



Flood Risk Assessment & Drainage Strategy



Greenhill Nursery Allerton, Liverpool

Ironside Farrar Limited
3 Worsley Court
High Street
Worsley
Manchester
M28 3NJ

30075/SRG
June 2014

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DEVELOPMENT AT GREENHILL NURSERY
LIVERPOOL
FLOOD RISK ASSESSMENT
& DRAINAGE STRATEGY

1.0 Introduction

Morris Homes intends to pursue a planning application for a residential development consisting of up to 83no. dwellings at a site off Greenhill Road, Liverpool.

The Environment Agency Flood Map indicates the site is situated in Flood Zone 1 with a chance of flooding of less than 0.1% (or 1 in 1000) but as the site is greater than 1ha in area, a Flood Risk Assessment, in accordance with the National Planning Policy Framework is required to ensure the development is undertaken in a safe manner and to ensure it will not increase the risk of flooding to other areas.

2.0 Site Description

The site extends to approximately 2.64ha and is located off Greenhill Road, Allerton, Liverpool. The site is located some 5km to the south east of Liverpool city centre and the grid reference of the site is SJ 40265 85456; the Location and Site plan are included in Appendices A and B.

At present, the irregular shaped site is occupied by the former Greenhill Nurseries and there are existing glasshouses remaining on the site. Areas not occupied by glasshouses and access roads are heavily overgrown grass. The site extends from Greenhill Road on the northern boundary to Nursery Lane on the southern boundary. The eastern boundary is formed by the main Liverpool-London railway line for the northern portion and an existing bungalow for the southern portion. Nursery Lane runs along the majority of the southern boundary but the site is separated from Nursery Lane in some locations due to existing residential properties. The entire western boundary is formed by the rear boundaries of the adjacent residential property on Long Lane. There are dense, existing trees along the northern boundary with Greenhill Road; the road rises in an easterly direction to cross the railway and there are steep slopes down to the site. At the base of this slope there is a short section of ditch that has standing water in it with no apparent inlet or outlet. From this point there is a shallow, ill defined dry ditch running through the site to the boundary of the existing bungalow on the eastern boundary; again there is no sign of a culvert where the ditch finishes.

There are also large trees along the eastern and western boundaries but there are no trees where the railway forms the eastern boundary. As detailed, there are numerous existing glasshouses on the site and the remains of the bases of several more. In the centre of the site is the boiler house and this is surrounded by tarmac hard standing.

Generally, the site falls from north to south towards the Nursery Lane boundary.

Levels along the back of footpath on Greenhill Road vary from 31.36m to 34.48m at the railway bridge; the site at the base of the embankment falls from 30.17m at the north west corner to 29.83m adjacent to the railway. Along the eastern boundary with the railway, the levels vary from 30.26m in the north east to 29.38m at the boundary of the bungalow. The boundary continues to fall to Nursery Lane where the level is 28.28m. Existing houses on Nursery Lane are at 29.08m and the back of footpath on Nursery Lane rises to 28.45m. The western boundary rises from a level of 28.54m to approximately 30.00m in the north west corner.

The topographical survey is included in Appendix C.

A selection of photographs, together with an aerial photo is included in Appendix D to illustrate the site at the present day and

3.0 Forms of Flooding

The Technical Guidance to the National Planning Policy Framework requires all forms of flooding to be considered.

3.1 Flooding from Rivers

The Environment Agency Flood Risk map is included as Appendix E.

It can be seen from the map that the site is located in Flood Zone 1 with a chance of flooding of less than 0.1% (or 1 in 1000). There is an open water course indicated on the existing site plan and the records received from Liverpool CC. From the topographical survey and site visit, it has been established this watercourse is no more than a very shallow, overgrown and poorly maintained ditch. The point at which it is shown to sink could not be located on site and no evidence of the culvert shown as running under the railway. It is concluded this watercourse may have been abandoned and is certainly not significant.

The site is therefore not at risk of flooding from rivers.

It is intended the ditch will be cleaned out and diverted to suit the development layout and will tie into existing culverts at either end.

3.2 Flooding from the Sea

See 3.1 above.

3.3 Flooding from Land

Intense rainfall, often of short duration, that is unable to soak into the ground or enter drainage systems can run quickly off land and result in local flooding.

As described above, the levels to the north of the site rise quite steeply and run-off will therefore be directed west along Greenhill Road. As all other levels fall away to the south, the site is therefore at a very low risk of flooding as a result of run-off from the adjacent land. It will be important, however, to ensure that in exceptional circumstances any surface run-off can be conveyed through the site along designated routes. An emergency footpath link is proposed on the southern boundary to Nursery Lane.

The levels of the development should be designed to direct any overland flows through the site.

Reference should be made to the Surface Water Flood Model for the 1 in 200 year event included in the information from Liverpool CC included in Appendix K. This model indicates the site to experience only potentially shallow flood depths of 0.1m to 0.3m in the 200 year event. It should be remembered this is the existing site and shows the presence of low areas within the site. The developed site will be re-contoured to ensure there are no such low spots and falls are continuous through the site. Appendix J includes the RMS (Risk Management Solutions) flood data which indicates only a small portion of the site to be potentially at risk of flooding in the 1000 year event.

The site is therefore considered to be at low risk of flooding from land.

Reference should also be made to section 4 relating to the site drainage.

