White Young Green

West Southall
Eastern Access

Flood Risk Assessment
For

National Grid Property

V2 Sept 2008

thinking beyond construction

DOCUMENT VERIFICATION

Brigantine House
27-31 Cumberland Street
Bristol
BS2 8NL

Tel: [redacted]
Fax:
E-mail:
Website: **www.wyg.com**

Client: National Grid Property Holdings

Project: West Southall Eastern Access

Job Number: A012564-E

Document Title: Flood Risk Assessment

Prepared by: [redacted]

Signed: **Date:**

Checked and Approved for Issue by: [redacted]

Signed: **Date:**

DOCUMENT HISTORY

Date	Description	Prepared by	Checked and Approved by
	Issue 1 Draft Issue 2 Final	[redacted]	[redacted]
17.06.08	Revised		
12.09.08	Revision 2	[redacted]	[redacted]

CONTENTS

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. Separate flood risk assessments (FRA's) have been prepared for the site and the Yeading Brook crossings.

It is also proposed to improve access on the eastern side of the site by providing a new link road connecting to South Road, which is the subject of this FRA report. The revised route will take the new road through a small residential/commercial area between The Crescent and Randolph Road.

Other proposed improvements to this area include widening the highway bridge over the railway, widening the connections and alignment along Beaconsfield Road South Road and The Crescent and creating/modifying associated junctions to accommodate the additional traffic and footpath loading.

WYG Engineering Ltd has been appointed by National Grid Property to carry out a Flood Risk Assessment relating to hydrological and hydraulic implications of the new revised link road in support of a planning application.

1.1 Brief

This Flood Risk Assessment is prepared in accordance with the requirements of Planning Policy Statement (PPS) 25, 'Development and Flood Risk' published by the Department of Communities and Local Government. PPS 25 sets out the framework for planning decisions made by the local, regional and national government and the Environment Agency (EA). In order that planning authorities can make informed decisions on the development of sites in areas at risk of flood, PPS 25 requires the developer to carry out an assessment of flood risk.

This report addresses the requirements given in Annex E of PPS 25 and other issues which are deemed relevant to flood risk. These requirements include the following:

- Assessment of the magnitude and severity of flood risk to the site.
- Assess suitability of site and development through the use of the Sequential Test & Exception Test (if required).
- Assess impact of proposed development on flood risk to adjacent developments.
- Determine ability of existing and proposed drainage to accommodate development flows with respect to surface flooding.
- Demonstrate that appropriate mitigation measures have been taken to prevent flooding.
- Demonstrate that appropriate emergency situations have been considered e.g. overland flow paths, evacuation routes.

2.0 EXISTING SITE

2.1 Location and Topography

The site is located on the west side of South Road, which forms the east boundary. The main railway line forms the south boundary; the west boundary is formed by a row of houses that line down Randolph Road, which are to remain when the new road is constructed. The north boundary is formed by NO.8 The Crescent. The approximate grid reference for the centre of the site is 512570, 179880.

The site is generally flat in terms of topography, but there is an embankment that rises to meet South Road as it crosses over the railway. A location plan can be viewed in Appendix A.

There are additional modifications to the road layout south of the railway lines.

2.2 Current Land Use

The proposed link road improvement site is currently a small urban area comprising houses, small commercial and industrial units and an area (1500 sqm) of public open space. Circling this area are The Crescent and Randolph Road; all houses along Randolph Road are to remain except house numbers 1, 3, 5, 7 9 and 11, these will need to be removed to make way for the new road. A plan of the existing site can be viewed in Appendix B.

2.3 Flood Risk to the Existing Site

The nearest watercourse to the site is the Yeading Brook, which is located 1km west of the access road network. Interpretation of the Environment Agency's Flood Zone Map Appendix C, indicates that the site is within Flood Zone 1 (land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%); and is therefore suitable for all development, according to PPS25 Table D1.

2.4 Existing Development Drainage

Currently all surface water drains into the Thames Water Surface Water Sewers via gullies located along the road networks and parking areas, and pipes and guttering from the houses etc, Appendix D.

Total Area North of the Railway ***10,700 m^2*** *approx* (1.1ha)

Impermeable Areas

Crescent Road	1,400 m^2 approx
South Road	2,600 m^2 approx
Water Tower Roads	1,050 m^2 approx
Garage area	800 m^2 approx
Houses in Crescent Road	850 m^2 approx
Houses in Randolph Road	500 m^2 approx
Play Area	300 m^2 approx
Total Impermeable	***7,500 m^2***

Permeable Areas

Public Open Space	1,600 m^2
Garden	850 m^2
Railtrack	450 m^2
Highway Embankment	300 m^2
Total Permeable	***3,200* m^2**

Typical run-off rates from the existing development north of the railway for a time of concentration of 30 minutes are presented in Table 2.1.

TABLE 2.1: APPROXIMATE RUNOFF RATES EXISTING SITE(0.75Ha Impermeable Area)

	Modified Rational Method Calculations		
Return Period yrs	**30 min FEH Storm (mm)**	**Storm Volume V (m^3)**	**Peak Flow Q (l/s)**
2	11.5	86.00	47.9
10	21.4	160.00	89.2
20	27.2	204.00	113.3
50	37.0	278.00	154.2
100	46.2	347.00	192.5

2.5 Existing Sewer Network

The Thames Water sewer records show a surface water sewer running around Crescent Road and discharging via a 300mm pipe into South Road and hence north.

A secondary connection at the head of the sewer will allow excess flow to pass down a further sewer in Randolph Road. Whilst we have no knowledge of surface water flooding in the area, the estimated gradient of the sewer is 1:272. This will give a pipe full capacity of around 67l/s. This is close to the Q_5 runoff value for the whole area. Surcharging would provide some extra capacity and it is also likely that the area around the Water Tower drains into the gas works system. The existing system can thus be expected to provide around a 1:5 year return period capacity provided there is no reduction in capacity downstream.

South of the railway the existing development drains into a 225 mm diameter public sewer which flows to the south. Insufficient details are available to enable an estimate of the capacity of this sewer to be made.

3.0 PROPOSED DEVELOPMENT

3.1 Development Description

The Eastern Access Road will provide entry to the proposed development at the former Southall Gas Works site and will aim to provide suitable traffic flows between the West Southall development and the existing traffic network.

This proposal consists of the construction of a new junction onto South Road just north of the station, the construction of a new length of highway to serve the main site, amendments to the South Road/Beaconsfield Road junction, and minor connecting roads to serve properties no longer served by the original Crescent Road.

Ultimately, it is anticipated that in future the bridge over the railway will be widened and the junction with Southbridge Way and The Green improved.

The proposed works to The Crescent will result in the removal of residential properties along the southern half of The Crescent (No's 20 to 32); a motor repair garage, and an area of public open space (0.15ha). 6 houses in Randolph Road will also be demolished.

3.2 Flood Risk to the Development

The site is not identified as being at risk within the Environment Agency's floodplain mapping. The nearest watercourse to the site is Yeading Brook, which is, located approximately 1.1km west of the access road network; the extent of the 1 in 100-year floodplain lies approximately 1km west of the access road network.

There are no reported problems with flooding from other sources such as overloading of drainage, and so the site is considered to remain as Flood Zone 1, low risk. However, the surface water sewer appears to have been designed to a lower standard than currently applicable.

The proposals will utilise the existing drainage outfall and will result in some ground raising at the new junction; and a reduction in impermeable area therefore there will be no increase in flood risk to the development (subject to survey and the agreement of Thames Water).

3.3 Flood Risk from the Development

Foul Water Drainage

The new road link will result in a reduction in foul water flows from the site. Therefore, no additional infrastructure or changes to the existing network are proposed; except the abandonment of some pipes along The Crescent (subject to survey and the agreement of Thames Water).

Surface Water Drainage

Currently all surface water drains into the Thames Water Surface Water Sewers via gullies located along the road networks along Beaconsfield Road, The Crescent and Randolph Road and pipes and guttering from the houses etc.

The proposals will result in a reduction in impermeable area due to the removal of buildings and paved surfaces and the introduction of landscaped areas as follows:

North Area

10,700 **m^2** *approx* (1.1ha)

Impermeable Areas

South Road	2,600 m^2 approx
Remains of the Crescent	100 m^2 approx

New Access Road	1,800 m^2 approx
Water Tower Roads	1,050 m^2 approx
Residents' Access	650 m^2 approx
Plaza	550 m^2 approx
Total Impermeable	***6,750 m^2***

Permeable Areas

Play Area	1,050 m^2 approx
Plaza	550 m^2 approx
Southern Strip	1,550 m^2 approx
Misc	800 m^2 approx
Total Permeable	***3,950 m^2***

The resulting runoff rates from the proposed development, without attenuation, during a 100-year rainfall event 30-minute storm duration are presented in Table 3.1.

TABLE 3.1: APPROXIMATE RUNOFF RATES PROPOSED DEVELOPMENTS (0.67Ha Impermeable Area)

	Modified Rational Method Calculations		
Return Period yrs	**30 min FEH Storm (mm)**	**Storm Volume V (m^3)**	**Peak Flow Q (l/s)**
2	11.5	77.00	42.8
10	21.4	144.00	79.7
20	27.2	182.00	101.2
50	37.0	248.00	137.7
100	46.6	312.00	173.4

3.4 Runoff Rates

PPS 25 Para F6 states that:

F6 Surface water from a developed site should, as far as is practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, whilst reducing the flood risk to the site itself and elsewhere, taking climate change into account. This should be demonstrated as part of the flood risk assessment.

This is further clarified in the Planning Policy Statement 25 Practice Guide, June 2008 which states within Para 5.50:

5.50 Runoff from previously developed sites should be compared with existing rates, not greenfield rates for the site before it was developed. Developers are, however, strongly encouraged to reduce runoff rates from previously developed sites as much as is reasonably practicable.

The runoff rates presented in Table 3.1 when compared to Table 2.1 demonstrate that the proposals in themselves will reduce runoff by around 11%.

