

Muse Developments Ltd, South
Tyneside Council and Nexus
South Shields Interchange
Drainage and flood risk assessment

FRA/239812

Issue 4 | 30 June 2015

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 239812-00

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| | | Name | Chris Heath | Simon Barugh | Jonathan Portlock |
| | | Signature | | | |
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Calculations

1 Introduction

South Tyneside Council, Nexus and Muse Developments Ltd propose to construct a new transport interchange at South Shields, located to the south of the existing Metro Station.

This report will assess the risk to the proposed development from flooding, and how the management of surface water at the proposed development will impact on others.

2 Existing site

The site currently comprises minor public highways, car parking, a Royal Mail delivery office, railway embankments and an unsurfaced area where buildings have been demolished.

The site is relatively flat, with existing levels in the order of 9m at the southern boundary, and 6.5m at the northern boundary.

Impermeable areas within the site are positively drained, with gullies provided to external hard standings and public highways. It is assumed that these areas discharge to the public combined sewerage system that crosses the site.

Topographical survey plans are included in Appendix A.

3 Proposed Development

The development consists of a transport interchange, associated external bus stands and circulation, a new platform, as well as separate retail/office building and public realm works to the area of the existing Metro station.

The proposed site layout is included in Appendix B.

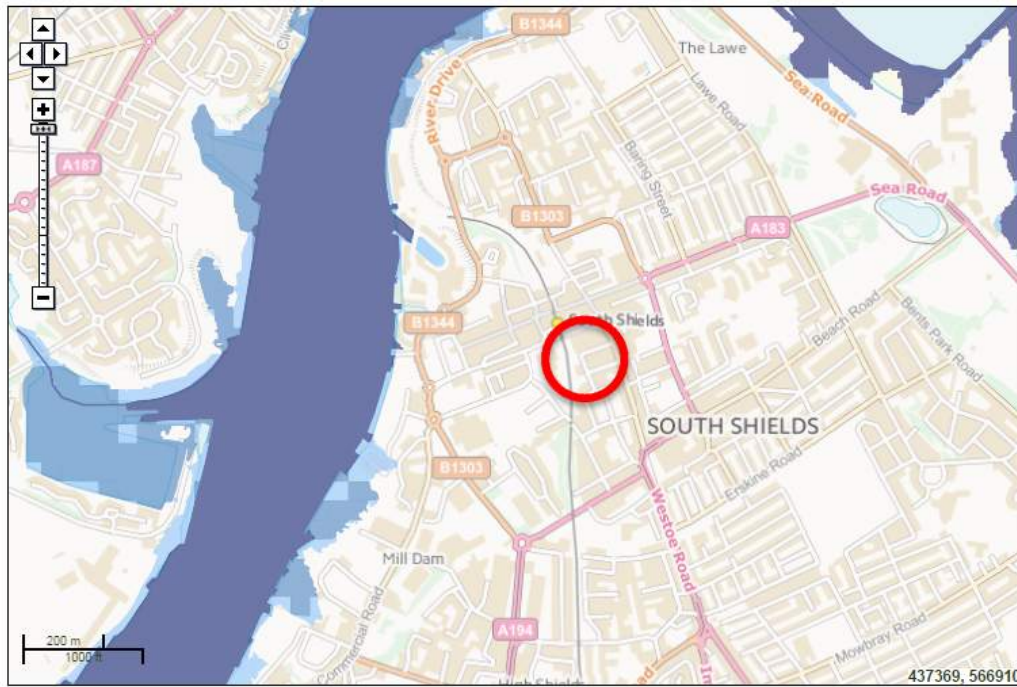
4 Potential Sources of flooding and mitigation measures

The risk of flooding to the development has been assessed on readily available information only. No hydraulic modelling has been undertaken on the existing public or private drainage systems.

Assessments of existing storm water flows has been made using estimated existing impermeable areas and flat rainfall rates. Surface water storage volumes have been assessed using MicroDrainage Quick Storage Estimate.

4.1 Flooding from watercourses and the sea

The Environment Agency (EA) has produced flood maps, readily available on their website, that indicate the risk of flooding from rivers and the sea. The flood map for the development site is shown in Figure 1 below.



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Site Location

Figure 1 – Risk of flooding from rivers and sea

Flood maps for the development site confirm that the proposed development is not at risk of flooding from rivers, or from the sea.

The development is not at risk of flooding from rivers or the sea.

4.2 Flooding from surface water and overland flow.

The EA has produced maps, readily available on their website, that indicate the potential risk of flooding from surface water. The surface water flood map for the development is shown in Figure 2 below.



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Figure 2 – Risk of flooding from surface water

The maps indicate that areas of the development site are currently at risk of flooding from surface water. This may be due to a number of reasons, such as poorly maintained or inadequate provision of drainage, local low lying topography and low spots, or overland flow from the surrounding area.

The design of the new surface water drainage system should be in accordance with current design standards, including the Building Regulations 2000 Approved Document H, and BS EN 752:2008. Consideration will be given to flows entering the site from adjacent land.

Site levels should be carefully considered to ensure that any surface flooding is directed away from building thresholds, and other vulnerable building openings and infrastructure.

Subject to the above mitigation measures, the development should not be at risk of flooding from surface water and overland flow.

4.3 Flooding from groundwater

Ground investigation works are yet to be undertaken, however high groundwater levels may be encountered on the site.

Appropriate waterproofing should be provided to areas of the building that may be susceptible to ingress of groundwater, including any proposed pipe work and storage tanks.