3.4 Flooding from Groundwater

During the walkover survey there was no evidence of standing water on the site. Reference to the Envirocheck Flood data included in Appendix J indicates the site has only a limited potential for groundwater flooding to occur and reference to the Liverpool CC map of areas susceptible to groundwater flooding in Appendix K indicates the site lies outside of such areas.

Site levels will ensure finished floor levels are set above existing ground levels.

The site is therefore not considered to be at risk of flooding from groundwater.

3.5 Flooding from Sewers

The record of Public Sewers has been obtained from United Utilities and is included in Appendix F. United Utilities have been consulted with regards to flooding from the public sewerage system and their response is included in Appendix G. They have confirmed the site should be served on a separate system with a combined connection to the 375mm dia. combined sewer in Greenhill Road. The maximum flow rate permitted is 25l/s.

The records indicate the nearest public sewer is a 375mm dia. combined sewer running to the west in Greenhill Road; if there was any surcharge from this sewer the flows would be to the west and not towards the site. There are also 225mm dia. combined sewers in Nursery lane but these fall away from the site.

The site itself is therefore not considered to be at significant risk of flooding from sewers but the final drainage proposals for the site will need to be agreed with United Utilities to ensure the risk of flooding to other areas is not exacerbated.

3.6 Flooding from Reservoirs, Canals and Other Artificial Sources

There are no potential artificial sources of flooding to the site.

4.0 Development and Drainage

In line with common practice, it is proposed the surface water discharge from the proposed development should mimic that from the existing site.

The Greenfield run-off rates have been assessed for the development area using the IoH Report 124 and result in flows of 11.7, 22.7 and 27.9l/s in the 1, 30 and 100 year events. Consultation with United Utilities has confirmed the maximum discharge rate of 25l/s for the development.

A connection to the existing public surface water sewer in Greenhill Road is possible and the Sketch Drainage Layout included in Appendix H has been prepared to demonstrate the site can be developed without increasing flood risk elsewhere. Attenuation will be included in the system in the form of oversized pipes and a flow control introduced to limit the flows. The hydraulic calculations included in Appendix I indicate the proposed system will restrict flows to 24.9, 24.8 and 24.9 l/s in the 1, 30 and 100 year event including 30% climate change allowance.. There is no surface flooding on the site in the 100year event (including climate change allowance).

Final details of the proposed drainage system will need to be discussed with United Utilities.

It has been assumed the ground conditions will not be suitable for infiltration SUDS techniques but this will be confirmed following the detailed intrusive site investigation.

Foul drainage will require a new connection to the combined sewer in Greenhill Road.

5.0 Conclusions

- The site is located within Flood Zone 1 with a low probability of flooding.
- The site is at a low risk of flooding from other sources.
- Flows from the site should be discharged to the public sewer at a maximum flow rate of 25l/s as detailed by United Utilities.
- Infiltration SUDS techniques are not considered to be suitable on the site but measures such as permeable driveways will be considered.
- Existing land drainage within the site will be diverted where required and improved to ensure the site is protected against run-off from adjacent land.

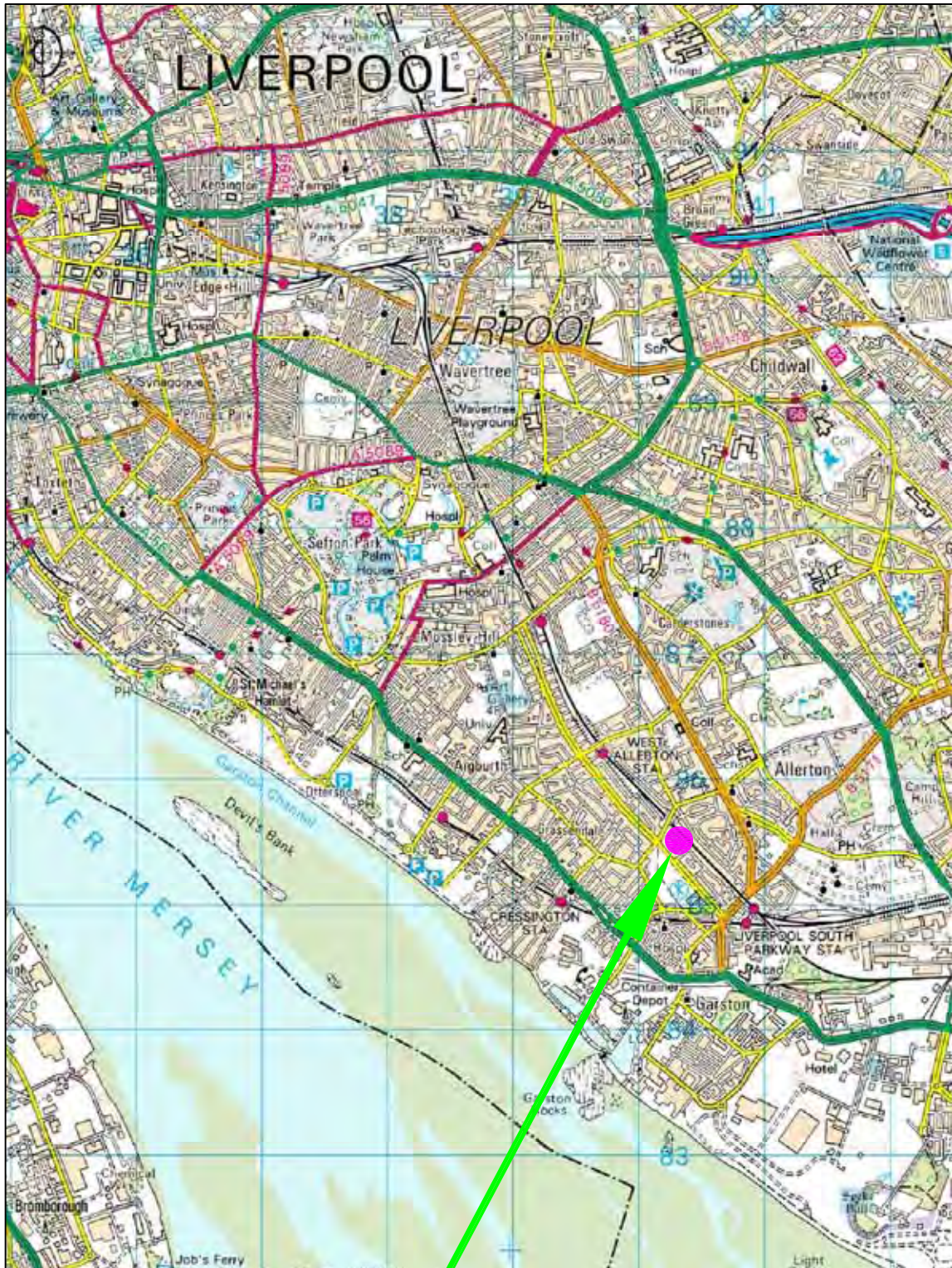
- Foul drainage may be connected to the existing public combined sewer in Greenhill Road.