However, the new drainage system should be designed for no surface flooding for a 1:30 year return period storm in accordance with Sewers for Adoption 6 Edition. Additionally, the Environment Agency has requested that the discharge should be limited to undeveloped geenfield runoff rates, wherever practical. This standard is more severe than the Environment Agency's published policy (under PPS25 and the Environmental Agency/DEFRA Document "Preliminary Rainfall Run-off Management for Development, 2007").

The design should also take future climate change into account. PPS 25 recommends an increase in design rainfall rates of 30% up to the year 2115.

The incorporation of flow reduction facilities into existing infrastructure is not always practical. The opportunities to meet the requested standards are discussed in the following sections.

3.5 SUDS Options Matrix

An objective of this FRA is to investigate the feasibility of using SUDS to achieve the required reduction in runoff rates post development. A detailed drainage design for the proposals will be carried out in due course, once the concepts presented in this FRA have been agreed with the EA.

This following table provides an overview, in the form of a matrix, of the feasibility of a range of SuDs techniques, in order to identify which measures may be suitable for the proposed development.

TABLE 3.2: SUDS FEASIBILITY MATRIX

Technique	***Physical Constraints***	***Feasibility***
Permeable pavement/ porous hardstanding areas	Requires a reasonably level site	Not Feasible
Green roofs	Roof slope for proposed buildings will preclude their use; flat roofs are ideal; also known as brown roofs and garden roofs.	Not Applicable
Bio-retention – shallow landscaped infiltration areas	Primarily used to remove pollutants from runoff and due to their shallow nature are not as effective at runoff attenuation as other SUDS techniques.	Not Feasible, requires large areas of land
Soakaways and infiltration trenches	Require infiltration rates of 1×10^{-6} m/s or greater. Shallow soakaways or infiltration trenches would be required where groundwater is shallow (i.e. less than 2.0 mbgl).	Maybe considered subject to site investigation and agreement with Thames Water
Cellular Storage	Modular plastic Geocellular systems with a high void ratio that can be used to create a below ground infiltration (soakaway) or storage structure.	Not Feasible under major access road
Grassed filter strips – wide gently sloping areas of grass or other vegetation	Normally used to treat polluted runoff from car parks or roads. Not as effective at runoff attenuation as other SUDS techniques.	Not Feasible, require large area May be limited potential to residential access

TABLE 3.2: SUDS FEASIBILITY MATRIX		
Technique	***Technique***	***Technique***
Infiltration basins / swales	Are widely applicable for attenuation and treatment of surface runoff by infiltration into the ground. Require slope of no more than 4-10% and can act as a substitute for soakaways where groundwater is shallow – need to consider the impact these techniques have on local groundwater levels.	Limited potential - as for filter strips
Non-infiltration swales	Used in the same concept as carrier ditches or storage bunds.	Feasible; subject to agreement with Thames Water
Filter drains	These are normally used adjacent to areas of car parking or roads and convey runoff via flow through an engineered substrate (normally gravel).	Feasible; may use for access road with option of perforated pipe to convey water to other storage system for extreme storms
Balancing ponds	These are permanent ponds that provide storage above the resting water level in the pond. Are appropriate for most sites but require suitable space. Require impermeable soils, or can be lined.	Not Feasible
Rainwater Harvesting	The collection and recycling of rainwater to be used for irrigation and other non-potable use	Not Applicable
Balancing Tanks	Storage tanks; can be located inside buildings or underground; can work in conjunction with oversize pipes; location for this site would be beneath public highway.	Not Feasible or required
Oversize Drainage Pipes	Usually last resort when no other techniques possible. Generally only feasible where a minor reduction in peak flow is required.	Not Suitable

On the basis of the SUDS feasibility study, there are only a very few techniques that would be appropriate for use at this site. According to the building regulations, the preferred option would be to utilise infiltration-based methods, such as swales and infiltration basins and/or soakaways, which would mimic a natural hydrological regime at this site and provide recharge of any underlying aquifer.

The use of these methods is not generally suitable in the Greater London area due to clay sub suds. However, this is subject to geotechnical investigation results. Thames Water has advised that they will not accept discharge from open attenuation ponds or soakaways.

4.0 PROPOSED DEVELOPMENT

As the public surface waster sewer is the only outfall available for the site flow, reduction methods are restricted to those constructed using 'hard' engineering techniques.

Proposed Drainage

Drainage of the proposals can be considered in respect of 4 zones(Reference appendix E):-

1. The junction of the straight and Randolph Road.
2. The new West Southall Access Road.
3. South Road north of the railway.
4. South Road south of the railway.

Flow reduction to the Environment Agency's requested standard would require discharge rates to be reduced to 23.9l/s/ha for a 1:100 year event including a climate change allowance.

4.1 Zone 1

This is an area of approximately 1,650m^2 which will drain via the existing public surface water sewer in Randolph Road. Flows to this sewer will be reduced by around 32% due to the demolition of 6 properties to the south of Randolph Road.

Further reduction flows to undeveloped runoff, rates would require a small diameter control. For this area the Q_{100} flow would be 3.9l/s and a typical control would be a 43mm orifice. This would be prone to blocking and is not practicable (reference CIRIA CR609, Sustainable Drainage Systems).

4.2 Zone 2

This zone would be the subject of major reconstruction and will require a new drainage system. It covers an area of approximately 7,200m^2. It would therefore be feasible to provide attenuation storage as part of the works.

The main runoff collection route is down the new access to the south-west of the zone and then into a diverted public sewer.

Areas of open space that would have potential for use as ponds are addressed as follows:-

a) South of the access road:
Part of this area is at a suitable low level but is located behind the Network Rail boundary and hence is not available.

The remaining section is infill between the higher ground of the access road, piazza and south Road, dropping down to meet the railway.

Use of this area would require gradients of 1:3 or steeper resulting in a very artificial depressed area.

b) There is a small area of landscaping at the end of Randolph Road. This again would require steep slopes but would still not provide a significant volume of storage.

c) The play area at the north of the site:
Existing ground levels are above the surrounding areas to the north and west. Excavation to produce a pond would destroy the existing mature trees which are intended to remain. The use of a play area to attenuate any but the more infrequent storms is not desirable.

In addition to the above, Thames Water has indicated that they would consider drainage connections from open areas to be 'land drainage' and would not accept any flows from these areas.

Accordingly, the only practical means of attenuation for this area is by the provision of a tank under the new highway.

The undeveloped Greenfield runoff rates from this area for a 1:100year storm would be 15.1l/s. This could be achieved (including a 30% climate change allowance) by the construction of a 150m^3 attenuation tank, with the outlet controlled by a 25m X 100mm diameter throttle pipe. This will give a reasonable match to undeveloped flow rates from more frequent storms (see Appendix G).

4.3 Zone 3

This comprises South Road to the centre of the railway bridge.

The road is to be widened, resulting in a slight increase in area draining to the existing sewer connection. However, a section of the crescent will be removed from the main site drainage. This leaves the impermeable area draining to the connection manhole almost unchanged at approximately 2750m^2. Attenuation to undeveloped run-off rates would require around 150m^3 of storage, similar to the main site. This would need to be installed under a major traffic route incurring additional expense and disruption to the public. Accordingly it is proposed to continue to utilise the existing 225 mm diameter public sewer as the outfall.

4.4 Zone 4

Is an area of highway improvements to the south of the railway line and extends over an area of around 4000m^2. Of this 230m^2 is a landscaped island and 300m^2 is located over Network Rail land, the remainder being fully paved.

The junction improvements will result in all the area being hard surfaced, an increase of 15%.

It is not practical to construct a large attenuation tank (approx. 250m^3) under a large major junction as would be required to reduce the run-off from the whole area to undeveloped sites.

The new area would have an approximate rate of run-off of 1.3 l/s. This would require a storage volume of around 32m^3 for a Q_{100} + 30% event with a 25mm diameter orifice as the control. The control size is too small to be practicable. However, subject to available space between utility services, it would be possible to provide this volume by means of an off-line 1.2m diameter pipe 29m long within the footprint of the current island. The discharge will be effectively limited by the capacity of the existing 225mm pipe, which will remain unchanged.

5.0 CONCLUSIONS

Interpretation of the Environment Agency's Flood Zone Map indicates that the site is within Flood Zone 1 (land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%); and is therefore suitable for all development.

The proposals will actually result in a reduction of impermeable area through removal of buildings and the introduction of landscaped areas in and around the development. As a result flood risk elsewhere will be reduced.

The proposals thus meet with the requirements of PPS 25 and hence the Local Plans without the incorporation of any additional attenuation.

Greenfield run-off from the existing site, north of the railway, as defined by PPS 25, is estimated to be 173.4 l/s for a 1:100 year 30 minute storm.

The Environmental Agency have requested that flows are reduced to undeveloped Greenfield rates. This is a requirement more severe than required by either PPS 25 or the Environmental Agency's published policy.

The undeveloped Greenfield run-off rates north of the railway have been estimated using the I0H124 method to be 25.6 l/s/ha for a 1:100 year event.

Based on the findings of this report, it is considered that there will be no increase in flood risk either to the development or to other properties as a result of implementing the proposals. The development thus meets the requirements of PPS 25.

It is not practicable to provide attenuation in all zones of the development due to either a zone being too small to have an effective control or an attenuation facility would involve major excavation in a heavily used highway.

