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320120179P

Briery Homes

Land at Accrington Road, Whalley
Flood Risk Assessment /
Drainage Strategy

T1528-D-01

14th February 2012

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Document Control Sheet

Land at Accrington Road, Whalley
Flood Risk Assessment

Job	Date	Issue	Copy
T1528	14 th February 2012		

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1. Development & Site Description

- 1.1. PSA Design have been commissioned to undertake a Flood Risk Assessment & Drainage Strategy to support an **outline planning application** being made by Briery Homes for a proposed residential development for the over 55's on land adjacent to Accrington Road, Whalley (the sites location is shown on Figures 1 and 2).
- 1.2. The national grid reference for the site is 373550E, 436008N.
- 1.3. The proposed works include the erection of 40 retirement flats, 38 bungalows with associated roads and parking areas.
- 1.4. The topographical survey for the site is included as Drawing T1528-D-02
- 1.5. The indicative site plan outlining the proposals can be seen on the Architects drawing attached
- 1.6. The total site area is approximately 2.97ha.

2. Definition of Flood Hazard and Probability

- 2.1. Reference to the Environment Agency's online flood mapping clearly indicates that the site lies within Flood Zones 1, 2 and 3a and is at direct risk of fluvial flooding from the River Calder. However it should be noted that almost 60% of the proposed units would lie within Flood Zone 1.
- 2.2. The Environment Agency describes the various Flood Zones as follows:
 - Flood Zone 1 as located in an area with the flood risk classed as "Low Probability", with less than 1 in 1000 annual probability of river or sea flooding.
 - Flood Zone 2, "Medium Probability", comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year.

- Flood Zone 3a, "High Probability", comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
- 2.3. Detailed flood level data has been acquired from the Environment Agency and is summarised on Figure 3. The flood mapping indicates that Flood Zone 3 is bounded to the south within the banks of River Calder. Inspection of the detailed topographical survey confirms this, however it would suggest that small area (20m²) may be inundated during a peak flood event.
- 2.4. The mapping shows that the majority of the western area of the site falls within Flood Zone 2 with an area of Flood Zone 1 along the east to northeast boundary. Again, this is reflected when referenced to the topographical survey.

3. Compliance with PPS 25

- 3.1. The Architects proposals show no development will take place within a 16m buffer from the southern boundary. Therefore the small area of the site currently located in Flood Zone 3 will remain as open space. It should be noted that as part of the development proposals excavation will take place on the southern part of the site to expand Flood Zone 3a and thereby create additional floodplain volume which will help protect this site and effectively reduce flood risk to other areas downstream.
- 3.2. With reference to Table D 2 of PPS 25 a development consisting of "dwelling houses" would fall into the "More Vulnerable" classification
- 3.3. Therefore, in accordance with Table D.3 of PPS 25 the site proposals are deemed "appropriate" for development within Flood Zones 1 and 2.

4. Sources of Flooding

- 4.1. In accordance with PPS25, flood risk has been assessed from the following sources; tidal and river, surface water and flooding from the land, groundwater, sewer flooding and artificial sources (i.e. canals, reservoirs etc)

Tidal and Fluvial Flooding

- 4.2. PPS25 sets out a clear strategy not just to meet the minimum requirements based on existing scenarios but to safeguard proposed developments against the effects of climatic change. It is therefore important to assess the impact of climatic change on future flood levels and set proposed floor levels accordingly.
- 4.3. Reference to the Environment Agency flood level data included as Figure 3 shows modelling nodes close to the site and lists the flood level for each event. In order to ascertain a flood level at the proposed site it has been necessary to interpolate between the modelling nodes to the east and west. **The Q100+CC level at the site has been calculated at 45.98mAOD.**
- 4.4. As the majority of the dwellings on site will be single storey type bungalows the Environment Agency would normally require that a freeboard of 600mm be included when assessing minimum floor levels. Therefore for the purposes of this development the **floor levels will be set at a minimum of 46.60mAOD** with surrounding ground levels 150mm below that (46.45mAOD) and graded down back to existing.

Surface Water and Flooding from the Land

- 4.5. Inspection of aerial photograph and the topographical survey has not identified any significant areas of hardstanding which could shed floodwater onto the development.
- 4.6. Flood risk from this source is expected to be low.