6.0 Recommendations

- Suitable tried and tested planning conditions shall be agreed to address the drainage of the site in accordance with the flood risk assessment & drainage strategy.
- Following initial consultation, further discussions should take place with United Utilities with regard to connecting the development to the existing combined sewer.
- Attenuation will need to be incorporated into the surface water drainage to ensure flows are limited to the specified discharge rate.
- SUDS measures should be investigated and included within the drainage system where possible.
- The external levels shall be designed to ensure overland flood routes exist in the green corridors through the development for use in exceptional circumstances.
- The upstream and downstream culvert details should be determined on site to enable the reinstatement of the open ditch through the development.

APPENDIX A

Site Location Plan

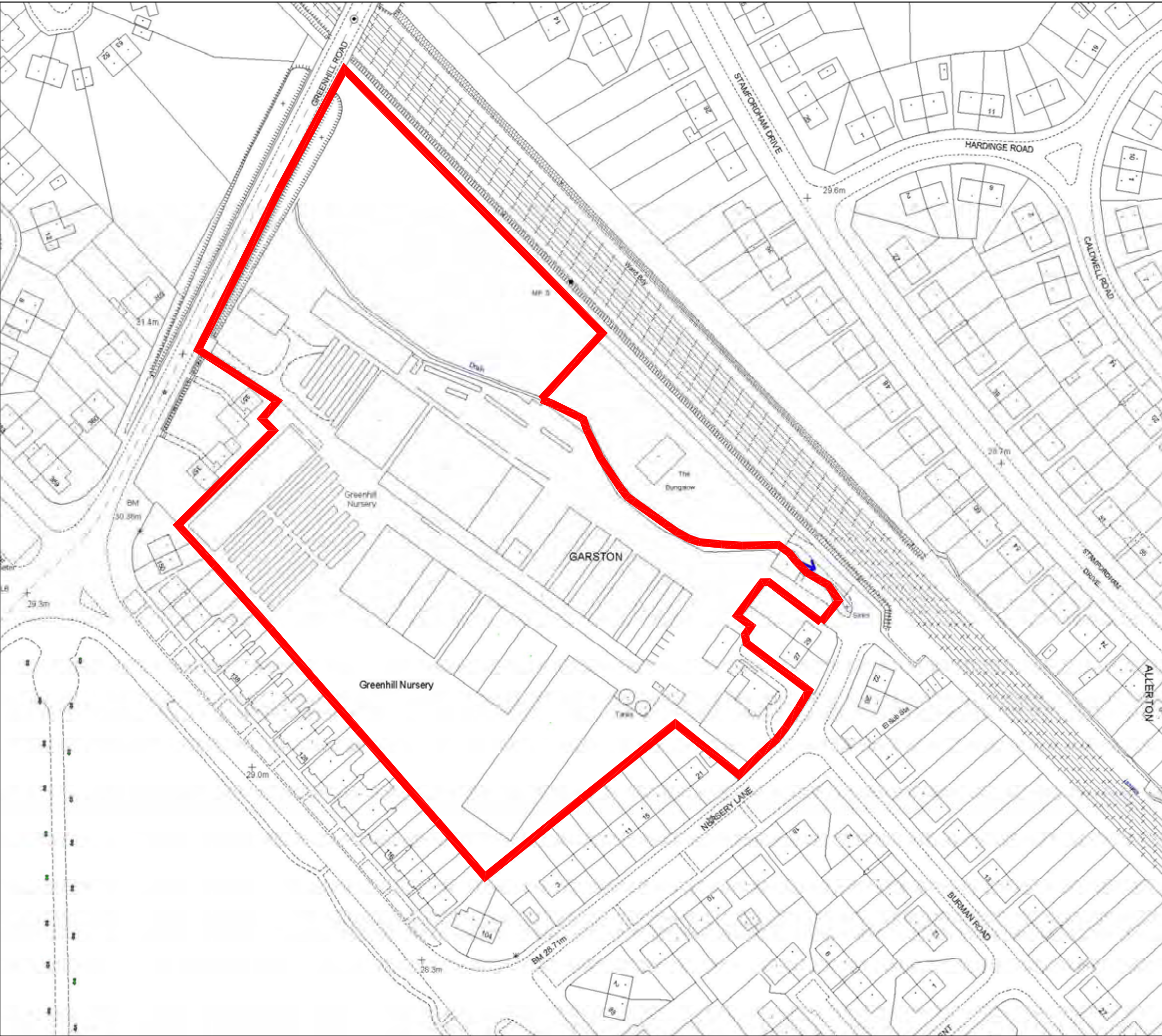


Site Location

<p>North Arrow</p> <p>Quality Assurance</p> <p>UKAS 9001</p> <p>ISO 9001:2008</p> <p>9001 Certificate</p> <p>0800545639</p>	<p>Greenhill Nursery Allerton, Liverpool</p> <p>Morris Homes</p> <p>Site Location Plan</p>	<p>Ironsides Farrar Environmental Planners Civil Engineers Landscape Architects Graphic Design</p> <p>3 Worsley Court MANCHESTER M20 3NU Tel: 0161 703 8801 Fax: 0161 703 8279 manchester@ironsidesfarrar.com</p> <p>EDINBURGH BELLSHILL</p> <p>Drawing No. 30075/App A</p>
<p>Original Size: A4</p>	<p>Copyright Acknowledgment: Greenhill Nursery</p> <p>Drawn By: N.B.</p> <p>Checked By: S.R.G.</p> <p>Date: June 14</p> <p>Scale: 1:50000</p>	<p>Revision:</p>