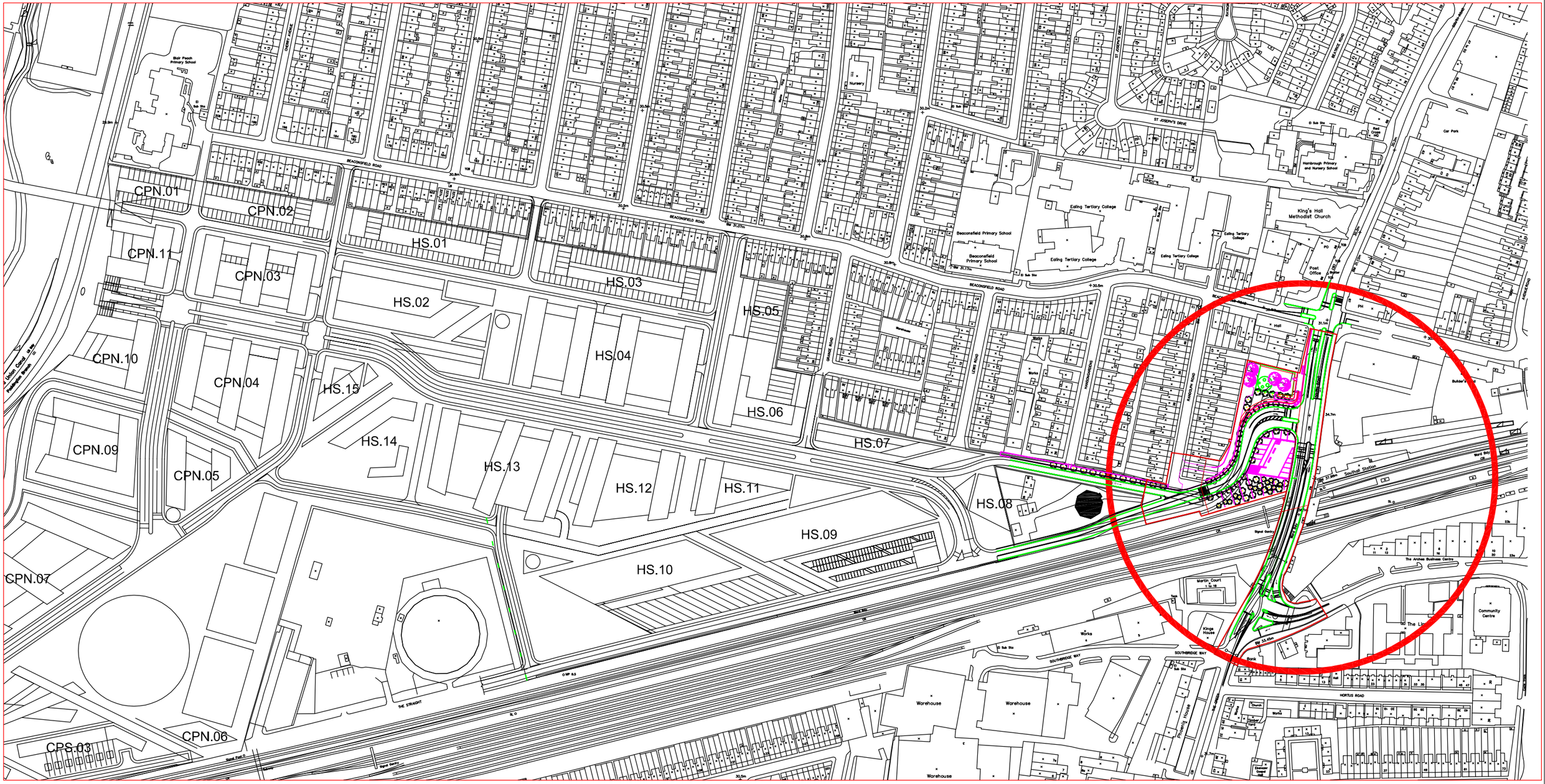
The new works do provide some opportunity to provide attenuation. A tank of 150m^3 with a 25m x 150m dia through pipe control will reduce the Q_{100} + 30% peak flow from Zone 2 from 95 l/s to the undeveloped Q_{100} flow of 15.1 l/s.

South of the railway a 32m^3 could be installed within the current landscaped area, subject to the presence of other utilities. This would allow the flow from the local increase in surface area to be reduced to Greenfield rates.

APPENDIX FRA-E A

Location Plan

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



Rev	Description	By	Chk	App	Date

Brigantine House
27-31Cumberland Street
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
EASTERN ACCESS
FLOOD RISK ASSESSMENT

Drawing Title:

LOCATION PLAN

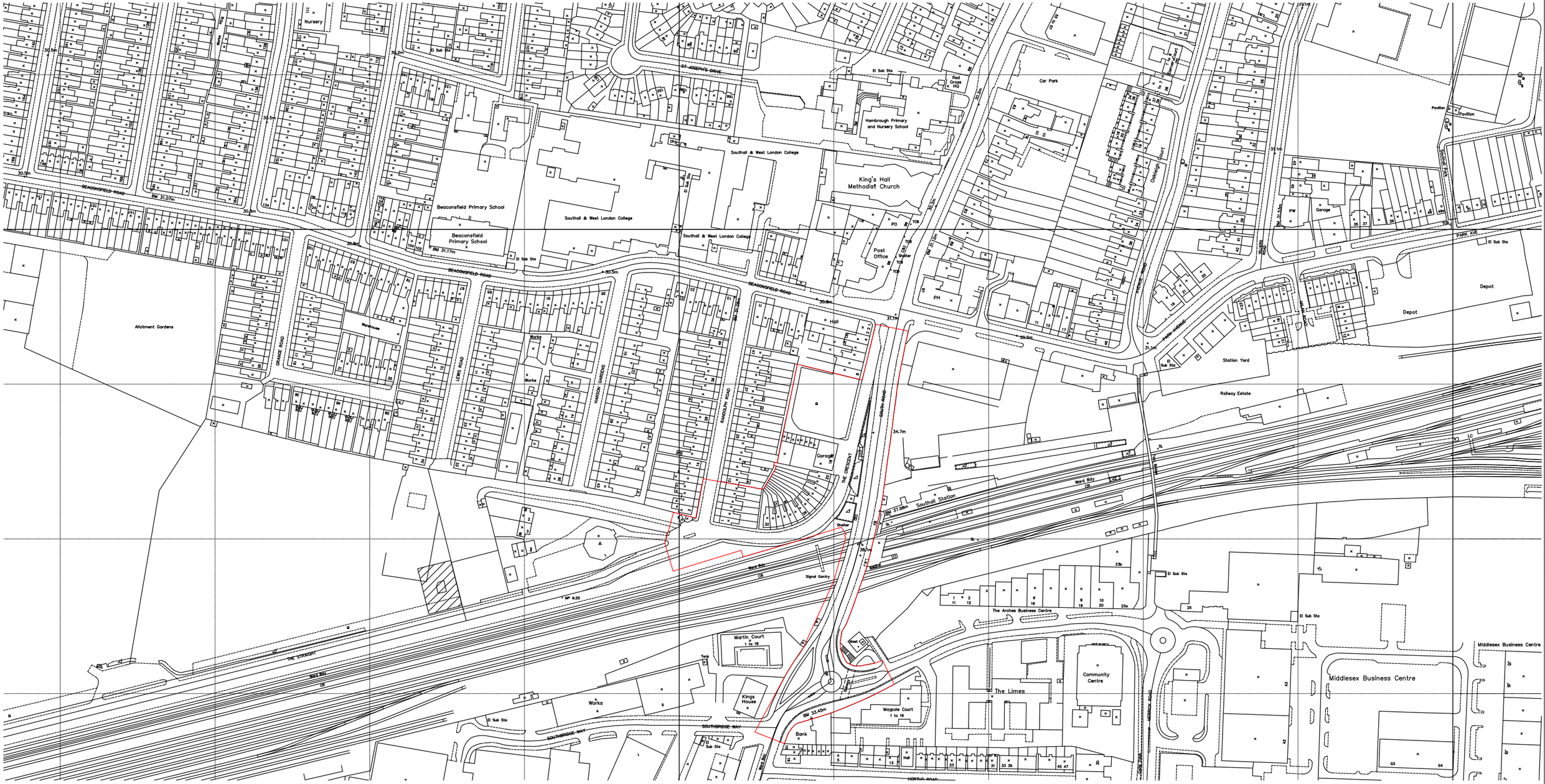
Scale at A3	Drawn By	Date	Checked By	Date	Approved By	Date
NTS	RB	16/9/2008				

Project No.	Office	Discipline	Drawing No.	Revision
A012564-E	28	C	APPENDIX FRA-E A	

APPENDIX FRA-E B

Existing Site Plan

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



Rev	Description	By	Chk	App	Date

Brigantine House
27-31Cumberland Street
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
EASTERN ACCESS / THE CRESCENT
FLOOD RISK ASSESSMENT

Drawing Title:

EXISTING SITE OS PLAN
APPROXIMATE RED LINE BOUNDARY AREA

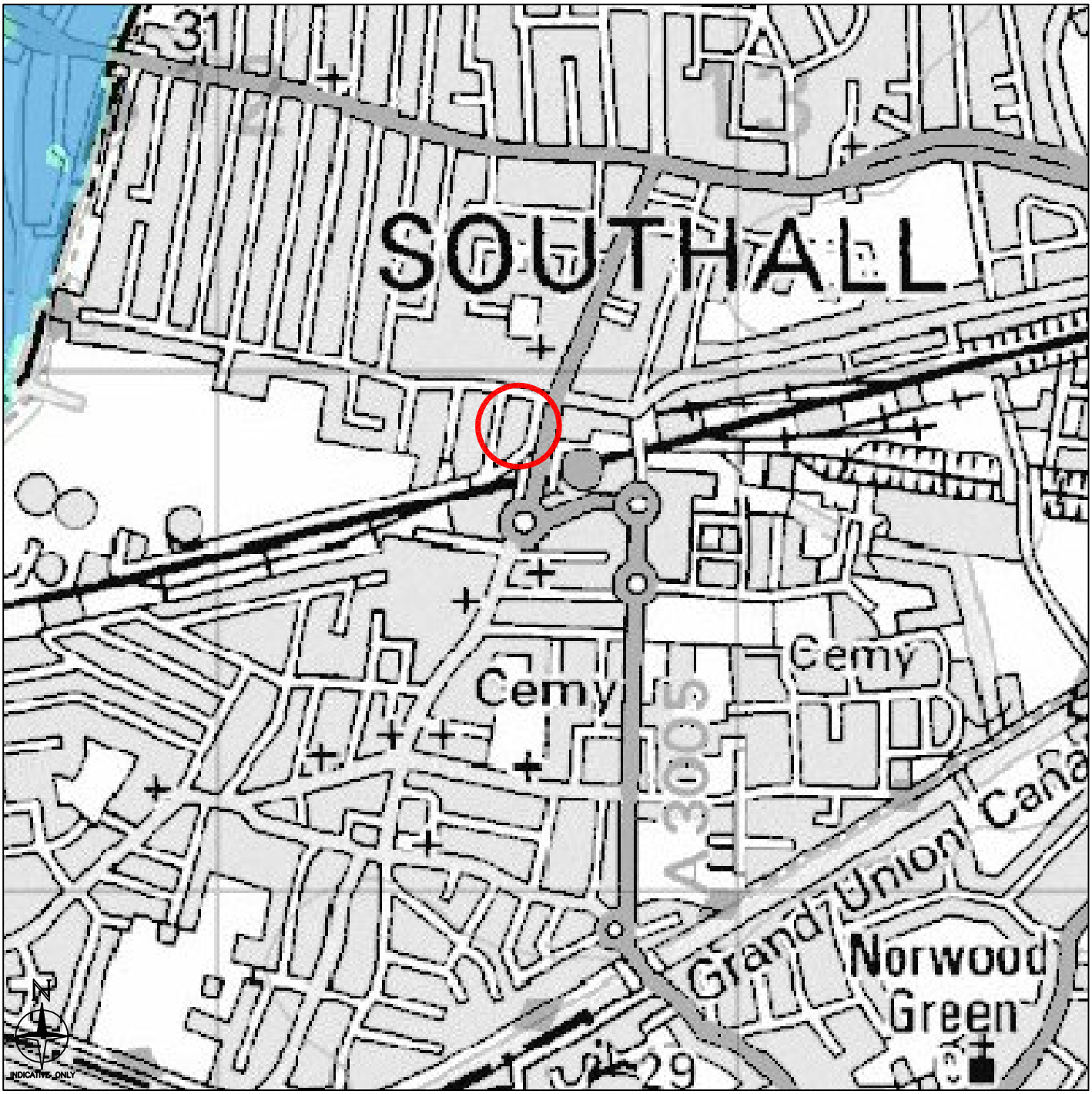
Scale at A3	Drawn By	Date	Checked By	Date	Approved By	Date
NTS	RB	16/9/2008				