Groundwater

- 4.7. Given the topography of the land and reference to the ground investigation report, groundwater flooding is considered unlikely.
- 4.8. The Strategic Flood Risk Assessment for Ribble Valley also makes reference to Groundwater flooding and states "Following consultation with the EA, no evidence of groundwater flooding in the area has been identified" and "using the best available information are not considered to be a significant risk at this time".
- 4.9. Flood risk from this source has not been considered further.

Sewer Flooding

- 4.10. Reference to Figure 4 shows an extract of United Utilities sewer records. The nearest surface water sewers are to the north of Accrington Road and are not considered a threat to the site having no direct pathways.

Artificial Sources

- 4.11. Inspection of the aerial photo graphs and OS mapping has established that no artificial sources were identified in the vicinity of the site.
- 4.12. Flood risk from this source has not been considered further.

5. Drainage Strategy

Surface Water Management

- 5.1. The Environment Agency will normally require that, for the range of annual flow rate probabilities, up to and including the 1% annual probability (1 in 100 year event) the developed rate of run-off into a watercourse should be no greater than the undeveloped rate of run-off for the same event. (In the case of brownfield sites, drainage proposals will be measured against the existing performance of the site). Water Authorities normally take a similar approach to that of the Environment Agency, however they would normally ask that flows be restricted to include up to the 3.33% annual probability (1 in 30 year event), whilst demonstrating that the 1 in 100 year event does not pose a threat to the locality (known as designing for exceedance). Both these requirements are in line with the strategy outlined in PPS25 which states *"surface water arising from a development site should, as far as practicable be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account."*
- 5.2. Climate change (CC) will be taken into account by increasing the rainfall intensity by 30% in line with Environment Agency and PPS 25 guidelines.

- 5.3. Building Regulations and PPS 25 also outline a preferred hierarchy for the disposal of surface water run-off. The Building Regulations states that consideration should be given to discharge to soakaways, infiltration systems, watercourses or finally adopted sewers in that priority order

Existing Site Drainage

- 5.4. The existing site is 'greenfield' and therefore there is currently no formal site drainage.

Proposed Drainage Solutions – Surface Water

- 5.5. The impermeable areas of the proposed development have been calculated and are highlighted on Drawing T1528/D/01. It is assumed that in line with best practice that the detailed design of the site will ensure that driveways will be laid to fall into adjacent landscaping areas. However, to provide a robust assessment it has been assumed at this stage that 50% of the driveways will fall into the drainage system. **The total impermeable area for the site is 9,956m².**
- 5.6. This drainage strategy seeks to assess that a suitable solution can be provided in line with PPS25. A ground investigation has been undertaken and percolation test carried out. The investigation concluded that the site is mainly clay and therefore surface water drainage by soakaways would not be appropriate.
- 5.7. Given the topography of the land it is safe to assume that all greenfield run-off from the site currently outfalls direct to the River Calder. MicroDrainage has been used to assess the existing greenfield run-off rates from the 2.97ha site based on the "IoH 124 Report" methodology. The calculations are included within Appendix A and summarised in Table 1 below.

Event	Greenfield Run-off (l/s)
1 in 1yr	24.6
1 in 30yr	48.0
1 in 100yr	58.9

Table 1: Existing Greenfield Runoff

- 5.8. As soakaways are not a viable option and looking at a worse case scenario where no additional drainage measures (rainwater harvesting, green-roofs, swales etc) are implemented at detailed design stage, then the all surface water from the development would drain directly to the River Calder at the existing sites greenfield run off rate
- 5.9. It must therefore be demonstrated that a suitable drainage proposal can be achieved that discharges to the River Calder at rates restricted to existing. In line with PPS25 two scenarios will be assessed, the 1 in 30 year (3.33%) and 1 in 100 year (1%) event. An allowance for 30% climatic change will be applied and flows restricted and attenuated to the 1 in 1 year rate of 24.6l/s
- 5.10. WinDES Microdrainage has been used to assess the run-off rates and attenuation requirements for each event. These calculations are included in Appendix B with the results summarised in Table 2 below.

	1 in 30yr Storm (+30% CC)	1 in 100yr Storm (+30% CC)
Proposed Imp Area	9,956 m ²	
Run-off Restriction (1 in 1yr Existing Run-off)	24.6 l/s	
Attenuation Requirement	249.5 m ³	364.8 m ³

Table 2: Proposed Attenuation Requirements

- 5.11. There are many options available to accommodate this storage requirement within the proposed drainage system such as oversized pipes, cellular storage, balancing ponds or lined trenches.
- 5.12. The system should be designed to accommodate the 1 in 30 year event (249.5m³).
- 5.13. The design should also assess the impact of the 1 in 100 year event exceedance volume of 115.3m³ (364.8-249.5). The site levels should ensure that this flood water is directed to landscaped areas, carriageways, parking areas etc and route water away from property thresholds.
- 5.14. To ensure that a valid option is achievable then in this instance we have calculated the requirements utilising a cellular storage system under the access road or landscaped areas.