APPENDIX B

Existing Site Plan

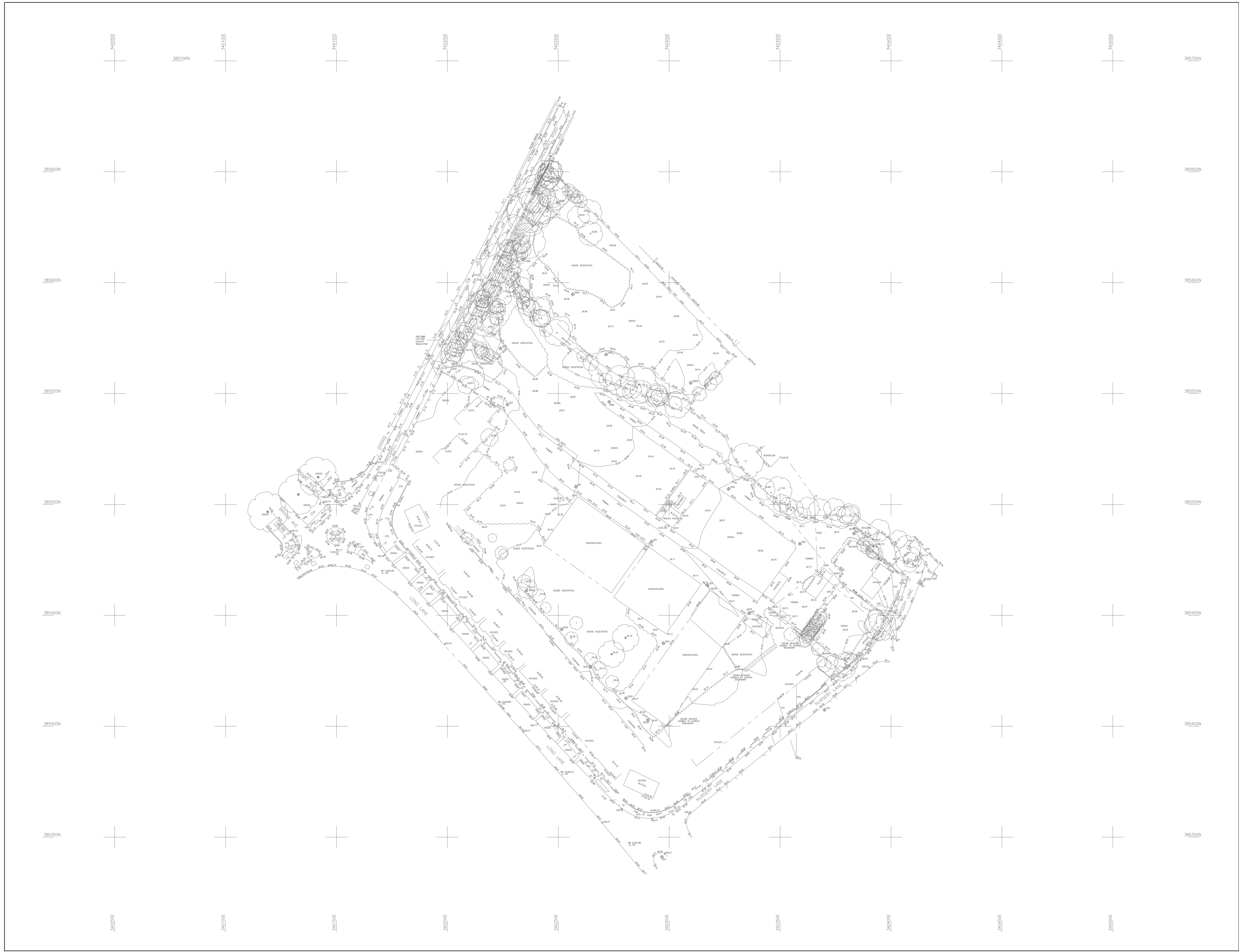


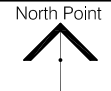

KEY

SITE BOUNDARY

 North Point	Project Greenhill Nursery Allerton, Liverpool		IronsideFarrar Environmental Consultants Environmental Planners Civil Engineers Landscape Architects Graphic Design 3 Worsley Court MANCHESTER M28 3NJ Tel. 0161 703 8801 Fax. 0161 703 8279 manchester@ironsidefarrar.com EDINBURGH BELLSHILL
	Quality Ass.	Client Morris Homes	
	UKAS 005 Quality Assurance ISO 9001:2008 SGS Certificate GB02/54539	Title Existing Site Plan	
	Original Size A3	Copyright Acknowledgement Ordnance Survey © © Crown Copyright. All rights reserved. Licence No. AL100017966.	
Drawing No. 30075/App B		Revision	

APPENDIX C
Topographical
Survey



 North Point Quality Ass. UKAS 905 Quality Assurance ISO 9001:2008 SGS Certificate GB02/54539	Project Greenhill Nursery Allerton, Liverpool		 Ironsides Farrar Environmental Planners Civil Engineers Landscape Architects Graphic Design 3 Worsley Court, MANCHESTER M20 3NU Tel: 0161 703 8801 Fax: 0161 703 8279 manchester@ironsidesfarrar.com EDINBURGH BELLSHILL
	Client Morris Homes		
	Title Topographical Survey		
	Original Size A1		
Copyright Acknowledgement Ordnance Survey © Crown Copyright. All rights reserved. Licence No. AL100017966.	Drawn NB	Checked By SRG	Drawing No. 30075/App C
	Date June 14	Scale 1:1000	Revision

APPENDIX D

Aerial & Site Photographs



KEY

SITE BOUNDARY



<div>North Point</div> <div></div> <div>Quality Ass.</div> <div>UKAS 005</div> <div>Quality</div> <div>Assurance</div> <div>ISO 9001:2008</div> <div>SGS Certificate</div> <div>GB02/54539</div>		<div>Project</div> <div>Greenhill Nursery</div> <div>Allerton, Liverpool</div> <div>Client</div> <div>Morris</div> <div>Homes</div> <div>Title</div> <div>Aerial</div> <div>Photograph</div>		<div>IronsideFarrar</div> <div>EnvironmentalConsultants</div> <div>EnvironmentalPlanners</div> <div>CivilEngineers</div> <div>LandscapeArchitects</div> <div>GraphicDesign</div> <div>3 Worsley Court MANCHESTER M28 3NJ</div> <div>Tel. 0161 703 8801 Fax. 0161 703 8279</div> <div>manchester@ironsidefarrar.com</div> <div>EDINBURGH</div> <div>BELLSHILL</div>	
Original Size	Copyright Acknowledgement	Drawn	Checked By	Drawing No.	Revision
A3	Ordnance Survey® ©Crown Copyright. All rights reserved. Licence No. AL100017966.	NB	SRG	30075/App D	
		Date	Scale		
		June 14	NTS		