Project No.	Office	Discipline	Drawing No.	Revision
A012564-E	28	C	APPENDIX FRA-E B	

APPENDIX FRA-E C

Flood Zone Map

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



Rev	Description	By	Chk	App	Date

Brigantine House
27-31Cumberland Street
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
EASTERN ACCESS - THE CRESCENT
FLOOD RISK ASSESSMENT

Drawing Title:
ENVIRONMENT AGENCY
FLOOD ZONE MAP

Scale at A4	Drawn By	Date	Checked By	Date	Approved By	Date
NTS	CC	18/03/2008				

Project No.	Office	Discipline	Drawing No.	Revision
A012564-E	28	C	APPENDIX FRA-E 0	

APPENDIX FRA-E D

Thames Water Sewer Plans

ALS/ALS Standard/2005_248039

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

100 metre intervals

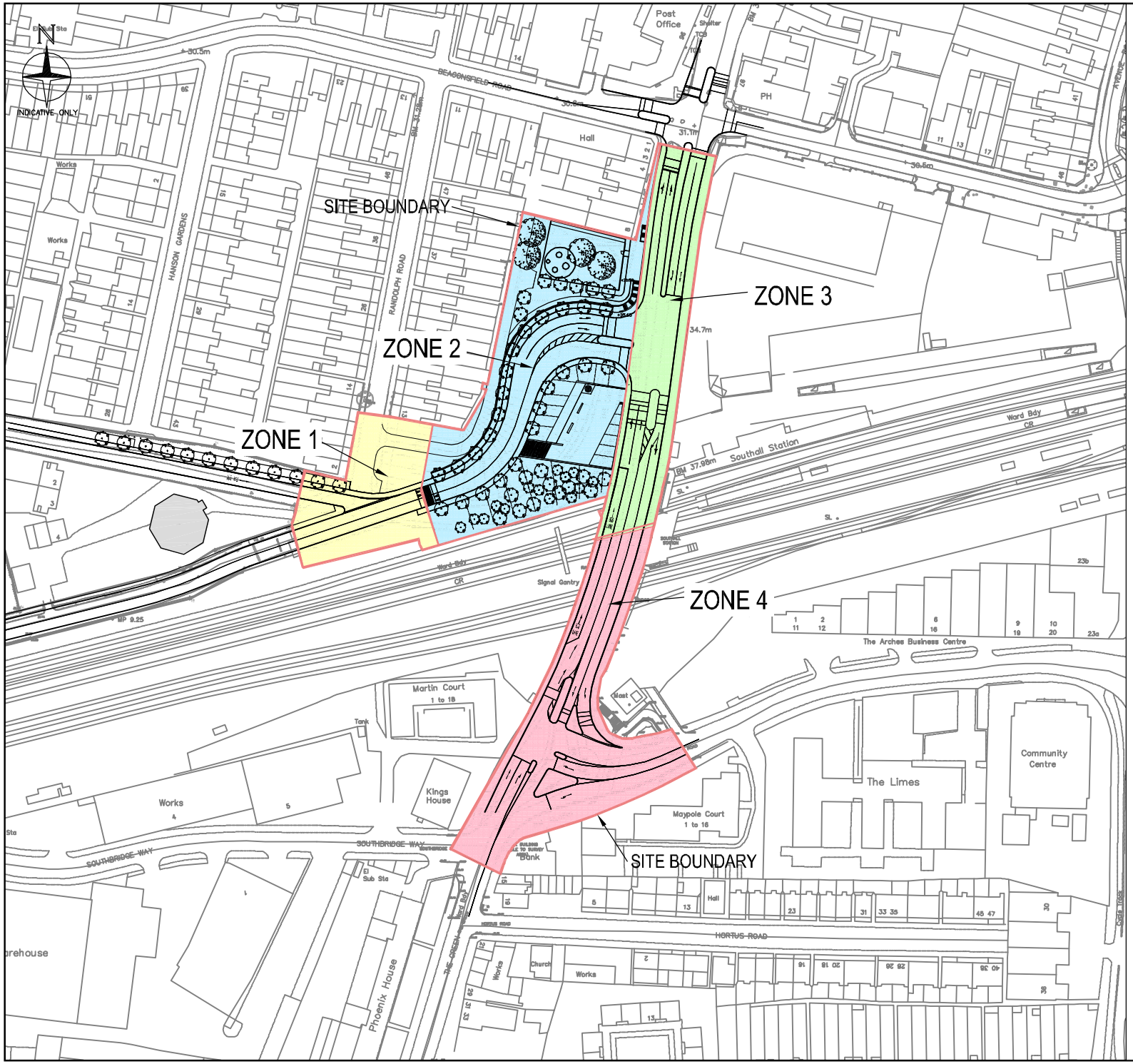
EAGLE hardcopy facility - Normal Map.
The plot is centred on (512626 , 179935), which is in TQ1279NE. Printed on 24 November 2005 at 9:58:24 by OARTHURS.

Comments:
SEWER

APPENDIX FRA-E E

Drainage Schematic

FILENAME : N:\PROJECTS\A012501 - A013000\A012564\ACAD\CIVILS\HISTORY\A012564_APPENDIX FRA-E-E SHEET 1 OF 3_R0.DWG | PLOTTED BY : BRETT.EAMER | PLOTTED DATE : 18 September 2008 14:25:02



REV	DESCRIPTION	BY	CHK	APP	DATE

Client:

BRIGANTINE HOUSE
27-31 CUMBERLAND STREET
BRISTOL
BS2 8NL

TEL: +44 (0)117 924 4144
FAX: +44 (0)117 924 4145
e-mail: bristol@wyg.com

White Young Green

Project:

WEST SOUTHALL
YEADING BROOK
FLOOD RISK ASSESSMENT

Drawing Title:

EASTERN ACCESS
DRAINAGE SCHEMATIC
SHEET 1 OF 3

Scale	@A4	Drawn	Date	Checked	Date	Approved	Date
1:500		B.C.E	17/09/08	R.C.B.	17/09/08	R.C.B.	17/09/08

Project No.	Office	Type	Drawing No.	Revision
A012564	28	C	APPENDIX FRA-E-E	-

SHEET SIZE : A4 PORTRAIT

N

INDICATIVE ONLY

DIVERT SW TO TW REQUIREMENTS AND MAINTAIN EXISTING CONNECTIONS.

NEW SITE DRAINAGE.

225Ø DRAIN TO EXISTING SWS.

225Ø

25m x 100Ø THROTTLE PIPE.

84m² x 1.8m DEEP ATTENUATION TANK.

DRAIN TO SWALES EITHER SIDE, IF POSSIBLE.

DRAIN VIA EXISTING SEWER IN RANDOLPH ROAD.

SEE DRAWING NO. A012564 APPENDIX FRA-E-E SHT 3 OF 3

LEGEND

- NEW SURFACE WATER DRAINAGE.
- EXISTING PUBLIC SURFACE WATER SEWER.
- EXISTING PUBLIC FOUL WATER SEWER.
- EXISTING PUBLIC SURFACE WATER SEWER TO BE ABANDONED.
- EXISTING PUBLIC FOUL WATER SEWER TO BE ABANDONED. (SUBJECT TO SURVEY AND TW AGREEMENT).

