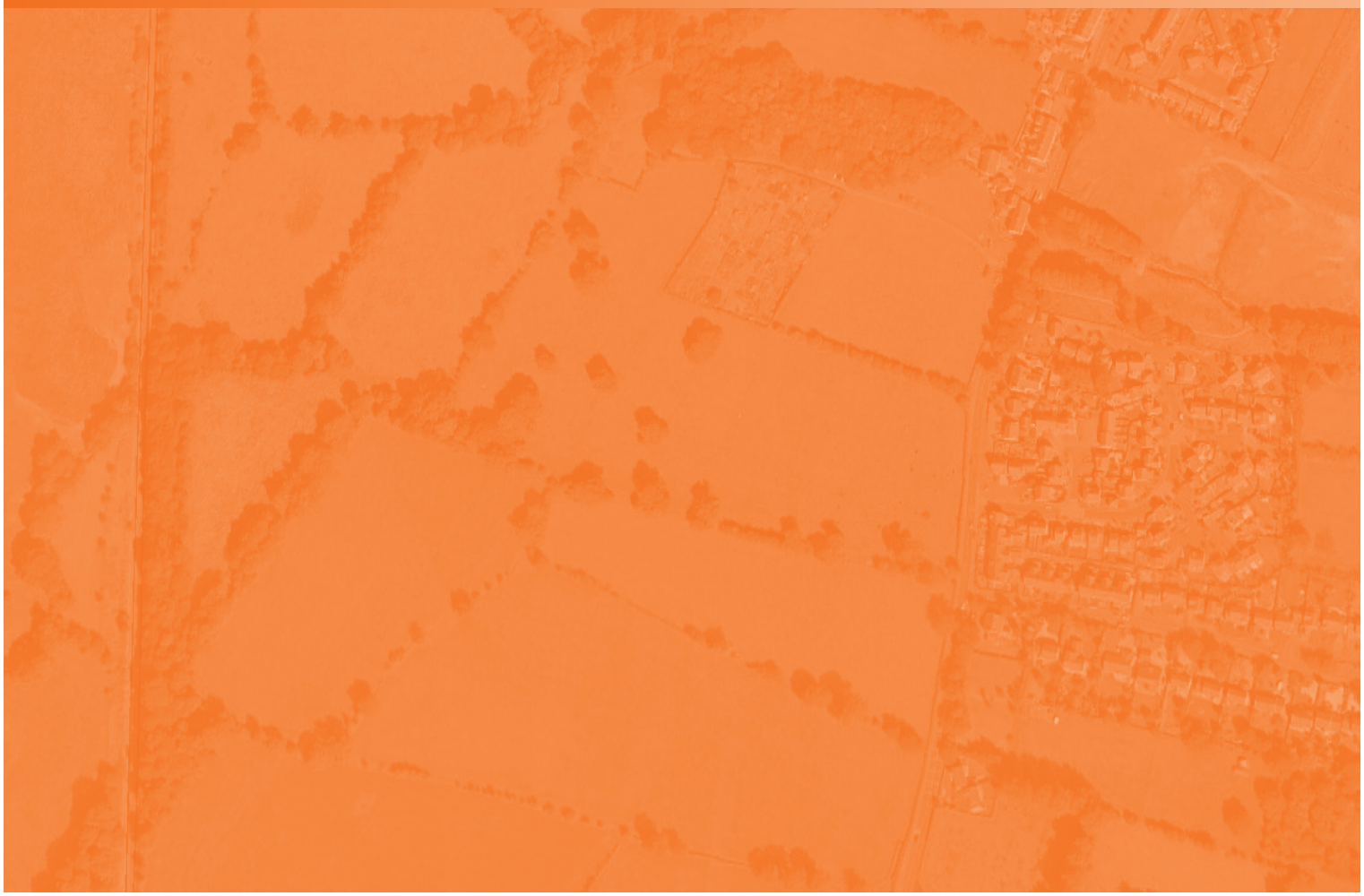
BARROW LANDS
COMPANY LIMITED

David Lock Associates
Town Planning and Urban Design

Flood Risk Assessment

PROPOSED DEVELOPMENT OF LAND TO THE WEST OF WHALLEY ROAD, BARROW, LANCASHIRE

Prepared by **Rutter Johnson**
May 2012



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consultancy engineering business environment

Rutter Johnson
Consulting Civil & Structural Engineers

FLOOD RISK ASSESSMENT (FRA)

PROPOSED RESIDENTIAL DEVELOPMENT
LAND WEST OF WHALLEY ROAD
BARROW
Nr CLITHEROE
LANCASHIRE

FOR
BARROW LANDS COMPANY LIMITED

REPORT NO: **RJ-BL - FRA**

DATE: **MAY 2012**

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Contents

1.0 INTRODUCTION

1.1 Rutter Johnson are instructed by Barrow Lands Company Limited to prepare a Flood Risk Assessment (FRA) to accompany an outline planning application for the residential development of land located west of Whalley Road, Barrow, near Clitheroe, Lancashire.

