	24.22	27.27	25.24	27.27	0.000021	0.26	100.51	102.16	0.05
ylower	65	Bridge										
ylower	60	Q20	12.58	24.2	26.73		26.73	0.000094	0.43	34.65	41.92	0.11
ylower	60	Q100	15.98	24.2	27.06		27.06	0.000066	0.4	49.22	46.43	0.09
ylower	60	Q100+20%	17.71	24.2	27.26		27.27	0.000051	0.37	59.07	49.25	0.08

HEC-RAS Plan: Plan 01

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
ylower	50	Q20	12.58	24.17	26.71		26.73	0.000147	0.62	34.26	30.5	0.14
ylower	50	Q100	15.98	24.17	27.04		27.06	0.000133	0.65	44.24	30.5	0.14
ylower	50	Q100+20%	17.71	24.17	27.24		27.26	0.000118	0.65	50.51	30.5	0.13
ylower	40	Q20	12.58	24.15	26.7		26.73	0.000166	0.64	23.05	12.64	0.15
ylower	40	Q100	15.98	24.15	27.03		27.05	0.000159	0.7	27.22	13.03	0.15
ylower	40	Q100+20%	17.71	24.15	27.23		27.26	0.000146	0.71	29.91	13.27	0.15
ylower	35	Q20	12.58	24.06	26.7		26.71	0.000124	0.61	31.42	21.74	0.13
ylower	35	Q100	15.98	24.06	27.02		27.04	0.000122	0.66	38.74	23.21	0.13
ylower	35	Q100+20%	17.71	24.06	27.23		27.25	0.000113	0.67	43.61	24.13	0.13
ylower	30	Q20	18.73	24.08	26.67		26.71	0.000276	0.9	35.1	26.46	0.18
ylower	30	Q100	23.72	24.08	27		27.04	0.000272	0.97	43.75	26.96	0.19
ylower	30	Q100+20%	26.65	24.08	27.2		27.24	0.00026	0.99	49.3	27.27	0.18
ylower	20	Q20	18.73	24.1	26.67		26.69	0.0002	0.61	38.91	31.68	0.16
ylower	20	Q100	23.72	24.1	27		27.02	0.000165	0.63	49.44	32.6	0.15
ylower	20	Q100+20%	26.65	24.1	27.21		27.23	0.000146	0.64	56.24	33.18	0.14
ylower	10	Q20	18.73	24.57	26.58	25.56	26.68	0.000234	1.4	15.55	10	0.32
ylower	10	Q100	23.72	24.57	26.89	25.72	27.01	0.000237	1.52	18.75	10.66	0.32
ylower	10	Q100+20%	26.65	24.57	27.09	25.8	27.21	0.00023	1.57	20.92	11.1	0.32

DO NOT SCALE: Contractor to check all dimensions and report any omissions or errors



Rev	Description	By	Chk	App	Date
A	Flood Relief Channel Diversion revised	KP	RB	RB	20/06/08

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White Young Green

Consulting Engineers

Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:

WEST SOUTHALL
YEADING BROOK
FLOOD RISK ASSESSMENT

Client:

Drawing Title:

CROSS SECTIONS FOR
LOCAL HECRAS MODEL

Scale at A3	Drawn By	Date	Checked By	Date	Approved By	Date
1:1000	*DW*	*07/03/08*	*R.C.B.*	*07/03/08*	*R.C.B.*	*07/03/08*

Project No.	Office	Discipline	Drawing No.	Revision
A012564	28	C	SK107	A

APPENDIX FRA 6.2

Surface Water Attenuation

White Young Green

Project No	A0 12564
Calculation Sheet No	1
Office	
Division	
Project Title	WEST SOUTHALL
Prepared by	RCB
Work Section	SW ATTENUATION – PUMP LANE
Date	7/1/07

USING IOH FIGURES FOR DISCHARGE

Q_{BAR} = 16 l/s/ha

Q_{100} = 24 l/s/ha (sht 15)

New impermeable area = 4600 m²

Hence discharge @ 50mm/hr = 66 l/s.

For permitted discharge of 24/s/ha

at 1:100yr ≈ 11.5 l/s.