Subject to the above mitigation measures, the development is not at risk of flooding from groundwater.

4.4 Flooding from existing and proposed drainage systems

There are a number of existing drainage systems within and adjacent to the development site, most notably public combined sewers that cross the site and will be affected by the proposed works. Existing drainage may be in poor condition, may have insufficient capacity, and therefore may not provide the same standard of protection against flooding as drainage designed to current standards.

Information relating to any previous flooding from the existing drainage system is not readily available.

Public combined sewers within the site vary in diameter from 225mm to 600mm. It is likely that they will need to be diverted to facilitate new buildings, and early consultation with Northumbrian Water (NW) is recommended.

A copy of NW's sewer records is included in Appendix C.

There is the potential for flooding from existing and proposed drainage systems to occur when the design standard of the drainage systems is exceeded, or when maintenance issues occur within the drainage systems that prevent them from operating as designed.

To mitigate these risks, the measures for managing surface flooding outlined in Section 4.2 above should be adopted. In addition, connection points into external drainage systems should be carefully considered to ensure that internal floor levels are not lower than external levels, whereby surcharging of the drainage system may result in internal flooding.

Subject to the above mitigation measures, the development is not at risk of flooding from the proposed and existing drainage systems up to the design standard of those systems.

There are large diameter sewers present on the site, and it is likely that these will need to be diverted.

5 Surface water Management

5.1 Existing site drainage

The existing site is largely hard paved, with some permeable areas where previous buildings have recently been demolished, and a permeable railway embankment where a new platform is proposed.

Drawing C.960.SK.001, contained within Appendix D, shows the existing site, and indicates the extent of existing permeable areas. The total site boundary is approximately 10,900m². Of this area, 645m² comprises the impermeable/drained area of the existing Metro station.

For the proposed interchange site, within a 10,255m² boundary, 1,300m² is permeable, 865m² is track that will be unaffected by the proposals, and 8,090m² impermeable.

The topographical survey indicate that the existing site is well served by gullies within the public highway, and additional gullies within the private hardstanding areas. It is assumed that these gullies connect to the public combined sewerage system that crosses the site.

Using a flat rate of 50mm/hour rainfall across impermeable areas, 112 l/s discharges from the site interchange to the public sewer.

5.2 Proposed site drainage

Sustainable drainage systems (SuDS) aim to mimic the natural environment, with storm water treated as close to source as possible, and natural surface water corridors maintained. Features such as swales, ponds and permeable surfaces are often incorporated.

The nature and layout of the development, on a constrained urban site with many surfaces hard paved to allow the normal operation of the site, does not lend itself to these features. As such, any surface water management is likely to be in the form of underground storage.

As it is unlikely that the provision of sufficient SuDS features to treat storm water will be practical, an oil separator, selected in accordance with EA pollution prevention guidance note 3, should be provided. Roof water should, where possible, not pass through the separator.

In accordance with the hierarchy set out in the Approved Document H, surface water should be disposed of to one of the following, in order of preference:

- An adequate soakaway or some other adequate infiltration system; or, where not reasonably practicable,
- A watercourse; or, where not reasonably practicable,
- A sewer.

Infiltration testing should be undertaken as part of any ground investigation works. However the nature of the site and the proximity of existing and proposed buildings may preclude the use of infiltration systems.

The nearest watercourse, the River Tyne, is approximately 500m to the west of the development site. A route to the Tyne for a new surface water outfall is unlikely to be practical or economical.

An outfall to the existing public sewerage system is therefore the likely preferred option. There are a number of combined public sewers surrounding the site in Keppel Street and Fowler Street that may provide a suitable outfall for the disposal of both foul and surface water.

As part of these proposals, the existing Metro station will be demolished and the area turned over to public realm. There will be no increase in impermeable area, and the current drainage arrangements regarding connections to the public sewerage system are expected to be maintained.

The proposals result in an increase of impermeable area at the interchange to 8,225m². Drawing C.960.SK.001, contained within Appendix D, shows the site, and indicates the extent of proposed permeable areas. Using a flat rate of 50mm/hour rainfall across impermeable areas, 8,225m² results in 114 l/s discharging from the site.

A pre-development enquiry was submitted to NW in March 2015, detailing the pre and post development impermeable areas and resulting surface water flows. Responding to the pre-development enquiry, NW confirmed that, subject to it being demonstrated that other means of the disposal of surface water are not available, surface water may discharge to the public combined sewer at a restricted rate of 70 l/s without adversely impacting on the sewer. A copy of NW's response to the pre-development enquiry and is included in Appendix C.

As NW's permitted discharge rate exceeds the unrestricted run-off from the proposed site, some surface water storage will be required.

MicroDrainage Quick Storage Estimate has been used to calculate storage volumes. To restrict the proposed development to 70 l/s, up to approximately 240m³ will be required. In accordance with current planning guidance, an allowance for potential climate change of 30% has been allowed for in the above volumes.

MicroDrainage calculations have been included in Appendix D.

The arrangement of the drainage system is subject to detailed design. It may be beneficial for some areas of the development (the proposed retail units, for example) to be allowed to discharge to the public sewer unrestricted. Under these conditions, the total discharge to the public sewer should not exceed 70 l/s, and additional storage may be required to compensate for the increased discharge from unrestricted areas of the development.

The proposed drainage system should be designed in accordance with BS EN 752, and should ensure that no flooding occurs during the critical 1 in 30 year storm. Flood routing during the 1 in 100 year storm should be assessed to ensure that it does not affect buildings on site, and is not allowed to run off the site onto adjacent land.