1.2 This site has an area of some 18.26 hectares [45.12 acres] and in accordance with the National Planning Policy Framework (NPPF) sites in excess of 1.0ha require a FRA to be submitted with any Planning Application. The Technical Guidance to NPPF at para. 5 Table 1 states:-

> *Flood risk assessment requirements*
> *For development proposals on sites comprising one hectare or above the vulnerability of flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on the surface water run-off, should be incorporated in a flood risk assessment. This need only be brief unless factors above or other local considerations require particular attention.*

2.0 SITE DETAILS

2.1 **Site Location**

This irregular shaped 18.26 hectare site is located to the south-west of the village of Barrow; it lies directly to the west of Whalley Road, 2.5km (1.5 miles) north of Whalley town centre and 5km (3.1 miles) south of Clitheroe town centre. It is situated within the Borough of Ribble Valley and in the County of Lancashire.

Refer to Appendix A

The OS grid reference of this development site is SD734381

For the purposes of the determination of the outline planning application, the local planning authority is Ribble Valley Borough Council; the local highway authority is Lancashire County Council.

2.2 **Site Description**

This irregular shaped site is some 18.26 hectares in area and is bounded to the east by Whalley Road, to the north and west by Barrow Brook, an existing open watercourse and to the south by open land and field boundaries.

The site is currently under agricultural occupancy and is used for general grazing; a small central area (0.79 ha) adjacent to but outside the proposed development site owned by Barrow Lands Company Limited (BLCL) is used as private allotment gardens. A further piece of land (1.3 ha) adjacent to the western boundary of the development site, and also owned by BLCL, is an area of marshy grassland that is non-statutory Biological Heritage Site.

A recent development on this site by United Utilities Plc in mid 2011 has included the construction of a large diameter underground storm water detention tank with its associated infrastructure. This has been installed to specifically alleviate localised flooding of existing properties north of this development site at Catlow Terrace, Barrow.

Reference to the Environment Agency (EA) local flood maps shows that the area of the site proposed for development is located within Flood Zone 1.

Refer to Appendix B

A linear land strip following the route of Barrow Brook alongside the western boundary is denoted as being within Flood Zone 3. This area is primarily along the route of the open watercourse, which during times of high flows overtops the stream banks. A downstream culvert beneath the railway acts as a throttle and causes a restriction to water passing through this culvert section.

2.3 Site Topography

Assessment of the existing site topography has been carried out using published mapping contours, Ordnance Survey (LIDAR) ground height data and available topographical surveys carried out on portions of this site.

In general, the existing land contours show a consistent fall in a westerly/south westerly direction from the higher elevation land adjacent to Whalley Road at the eastern site boundary. The existing ground levels along the eastern boundary are in the range 75.2m – 72.5m AoD falling westward to 61.5m AoD at the western boundary.

Assessing the site contours confirms that currently the overland surface water flows towards and discharges to Barrow Brook; this is the main receiving watercourse for this development site.

2.4 Access and Egress

The site is currently accessed via two gated field entrances both located off Whalley Road along the eastern site boundary. These are located one to the north corner adjacent to Catlow Terrace and the second located mid-way along Whalley Road opposite the existing road junction with Whiteacre Lane; this accesses an existing track leading west across the site and linking at the western boundary with an existing footpath and footbridge that crosses over Barrow Brook.

2.5 Development Proposals

The proposed development of this site is for residential purposes along with associated works. The development proposals are in outline, except access with other matters reserved for later approval. However, for the purposes of this FRA it has been assumed that the proposals will produce the following land uses:

Site Area	= 18.26 hectares.
Residential Development	= 10.68 ha
Highway/Footways	= 4.62 ha
Landscaping and Planting	= 1.33 ha
Open Space Provision	= 1.38 ha
Utilities	= 0.25 ha

As the application is in outline, with most matters reserved for later approval, final detailed layout or master plan proposals have not yet been confirmed. However a conventional layout of highways will link the residential areas, these will be interlinked with footways and paths connecting to open space and landscaped areas. Access is to be on Whalley Road. Existing public surface and foul water sewers that cross the site will be located under the proposed public highways and any existing easements will be maintained. New development sewers offered for adoption will be planned under proposed public highways, public footways or public open space areas.

Refer to Appendix C

3.0 FLOOD RISK

3.1 Historical Flooding & Strategic Flood Risk Assessment

Enquiries made with the relevant statutory authorities reveal no record of any surface water flooding within this proposed development site. Furthermore reference to the Ribble Valley Borough Council Strategic Flood Risk Assessment Level One (SFRA) dated May 2010 does not identify any specific flooding issues on this site.

The EA flood map indicates an area of Zone 3 flooding directly alongside the route of Barrow Brook to the west of the site. Based on the annotated Zone 3 areas it is apparent that during high water flows in Barrow Brook, the water overtops the stream banks and creates localised flood areas.

Downstream of the site Barrow Brook flows below the railway via an existing culvert. This culvert will create a "throttle" restriction to high volume water flow under the railway; this restriction will create a rise in the upstream water level and a resulting over topping of the stream banks.