Use Top portion of old outfall channel. say 54 m × 5.5m bed width + 1:3 side slopes

– Using 100ϕ ×10 m Thrttle pipe (sht 3)

= storage required = 145 m³ at 0.513 m³ depth.

peak flow = 11.4 @ 1:100yr.

For 100 yr + 30% rainfall (sht 6)

storage 261 m³

@ depth 0.644 m

peak flow 12.6 l/s.

White Young Green

White Young Green

Project No	AO12564
Calculation Sheet No	2
Office	
Division	

Project Title	West southall.	Prepared by	R.C.B
Work Section	S.W. Attenuation – Pump Lane.	Date	7/1/07

or using MOS profile hydro brake.

- 147 mm dia (sht 9)

for 1:100 yr. storage = 193 m³

at depth = 0.509 m

peak flow = 10.3 l/s

for 1:100 yr + 30% rainfall. (sht 13)

storage = 262 m³

at depth = 0.652 m

peak flow = 10.9 l/s

White Young Green
Brigantine House
27-31 Cumberland Street
Bristol BS2 8NL

West Southall
Pump Lane Link Road
Attenuation

Date Jan 07
File pump lane 2007.SRC
Micro Drainage

Designed By RCB
Checked By
Source Control W.10.3

Summary of Results for 100 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Overflow (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Overflow Volume (m³)	Maximum Volume (m³)	Status
30 Summer	10.4	0.0	10.4	25.5273	0.4272	0.0	156.4	O K
60 Summer	10.7	0.0	10.7	25.5538	0.4537	0.0	168.1	O K
120 Summer	10.8	0.0	10.8	25.5603	0.4602	0.0	171.0	O K
180 Summer	10.7	0.0	10.7	25.5553	0.4552	0.0	168.7	O K
240 Summer	10.7	0.0	10.7	25.5488	0.4487	0.0	165.9	O K
360 Summer	10.5	0.0	10.5	25.5323	0.4322	0.0	158.7	O K
480 Summer	10.2	0.0	10.2	25.5143	0.4142	0.0	150.8	O K
600 Summer	10.0	0.0	10.0	25.4958	0.3957	0.0	142.9	O K
720 Summer	9.8	0.0	9.8	25.4778	0.3777	0.0	135.2	O K
960 Summer	9.3	0.0	9.3	25.4453	0.3452	0.0	121.9	O K
1440 Summer	8.6	0.0	8.6	25.3913	0.2912	0.0	100.2	O K
30 Winter	10.9	0.0	10.9	25.5717	0.4717	0.0	176.1	O K
60 Winter	11.3	0.0	11.3	25.6023	0.5022	0.0	190.0	O K
120 Winter	11.4	0.0	11.4	25.6128	0.5127	0.0	195.0	O K
180 Winter	11.3	0.0	11.3	25.6038	0.5037	0.0	190.8	O K
240 Winter	11.2	0.0	11.2	25.5948	0.4947	0.0	186.6	O K
360 Winter	10.9	0.0	10.9	25.5713	0.4712	0.0	175.8	O K
480 Winter	10.6	0.0	10.6	25.5442	0.4442	0.0	163.9	O K
600 Winter	10.3	0.0	10.3	25.5173	0.4172	0.0	152.2	O K
720 Winter	10.0	0.0	10.0	25.4917	0.3917	0.0	141.1	O K
960 Winter	9.4	0.0	9.4	25.4463	0.3462	0.0	122.1	O K
1440 Winter	8.3	0.0	8.3	25.3718	0.2717	0.0	92.7	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
30 Summer	94.04	35
60 Summer	53.46	64
120 Summer	30.38	116
180 Summer	21.83	144
240 Summer	17.27	176
360 Summer	12.41	244
480 Summer	9.82	312
600 Summer	8.18	380
720 Summer	7.05	446
960 Summer	5.60	578
1440 Summer	4.05	828
30 Winter	94.04	35
60 Winter	53.46	62
120 Winter	30.38	118
180 Winter	21.83	150
240 Winter	17.27	186
360 Winter	12.41	264
480 Winter	9.82	338
600 Winter	8.18	408
720 Winter	7.05	478
960 Winter	5.60	612
1440 Winter	4.05	868