Subject to the above, the development is not at risk of flooding from the proposed drainage system for up to and including the 1 in 100 year storm. In addition, NW have confirmed that public sewerage system has capacity for surface water to discharge to it at a restricted rate of 70 l/s. Appropriate

allowances will be made for potential climate change, and surface water storage will be required.

6 Conclusions

In accordance with the current design proposals, the development is not at risk of flooding from rivers, the sea, groundwater, surface water, existing and proposed drainage systems.

There are large diameter public sewers within the site, and it is likely that these sewers will need to be diverted. Early consultation with NW is recommended.

The proposals result in a minor increase to impermeable area on the site, and as such some management of surface water will be required. NW have confirmed that, subject to it being demonstrated that alternative means of disposal are unavailable, surface water may discharge to the public sewer at a restricted rate of 70 l/s. Up to 240m³ of surface water storage may be required.

Appendix A

Topographical Survey



Note:
Some services may have been omitted due to parked vehicles.
The Ordnance Survey file is to be used as a guide only.

OS Buildings Surveyed Buildings

This survey has been orientated to the Ordnance Survey (OS) National Grid (OSGB36) via Global Navigational Satellite Systems (GNSS) and the O.S. Active Network (OS Net).

A true OSGB36 coordinate has been established near to the site centre via a transformation using the OSTN02 & OSGM02 transformation models.
The survey has been correlated to this point and a further one or more OSGB36 points established to create a true O.S. bearing for angle orientation.

No scale factor has been applied to the survey therefore the coordinates shown are arbitrary & not true O.S. Coordinates which have a scale factor applied.

Please refer to Survey Station Table to enable establishment of the on-site grid.

Legend:

| | | | | | | |
|--|----------|--|-----|-----------------------|--|------------------------|
| | Boundary | | IC | Inspection chamber | | Ball |
| | Pipe | | PA | Pipe access | | Buried level indicator |
| | Cable | | CT | Cable tray | | Bus |
| | Bg | | Bg | Back-gully | | Vp |
| | Dp | | Dp | Down pipe | | Ovp |
| | PA | | PA | Pipe above ground | | Lbx |
| | MH | | MH | Manhole | | Lbx |
| | SL | | SL | Station level | | Lbx |
| | TL | | TL | Threshold level | | Lbx |
| | U | | U | Area of Undergrowth | | Lbx |
| | W | | W | Woodland | | Lbx |
| | R | | R | Ridge Level | | Lbx |
| | E | | E | Electric | | Lbx |
| | BW | | BW | Brick Wall | | Lbx |
| | CW | | CW | Concrete Wall | | Lbx |
| | G | | G | Gas | | Lbx |
| | ER | | ER | Earth-rod | | Lbx |
| | WM | | WM | Water meter | | Lbx |
| | GV | | GV | Gas valve | | Lbx |
| | AV | | AV | Air valve | | Lbx |
| | ICU | | ICU | Underfloor inspection | | Lbx |
| | R | | R | Road | | Lbx |
| | RW | | RW | Roadside wall | | Lbx |
| | PW | | PW | Post & Wire | | Lbx |
| | CL | | CL | Chain Link | | Lbx |
| | WP | | WP | Wooden Panels | | Lbx |
| | MP | | MP | Metal post | | Lbx |
| | GM | | GM | Gas marker post | | Lbx |
| | S | | S | Soil | | Lbx |
| | TWL | | TWL | Top of Wall level | | Lbx |

| Rev | Date | Description | Drawn | O. Ref. |
|-----|------|-------------|-------|---------|
|-----|------|-------------|-------|---------|



- Topographical Surveys
- Site Engineering
- Utility / CCTV Surveys
- Measured Building Surveys
- 3D Laser Scanning
- Revit & BIM Models

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| | | |
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|------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|