REV	DESCRIPTION	BY	CHK	APP	DATE

Client:

BRIGANTINE HOUSE
27-31 CUMBERLAND STREET
BRISTOL
BS2 8NL

TEL: +44 (0)117 924 4144
FAX: +44 (0)117 924 4145
e-mail: bristol@wyg.com

White Young Green

Project:

WEST SOUTHAL
YEADING BROOK
FLOOD RISK ASSESSMENT

Drawing Title:

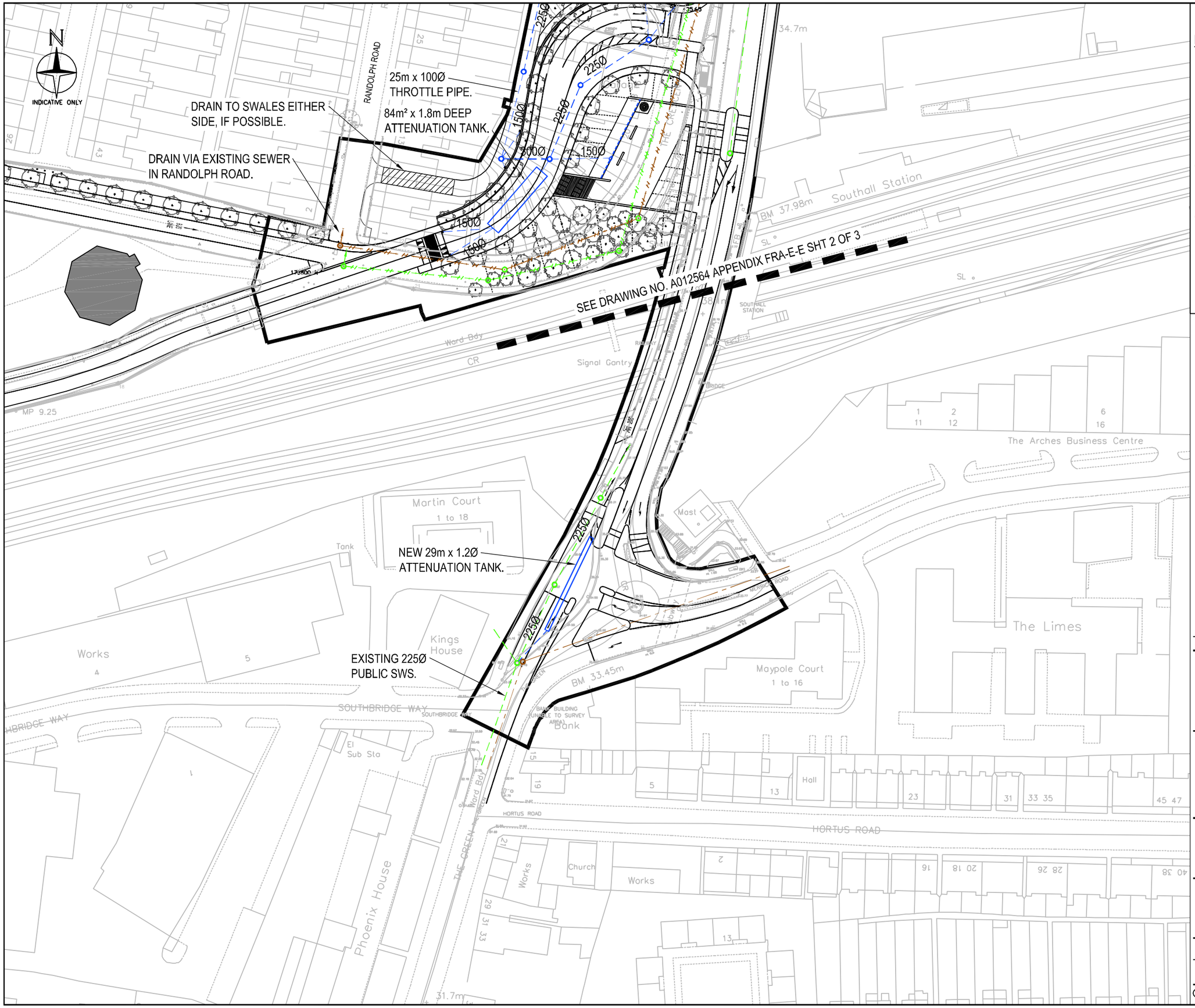
EASTERN ACCESS
DRAINAGE SCHEMATIC
SHEET 2 OF 3

Scale @ A3	Drawn	Date	Checked	Date	Approved	Date
1:1000	B.C.E	17/09/08	R.C.B.	17/09/08	R.C.B.	17/09/08

Project No.	Office	Type	Drawing No.	Revision
A012564	28	C	APPENDIX FRA-E-E	-

SHEET SIZE : A3 LANDSCAPE

FILENAME : N:\PROJECTS\A012501 - A013000\A012564\ACAD\CIVILS\HISTORY\A012564_APPENDIX FRA-E-E SHEET 2 & 3 OF 3_R0.DWG | PLOTTED BY : BRETT.EAMER | PLOTTED DATE : 18 September 2008 12:58:23



LEGEND

- NEW SURFACE WATER DRAINAGE.
- EXISTING PUBLIC SURFACE WATER SEWER.
- EXISTING PUBLIC FOUL WATER SEWER.
- EXISTING PUBLIC SURFACE WATER SEWER TO BE ABANDONED.
- EXISTING PUBLIC FOUL WATER SEWER TO BE ABANDONED. (SUBJECT TO SURVEY AND TW AGREEMENT).

REV	DESCRIPTION	BY	CHK	APP	DATE

Client:

BRIGANTINE HOUSE
27-31 CUMBERLAND STREET
BRISTOL
BS2 8NL

TEL: +44 (0)117 924 4144
FAX: +44 (0)117 924 4145
e-mail: bristol@wyg.com

White Young Green

Project:

WEST SOUTHAL
YEADING BROOK
FLOOD RISK ASSESSMENT

Drawing Title:

EASTERN ACCESS
DRAINAGE SCHEMATIC
SHEET 3 OF 3

Scale @ A3	Drawn	Date	Checked	Date	Approved	Date
1:1000	B.C.E	17/09/08	R.C.B.	17/09/08	R.C.B.	17/09/08

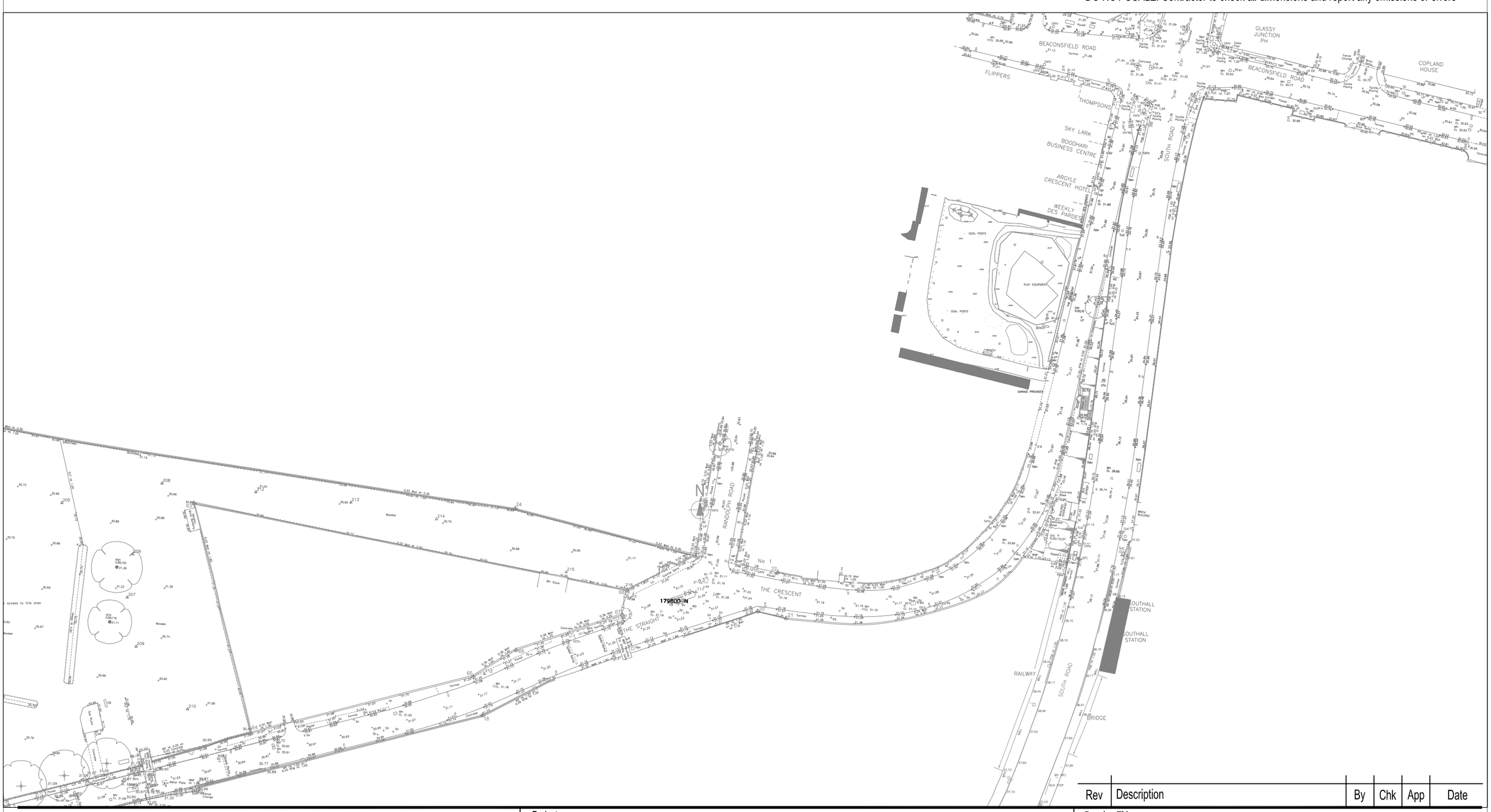
Project No.	Office	Type	Drawing No.	Revision
A012564	28	C	APPENDIX FRA-E-E	-

SHEET SIZE : A3 LANDSCAPE

APPENDIX FRA-E F

Topographic Survey

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



Rev	Description	By	Chk	App	Date

Brigantine House
27-31Cumberland Street
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
YEADING BROOK
FLOOD RISK ASSESSMENT

Client:

Drawing Title:
EASTERN ACCESS
TOPOGRAPHICAL SURVEY

Scale at A3	Drawn By	Date	Checked By	Date	Approved By	Date
1:1000	KP	23/06/08	R.C.B.	23/06/08	R.C.B.	23/06/08

Project No.	Office	Discipline	Drawing No.	Revision
A012564	28	C	APPENDIX F	-

APPENDIX FRA-E G

Calculations

Calculation *Cover Sheet*

Brigantine House
27-31 Cumberland street
Bristol
BS2 8NL

[redacted]