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	100
Site Location	511550 179950 TQ 11550 79950
C (1km)	-0.025
D1 (1km)	0.300
D2 (1km)	0.315
D3 (1km)	0.233
E (1km)	0.308
F (1km)	2.562
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	30
Longest Storm (mins)	1440
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+0

Time / Area Diagram

Total Area (ha) = 0.480

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	0.240	4	8	0.240

Tank/Pond Details

Invert Level (m) 25.100 Ground Level (m) 26.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	297.0	0.60	491.0	1.20	621.0	1.80	621.0	2.40	621.0
0.10	329.0	0.70	524.0	1.30	621.0	1.90	621.0	2.50	621.0
0.20	362.0	0.80	556.0	1.40	621.0	2.00	621.0		
0.30	394.0	0.90	589.0	1.50	621.0	2.10	621.0		
0.40	427.0	1.00	621.0	1.60	621.0	2.20	621.0		
0.50	459.0	1.10	621.0	1.70	621.0	2.30	621.0		

Pipe Outflow Control

Pipe Diameter (m)	0.100	Roughness (mm)	0.600	Invert Level (m)	25.100
Slope (1:x)	100.0	Entry Loss Coef	0.500		
Length (m)	10.000	Coef of Contraction	0.600		

Weir / Flume Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Crest Level (m) 26.000

White Young Green
Brigantine House
27-31 Cumberland Street
Bristol BS2 8NL

Date Jan 07	West Southall
File pump lane 2007.SRC	Pump Lane Link Road
Micro Drainage	Attenuation
	Designed By RCB
	Checked By
	Source Control W.10.3

Summary of Results for 100 year Return Period (+30%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Overflow (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Overflow Volume (m^3)	Maximum Volume (m^3)	Status
30 Summer	11.6	0.0	11.6	25.6348	0.5347	0.0	205.2	O K
60 Summer	12.0	0.0	12.0	25.6703	0.5702	0.0	222.0	O K
120 Summer	12.2	0.0	12.2	25.6843	0.5843	0.0	228.8	O K
180 Summer	12.1	0.0	12.1	25.6783	0.5783	0.0	226.0	O K
240 Summer	12.0	0.0	12.0	25.6713	0.5712	0.0	222.6	O K
360 Summer	11.9	0.0	11.9	25.6543	0.5542	0.0	214.4	O K
480 Summer	11.6	0.0	11.6	25.6348	0.5347	0.0	205.1	O K
600 Summer	11.4	0.0	11.4	25.6148	0.5147	0.0	195.7	O K
720 Summer	11.2	0.0	11.2	25.5942	0.4942	0.0	186.4	O K
960 Summer	10.8	0.0	10.8	25.5582	0.4582	0.0	170.2	O K
1440 Summer	10.0	0.0	10.0	25.4953	0.3952	0.0	142.7	O K
30 Winter	12.2	0.0	12.2	25.6888	0.5888	0.0	230.9	O K
60 Winter	12.6	0.0	12.6	25.7288	0.6288	0.0	250.7	O K
120 Winter	12.8	0.0	12.8	25.7483	0.6483	0.0	260.7	O K
180 Winter	12.8	0.0	12.8	25.7423	0.6423	0.0	257.5	O K
240 Winter	12.7	0.0	12.7	25.7313	0.6313	0.0	252.0	O K
360 Winter	12.4	0.0	12.4	25.7078	0.6078	0.0	240.4	O K
480 Winter	12.1	0.0	12.1	25.6803	0.5803	0.0	226.7	O K
600 Winter	11.8	0.0	11.8	25.6513	0.5512	0.0	212.9	O K
720 Winter	11.5	0.0	11.5	25.6228	0.5227	0.0	199.4	O K
960 Winter	10.9	0.0	10.9	25.5712	0.4712	0.0	175.8	O K
1440 Winter	9.8	0.0	9.8	25.4833	0.3832	0.0	137.5	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
30 Summer	94.04	36
60 Summer	53.46	64
120 Summer	30.38	120
180 Summer	21.83	154
240 Summer	17.27	184
360 Summer	12.41	250
480 Summer	9.82	318
600 Summer	8.18	386
720 Summer	7.05	454
960 Summer	5.60	588
1440 Summer	4.05	842
30 Winter	94.04	35
60 Winter	53.46	64
120 Winter	30.38	118
180 Winter	21.83	170
240 Winter	17.27	194
360 Winter	12.41	270
480 Winter	9.82	344
600 Winter	8.18	418
720 Winter	7.05	490
960 Winter	5.60	628
1440 Winter	4.05	894