CLIENT
The Harris Partnership

PROJECT
South Shields Town Centre Tyne & Wear

TITLE
Topographical Survey

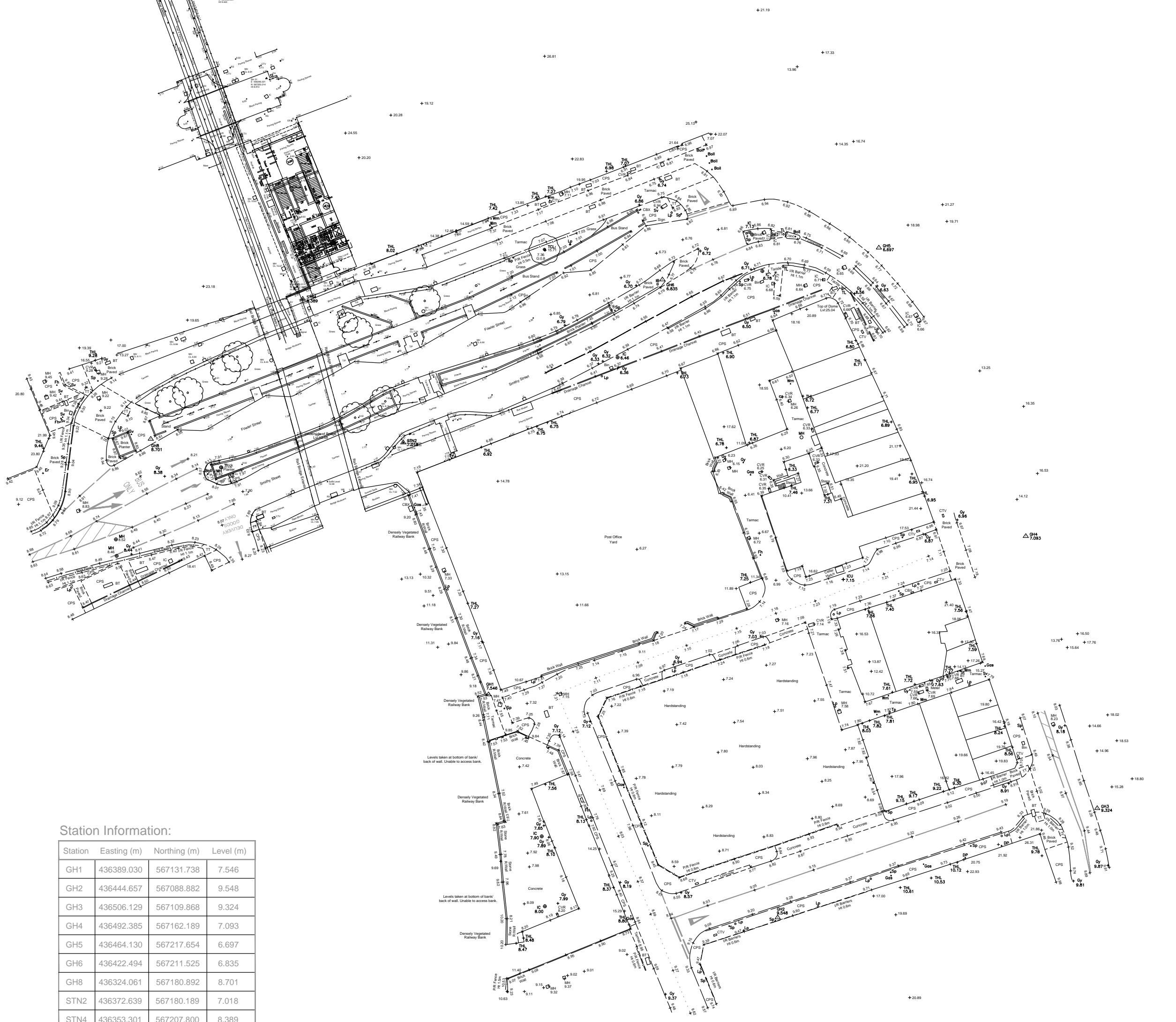
| | |
|---------------------------|-----------------------------|
| SCALE A2@ 1:500 | DATE 02/09/2014 |
| DRAWN JT/JC | QUALITY REF C1122 |

| | |
|------------------|-----------|
| Level datum | See notes |
| Grid orientation | See notes |
| Job number | 20753 |

| | | | |
|-------------|-----------|------|---|
| Drawing No. | 20753_OGL | Rev. | 0 |
|-------------|-----------|------|---|

Comments
This plan should only be used for its original purpose. Greenhatch Group accepts no responsibility for this plan if supplied to any party other than the original client.
All dimensions should be checked on site prior to design and construction.
Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only.

Notes:



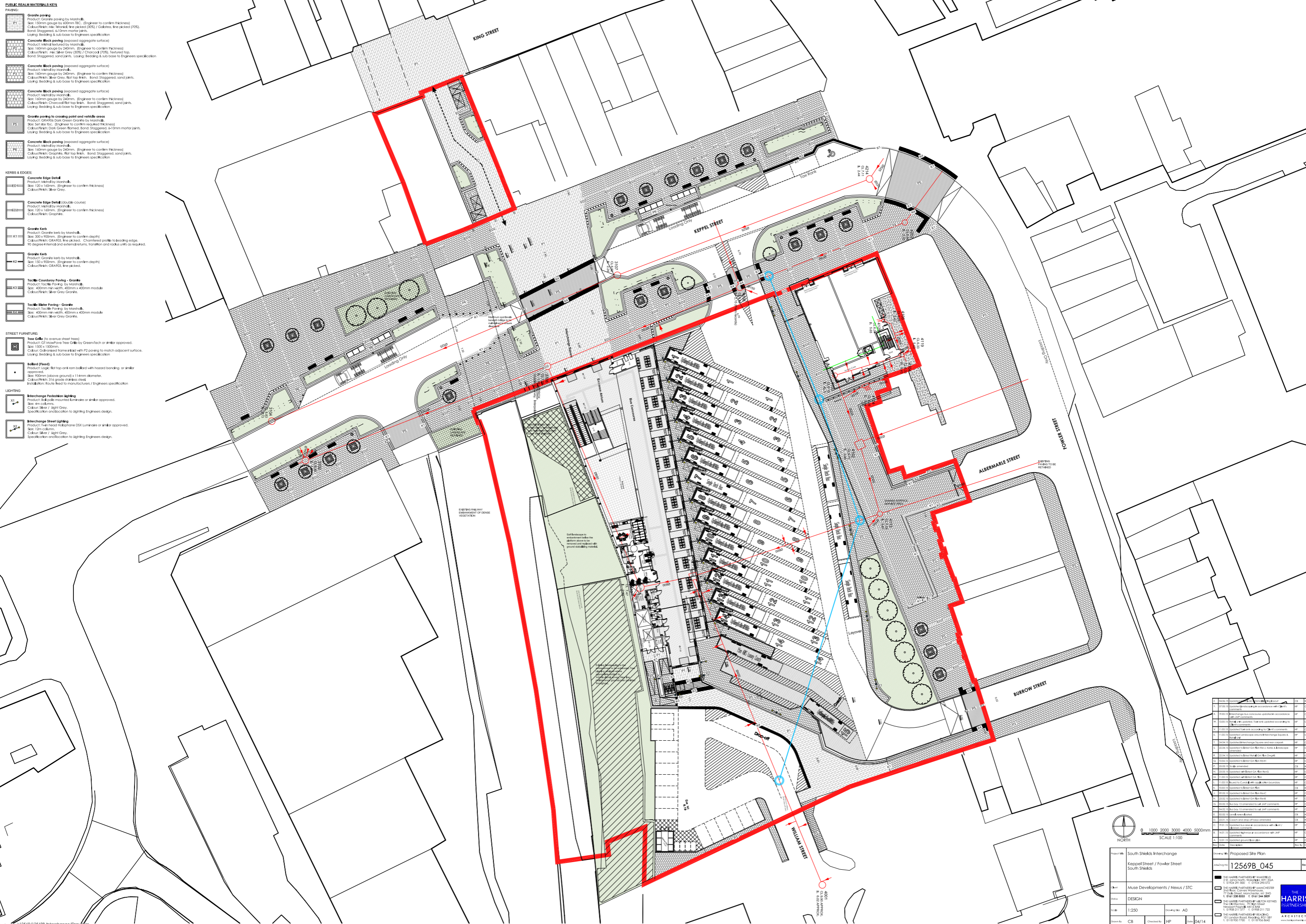
Station Information:

| Station | Easting (m) | Northing (m) | Level (m) |
|---------|-------------|--------------|-----------|
| GH1 | 436389.030 | 567131.738 | 7.546 |
| GH2 | 436444.657 | 567088.882 | 9.548 |
| GH3 | 436506.129 | 567109.868 | 9.324 |
| GH4 | 436492.385 | 567162.189 | 7.093 |
| GH5 | 436464.130 | 567217.654 | 6.697 |
| GH6 | 436422.494 | 567211.525 | 6.835 |
| GH8 | 436324.061 | 567180.892 | 8.701 |
| STN2 | 436372.639 | 567180.189 | 7.018 |
| STN4 | 436353.301 | 567207.800 | 8.389 |

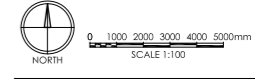
Appendix B

Proposed Site Plan

- PUBLIC REALM MATERIALS KEY**
- PAVING:**
- Granite paving**
Product: Granite paving by Marshall.
See: 150mm gauge by 400mm TBC. (Engineer to confirm thickness)
Colour/Finish: See Marshall line pack (D52) / Gabbres, line packed (D52).
Bond: Staggered, 10mm mortar joints.
Laying: Bedding & sub-base to Engineers specification.
 - Concrete Block paving (exposed aggregate surface)**
Product: Metral by Marshall.
See: 100mm gauge by 240mm. (Engineer to confirm thickness)
Colour/Finish: See Silver Grey (D52) / Charcoal (D52). Textured top.
Bond: Staggered, sand joints. Laying: Bedding & sub-base to Engineers specification.
 - Concrete Block paving (finished aggregate surface)**
Product: Metral by Marshall.
See: 100mm gauge by 240mm. (Engineer to confirm thickness)
Colour/Finish: See Grey, Red top Iron. Bond: Staggered, sand joints.
Laying: Bedding & sub-base to Engineers specification.
 - Concrete Block paving (exposed aggregate surface)**
Product: Metral by Marshall.
See: 100mm gauge by 240mm. (Engineer to confirm thickness)
Colour/Finish: Charcoal Red top Iron. Bond: Staggered, sand joints.
Laying: Bedding & sub-base to Engineers specification.
 - Granite paving to creating point and vehicle areas**
Product: GRAPES Dark Green Granite by Marshall.
See: Set in 1:2 concrete. (Engineer to confirm required thickness)
Colour/Finish: Dark Green Bonded. Bond: Staggered, 10mm mortar joints.
Laying: Bedding & sub-base to Engineers specification.
 - Concrete Block paving (exposed aggregate surface)**
Product: Metral by Marshall.
See: 100mm gauge by 240mm. (Engineer to confirm thickness)
Colour/Finish: Graphite Red top Iron. Bond: Staggered, sand joints.
Laying: Bedding & sub-base to Engineers specification.
- KERBS & EDGES:**
- Concrete Edge Detail**
Product: Metral by Marshall.
See: 120 x 100mm. (Engineer to confirm thickness)
Colour/Finish: Silver Grey.
 - Concrete Edge Detail (double course)**
Product: Metral by Marshall.
See: 120 x 100mm. (Engineer to confirm thickness)
Colour/Finish: Graphite.
 - Granite Kerb**
Product: Granite kerb by Marshall.
See: 300 x 100mm. (Engineer to confirm depth)
Colour/Finish: GRAPES. Chromed profile to leading edge.
90 degree internal and external corners, transition and radius with chamfered.
 - Granite Kerb**
Product: Granite kerb by Marshall.
See: 150 x 100mm. (Engineer to confirm depth)
Colour/Finish: Gabbres, line packed.
 - Tactile Courtyard Paving - Granite**
Product: Tactile Paving by Marshall.
See: 400mm min width, 400mm x 400mm module.
Colour/Finish: Silver Grey Granite.
 - Tactile Water Paving - Granite**
Product: Tactile Paving by Marshall.
See: 400mm min width, 400mm x 400mm module.
Colour/Finish: Silver Grey Granite.
- STREET FURNITURE:**
- Tree Cuffs (to avenue street trees)**
Product: G1 MacaPave Tree Cuff by GreenTech or similar approved.
See: 150 x 100mm.
Colour: Galvalume frame infill with P2 paving to match adjacent surface.
Laying: Bedding & sub-base to Engineers specification.
 - Bollard (Fixed)**
Product: See top ank can bollard with hazard banding or similar approved.
See: 100mm (above ground) x 114mm diameter.
Colour/Finish: 316 grade stainless steel.
Installation: Route lead to manufacturer / Engineers specification.
- LIGHTING:**
- Interchange Pedestrian Lighting**
Product: See table mounted luminaire or similar approved.
See: 4m columns.
Colour: Silver / Light Grey.
Specification and location to lighting Engineers design.
 - Interchange Street Lighting**
Product: See table mounted luminaire or similar approved.
See: 12m columns.
Colour: Silver / Light Grey.
Specification and location to lighting Engineers design.