These could be in the form of one large unit or several smaller individual systems with their own flow control devices. Assuming one large unit a volume of 249.5m^3 would equate to a system measuring approximately $30\text{m(L)} \times 6\text{m(W)} \times 1.56\text{m(D)}$. Such a system would afford a total storage capacity of 266.7m^3 .

- 5.15. It is important to note that this system takes no account of the peripheral storage that will be available within the remainder of the proposed drainage network and therefore the figure above is likely to be considerably less.

6. Foul Drainage

- 6.1. Whilst not a requirement of PPS25, the following section discusses the issue of the foul drainage for the proposed development.
- 6.2. There are currently no foul or combined sewers serving the site.
- 6.3. The foul flow from the development will be generated by the residential dwellings. Calculations have been undertaken to assess the predicted run-off using standard industry guidelines and these are included as Appendix C. In summary the peak average flow would be **10.4 l/s** and the average daily flow would be **40,140 l/day**.
- 6.4. It should be noted that as part of the nearby Lawsonsteads planning application (3/2011/0111/P) United Utilities confirmed that the Whalley Wastewater Treatment Works could accommodate 222 dwellings immediately with other dwellings being accommodated after a 54 month period. This period was to allow the sewage undertaker to address capacity at the Whalley Wastewater Treatment Works and the capacity of the sewer network serving the development and feeding into the Whalley Wastewater Treatment Works.
- 6.5. As the Lawsonsteads planning application was refused it is considered that the proposed 78 dwellings could be easily accommodated by the existing treatment works. We have contacted United Utilities to confirm this assumption and at the time of writing this report are currently awaiting a response.
- 6.6. It is therefore recommended that foul drainage serving the site will discharge to the existing adopted sewerage network. To this end, final connection points and layout should be discussed and agreed by United Utilities at detailed design stage. Should for any reason this approach not

be feasible, then there is sufficient room on site to ensure that foul discharge is dealt with by means of a sewage treatment plant. The Architects layout highlights an area to the south east of the site where such a facility could be accommodated.

- 6.7. If required, the design and specification of the treatment plant would be subject to Environment Agency approval and consent. Whilst outfall from a modern treatment plant is suitable for discharge direct to a watercourse it is recommended that it should first pass through a reeded wetland area. This would further enhance the water quality by providing a secondary treatment zone. It would also be recommended that a maintenance agreement be established to ensure regular maintenance and de-sludging of the plant.

7. Conclusions

- 7.1 The site is located in Flood Zones 1, 2 and 3a. However, no development will take place within Flood Zone 3a and excavation works undertaken as part of the development will expand the existing Flood Zone 3a thereby creating additional floodplain volume (circa 3000m³) which will reduce flood risk to others downstream.
- 7.2. Finished floor levels will be set at a minimum of 46.60m AOD, 600mm above the 1 in 100yr event adjusted for climatic change.
- 7.3. Flows from the proposed development site will be restricted to the existing 1 in 1 year run-off rates including an allowance for an increase of 30% to account for climatic change. This strategy will meet and exceed the requirements of PPS25. It will provide betterment to the existing surface water run-off experienced on site as all existing run-off over and above the 1 in 1 year rates will be restricted to this level.
- 7.4. Reference to the ground investigation indicates that soakaways would not be a viable option. Whilst the attenuation facilities and drainage design will be finalised at detail design stage, this report has outlined a relatively simple sustainable solution to provide capacity to accommodate a 1 in 30 year event with an allowance for 30% increase due to climatic change.
- 7.5. Careful detailed design of levels throughout the site will ensure that exceedance flows are directed away from building thresholds and flood waters are temporarily stored in landscaped / paved areas.

Briery Homes

Land at Accrington Road, Whalley

Flood Risk Assessment & Drainage Strategy

- 7.6 Foul discharge rates have been identified and it is anticipated that foul sewage would be discharged to the existing drainage network that ultimately outfalls into the Whalley Wastewater Treatment Works (subject to further consultation with United Utilities at detailed design stage). Failing that a suitable on site sewage treatment plant solution could be readily achieved.
- 7.7 All works up to and including an 8m setback from the top of the embankment of the River Calder will be subject to Environment Agency approval and necessary consents.