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	100
Site Location	511550 179950 TQ 11550 79950
C (1km)	-0.025
D1 (1km)	0.300
D2 (1km)	0.315
D3 (1km)	0.233
E (1km)	0.308
F (1km)	2.562
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	30
Longest Storm (mins)	1440
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+30

Time / Area Diagram

Total Area (ha) = 0.480

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	0.240	4	8	0.240

Tank/Pond Details

Invert Level (m) 25.100 Ground Level (m) 26.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	297.0	0.60	491.0	1.20	621.0	1.80	621.0	2.40	621.0
0.10	329.0	0.70	524.0	1.30	621.0	1.90	621.0	2.50	621.0
0.20	362.0	0.80	556.0	1.40	621.0	2.00	621.0		
0.30	394.0	0.90	589.0	1.50	621.0	2.10	621.0		
0.40	427.0	1.00	621.0	1.60	621.0	2.20	621.0		
0.50	459.0	1.10	621.0	1.70	621.0	2.30	621.0		

Pipe Outflow Control

Pipe Diameter (m)	0.100	Roughness (mm)	0.600	Invert Level (m)	25.100
Slope (1:x)	100.0	Entry Loss Coef	0.500		
Length (m)	10.000	Coef of Contraction	0.600		

Weir / Flume Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Crest Level (m) 26.000

White Young Green		Page 1
Brigantine House	West Southall	
27-31 Cumberland Street	Pump Lane Link Road	
Bristol BS2 8NL	Attenuation	
Date Jan 07	Designed By RCB	
File pump lane 2007.SRC	Checked By	
Micro Drainage	Source Control W.10.3	

Summary of Results for 100 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Overflow (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Overflow Volume (m^3)	Maximum Volume (m^3)	Status
30 Summer	10.3	0.0	10.3	25.5238	0.4237	0.0	155.0	O K
60 Summer	10.3	0.0	10.3	25.5493	0.4492	0.0	166.2	O K
120 Summer	10.3	0.0	10.3	25.5538	0.4537	0.0	168.1	O K
180 Summer	10.3	0.0	10.3	25.5443	0.4442	0.0	164.0	O K
240 Summer	10.3	0.0	10.3	25.5348	0.4347	0.0	159.6	O K
360 Summer	10.3	0.0	10.3	25.5123	0.4122	0.0	149.9	O K
480 Summer	10.3	0.0	10.3	25.4883	0.3882	0.0	139.7	O K
600 Summer	10.3	0.0	10.3	25.4643	0.3642	0.0	129.7	O K
720 Summer	10.3	0.0	10.3	25.4418	0.3417	0.0	120.3	O K
960 Summer	10.3	0.0	10.3	25.4023	0.3022	0.0	104.5	O K
1440 Summer	9.8	0.0	9.8	25.3428	0.2427	0.0	81.7	O K
30 Winter	10.3	0.0	10.3	25.5693	0.4692	0.0	175.1	O K
60 Winter	10.3	0.0	10.3	25.5993	0.4992	0.0	188.6	O K
120 Winter	10.3	0.0	10.3	25.6093	0.5092	0.0	193.2	O K
180 Winter	10.3	0.0	10.3	25.5972	0.4972	0.0	187.8	O K
240 Winter	10.3	0.0	10.3	25.5832	0.4832	0.0	181.4	O K
360 Winter	10.3	0.0	10.3	25.5522	0.4522	0.0	167.4	O K
480 Winter	10.3	0.0	10.3	25.5178	0.4177	0.0	152.3	O K
600 Winter	10.3	0.0	10.3	25.4828	0.3827	0.0	137.3	O K
720 Winter	10.3	0.0	10.3	25.4488	0.3487	0.0	123.3	O K
960 Winter	10.3	0.0	10.3	25.3918	0.2917	0.0	100.5	O K
1440 Winter	9.5	0.0	9.5	25.3123	0.2122	0.0	70.4	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
30 Summer	94.04	35
60 Summer	53.46	64
120 Summer	30.38	120
180 Summer	21.83	146
240 Summer	17.27	178
360 Summer	12.41	244
480 Summer	9.82	312
600 Summer	8.18	378
720 Summer	7.05	442
960 Summer	5.60	568
1440 Summer	4.05	810
30 Winter	94.04	35
60 Winter	53.46	64
120 Winter	30.38	118
180 Winter	21.83	170
240 Winter	17.27	190
360 Winter	12.41	266
480 Winter	9.82	340
600 Winter	8.18	408
720 Winter	7.05	474
960 Winter	5.60	598
1440 Winter	4.05	828