| Code | Description | Material | Quantity | Unit | Notes |
|------|-----------------------|---------------------|----------|----------------|-------|
| 1.01 | Concrete paving | Concrete | 150 | m ² | |
| 1.02 | Concrete block paving | Concrete | 200 | m ² | |
| 1.03 | Granite paving | Granite | 100 | m ² | |
| 1.04 | Granite kerb | Granite | 50 | m | |
| 1.05 | Concrete edge detail | Concrete | 200 | m | |
| 1.06 | Tactile paving | Granite | 50 | m ² | |
| 1.07 | Tree cuffs | Galvalume | 10 | units | |
| 1.08 | Bollards | 316 stainless steel | 5 | units | |
| 1.09 | Lighting columns | Steel | 10 | units | |
| 1.10 | Lighting luminaires | Various | 20 | units | |
| 1.11 | Concrete | Concrete | 500 | m ³ | |
| 1.12 | Granite | Granite | 100 | m ³ | |
| 1.13 | Concrete | Concrete | 200 | m ³ | |
| 1.14 | Concrete | Concrete | 100 | m ³ | |
| 1.15 | Concrete | Concrete | 50 | m ³ | |
| 1.16 | Concrete | Concrete | 20 | m ³ | |
| 1.17 | Concrete | Concrete | 10 | m ³ | |
| 1.18 | Concrete | Concrete | 5 | m ³ | |
| 1.19 | Concrete | Concrete | 2 | m ³ | |
| 1.20 | Concrete | Concrete | 1 | m ³ | |



Project: South Shields Interchange
 Keppel Street / Fowler Street
 South Shields

Client: Muse Developments / Nexus / STC

Phase: DESIGN

Scale: 1:250

Drawn by: CB

Checked by: HP

Date: 04/14

Proposed Site Plan
 Drawing No: 12569B_045
 Rev: Z

THE HARRIS PARTNERSHIP
 10, GUYANA DRIVE, SOUTH SHIELDS, NORTH TYNNE
 TEL: 0191 261 8888
 WWW.HARRISPARTNERSHIP.CO.UK

Appendix C

Northumbrian Water Pre- Development Enquiry Response

Ext: 36603
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Email: niki.mather@nwl.co.uk
Our Ref: 15NO35B30A
Your Ref:

Leat House, Pattinson Road, District 15,
Washington, Tyne & Wear, NE38 8LB, UK
Telephone: +44 (0) 845 604 7468
Fax: +44 (0) 191 419 6768
Website: www.nwl.co.uk

Tuesday, 24 March 2015

ARUP
Central Square
Forth Street
Newcastle upon Tyne
NE1 3PL

Dear Mr. Chris Heath,

Re: Pre-Development Enquiry – Keppel Street, South Shields

Further to receiving the Pre-Development Enquiry for the above proposed development on 11th March 2015, we are now able to provide the following response.

We have based our response on the information in your application and accompanying correspondence. Therefore, should any of the information now be different, then you must ensure that you inform us of any changes as further Network Modelling may be required and our response may also change, leading to this response being invalid.

Northumbrian Water assesses the impact of the proposed development on our assets and assess the capacity within our network's to accommodate and treat the anticipated flows arising from the development. We do not offer comment on aspects of planning applications that are outside of our area of control.

Enclosed for your information is a scaled extract showing the approximate position of our water and wastewater networks and associated asset's. Please note that the actual position of any water main's or sewer's shown on the plan must be established by taking trial holes in all cases.

An appropriate method statement and risk assessment must be provided to us prior to gaining approval for any trial hole investigation's, at least 5 working days in advance of starting any work onsite.

Also enclosed is our extract showing locations within the approximate vicinity of this site that have, from our records, experienced flooding. This has been provided to demonstrate the known flood risks within the vicinity which have been considered as part of our assessment on this enquiry.

We have also carried out a review of your application and can confirm the following:

Sewerage and Sewage Treatment

Northumbrian Water would ask that you please separate the foul and surface water flows in accordance with Part H of the Building Regulations prior to the final connection to the public sewer.

- Foul Water Discharge

The foul flows are be permitted to discharge without restriction to the combined sewerage system (or sewer diversion) within the site boundary, at one or more convenient location's in terms of layout. Where possible any existing connection's should be utilised for the proposed development.

- Surface Water Discharge

No surface water flow from the proposed development will be allowed to connect into the existing public sewerage system unless it is proven that the alternative options which are listed within Part H of the Building Regulations 2010 are not available:

Rainwater from a system provided pursuant to sub-paragraphs (1) or (2) shall discharge to one of the following, listed in order of priority –

(a) an adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable,

(b) a watercourse; or, where that is not reasonably practicable,

(c) a sewer.