It is a requirement of NPPF that the development proposals do not result in any increase in flood risk downstream of the site and should seek to reduce flood risk overall. Thus the surface water discharge from the proposed development is to be attenuated and is to include due allowance for climate change.

United Utilities Plc (UU) is responsible for the maintenance of public surface water and foul water sewers within the Borough and surrounding areas. Records held by UU show that an adopted surface water sewer crosses the northeast corner of the site and discharges into Barrow Brook. In addition a public combined water sewer flows southwards through the central portion of the site parallel to and approximately 165m west of Whalley Road.

3.2 Environment Agency Flood Map

The EA is the statutory legislative authority having, as part of their wider role, responsibility for flooding issues. Within their current documentation they categorise land areas into 3 distinct Flood Zones, as follows:-

- Zone 1
- Zone 2
- Zone 3a
- Zone 3b

These zones relate to the following:-

Zone 1 land areas – Land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%) – LOW PROBABILITY

Zone 2 land areas – Land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) in any one year – MEDIUM PROBABILITY

Zone 3a land areas – Land assessed to have a 1 in 100 or greater annual probability or river flooding (>1%) in any year – HIGH PROBABILITY

Zone 3b land areas – Land areas where water has to flow or to be stored in times of flood – FUNCTIONAL FLOODPLAIN.

Reference to the published EA Flood Map for this locality establishes the whole of the proposed development on this site is designated **Flood Zone 1 –** LOW PROBABILITY i.e. less than 1 in 1000 annual probability of river flooding in any one year**.** An area of Zone 3 flooding is identified bordering the site boundary alongside the route of Barrow Brook; this Zone 3 is outside the proposed development area.

Refer to Appendix B

3.3 Sequential Approach and Exception Tests

Sequential Approach

The NPPF requires a risk-based approach to be applied to determine the suitability of land for development in flood risk areas and where possible development should be located in areas of lowest flood risk i.e. Flood Zone 1.

NPPF Technical Guidance Table 1 requires that all development sites of 1.0ha area or larger and any sites or part of site which lie in land at risk of flooding ie Zones 2 & 3, must be subject to a FRA.

This proposed development site is in excess of the 1.0 ha area however the whole of the proposed development of this site is located within Flood Zone 1 designation thus no sequential test is required to be satisfied as the development is located in the area of lowest risk.

Exceptions Test

Similarly, since the whole of the development on this site lies within Flood Zone 1 there is no requirement to undertake or satisfy the Exceptions Test.

4.0 SURFACE WATER RUN OFF

4.1 Requirements for Surface Water Drainage of the Developed Site

The NPPF recommends that surface water generated by a developed site should be managed by a sustainable surface drainage management system.

Technical guidance to NPPF at Table 1:footnote 2 states:-
Sustainable drainage systems cover the whole range of sustainable approaches to surface drainage management. They are designed to control surface water run off close to where is falls and to mimic natural drainage as closely as possible.

Undeveloped sites generally rely on natural drainage to convey or absorb rainfall, the water either soaking into the ground or flowing across the ground surface contours into watercourses, providing a natural water flow to the benefit of the environment and local ecology. Sites used for agricultural purposes often have underground land drainage pipe networks discharging to open ditches and watercourses.

The effect of development is generally to reduce the permeability of parts of the site after development. These development changes often result in an alteration to the site's response to rainfall and in particular can lead to an increase in the volume of rainfall that runs off the developed site and can increase the rate at which peak storm rainfall flows from the site.

It is important that surface water drainage proposals ensure that volumes and peak flow rates of surface water discharging from the site are no greater after development than those that exist prior to development and where possible developments should seek to reduce surface water run-off where ever possible.

The proposals should demonstrate that after development there will be no increased flood risk to any areas beyond the site boundary and by implementing the recommendations of NPPF that flood risk overall is, where possible, reduced.

4.2 Site Areas

The development site is 18.26 hectares total area.

The current site is totally agricultural farmland therefore the current discharge is considered to be 100% green field rural run-off.

The proposed residential development is outlined above at Para. 2.5.

The highway and footway provision creates 4.62ha impermeable surfacing.

The area allocated to dwellings is some 10.68 ha of which 66% is considered impermeable the remainder is allocated to garden area; the impermeable portion is therefore 7.04 ha.

The total impermeable area resulting from the development is under 12 ha.

4.3 Existing Site Run Off

Existing surface water run-off from this Greenfield site is by overland water flows following the existing ground contours westward and discharging to Barrow Brook.

The topographical survey and 3D ground modelling identifies the overland flow path for surface water on the undeveloped site.

Refer to Appendix D

4.4 Surface Water Run Off from the Developed Site

The design of the development as planned will include Sustainable Urban Drainage Systems (SUDS).

Preliminary calculations based on IH 124 method for this region produces a green-field runoff value Q_{bar} = 217 litres/sec for the un-developed site, this equates to 11.76 l/sec/ha.