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	100
Site Location	511550 179950 TQ 11550 79950
C (1km)	-0.025
D1 (1km)	0.300
D2 (1km)	0.315
D3 (1km)	0.233
E (1km)	0.308
F (1km)	2.562
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	30
Longest Storm (mins)	1440
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+0

Time / Area Diagram

Total Area (ha) = 0.480

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	0.240	4	8	0.240

Tank/Pond Details

Invert Level (m) 25.100 Ground Level (m) 26.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	297.0	0.60	491.0	1.20	621.0	1.80	621.0	2.40	621.0
0.10	329.0	0.70	524.0	1.30	621.0	1.90	621.0	2.50	621.0
0.20	362.0	0.80	556.0	1.40	621.0	2.00	621.0		
0.30	394.0	0.90	589.0	1.50	621.0	2.10	621.0		
0.40	427.0	1.00	621.0	1.60	621.0	2.20	621.0		
0.50	459.0	1.10	621.0	1.70	621.0	2.30	621.0		

Hydro-Brake Outflow Control

Design Head (m) 0.750 Hydro-Brake Type MD5 Invert Level (m) 25.100
Design Flow (l/s) 11.5 Diameter (mm) 147

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	4.9	0.80	11.7	2.00	18.3	4.00	25.9	7.00	34.3
0.20	9.3	1.00	13.0	2.20	19.2	4.50	27.5	7.50	35.5
0.30	10.3	1.20	14.2	2.40	20.1	5.00	29.0	8.00	36.6
0.40	10.2	1.40	15.3	2.60	20.9	5.50	30.4	8.50	37.8
0.50	10.3	1.60	16.4	3.00	22.4	6.00	31.7	9.00	38.9
0.60	10.6	1.80	17.4	3.50	24.2	6.50	33.0	9.50	39.9

Weir / Flume Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Crest Level (m) 26.000

White Young Green		Page 1
Brigantine House 27-31 Cumberland Street Bristol BS2 8NL	West Southall Pump Lane Link Road Attenuation	Micro Drainage
Date Jan 07 File pump lane 2007.SRC	Designed By RCB Checked By	
Micro Drainage	Source Control W.10.3	

Summary of Results for 100 year Return Period (+30%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Overflow (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Overflow Volume (m^3)	Maximum Volume (m^3)	Status
30 Summer	10.4	0.0	10.4	25.6343	0.5342	0.0	204.8	O K
60 Summer	10.5	0.0	10.5	25.6703	0.5702	0.0	222.0	O K
120 Summer	10.6	0.0	10.6	25.6863	0.5863	0.0	229.7	O K
180 Summer	10.5	0.0	10.5	25.6783	0.5783	0.0	225.8	O K
240 Summer	10.5	0.0	10.5	25.6678	0.5677	0.0	220.8	O K
360 Summer	10.4	0.0	10.4	25.6458	0.5457	0.0	210.3	O K
480 Summer	10.3	0.0	10.3	25.6218	0.5217	0.0	199.1	O K
600 Summer	10.3	0.0	10.3	25.5977	0.4977	0.0	187.9	O K
720 Summer	10.3	0.0	10.3	25.5732	0.4732	0.0	176.9	O K
960 Summer	10.3	0.0	10.3	25.5293	0.4292	0.0	157.3	O K
1440 Summer	10.3	0.0	10.3	25.4498	0.3497	0.0	123.7	O K
30 Winter	10.6	0.0	10.6	25.6888	0.5888	0.0	230.9	O K
60 Winter	10.8	0.0	10.8	25.7298	0.6298	0.0	251.3	O K
120 Winter	10.9	0.0	10.9	25.7518	0.6518	0.0	262.3	O K
180 Winter	10.9	0.0	10.9	25.7473	0.6473	0.0	260.0	O K
240 Winter	10.8	0.0	10.8	25.7328	0.6328	0.0	252.7	O K
360 Winter	10.6	0.0	10.6	25.7043	0.6043	0.0	238.7	O K
480 Winter	10.5	0.0	10.5	25.6723	0.5722	0.0	223.1	O K
600 Winter	10.4	0.0	10.4	25.6388	0.5387	0.0	207.0	O K
720 Winter	10.3	0.0	10.3	25.6042	0.5042	0.0	190.9	O K
960 Winter	10.3	0.0	10.3	25.5382	0.4382	0.0	161.2	O K
1440 Winter	10.3	0.0	10.3	25.4208	0.3207	0.0	111.9	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
30 Summer	94.04	36
60 Summer	53.46	64
120 Summer	30.38	122
180 Summer	21.83	166
240 Summer	17.27	194
360 Summer	12.41	258
480 Summer	9.82	326
600 Summer	8.18	392
720 Summer	7.05	460
960 Summer	5.60	592
1440 Summer	4.05	840
30 Winter	94.04	36
60 Winter	53.46	64
120 Winter	30.38	120
180 Winter	21.83	174
240 Winter	17.27	222
360 Winter	12.41	278
480 Winter	9.82	354
600 Winter	8.18	428
720 Winter	7.05	500
960 Winter	5.60	636
1440 Winter	4.05	880