In this instance, we would recommend that a restricted surface water flow of 70 l/sec would be permitted to discharge to the combined sewerage system (or sewer diversion) within the site boundary, at one or more convenient location's in terms of layout.

- Protection of Existing Sewerage Assets

We wish to draw your attention to the existing sewer's which pass through the site. These sewer's could be diverted, protected or accommodated within your site layout with an appropriate easement.

Part H of the Building Regulations also details the reasons why Northumbrian Water does not permit buildings to be built over or near to its sewerage network:

1. Undue risk in the event of failure of the drain or sewer
2. Maintaining access
3. Protection of the drain or sewer during construction
4. Protection form settlement
5. Protection against piling

To discuss the diversion of this asset in further detail, please contact our Mr. Roger Perkins on 0191 419 6621.

- Sewage Treatment Capacity

The Sewage Treatment Works to which this development finally discharges to is able to accept the additional flows.

Water Efficiency Information

Water efficiency information can be found on our website by following the web link below:

http://www.nwl.co.uk/using_water_wisely.pdf

or alternatively, the Environment Agency also provides useful information by following the next web link:

www.environment-agency.gov.uk/subjects/waterres/287169/?version=1&lang=_e

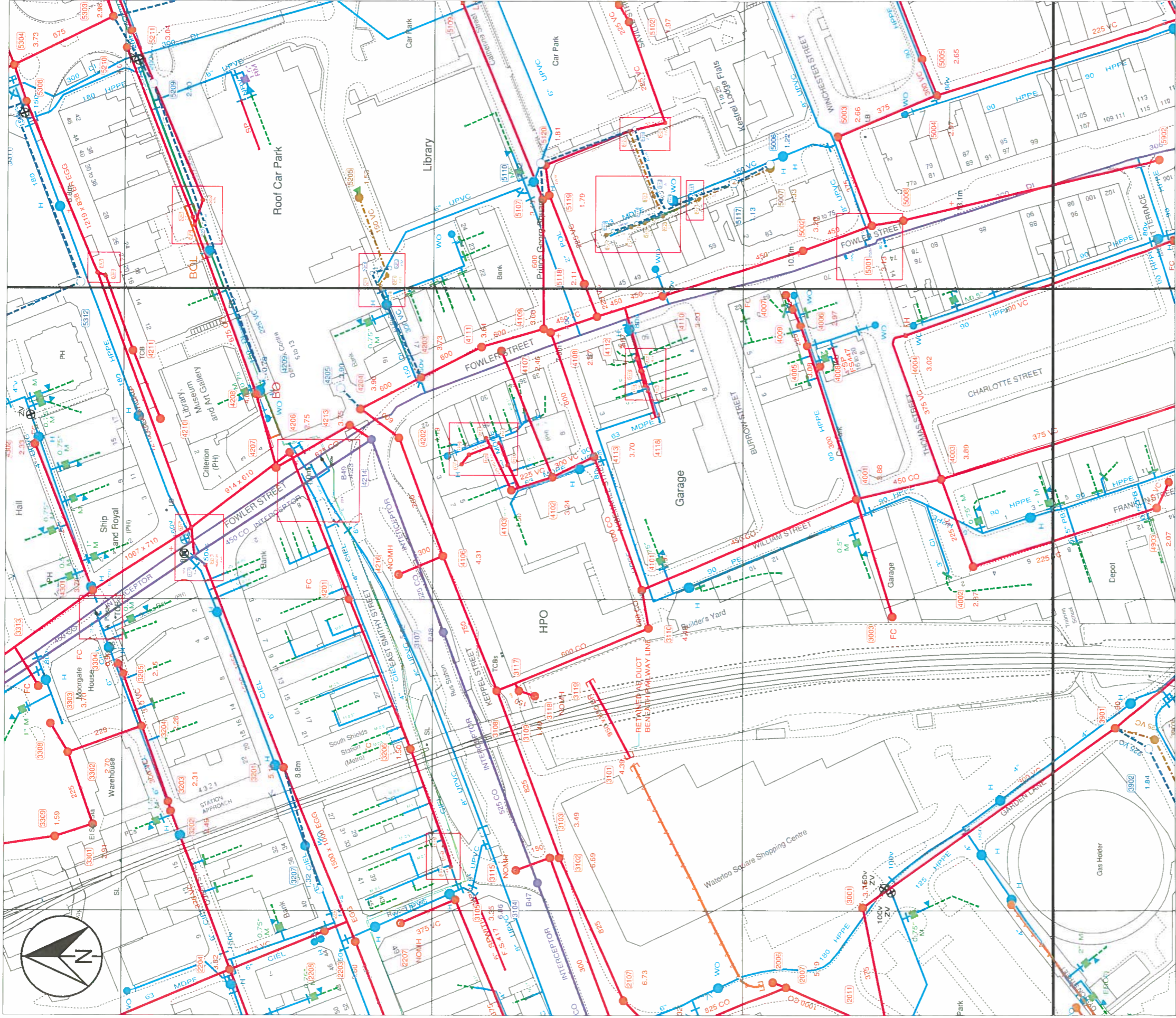
Please note that this response is valid for 1 year only and you should resubmit your proposals should this period lapse prior to your development beginning.

Should you require any further assistance or information, then please do not hesitate to contact me at niki.mather@nwl.co.uk or alternatively on 0191 419 6603, please quote our reference number above in any future correspondence.