Greenhill Road, East to Site Access.



View West on Greenhill Road from railway bridge.



Site and railway from Greenhill Road.



Nursery Lane West from the Site.



General Site view North.



Boiler house and existing glass houses.



General view South along Eastern boundary.



Eastern boundary with railway.



Existing ditch crossing Site.



Greenhill Road boundary.



View North along Western boundary.



General Site view, North to Greenhill Road.

APPENDIX E

**Environment Agency
Flood Risk Information**

From: Reynolds, Helen A [helen.reynolds02@environment-agency.gov.uk]
Sent: 19 June 2014 09:45
To: Simon Gough
Subject: STH3243HR - Greenhill Nursery, Allerton, Liverpool
Attachments: STH3243HR Map 2.pdf

Dear Simon

Request for information under the Freedom of Information Act 2000 (FOIA) /
Environmental Information Regulations 2004 (EIR)

Further to your request of 18 June in which you ask for any flooding data we hold for Greenhill Nursery, Allerton, Liverpool, I can confirm that this area does not sit in a flood zone and as such we have no flood history for the site or area.

I hope that we have correctly interpreted your request. Please see the attached Standard Notice or licence for details of permitted use.

We respond to requests for recorded information that we hold under the Freedom of Information Act 2000 (FOIA) and the associated Environmental Information Regulations 2004 (EIR).

If you are not satisfied with our response to your request for information you can contact us within 2 calendar months to ask for our decision to be reviewed.

Yours sincerely

Helen Reynolds
Customers and Engagement Officer
Cumbria and Lancashire + Greater Manchester, Merseyside and Cheshire
Environment Agency
Ghyll Mount, Gillan Way, Penrith 40 Business Park, Penrith, Cumbria, CA11 9BP
Telephone: 01768 215848
Email: NWinforequests@environment-agency.gov.uk

Follow us on Twitter @EnvAgencyNW
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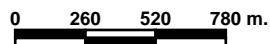
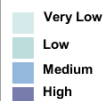
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We may have to make this message and any reply to it public if asked to under the Freedom of Information Act, Data Protection Act or for litigation. Email messages and attachments sent to or from any Environment Agency address may also be accessed by someone other than the sender or recipient, for business purposes.