The calculated 1 in 100 year storm event run-off Q_{bar} = 452 l/sec total that equates to 24.75 l/sec/ha.

Applying a 20% reduction in line with the SFRA gives a reduced greenfield discharge of 9.4 l/sec/ha and the maximum allowable post development discharge for a 1 in 100year storm = 19.56 litres/sec/ha. The final design of the SUDS system will require a +30% increase in storm event to cater for future climate change effects.

Based on the development proposals above the housing allocation will have an estimated 66% impermeable surfacing and the highway a 100% impermeable surfacing. This gives a preliminary assessment of 4.62ha + 0.66x10.68ha = 11.66ha impermeable area.

Limiting flows to greenfield value less 20% gives a surface water discharge of 116.8 l/sec and a maximum of 243 l/sec during a peak 1 in 100 year storm event +30% for climate change effects.

Preliminary storage volume sizing shows a requirement to store some 12,100 m3 of attenuated surface water to limit the outflow to 114 l/sec. without overflowing the selected attenuated storage system.

At this stage detailed design is not complete however it is proposed that a series of interlinked storage systems will be used to provide the overall storage volume required; these will include tank sewers, off-line swales and ponds and a final vortex control valve that provides the final discharge control to the receiving water course.

Refer to Appendix E

The provision of this attenuation surface water system complete with final flow control valve will provide a reduction in the surface water flows to Barrow Brook and will therefore assist in reducing flood risk downstream of this site.

This can be controlled by a suitably worded planning condition on a planning consent for the development of the site.

It must be recognised that extreme rainfall storms exceeding the published 1in100year +30% climate change storm event may result in some localised over-topping of the storage facility; in such cases this is considered to be exceptional storm conditions that exceed the design parameters.

4.5 Foul Water discharge from the Developed Site

The proposed development site is currently undeveloped and therefore produces no foul water flow.

A 225mm diameter Public Combined Water sewer runs southwards through the site and eventually discharges to the Whalley Wastewater Treatment Works (WWWTW). This sewer is located some 165m west of and parallel to Whalley Road.

The capacity at WWWTW is currently being reviewed and network modelling is ongoing; recent discussions with UU Plc indicate that there is only very limited available capacity for additional flow to this Works and that a programme of upgrading works is being prepared by UU Plc for the Treatment Works. These upgrade works are scheduled to be complete by mid 2016.

During the period before completion of the WWWTW capacity upgrade, Developers are being advised by UU Plc that any new development must be designed with separate surface water and foul water drainage systems with all surface water being routed away from the public foul sewer network.

In addition any new development should not increase the foul water rate of discharge that exist pre-development until after mid 2016; this requirement ensures no additional sewage loading at the WWWTW at its current capacity.

For this proposed development on land west of Whalley Road Barrow, the final estimated foul water loading onto the public foul water sewer, assuming normal gravity flow is as follows.

EXISTING SEWER LOADING FROM UN-DEVELOPED SITE
The existing site is greenfield and as such generates no foul water flow = 0.0 l/sec

PROPOSED SEWER LOADING FROM DEVELOPED SITE

Surface Water Loading Assessment from proposed development

Surface Water discharge to public sewer = ZERO l/sec, surface water discharge is directly to Barrow Brook via a SUDS system to be installed as a key part of the development.

Foul Water Loading Assessment from proposed development

Foul Water discharge to public sewer

Development Pre 2016	= 150 dwellings	= 9.3 l/sec
Development Post 2016	= 350 dwelling	= 21.6 l/sec
Total final development	= 500 (approx.) dwellings	= 30.9 l/sec.

4.6 Proposed Foul Water disposal system for the developed site

Based on the constraints set by UU Plc the design of the foul water system for this site has been developed to ensure that there is no increase in foul water discharge rate during the period up to mid 2016; after 2016 foul water flows can be increased as the capacity at WWWTW will have been increased to cater for new developments in the locality.

Assessing this site, the existing ground contours dictate the finished development levels. The land generally falls westwards from the higher contours adjacent to Whalley Road along the east boundary to the lower ground contours along the west boundary adjacent to Barrow Brook.

The existing public combined water sewer runs centrally through the site and as such, in the final development is at a level suitable to receive gravity foul water discharge from 300 new dwellings on the site; the remaining 200 dwellings that will be set at the lower ground contours west of the public sewer will require a foul water pump station to be installed to pump collected foul water to the elevated public sewer.

The UU Plc sewer records show that this 225mm diameter foul sewer has very slack gradient through the central section of the site. Reference to the records show that between manholes 4101, 4001, 4901 the 225mm diameter sewer has a gradient in the range 1:580 to 1:591. This very shallow gradient not only limits the flow capacity in this sewer section but also results in low velocity flows that are much less than recommended guidelines; it is calculated that un-surcharged gravity flow capacity in this slack gradient section of the sewer is in the region of 18.5 litres per second at a velocity of 0.5 metres per second. Current legislation recommends minimum velocity of 0.75 metres per second.