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	100
Site Location	511550 179950 TQ 11550 79950
C (1km)	-0.025
D1 (1km)	0.300
D2 (1km)	0.315
D3 (1km)	0.233
E (1km)	0.308
F (1km)	2.562
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	30
Longest Storm (mins)	1440
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+30

Time / Area Diagram

Total Area (ha) = 0.480

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	0.240	4	8	0.240

Tank/Pond Details

Invert Level (m) 25.100 Ground Level (m) 26.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	297.0	0.60	491.0	1.20	621.0	1.80	621.0	2.40	621.0
0.10	329.0	0.70	524.0	1.30	621.0	1.90	621.0	2.50	621.0
0.20	362.0	0.80	556.0	1.40	621.0	2.00	621.0		
0.30	394.0	0.90	589.0	1.50	621.0	2.10	621.0		
0.40	427.0	1.00	621.0	1.60	621.0	2.20	621.0		
0.50	459.0	1.10	621.0	1.70	621.0	2.30	621.0		

Hydro-Brake Outflow Control

Design Head (m) 0.750 Hydro-Brake Type MD5 Invert Level (m) 25.100
Design Flow (l/s) 11.5 Diameter (mm) 147

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	4.9	0.80	11.7	2.00	18.3	4.00	25.9	7.00	34.3
0.20	9.3	1.00	13.0	2.20	19.2	4.50	27.5	7.50	35.5
0.30	10.3	1.20	14.2	2.40	20.1	5.00	29.0	8.00	36.6
0.40	10.2	1.40	15.3	2.60	20.9	5.50	30.4	8.50	37.8
0.50	10.3	1.60	16.4	3.00	22.4	6.00	31.7	9.00	38.9
0.60	10.6	1.80	17.4	3.50	24.2	6.50	33.0	9.50	39.9

Weir / Flume Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Crest Level (m) 26.000

White Young Green		Page 1
Portland Square 22-24 Portland House Bristol BS2 8RZ		Micro Drainage
Date File	Designed By Checked By	
CADS	Source Control W.9.4	

IoH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.500
Area (Ha)	1.000	Urban	0.000
SAAR (mm)	641.000	Region Number	6.000