Allerton, Liverpool



Legend

National Flood Risk Assessment (NaFRA)



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APPENDIX F
Existing Sewer
Records

APPENDIX G
Consultation with
United Utilities

140702_UU_Lunt(Flow Rates)

From: Lunt, John [John.Lunt@uuplc.co.uk]
Sent: 02 July 2014 11:17
To: Simon Gough
Cc: Wastewater Developer Services
Subject: (UU ref: DE0116) - Greenhill Nursery, Allerton, Liverpool (30075)

Hi Simon,

In reply, I can confirm that UU would have no objection in principle to the site being designed and served using a separate drainage system combining on site just prior to communicating with the public sewerage system. The surface water flows generated from the site should be limited to a maximum discharge rate of 25 l/s whilst discharging in to the public sewer located within Greenhill Road.

Due to the public sewer being relatively deep, we will consider the use of a back-drop scenario to alleviate possible construction difficulties associated with working on deep systems, details of which would need to be submitted beforehand for assessment purposes.

If I can be of any further assistance with the above then please don't hesitate to get in touch.

Regards,

John Lunt
Developer Query Engineer
DDI – 01925 679411

From: Simon Gough [mailto:simon.gough@ironsidefarrar.com]
Sent: 25 June 2014 17:41
To: Lunt, John
Subject: FW: Greenhill Nursery, Allerton, Liverpool(30075)

John, further to our original email regards the above, additional information has come to light that will influence the drainage of the site. The watercourse shown on the records crossing the site and then running under the railway is actually no more than a shallow ditch and at the railway is still only 0.95m deep. The manhole at the railway also has a lot of debris in it and the pipe does not appear to be running. To discharge into this system and get cover over pipes we would need to raise the site by up to 1.3m which we have been told is unacceptable to the planners.

We therefore propose to have a separate system on site and combine in the last manhole

140702_UU_Lunt(Flow Rates)

before
connection to the combined sewer.

There is a 375mm dia. combined sewer in Greenhill Road and at manhole 1502 a connection from the site can be made, albeit the sewer in Greenhill Road is some 6.2m deep. Alternatively, there is a 225mm dia. combined sewer at the junction of Nursery Lane and Burman Road. The depth is not known of this sewer but the site falls in this direction and manhole 4401 downstream is approximately 1.7m deep and could form the connection point.

As the site is presently a nursery we have assumed the site would be treated as Greenfield and we therefore propose to discharge at Greenfield rates calculated as 11.7, 22.7 and 27.9l/s in the 1, 30 and 100 year events.

I would be grateful if you could confirm the preferred connection point(4401 suggested) and the rate of flow United Utilities can accept from the site.

Regards

Simon Gough | Director | Ironside Farrar | 3 Worsley Court | Worsley | Manchester |M28 3NJ |
Tel: 0161 703 8801 | Fax: 0161 703 8279 | Mobile: 07717 023091 |
Web:ironsidefarrar.com

Find out more www.thehelix.co.uk

Aerial image courtesy of Alan Corrie

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From: Simon Gough
Sent: 17 June 2014 12:37 PM
To: 'Lunt, John'
Cc: 'Wastewater Developer Services'
Subject: Greenhill Nursery, Allerton, Liverpool(30075)

John, we are undertaking a Flood Risk Assessment for the above site, the details of which are indicated on the attached extract from the sewer records.
The site is the former Greenhill Nursery.

140702_UU_Lunt(Flow Rates)

Please could you confirm whether there are any flooding incidents relating to the Public Sewers in the vicinity of the site?

For the development it is likely the SW will be discharged to the watercourse and the foul to an available combined sewer, probably in Nursery Lane.
Please could you confirm this will be acceptable.

Your earliest attention to this matter would be most appreciated.

Regards

Simon Gough | Director | Ironside Farrar | 3 Worsley Court | Worsley | Manchester |M28 3NJ |
Tel: 0161 703 8801 | Fax: 0161 703 8279 | Mobile: 07717 023091 |
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APPENDIX H
Proposed Development
&
Drainage Layout

APPENDIX I

Hydraulic Calculations

Ironside Farrar Ltd		Page 1												
3 Worsley Court High Street Worsley Manchester	Proposed Greenfield Runoff Greenhill Nursery, Allerton													
Date Jun 14 File	Designed by RDE Checked by SRG													
Micro Drainage		Source Control 2014.1												
<p align="center"><u>ICP SUDS Mean Annual Flood</u></p> <p align="center">Input</p> <table> <tr> <td>Return Period (years)</td> <td>2</td> <td>Soil</td> <td>0.450</td> </tr> <tr> <td>Area (ha)</td> <td>2.638</td> <td>Urban</td> <td>0.000</td> </tr> <tr> <td>SAAR (mm)</td> <td>793</td> <td>Region Number</td> <td>Region 10</td> </tr> </table> <p align="center">Results 1/s</p> <p align="center">QBAR Rural 13.4 QBAR Urban 13.4</p> <p align="center">Q2 years 12.5</p> <p align="center">Q1 year 11.7 Q30 years 22.7 Q100 years 27.9</p>			Return Period (years)	2	Soil	0.450	Area (ha)	2.638	Urban	0.000	SAAR (mm)	793	Region Number	Region 10
Return Period (years)	2	Soil	0.450											
Area (ha)	2.638	Urban	0.000											
SAAR (mm)	793	Region Number	Region 10											
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Ironside Farrar Ltd		Page 1
3 Worsley Court High Street Worsley Manchester	Proposed SW Network Rev A Greenhill Nursery, Allerton	
Date Jul 14	Designed by RDE	
File 30075 Proposed SW Netw...	Checked by SRG	
Micro Drainage		Network 2014.1