Given the requirement by UU Plc that all new pre 2016 development is to produce no increased foul water discharge, this proposed development at Barrow will optimise the use of the foul water pump station from the on-set of development acting as both pump station and detention tank to balance, regulate and control foul water discharge flows.

As the pre 2016 development on this site is planned to produce 150 new dwellings, the foul water pump station must be constructed and commissioned to receive the foul water flows from the first tranche of new dwellings irrespective of their location on site.

Preliminary design of the foul pump station in accordance with Sewers for Adoption 6th Edition shows the following results.

For the final development it is proposed that 200 dwellings require pumped foul water discharge. A twin pump set duty standby pumping system of 5kW pump sets deliver 7.85 l/sec discharge flow at a velocity of 1 m/sec discharging to the public sewer. The pump station wet well requires 30m^3 storage capacity.

In order to use this pump station for the pre 2016 development it is proposed to divert half of the flow from the existing public sewer to the pump station; by introducing a bifurcation manhole on the existing sewer and using either a Y channel or side weir set above pipe invert a flow of 7.85 l/sec is diverted to the new pump station. The remainder of flow of some 10.65 l/sec continues along the original sewer line.

Combining this diverted flow of 7.85 l/sec in the new pump station with the incoming flow from the first150 new dwellings requires a minimal upgrade to the planned final pump station proposed for the overall final development.

The pump sets remain of similar capacity, the wet well storage volume increases to 45m^3 and most importantly the return flow pumped returned back to the existing sewer remains at 7.85 l/sec delivered at a velocity of 1 m/sec resulting in a combined flow in the sewer of 10.65 + 7.85 = 18.5 l/sec; this being equivalent to the pre-development flow capacity in the existing public sewer.

Thus there is no increase in flow within the existing public sewer downstream of the development site and therefore no increase in load at WWWTW during the pre 2016 development period. An additional major benefit results from the installation of this pump station in the available storage capacity in the pump wet well will provide an on-line tank that, during storm conditions will enable surcharged flows in the existing public sewer to utilise this storage volume. The pump sets will restrict the return flow to the sewer thus overall the sewer load flowing to WWWTW during storm periods will in fact be reduced.

Overall this proposed foul sewage discharge system satisfies UU Plc requirements to limit all pre 2016 foul water flows to no greater than existing pre-development flow rates and provides additional storage volume capacity to detain peak storm flows relieving the existing public sewer system upstream of the development; this will benefit existing properties in Barrow.

The pump station will be constructed in accordance with Sewers for Adoption documentation and offered for adoption by UU Plc. As such the pump station will be fitted with the telemetry control system that will provide close monitoring and possible remote pump control from the WWWTW.

This can be controlled by a suitably worded planning condition on a planning consent for the development of the site.

Refer to Appendix F

5.0 CONCLUSIONS

5.1 This FRA has identified that the area proposed for development on this site is located in an area designated Flood Zone 1 as defined by the EA Flood Map and SFRA and is therefore in a location which has a less than 1 in 1000 annual probability of river flooding in any year (<0.1%) which is the lowest level of flood risk.

5.2 The proposed sustainable drainage system utilising surface water storage and discharge flow control will result in no increase in flood risk on the site and no increase in flood risk downstream of the site boundary as a result of this development. Furthermore the proposals seek to reduce flows from the developed site in line with the published climatic change conditions.

5.3 Surface water discharge from the development will be dealt with in a sustainable manner that will "make space for water" in line with the current guidelines; the proposals also result in a reduction in peak flow surface water discharge from the developed site thereby reducing flood risk downstream in accordance with the NPPF Technical Guidelines.

5.4 This FRA demonstrates that the foul water flows generated by the proposed development satisfies UU Plc's criteria that for any development pre mid 2016 there is no increase in foul water flow to the WWWTW; development after mid 2016 will be catered for by the upgraded capacity at the treatment plant. This FRA demonstrates that the foul water pump station that is required for the final overall development will be utilised for the pre 2016 development to provide detention storage volume and pump control. This will result in no increase in foul water flow to WWWTW and also provide added off-line storage volume for peak storm flows in this partially combined sewer that benefits the existing sewers upstream of the development site. These matters can be controlled by a suitably worded planning condition on the outline planning consent for the development of the site.

5.5 In conclusion the submitted development proposals that are the subject of this FRA, do not result in any negative flood impact or increased flood risk on the site or on its direct surroundings; the proposals create a sustainable surface water drainage system all of which align with and fully satisfy the core aims of NPPF and the SFRA. The foul water discharge criteria are fully satisfied for development pre 2016, for the final development completion post 2016 and meet UU Plc.'s wastewater objectives. The proposed pumped foul drainage system increases available peak wastewater capacity of the existing public sewer during the pre 2016 period and thereby benefits existing properties upstream of the site. Therefore there are no flooding, sewerage or drainage reasons why the proposed development of this site should not proceed.