White Young Green

Office :	Bristol	Prepared by:	[redacted]
Division:	C & S	Date:	Sept 08
Project No :	A0112564		
Project Title :	West Southall – East Access		
Client :	National Grid Property Holdings		

Contents :

Set No.	Details	Page No.s
	Undeveloped green field Runoff	1
	Areas	2 – 4
	Zone 2 attenuation	5 - 10
	Zone 3 attenuation	11- 14
	Key plan	15

Design Philosophy :

Establish undeveloped green field run off rates using IOH 124 method (from Micro drainage programme)
Provide attenuation to undeveloped greenfield rate for any increase in impermeable area (zone 4)
Where practical reduce new development to undeveloped Greenfield rates as per EA request (Zone 2)

(Continue on separate sheet if necessary)

Status : Preliminary ✓ Working ☐

Checked by : RCB Date : Sept 08 Approved by : Date :

Revisions :

Rev	Date	Description	Checked	Approved	Pages Revised

White Young Green
Brigantine House
27-31 Cumberland Street
Bristol BS2 8NL
Date 21/8/08
File
Micro Drainage

West Southall
East Access

Designed By RCB
Checked By
Source Control W.11.2

Micro Drainage

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (Ha)	1.195	Urban	0.000
SAAR (mm)	641.000	Region Number	6

Results **l/s**

QBAR Rural	9.0
QBAR Urban	9.0
Q 100 years	26.6
Q 1 year	7.6
Q 2 years	7.9
Q 5 years	11.5
Q 10 years	14.5
Q 20 years	18.0
Q 25 years	19.3
Q 30 years	20.3
Q 50 years	23.5
Q 100 years	26.6
Q 200 years	33.7
Q 250 years	35.3
Q 1000 years	46.3

White Young Green

Consulting Engineers and Project Managers

White Young Green Consulting Engineers

Project No A012564-E

Calculation Sheet No 2

Office

Division

Project Title WEST SOUTHALL

Work Section EAST ACCESS

Prepared by R.L.B

Date Sept 06

North of Railway. - Existing

Impermeable	m²	
South Road.	2585	
The Cresent	1421	
The straight Junction	1037	
Play Area	294	
Garage	796	
Residential - The Cresent	845	
Residential - Randolph Rd	444	7472
Permeable		
Play Area	1474	
Back Gardens	651	
Front Gardens	211	
South strip	455	
The straight Junc.	104	
Embankment	316	
Misc.	86	3301
Total,		10647.

White Young Green

Consulting Engineers and Project Managers

White Young Green
Consulting Engineers

Project No A012564-E
Calculation Sheet No 3
Office
Division

Project Title WEST SOUTHALL
Work Section EAST ACCESS

Prepared by RCB
Date Sept 06

North of Railway – Proposed

	m²	
Impermeable		
South Road	2610	
(remainder of the crescent	120	
Upper Access	1236	
Lower Access	560	
The Straight Junction	1026	
Residents access	649	
Plazza	467	
stairs to Plazza	73	6735
Permeable.		
Play space	607	
North area	430	
Access Road Border	190	
Plazza West	447	
Plazza East	119	
Southern strip	1540	
Southern Block	323	
Southern by rest	160	
Misc. footpaths etc draining to landscape	222	4036
Total		10,773

White Young Green

Consulting Engineers and Project Managers

White Young Green Consulting Engineers

Project No A012564-E

Calculation Sheet No 4

Office

Division

Project Title WEST SOUTHALL

Work Section EAST ACCESS.

Prepared by RCB

Date sept 06

Effective Proposed Catchment Areas.

Zone	Location	Imp m^2	Perm m^2	Total m^2
1	Randolph Road.	1026	615	1641
2	New Access/ The Crescent	3099	3201	6300
3	South Road (N)	2744	—	2744
4	South Road (S)	4000	—	4000

For Zone 2 to Match IDH 124 flows

1:2yr = 6.6 l/s/ha ⇒ 42 l/s

1:30yr = 17.0 l/s/ha ⇒ 10.7 l/s

1:100yr = 23.9 l/s/ha ⇒ 15.1 l/s.

White Young Green
Brigantine House
27-31 Cumberland Street
Bristol BS2 8NL
Date sept 08
File throttle pipe.src
Micro Drainage

West Southall
East Access
Zone 2
Designed By RCB
Checked By
Source Control W.11.2

Micro Drainage

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 (m³)	Maximum Volume (m³)	Status
15 Summer	13.8	0.0	13.8	30.6322	1.3622	0.0	114.4	O K
30 Summer	13.6	0.0	13.6	30.7602	1.4902	0.0	125.2	O K
60 Summer	13.9	0.0	13.9	30.8232	1.5532	0.0	130.5	O K
120 Summer	13.8	0.0	13.8	30.7987	1.5287	0.0	128.4	O K
180 Summer	13.6	0.0	13.6	30.7542	1.4842	0.0	124.7	O K
240 Summer	13.4	0.0	13.4	30.7002	1.4302	0.0	120.1	O K
360 Summer	12.8	0.0	12.8	30.5858	1.3157	0.0	110.5	O K
480 Summer	12.3	0.0	12.3	30.4783	1.2083	0.0	101.5	O K
600 Summer	11.8	0.0	11.8	30.3833	1.1133	0.0	93.5	O K
720 Summer	11.3	0.0	11.3	30.2993	1.0293	0.0	86.4	O K
960 Summer	10.4	0.0	10.4	30.1463	0.8763	0.0	73.6	O K
1440 Summer	9.0	0.0	9.0	29.9313	0.6613	0.0	55.5	O K
2160 Summer	7.5	0.0	7.5	29.7339	0.4632	0.0	38.9	O K
2880 Summer	6.4	0.0	6.4	29.6136	0.3437	0.0	28.8	O K
4320 Summer	4.9	0.0	4.9	29.4763	0.2062	0.0	17.3	O K
5760 Summer	4.0	0.0	4.0	29.4099	0.1398	0.0	11.7	O K
7200 Summer	3.4	0.0	3.4	29.3648	0.0948	0.0	8.0	O K
8640 Summer	2.9	0.0	2.9	29.3363	0.0663	0.0	7.2	O K
10080 Summer	2.6	0.0	2.6	29.3498	0.0797	0.0	6.7	O K
15 Winter	13.8	0.0	13.8	30.9022	1.5522	0.0	128.7	O K
30 Winter	14.5	0.0	14.5	30.9537	1.6037	0.0	141.4	FLOOD RISK
60 Winter	14.9	0.0	14.9	31.0392	1.7692	0.0	148.6	FLOOD RISK
120 Winter	14.7	0.0	14.7	31.0047	1.7347	0.0	145.7	FLOOD RISK
180 Winter	14.4	0.0	14.4	30.9407	1.6707	0.0	140.4	FLOOD RISK
240 Winter	14.1	0.0	14.1	30.8607	1.5907	0.0	133.6	O K
360 Winter	13.3	0.0	13.3	30.6832	1.4232	0.0	119.5	O K
480 Winter	12.6	0.0	12.6	30.5395	1.2693	0.0	106.6	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	211.48	18
30 Summer	121.66	32
60 Summer	69.99	60
120 Summer	40.27	92
180 Summer	29.14	126
240 Summer	23.17	160
360 Summer	16.77	228
480 Summer	13.33	296
600 Summer	11.15	362
720 Summer	9.64	426
960 Summer	7.59	550
1440 Summer	5.42	794
2160 Summer	3.86	1152
2880 Summer	3.04	1504
4320 Summer	2.13	2208
5760 Summer	1.65	2944
7200 Summer	1.36	3672
8640 Summer	1.16	4368
10080 Summer	1.01	5104
15 Winter	211.48	18
30 Winter	121.66	32
60 Winter	69.99	60
120 Winter	40.27	96
180 Winter	29.14	134
240 Winter	23.17	172
360 Winter	16.77	246
480 Winter	13.33	316

White Young Green
Brigantine House
27-31 Cumberland Street
Bristol BS2 8NL
Date sept 08
File throttle pipe.src
Micro Drainage

West Southall
East Access
Zone 2
Designed By RCB
Checked By
Source Control W.11.2

Micro Drainage

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 (m³)	Maximum Volume (m³)	Status
600 Winter	11.9	0.0	11.9	30.4049	1.1346	0.0	95.3	O K
720 Winter	11.2	0.0	11.2	30.2888	1.0186	0.0	85.6	O K
960 Winter	10.1	0.0	10.1	30.0903	0.8203	0.0	68.9	O K
1440 Winter	8.3	0.0	8.3	29.9298	0.5597	0.0	46.9	O K
2160 Winter	6.5	0.0	6.5	29.6178	0.3477	0.0	29.2	O K
2880 Winter	5.3	0.0	5.3	29.5079	0.2372	0.0	19.9	O K
4320 Winter	3.8	0.0	3.8	29.3983	0.1283	0.0	10.8	O K
5760 Winter	3.0	0.0	3.0	29.3578	0.0878	0.0	7.4	O K
7200 Winter	2.5	0.0	2.5	29.3483	0.0783	0.0	6.6	O K
8640 Winter	2.1	0.0	2.1	29.3398	0.0698	0.0	5.8	O K
10080 Winter	1.9	0.0	1.9	29.3333	0.0632	0.0	5.3	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
600 Winter	11.15	394
720 Winter	9.64	450
960 Winter	7.59	578
1440 Winter	5.42	822
2160 Winter	3.86	1198
2880 Winter	3.04	1528
4320 Winter	2.13	2248
5760 Winter	1.65	2872
7200 Winter	1.36	3624
8640 Winter	1.16	4406
10080 Winter	1.01	5088

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	100
Site Location	510550 179250 TQ 10550 79250
C (1km)	-0.026
D1 (1km)	0.302
D2 (1km)	0.287
D3 (1km)	0.240
E (1km)	0.310
F (1km)	2.560
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+50

Time / Area Diagram

Total Area (ha) = 0.310

Time (mins) from:	to:	Area (ha)
0	4	0.310

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

Date sept 08
File throttle pipe.src
Micro Drainage

West Southall
East Access
Zone 2
Designed By RCB
Checked By
Source Control W.11.2