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.600	Minimum Backdrop Height (m)	0.000
Ratio R	0.400	Maximum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	0	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits








Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.906	4-8	0.559

Total Area Contributing (ha) = 1.465


Total Pipe Volume (m³) = 267.704

Network Design Table for Storm












PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	23.324	0.058	402.1	0.086	5.00	0.0	0.600	o	900	
1.001	10.487	0.026	403.3	0.144	0.00	0.0	0.600	o	900	
1.002	13.763	0.034	404.8	0.000	0.00	0.0	0.600	o	900	
1.003	14.199	0.035	405.7	0.117	0.00	0.0	0.600	o	900	
1.004	13.346	0.033	404.4	0.000	0.00	0.0	0.600	o	900	
1.005	32.185	0.080	400.0	0.033	0.00	0.0	0.600	o	900	
1.006	22.145	0.055	400.0	0.159	0.00	0.0	0.600	o	900	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	0.00	5.25	27.050	0.086	0.0	0.0	0.0	1.56	990.1	0.0
1.001	0.00	5.36	26.992	0.230	0.0	0.0	0.0	1.55	988.6	0.0
1.002	0.00	5.51	26.966	0.230	0.0	0.0	0.0	1.55	986.8	0.0
1.003	0.00	5.66	26.932	0.347	0.0	0.0	0.0	1.55	985.6	0.0
1.004	0.00	5.81	26.897	0.347	0.0	0.0	0.0	1.55	987.2	0.0
1.005	0.00	6.15	26.864	0.380	0.0	0.0	0.0	1.56	992.7	0.0
1.006	0.00	6.39	26.784	0.539	0.0	0.0	0.0	1.56	992.7	0.0


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3 Worsley Court High Street Worsley Manchester	Proposed SW Network Rev A Greenhill Nursery, Allerton	
Date Jul 14 File 30075 Proposed SW Netw...	Designed by RDE Checked by SRG	
Micro Drainage		Network 2014.1


Network Design Table for Storm


PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
2.000	21.361	0.053	400.0	0.225	5.00	0.0	0.600	o	900	
2.001	57.649	0.144	400.3	0.149	0.00	0.0	0.600	o	900	
2.002	33.729	0.084	401.5	0.107	0.00	0.0	0.600	o	900	
2.003	9.334	0.023	405.8	0.000	0.00	0.0	0.600	o	900	
3.000	37.751	0.094	401.6	0.118	5.00	0.0	0.600	o	900	
3.001	42.063	0.106	396.8	0.141	0.00	0.0	0.600	o	900	
1.007	25.693	0.064	400.0	0.018	0.00	0.0	0.600	o	900	
1.008	21.124	0.053	400.0	0.087	0.00	0.0	0.600	o	1200	
1.009	14.355	0.036	400.0	0.022	0.00	0.0	0.600	o	1200	
1.010	7.839	0.454	17.3	0.059	0.00	0.0	0.600	o	225	
1.011	3.373	0.022	150.0	0.000	0.00	0.0	1.500	o	225	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
2.000	0.00	5.23	27.032	0.225	0.0	0.0	0.0	1.56	992.7	0.0
2.001	0.00	5.84	26.979	0.374	0.0	0.0	0.0	1.56	992.3	0.0
2.002	0.00	6.21	26.835	0.481	0.0	0.0	0.0	1.56	990.8	0.0
2.003	0.00	6.31	26.751	0.481	0.0	0.0	0.0	1.55	985.5	0.0
3.000	0.00	5.40	26.928	0.118	0.0	0.0	0.0	1.56	990.7	0.0
3.001	0.00	5.85	26.834	0.259	0.0	0.0	0.0	1.57	996.7	0.0
1.007	0.00	6.66	26.728	1.297	0.0	0.0	0.0	1.56	992.7	0.0
1.008	0.00	6.85	26.363	1.384	0.0	0.0	0.0	1.86	2108.6	0.0
1.009	0.00	6.98	26.311	1.406	0.0	0.0	0.0	1.86	2108.6	0.0
1.010	0.00	7.02	26.275	1.465	0.0	0.0	0.0	3.16	125.8	0.0
1.011	0.00	7.08	25.821	1.465	0.0	0.0	0.0	0.94	37.2	0.0