Report prepared by
Lindsay Rutter B Sc., C Eng., M.I. Struct E

Signed …… Date MAY 2012

PROPOSED DEVELOPMENT
LAND WEST OF WHALLEY ROAD
BARROW, Nr CLITHEROE
LANCASHIRE

APPENDIX A

Site Location Plan

N

732 733 734 735 736 737 738 739 740.00m

384 383 382 381 380.00m 379 378.39m

Barrow Brook

Drain

Drain

Drain

Path (um)

Track

Track

1521

0806

0300

0300

5732

SI

SI

Pendle Hey

Kempe Vista

Abbey Terrace

WASHBROOK CLOSE

PAYNTER CLOSE

Playground

Playground

Sinks

Issues

El Sub Sta

Mill Brook Place

Cromton Terrace

Cotton Terrace

WHALLEY ROAD

UU Plc Detention Tank

El Sub Sta

Kempe View

Oakfield

OAK CLOSE

CHESTNUT CRESCENT

ASH CLOSE

BIRCH GROVE

Ormerod Terr

Warrington Terrace

Green Mount

The Acres

Oak Leigh

WHITEACRE LANE

WILLOW DRIVE

El Sub Sta

Cat Gri

Path (um)

WHALLEY ROAD

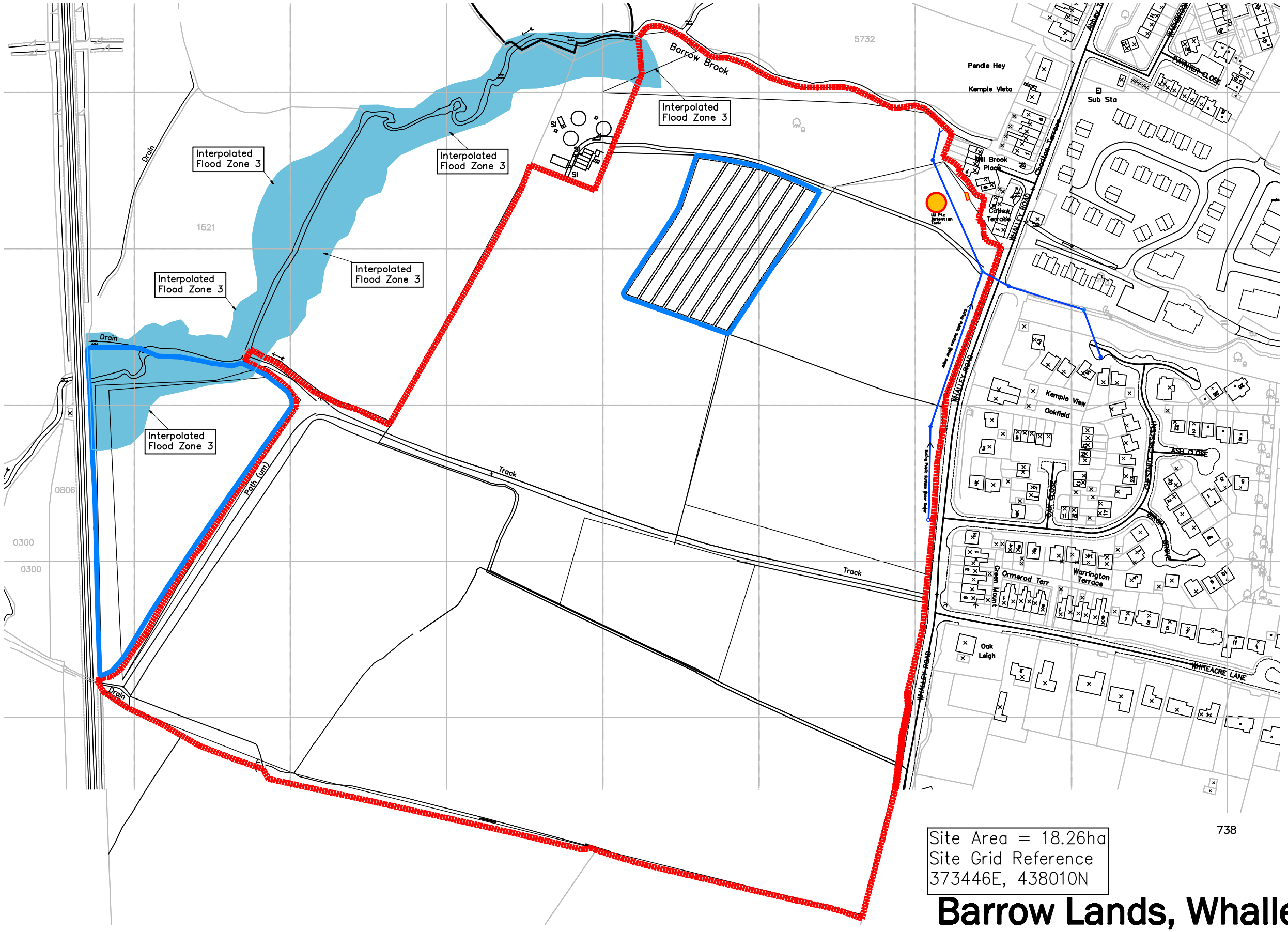
Site Area = 18.26ha
Site Grid Reference
373446E, 438010N