Yours sincerely,



Mr. Niki Mather
Technical Support Advisor
New Development



| Waste Water - NWL Responsibility | | Private/Non NWL | | Proposed | | | Water Network - Distribution | | | Network Types | | |
|----------------------------------|---|-----------------|---|-------------|---|-------------|------------------------------|---|---------|---------------|-------------|---|
| Combined | — | Combined | — | Combined | — | Combined | Treated | — | Treated | — | AB Asbestos | — |
| Foul | — | Foul | — | Foul | — | Foul | Raw | — | Raw | — | Abandoned | — |
| Surface | — | Surface | — | Surface | — | Surface | Fire | — | Fire | — | Out of Comm | — |
| Treated Eff | — | Trade Eff | — | Trade Eff | — | Trade Eff | Supply | — | Supply | — | | |
| Untreated Eff | — | Watercourse | — | Watercourse | — | Watercourse | Private | — | Private | — | | |
| Overflow | — | | — | | — | | | — | | — | | |



User : CAPEL

Title :

Date : 11/03/2015 10:51:07

Map Sheet : NZ3667SW

Centre Point : 436429,567149

Paper / Scale : A3@1:1250

The material contained on this plot has been reproduced from an Ordnance Survey map with permission of the controller of H.M.S.O. Crown Copyright Reserved. Licence No. WU298506
 The information shown on this plan should be regarded as approximate and is intended for guidance only. No Liability of any kind whatsoever is accepted by Northumbrian Water, its servants or agents for any omission. The actual position of any water mains or sewers shown on the plan must be established by taking trial holes in all cases. In the case of water mains Northumbrian Water must be given two working days notice of their intention to excavate trial holes. Private connections are not shown but their presence should be anticipated.
WARNING...Where indicated on the plan there could be abandoned asbestos cement materials or shards of pipe. If excavating in the vicinity of these abandoned asbestos cement materials, the appropriate Health & Safety precautions should be taken. Northumbrian Water accepts no liability in respect of claims, costs, losses or other liabilities which arise as the result of the presence of the pipes or any failure to take adequate precautions. Emergency Telephone Number: 0845 717 1100



Appendix D

Calculations

A3

A B C D E F G H

FEEI Total Red Line Site Boundary

Existing Areas - Proposed Interchange

FEEI Boundary

FHEI Area currently permeable but previously developed until 2012/2013

III Current area of track (existing drainage arrangements to remain)

IEE Current impermeable within boundary (various connections to public sewerage)

includes:

IEE $\dot{A} = 112 \text{ l/s}$ at 50mm/hour rainfall

Proposed Areas - Proposed Interchange

FEEI Proposed permeable area within boundary

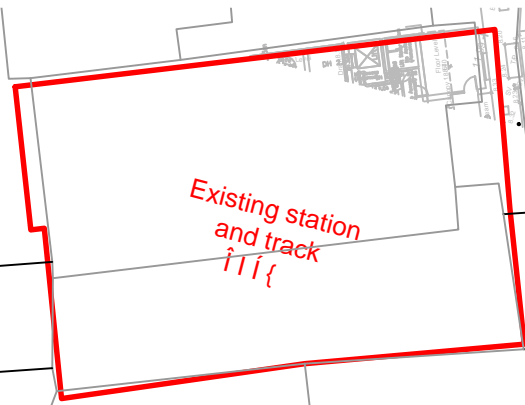
IEE Proposed impermeable area within boundary (excluding track)

IEE $\dot{A} = 14 \text{ l/s}$ at 50mm/hour rainfall

Existing Metro Station

III Boundary

Existing Metro station removed and public realm area to be provided. Impermeable area and connection arrangements to public sewer expected to remain unchanged.



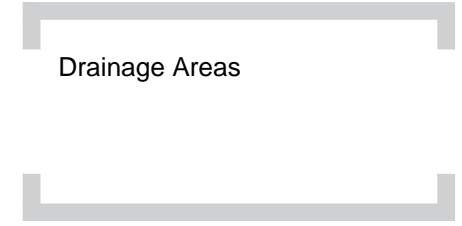
| | | | | |
|-------------------------------|----------|-----|------|------|
| P3 | 22/06/15 | CDH | SFB | SFB |
| Updated to reflect new layout | | | | |
| P2 | 09/03/15 | CDH | SFB | SFB |
| Updated to reflect new layout | | | | |
| P1 | 27/10/14 | CDH | SFB | SFB |
| Preliminary Issue | | | | |
| Issue | Date | By | Chkd | Appd |

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www.arup.com

Job Title
South Shields Interchange

Client
**South Tyneside Council
Nexus
Muse Developments Ltd**



| | |
|-----------------------------------|--------------------------------------|
| Scale at A3 1:500 | |
| Discipline Civils | |
| Job No 601522 | Drawing Status Preliminary |
| Drawing No C.960.SK.001 | Issue P3 |

Quick Storage Estimate

Micro Drainage

Variables

FSR Rainfall Cv (Summer)
 Return Period (years) Cv (Winter)
 Region Impemeable Area (ha)
 M5-60 (mm) Maximum Allowable Discharge (l/s)
 Ratio R Infiltration Coefficient (m/hr)
 Safety Factor
 Climate Change (%)

Enter Climate Change between -100 and 600

Quick Storage Estimate

Micro Drainage

Results

Global Variables require approximate storage of between 118 m³ and 238 m³.

These values are estimates only and should not be used for design purposes.

Enter Climate Change between -100 and 600