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<u>PIPELINE SCHEDULES for Storm</u>									
<u>Upstream Manhole</u>									
PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)	
1.000	o	900	1	29.150	27.050	1.200	Open Manhole	2400	
1.001	o	900	2	29.100	26.992	1.208	Open Manhole	2400	
1.002	o	900	3	29.150	26.966	1.284	Open Manhole	2400	
1.003	o	900	4	29.250	26.932	1.418	Open Manhole	2400	
1.004	o	900	5	29.350	26.897	1.553	Open Manhole	2400	
1.005	o	900	6	29.400	26.864	1.636	Open Manhole	2400	
1.006	o	900	7	29.800	26.784	2.116	Open Manhole	2400	
2.000	o	900	8	29.400	27.032	1.468	Open Manhole	2400	
2.001	o	900	9	29.600	26.979	1.721	Open Manhole	2400	
2.002	o	900	10	29.750	26.835	2.015	Open Manhole	2400	
2.003	o	900	11	29.850	26.751	2.199	Open Manhole	2400	
3.000	o	900	12	29.800	26.928	1.972	Open Manhole	2400	
3.001	o	900	13	29.750	26.834	2.016	Open Manhole	2400	
1.007	o	900	14	29.900	26.728	2.272	Open Manhole	2400	
1.008	o	1200	15	30.100	26.363	2.537	Open Manhole	2700	
1.009	o	1200	16	30.640	26.311	3.129	Open Manhole	2700	
1.010	o	225	17	31.290	26.275	4.790	Open Manhole	2700	
1.011	o	225	18	31.750	25.821	5.704	Open Manhole	1200	
<u>Downstream Manhole</u>									
PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)	
1.000	23.324	402.1	2	29.100	26.992	1.208	Open Manhole	2400	
1.001	10.487	403.3	3	29.150	26.966	1.284	Open Manhole	2400	
1.002	13.763	404.8	4	29.250	26.932	1.418	Open Manhole	2400	
1.003	14.199	405.7	5	29.350	26.897	1.553	Open Manhole	2400	
1.004	13.346	404.4	6	29.400	26.864	1.636	Open Manhole	2400	
1.005	32.185	400.0	7	29.800	26.784	2.116	Open Manhole	2400	
1.006	22.145	400.0	14	29.900	26.728	2.272	Open Manhole	2400	
2.000	21.361	400.0	9	29.600	26.979	1.721	Open Manhole	2400	
2.001	57.649	400.3	10	29.750	26.835	2.015	Open Manhole	2400	
2.002	33.729	401.5	11	29.850	26.751	2.199	Open Manhole	2400	
2.003	9.334	405.8	14	29.900	26.728	2.272	Open Manhole	2400	
3.000	37.751	401.6	13	29.750	26.834	2.016	Open Manhole	2400	
3.001	42.063	396.8	14	29.900	26.728	2.272	Open Manhole	2400	
1.007	25.693	400.0	15	30.100	26.663	2.537	Open Manhole	2700	
1.008	21.124	400.0	16	30.640	26.311	3.129	Open Manhole	2700	
1.009	14.355	400.0	17	31.290	26.275	3.815	Open Manhole	2700	
1.010	7.839	17.3	18	31.750	25.821	5.704	Open Manhole	1200	
1.011	3.373	150.0		31.867	25.798	5.844	Open Manhole	0	
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<p align="center"><u>Simulation Criteria for Storm</u></p> <p> Volumetric Runoff Coeff 0.750 Additional Flow - % of Total Flow 0.000 Areal Reduction Factor 1.000 MADD Factor * 10m³/ha Storage 2.000 Hot Start (mins) 0 Inlet Coeffiecient 0.800 Hot Start Level (mm) 0 Flow per Person per Day (l/per/day) 0.000 Manhole Headloss Coeff (Global) 0.500 Run Time (mins) 60 Foul Sewage per hectare (l/s) 0.000 Output Interval (mins) 1 </p> <p> Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0 Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0 </p> <p align="center"><u>Synthetic Rainfall Details</u></p> <p> Rainfall Model FSR Profile Type Summer Return Period (years) 2 Cv (Summer) 0.750 Region England and Wales Cv (Winter) 0.840 M5-60 (mm) 19.600 Storm Duration (mins) 30 Ratio R 0.400 </p>		
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Online Controls for Storm

Hydro-Brake Optimum® Manhole: 17, DS/PN: 1.010, Volume (m³): 41.9


Unit Reference	MD-SHE-0196-2500-2525-2500
Design Head (m)	2.525
Design Flow (l/s)	25.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	196
Invert Level (m)	26.275
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.525	24.9	Kick-Flo®	1.524	19.6
Flush-Flo™	0.731	24.9	Mean Flow over Head Range	-	21.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.8	1.200	23.5	3.000	27.1	7.000	40.7
0.200	18.4	1.400	21.6	3.500	29.2	7.500	42.1
0.300	21.9	1.600	20.1	4.000	31.1	8.000	43.4
0.400	23.4	1.800	21.2	4.500	32.9	8.500	44.7
0.500	24.3	2.000	22.3	5.000	34.6	9.000	46.0
0.600	24.7	2.200	23.3	5.500	36.3	9.500	47.2
0.800	24.9	2.400	24.3	6.000	37.8		
1.000	24.4	2.600	25.3	6.500	39.3		

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Storage Structures for Storm

Cellular Storage Manhole: 17, DS/PN: 1.010

Invert Level (m) 28.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	240.0	0.0	5.200	0.0	0.0
0.400	240.0	0.0	5.600	0.0	0.0
0.800	240.0	0.0	6.000	0.0	0.0
0.801	0.0	0.0	6.400	0.0	0.0
1.600	0.0	0.0	6.800	0.0	0.0
2.000	0.0	0.0	7.200	0.0	0.0
2.400	0.0	0.0	7.600	0.0	0.0
2.800	0.0	0.0	8.000	0.0	0.0
3.200	0.0	0.0	8.400	0.0	0.0
3.600	0.0	0.0	8.800	0.0	0.0
4.000	0.0	0.0	9.200	0.0	0.0
4.400	0.0	0.0	9.600	0.0	0.0
4.800	0.0	0.0	10.000	0.0	0.0

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