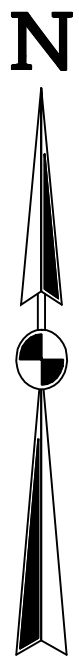
Barrow Lands, Whalley Road, Barrow.
SITE LOCATION PLAN
Scale 1:1250 @ A1
RJ-BL-P_01

PROPOSED DEVELOPMENT
LAND WEST OF WHALLEY ROAD
BARROW, Nr CLITHEROE
LANCASHIRE

APPENDIX B

EA FLOOD ZONE MAPPING





Site Area = 18.26ha
Site Grid Reference
373446E, 438010N

Barrow Lands, Whalley Road, Barrow.
INTERPOLATED FLOOD ZONE 3 AREA
Scale 1:2500 @ A3
RJ-BL-P_04

PROPOSED DEVELOPMENT
LAND WEST OF WHALLEY ROAD
BARROW, Nr CLITHEROE
LANCASHIRE

APPENDIX C

PROPOSED DEVELOPMENT MASTER PLAN

2840 - Barrow Lands
Levitt Bernstein

Barrow Lands: Masterplan

Date: 01 May 2012

PROPOSED DEVELOPMENT
LAND WEST OF WHALLEY ROAD
BARROW, Nr CLITHEROE
LANCASHIRE

APPENDIX D

EXISTING CONTOURS AND OVERLAND RUN-OFF FLOW ROUTE

Site Area = 18.26ha
Site Grid Reference
373446E, 438010N

Barrow Lands, Whalley Road, Barrow.
EXISTING CONTOURS & OVERLAND FLOW PATHS
Scale 1:1250 @ A1
RJ-BL-P_02

PROPOSED DEVELOPMENT
LAND WEST OF WHALLEY ROAD
BARROW, Nr CLITHEROE
LANCASHIRE

APPENDIX E

PRELIMINARY WATER STORAGE DESIGN

Link House
273 Crown Lane
Horwich BL6 5HY

Date 01 May 2012 17:16
File

Designed By Administrator
Checked By

Micro Drainage | Source Control W.11.2

IH 124 Mean Annual Flood

Input

Return Period (years)	100	SAAR (mm)	1229.000	Urban	0.000
Area (Ha)	18.260	Soil	0.500	Region Number	10

Results	l/s
QBAR Rural	217.6
QBAR Urban	217.6
Q 100 years	452.7
Q 1 year	189.3
Q 2 years	202.7
Q 5 years	259.0
Q 10 years	300.3
Q 20 years	342.1
Q 25 years	356.9
Q 30 years	369.0
Q 50 years	402.6
Q 100 years	452.7
Q 200 years	513.6
Q 250 years	533.2
Q 1000 years	661.6

Link House
273 Crown Lane
Horwich BL6 5HY

Date 11 March 2012 09:49
File Design 1.SRC

Designed By Lindsay Rutter
Checked By

Micro Drainage | Source Control W.11.2

Rainfall Details

Region	ENG+WAL	Cv (Summer)	0.750	Summer Storms	Yes
Return Period (years)	100	Cv (Winter)	0.840	Winter Storms	Yes
M5-60 (mm)	21.000	Shortest Storm (mins)	15	Climate Change %	+30
Ratio-R	0.200	Longest Storm (mins)	10080		

Time / Area Diagram

Total Area (ha) = 12.043

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	0.750	16	20	0.750	32	36	0.750	48	52	0.500	64	68	0.500
4	8	0.750	20	24	0.750	36	40	0.750	52	56	0.500	68	72	0.543
8	12	0.750	24	28	0.750	40	44	0.750	56	60	0.500			
12	16	0.750	28	32	0.750	44	48	0.750	60	64	0.500			

Tank/Pond Details

Invert Level (m) 61.500 Ground Level (m) 63.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	7500.0	0.40	8000.0	0.80	8500.0	1.20	9000.0	1.60	9500.0

Hydro-Brake Outflow Control

Design Head (m) 1.500 Hydro-Brake Type MD8 Invert Level (m) 61.500
Design Flow (l/s) 116.0 Diameter (mm) 389

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	11.7	0.50	65.5	1.20	105.1	2.00	132.3	3.00	160.9	5.00	207.4	7.00	245.4	9.00	278.2
0.20	26.1	0.60	75.1	1.40	112.5	2.20	138.4	3.50	173.6	5.50	217.5	7.50	254.0	9.50	285.9
0.30	40.5	0.80	87.5	1.60	119.4	2.40	144.3	4.00	185.5	6.00	227.2	8.00	262.3		
0.40	53.8	1.00	97.0	1.80	126.0	2.60	150.0	4.50	196.8	6.50	236.5	8.50	270.4		