Tank/Pond Details

Invert Level (m) 28.270 Ground Level (m) 31.100

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	84.0	0.50	84.0	1.00	84.0	1.50	84.0	2.00	84.0	2.50	84.0
0.10	84.0	0.60	84.0	1.10	84.0	1.60	84.0	2.10	84.0		
0.20	84.0	0.70	84.0	1.20	84.0	1.70	84.0	2.20	84.0		
0.30	84.0	0.80	84.0	1.30	84.0	1.80	84.0	2.30	84.0		
0.40	84.0	0.90	84.0	1.40	84.0	1.90	84.0	2.40	84.0		

Pipe Outflow Control

Pipe Diameter (m)	0.100	Roughness (mm)	0.600	Invert Level (m)	29.270
Slope (1:x)	272.0	Entry Loss Coef	0.500		
Length (m)	25.000	Coef of Contraction	0.600		

Weir / Flume Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Crest Level (m) 31.060

White Young Green Brigantine House 27-31 Cumberland Street Bristol BS2 8NL	West Southall East Access Zone 2	Page 1
Date sept 08 File throttle pipe.src	Designed By RCB Checked By	
Micro Drainage	Source Control W.11.2	

Summary of Results for 2 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
15 Summer	5.9	0.0	5.9	29.5243	0.2542	0.0	21.4	O K
30 Summer	5.9	0.0	5.9	29.5583	0.2882	0.0	24.0	O K
60 Summer	6.1	0.0	6.1	29.5773	0.3072	0.0	25.8	O K
120 Summer	6.1	0.0	6.1	29.5838	0.3137	0.0	26.3	O K
180 Summer	6.0	0.0	6.0	29.5743	0.3042	0.0	25.6	O K
240 Summer	5.9	0.0	5.9	29.5608	0.2907	0.0	24.4	O K
360 Summer	5.6	0.0	5.6	29.5318	0.2617	0.0	22.0	O K
480 Summer	5.3	0.0	5.3	29.5053	0.2352	0.0	19.8	O K
600 Summer	5.0	0.0	5.0	29.4833	0.2132	0.0	17.9	O K
720 Summer	4.8	0.0	4.8	29.4638	0.1937	0.0	16.3	O K
960 Summer	4.3	0.0	4.3	29.4313	0.1613	0.0	13.5	O K
1440 Summer	3.7	0.0	3.7	29.3883	0.1183	0.0	9.9	O K
2160 Summer	3.1	0.0	3.1	29.3598	0.0899	0.0	7.5	O K
2880 Summer	2.6	0.0	2.6	29.3498	0.0797	0.0	6.7	O K
4320 Summer	1.9	0.0	1.9	29.3343	0.0642	0.0	5.4	O K
5760 Summer	1.5	0.0	1.5	29.3263	0.0562	0.0	4.7	O K
7200 Summer	1.3	0.0	1.3	29.3223	0.0522	0.0	4.4	O K
8640 Summer	1.1	0.0	1.1	29.3193	0.0492	0.0	4.1	O K
10080 Summer	1.0	0.0	1.0	29.3168	0.0467	0.0	3.9	O K
15 Winter	5.9	0.0	5.9	29.5563	0.2862	0.0	24.0	O K
30 Winter	6.3	0.0	6.3	29.5943	0.3242	0.0	27.2	O K
60 Winter	6.4	0.0	6.4	29.6143	0.3442	0.0	28.9	O K
120 Winter	6.4	0.0	6.4	29.6128	0.3427	0.0	28.8	O K
180 Winter	6.2	0.0	6.2	29.5928	0.3227	0.0	27.1	O K
240 Winter	6.0	0.0	6.0	29.5693	0.2992	0.0	25.2	O K
360 Winter	5.5	0.0	5.5	29.5248	0.2547	0.0	21.4	O K
480 Winter	5.1	0.0	5.1	29.4878	0.2177	0.0	18.3	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	42.09	17
30 Summer	25.98	30
60 Summer	16.04	46
120 Summer	9.90	80
180 Summer	7.46	114
240 Summer	6.11	148
360 Summer	4.61	212
480 Summer	3.77	276
600 Summer	3.23	338
720 Summer	2.84	398
960 Summer	2.30	520
1440 Summer	1.71	754
2160 Summer	1.27	1100
2880 Summer	1.03	1468
4320 Summer	0.75	2200
5760 Summer	0.60	2936
7200 Summer	0.51	3624
8640 Summer	0.44	4368
10080 Summer	0.39	5136
15 Winter	42.09	17
30 Winter	25.98	30
60 Winter	16.04	48
120 Winter	9.90	86
180 Winter	7.46	122
240 Winter	6.11	158
360 Winter	4.61	224
480 Winter	3.77	288

White Young Green		Page 1
Brigantine House 27-31 Cumberland Street Bristol BS2 8NL	West Southall East Access Zone 2	Micro Drainage
Date sept 08 File throttle pipe.src Micro Drainage	Designed By RCB Checked By Source Control W.11.2	

Summary of Results for 30 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
15 Summer	9.1	0.0	9.1	29.9408	0.6728	0.0	56.4	O K
30 Summer	9.5	0.0	9.5	30.0083	0.7383	0.0	62.0	O K
60 Summer	9.7	0.0	9.7	30.0348	0.7648	0.0	64.2	O K
120 Summer	9.7	0.0	9.7	30.0298	0.7598	0.0	63.8	O K
180 Summer	9.5	0.0	9.5	30.0038	0.7338	0.0	61.6	O K
240 Summer	9.3	0.0	9.3	29.9713	0.7013	0.0	58.9	O K
360 Summer	8.9	0.0	8.9	29.9053	0.6353	0.0	53.3	O K
480 Summer	8.4	0.0	8.4	29.8458	0.5757	0.0	48.4	O K
600 Summer	8.0	0.0	8.0	29.7943	0.5242	0.0	44.0	O K
720 Summer	7.6	0.0	7.6	29.7492	0.4792	0.0	40.3	O K
960 Summer	7.0	0.0	7.0	29.6703	0.4002	0.0	33.6	O K
1440 Summer	5.9	0.0	5.9	29.5633	0.2932	0.0	24.6	O K
2160 Summer	4.8	0.0	4.8	29.4638	0.1937	0.0	16.8	O K
2880 Summer	4.1	0.0	4.1	29.4168	0.1468	0.0	12.3	O K
4320 Summer	3.3	0.0	3.3	29.3618	0.0918	0.0	7.7	O K
5760 Summer	2.5	0.0	2.5	29.3493	0.0792	0.0	6.7	O K
7200 Summer	2.1	0.0	2.1	29.3393	0.0692	0.0	5.8	O K
8640 Summer	1.8	0.0	1.8	29.3323	0.0622	0.0	5.2	O K
10080 Summer	1.6	0.0	1.6	29.3278	0.0577	0.0	4.8	O K
15 Winter	9.7	0.0	9.7	30.0258	0.7558	0.0	63.5	O K
30 Winter	10.2	0.0	10.2	30.1063	0.8363	0.0	70.3	O K
60 Winter	10.4	0.0	10.4	30.1418	0.8718	0.0	73.2	O K
120 Winter	10.3	0.0	10.3	30.1248	0.8548	0.0	71.8	O K
180 Winter	10.0	0.0	10.0	30.0818	0.8118	0.0	68.2	O K
240 Winter	9.7	0.0	9.7	30.0308	0.7608	0.0	63.9	O K
360 Winter	9.0	0.0	9.0	29.9323	0.6623	0.0	55.6	O K
480 Winter	8.4	0.0	8.4	29.8473	0.5772	0.0	48.5	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	106.81	17
30 Summer	62.81	31
60 Summer	36.93	52
120 Summer	21.72	86
180 Summer	15.92	120
240 Summer	12.77	154
360 Summer	9.36	222
480 Summer	7.51	286
600 Summer	6.33	350
720 Summer	5.51	412
960 Summer	4.37	538
1440 Summer	3.16	780
2160 Summer	2.28	1128
2880 Summer	1.82	1498
4320 Summer	1.29	2200
5760 Summer	1.01	2936
7200 Summer	0.83	3672
8640 Summer	0.71	4400
10080 Summer	0.63	5136
15 Winter	106.81	17
30 Winter	62.81	31
60 Winter	36.93	58
120 Winter	21.72	92
180 Winter	15.92	130
240 Winter	12.77	166
360 Winter	9.36	236
480 Winter	7.51	304

White Young Greer		Page 1
Brigantine House	West Southall	
27-31 Cumberland Street	East Access	
Bristol BS2 8NL	Zone 4- new imp area	
Date sept 08	Designed By rcb	
File south of railway.src	Checked By	
Micro Drainage	Source Control W.11.2	