Results

QBAR Rural (m3/s)	0.008	Q 100 years (m3/s)	0.024
QBAR Urban (m3/s)	0.008		

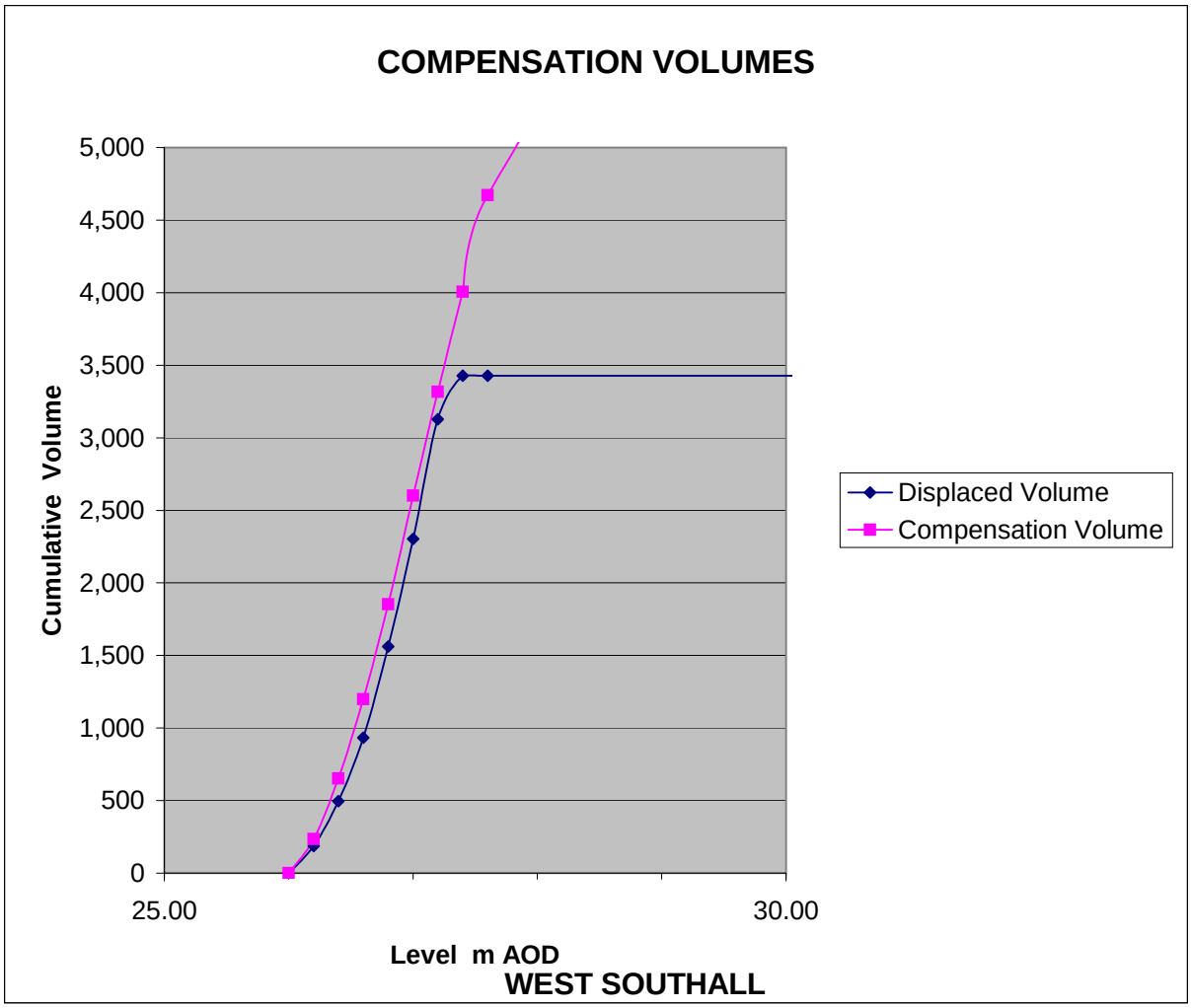
APPENDIX FRA 6.3

Compensation Volumes

level	Incremental		Cumulative	
	Displacement volume	Compensation Volume	Displacement volume	Compensation Volume
m AOD	m^3	m^3	m^3	m^3
33.00	0	7,627	3,427	12,298
27.60	0	665	3,427	4,671
27.40	300	690	3,427	4,006
27.20	824	715	3,127	3,316
27.00	741	747	2,303	2,601
26.80	630	655	1,562	1,854
26.60	437	546	932	1,199
26.40	308	418	495	653
26.20	187	235	187	235
26.00	0	0	0	0

$Q_{100+20\%}$ = 27.27

Q_{100} = 27.06



WEST SOUTHALL

PUMPLANE LINK ROAD

COMPENSATION STORAGE VOLUMES