Link House
273 Crown Lane
Horwich BL6 5HY

Date 11 March 2012 09:48
File Design 1.SRC

Designed By Lindsay Rutter
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 Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m^3)	Status
15 Summer	40.2	40.2	61.7983	0.2982	2291.1	O K
30 Summer	57.7	57.7	61.9328	0.4327	3362.9	O K
60 Summer	74.8	74.8	62.0973	0.5973	4703.5	O K
120 Summer	86.0	86.0	62.2753	0.7753	6188.6	O K
180 Summer	91.3	91.3	62.3788	0.8788	7073.0	O K
240 Summer	94.8	94.8	62.4538	0.9538	7721.2	O K
360 Summer	99.2	99.2	62.5548	1.0548	8607.6	O K
480 Summer	101.8	101.8	62.6193	1.1193	9178.1	O K
600 Summer	103.6	103.6	62.6618	1.1618	9557.2	O K
720 Summer	104.7	104.7	62.6903	1.1903	9810.1	O K
960 Summer	106.2	106.2	62.7298	1.2298	10166.4	O K
1440 Summer	107.9	107.9	62.7768	1.2768	10595.4	O K
2160 Summer	109.1	109.1	62.8078	1.3077	10877.0	FLOOD RISK
2880 Summer	109.3	109.3	62.8138	1.3137	10933.9	FLOOD RISK

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	106.19	84
30 Summer	78.41	95
60 Summer	55.35	118
120 Summer	37.01	168
180 Summer	28.68	222
240 Summer	23.89	276
360 Summer	18.37	384
480 Summer	15.20	494
600 Summer	13.10	606
720 Summer	11.59	696
960 Summer	9.53	814
1440 Summer	7.23	1072
2160 Summer	5.50	1488
2880 Summer	4.54	1904

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4320 Summer	108.7	108.7	62.7988	1.2987	10795.4	O K
5760 Summer	107.8	107.8	62.7733	1.2733	10561.7	O K
7200 Summer	106.5	106.5	62.7378	1.2378	10242.4	O K
8640 Summer	105.0	105.0	62.6978	1.1978	9879.0	O K
10080 Summer	103.3	103.3	62.6563	1.1563	9505.5	O K
15 Winter	44.8	44.8	61.8328	0.3327	2565.7	O K
30 Winter	63.6	63.6	61.9833	0.4832	3768.5	O K
60 Winter	79.2	79.2	62.1668	0.6668	5279.2	O K
120 Winter	90.6	90.6	62.3653	0.8653	6957.9	O K
180 Winter	96.1	96.1	62.4818	0.9818	7964.4	O K
240 Winter	99.7	99.7	62.5663	1.0663	8706.6	O K
360 Winter	104.4	104.4	62.6813	1.1813	9733.7	O K
480 Winter	107.2	107.2	62.7563	1.2563	10406.9	O K
600 Winter	109.0	109.0	62.8068	1.3067	10867.2	FLOOD RISK

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
4320 Summer	3.49	2728
5760 Summer	2.92	3536
7200 Summer	2.55	4336
8640 Summer	2.28	5112
10080 Summer	2.07	5880
15 Winter	106.19	84
30 Winter	78.41	95
60 Winter	55.35	120
120 Winter	37.01	170
180 Winter	28.68	222
240 Winter	23.89	276
360 Winter	18.37	384
480 Winter	15.20	492
600 Winter	13.10	602

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Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m^3)	Status
720 Winter	110.3	110.3	62.8413	1.3412	11183.7	FLOOD RISK
960 Winter	111.7	111.7	62.8803	1.3802	11543.5	FLOOD RISK
1440 Winter	113.3	113.3	62.9232	1.4232	11940.6	FLOOD RISK
2160 Winter	113.9	113.9	62.9412	1.4412	12109.6	FLOOD RISK
2880 Winter	113.5	113.5	62.9297	1.4297	11999.7	FLOOD RISK
4320 Winter	111.6	111.6	62.8752	1.3752	11497.1	FLOOD RISK
5760 Winter	109.3	109.3	62.8128	1.3127	10921.4	FLOOD RISK
7200 Winter	106.7	106.7	62.7428	1.2428	10288.1	O K
8640 Winter	104.0	104.0	62.6718	1.1718	9647.1	O K
10080 Winter	101.2	101.2	62.6028	1.1028	9029.4	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
720 Winter	11.59	710
960 Winter	9.53	912
1440 Winter	7.23	1142
2160 Winter	5.50	1604
2880 Winter	4.54	2060
4320 Winter	3.49	2940
5760 Winter	2.92	3784
7200 Winter	2.55	4600
8640 Winter	2.28	5392
10080 Winter	2.07	6176

PROPOSED DEVELOPMENT
LAND WEST OF WHALLEY ROAD
BARROW, Nr CLITHEROE
LANCASHIRE

APPENDIX F

PROPOSED FOUL WATER PUMP STATION LOCATION

Site Area = 18.26ha
Site Grid Reference
373446E, 438010N

Barrow Lands, Whalley Road, Barrow.
PROPOSED WASTEWATER PUMP STATION
Scale 1:1250 @ A1
RJ-BL-P_03

DAVID LOCK ASSOCIATES LIMITED
50 NORTH THIRTEENTH STREET, CENTRAL MILTON KEYNES, MK9 3BP
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