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 (m³)	Maximum Volume (m³)	Status
15 Summer	0.8	0.0	0.8	0.4092	0.4092	0.0	20.5	O K
30 Summer	0.9	0.0	0.9	0.4627	0.4627	0.0	23.1	O K
60 Summer	0.9	0.0	0.9	0.5142	0.5142	0.0	25.7	O K
120 Summer	1.0	0.0	1.0	0.5532	0.5532	0.0	27.7	O K
180 Summer	1.0	0.0	1.0	0.5627	0.5627	0.0	28.1	O K
240 Summer	1.0	0.0	1.0	0.5612	0.5612	0.0	28.1	O K
360 Summer	1.0	0.0	1.0	0.5552	0.5552	0.0	27.8	O K
480 Summer	1.0	0.0	1.0	0.5467	0.5467	0.0	27.3	O K
600 Summer	0.9	0.0	0.9	0.5352	0.5352	0.0	26.8	O K
720 Summer	0.9	0.0	0.9	0.5232	0.5232	0.0	26.2	O K
960 Summer	0.9	0.0	0.9	0.4907	0.4907	0.0	24.5	O K
1440 Summer	0.8	0.0	0.8	0.4332	0.4332	0.0	21.7	O K
2160 Summer	0.8	0.0	0.8	0.3637	0.3637	0.0	18.2	O K
2880 Summer	0.7	0.0	0.7	0.3107	0.3107	0.0	15.5	O K
4320 Summer	0.6	0.0	0.6	0.2302	0.2302	0.0	11.5	O K
5760 Summer	0.5	0.0	0.5	0.1782	0.1782	0.0	8.9	O K
7200 Summer	0.5	0.0	0.5	0.1428	0.1428	0.0	7.1	O K
8640 Summer	0.4	0.0	0.4	0.1173	0.1173	0.0	5.9	O K
10080 Summer	0.4	0.0	0.4	0.0993	0.0993	0.0	5.0	O K
15 Winter	0.9	0.0	0.9	0.4592	0.4592	0.0	23.0	O K
30 Winter	0.9	0.0	0.9	0.5197	0.5197	0.0	26.0	O K
60 Winter	1.0	0.0	1.0	0.5787	0.5787	0.0	28.9	O K
120 Winter	1.0	0.0	1.0	0.6263	0.6263	0.0	31.3	O K
180 Winter	1.0	0.0	1.0	0.6408	0.6408	0.0	32.0	O K
240 Winter	1.0	0.0	1.0	0.6413	0.6413	0.0	32.1	O K
360 Winter	1.0	0.0	1.0	0.6298	0.6298	0.0	31.5	O K
480 Winter	1.0	0.0	1.0	0.6168	0.6169	0.0	30.8	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	211.48	19
30 Summer	121.66	33
60 Summer	69.99	62
120 Summer	40.27	122
180 Summer	29.14	180
240 Summer	23.17	214
360 Summer	16.77	274
480 Summer	13.33	340
600 Summer	11.15	408
720 Summer	9.64	479
960 Summer	7.59	616
1440 Summer	5.42	882
2160 Summer	3.86	1276
2880 Summer	3.04	1844
4320 Summer	2.13	2980
5760 Summer	1.65	3112
7200 Summer	1.36	3824
8640 Summer	1.16	4504
10080 Summer	1.01	5248
15 Winter	211.48	18
30 Winter	121.66	32
60 Winter	69.99	62
120 Winter	40.27	118
180 Winter	29.14	176
240 Winter	23.17	228
360 Winter	16.77	286
480 Winter	13.33	364

White Young Green
Brigantine House
27-31 Cumberland Street
Bristol BS2 8NL
Date sept 08
File south of railway.src
Micro Drainage

West Southall
East Access
Zone 4- new imp area
Designed By rcb
Checked By
Source Control W.11.2

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 (m³)	Maximum Volume (m³)	Status
600 Winter	1.0	0.0	1.0	0.6003	0.6003	0.0	30.0	O K
720 Winter	1.0	0.0	1.0	0.5819	0.5819	0.0	29.1	O K
960 Winter	0.9	0.0	0.9	0.5362	0.5362	0.0	26.8	O K
1440 Winter	0.9	0.0	0.9	0.4547	0.4547	0.0	22.7	O K
2160 Winter	0.8	0.0	0.8	0.3602	0.3602	0.0	18.0	O K
2880 Winter	0.7	0.0	0.7	0.2917	0.2917	0.0	14.6	O K
4320 Winter	0.6	0.0	0.6	0.1952	0.1952	0.0	9.8	O K
5760 Winter	0.5	0.0	0.5	0.1398	0.1398	0.0	7.0	O K
7200 Winter	0.4	0.0	0.4	0.1053	0.1053	0.0	5.3	O K
8640 Winter	0.3	0.0	0.3	0.0833	0.0833	0.0	4.2	O K
10080 Winter	0.3	0.0	0.3	0.0678	0.0678	0.0	3.4	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
600 Winter	11.15	440
720 Winter	9.64	514
960 Winter	7.59	664
1440 Winter	5.42	940
2160 Winter	3.86	1344
2880 Winter	3.04	1728
4320 Winter	2.13	2464
5760 Winter	1.65	3176
7200 Winter	1.36	3888
8640 Winter	1.16	4584
10080 Winter	1.01	5248

White Young Green		
Brigantine House	West Southall	
27-31 Cumberland Street	East Access	
Bristol BS2 8NL	Zone 4- new imp area	
Date sept 08	Designed By rcb	
File south of railway.src	Checked By	
Micro Drainage	Source Control W.11.2	

Rainfall Details

Region	FSR Rainfall Model
Return Period (years)	100
Site Location	310550 179250 TQ 10550 79250
C (1km)	-0.026
D1 (1km)	0.322
D2 (1km)	0.287
D3 (1km)	0.249
E (1km)	0.319
F (1km)	2.560
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+30

Time / Area Diagram

Total Area (ha) = 0.053

Time (mins) from:	to:	Area (ha)
0	4	0.053

White Young Green		Page 4
Brigantine House	West Southall	
27-31 Cumberland Street	East Access	
Bristol BS2 8NL	Zone 4- new imp area	
Date sept 08	Designed By rcb	
File south of railway.src	Checked By	
Micro Drainage	Source Control W.11.2	

Tank/Pond Details

Invert Level (m) 0.000 Ground Level (m) 2.000

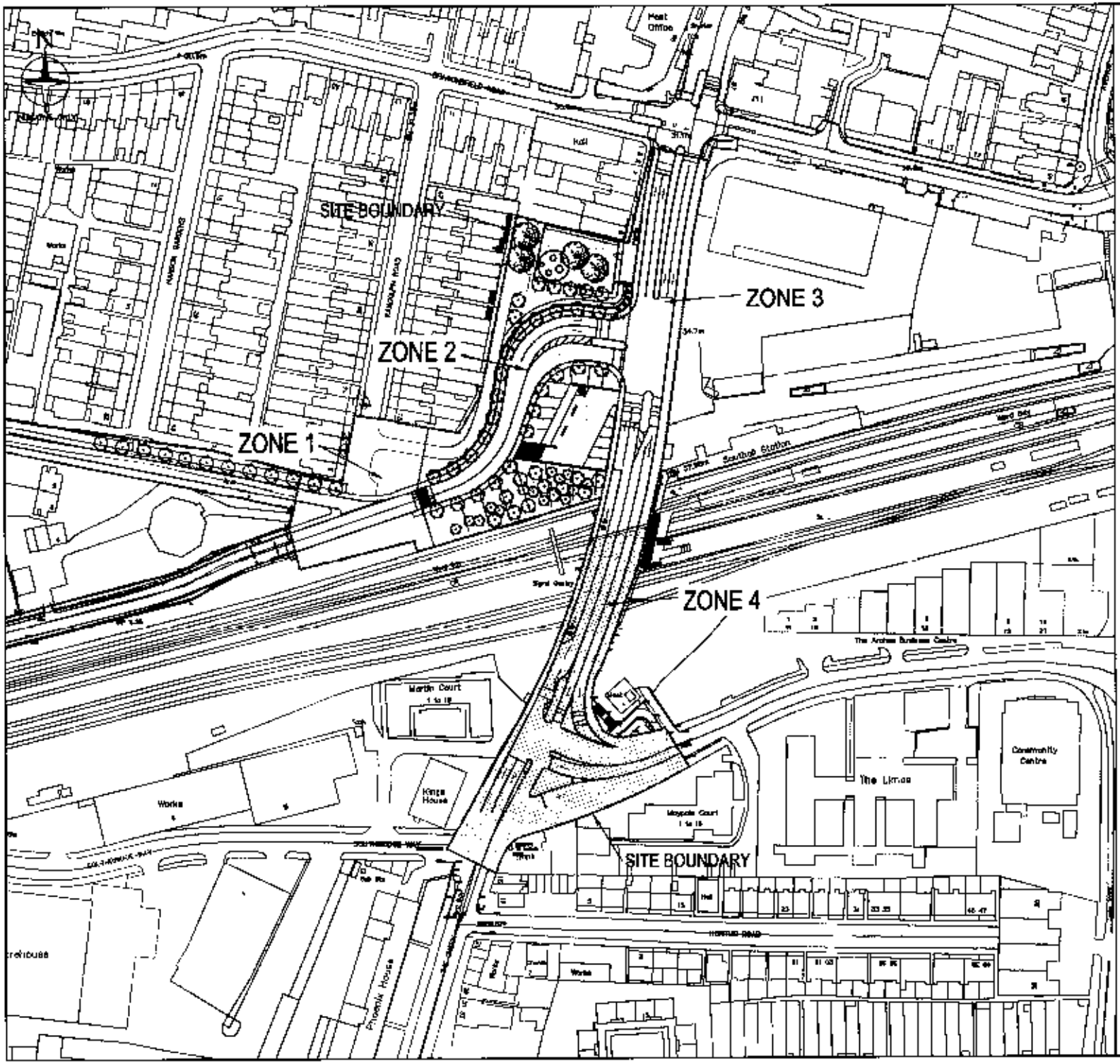
Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	50.0	0.50	50.0	1.00	50.0	1.50	50.0	2.00	50.0	2.50	50.0
0.10	50.0	0.60	50.0	1.10	50.0	1.60	50.0	2.10	50.0		
0.20	50.0	0.70	50.0	1.20	50.0	1.70	50.0	2.20	50.0		
0.30	50.0	0.80	50.0	1.30	50.0	1.80	50.0	2.30	50.0		
0.40	50.0	0.90	50.0	1.40	50.0	1.90	50.0	2.40	50.0		

Orifice Outflow Control

Diameter (m) 0.025 Invert Level (m) 0.000
Discharge Coefficient 0.600

Weir / Flume Overflow Control

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



REV	DESCRIPTION	BY	CHK	APP	DATE

Client

BRIGANTINE HOUSE
27-31 CUMBERLAND STREET
BRISTOL
BS2 8NL

TEL: +44 (0)117 924 4144
FAX: +44 (0)117 924 4145
e-mail: bristol@wyg.com

Project

WEST SOUTHALL
YEADING BROOK
FLOOD RISK ASSESSMENT

Drawing Title

EASTERN ACCESS
DRAINAGE SCHEMATIC
SHEET 1 OF 3

Scale @A4	Drawn	Date	Checked	Date	Approved	Date
1:500	B.C.E.	17/09/08	R.C.B.	17/09/08	R.C.B.	17/09/08

Project No	Office	Type	Drawing No.	Revision
A012564	28	C	APPENDIX FRA-E-E	-

SHEET SIZE A4 PORTRAIT