It is therefore concluded that the proposed development can be designed and constructed to meet and exceed the requirements of PPS25.

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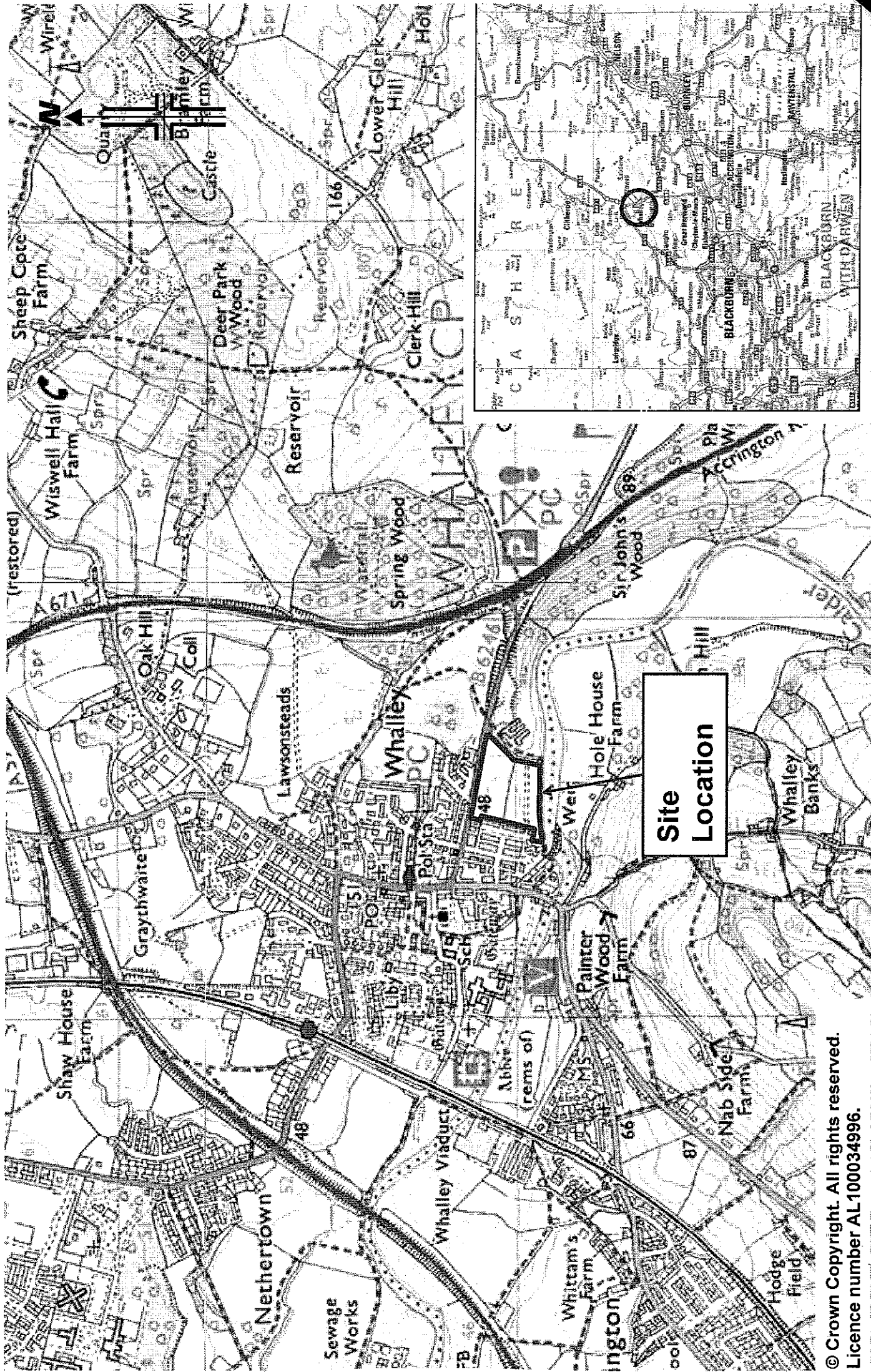
Figures

Figure 1 – Site Location

Figure 2 – Aerial Photograph

Figure 3 – Environment Agency Flood Level Data

Figure 4 – Extract of United Utilities mapping



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Client	Briery Homes
Job	Accrington Road, Whalley
Title	Location Plan

Drawn	GS
Checked	
Approved	

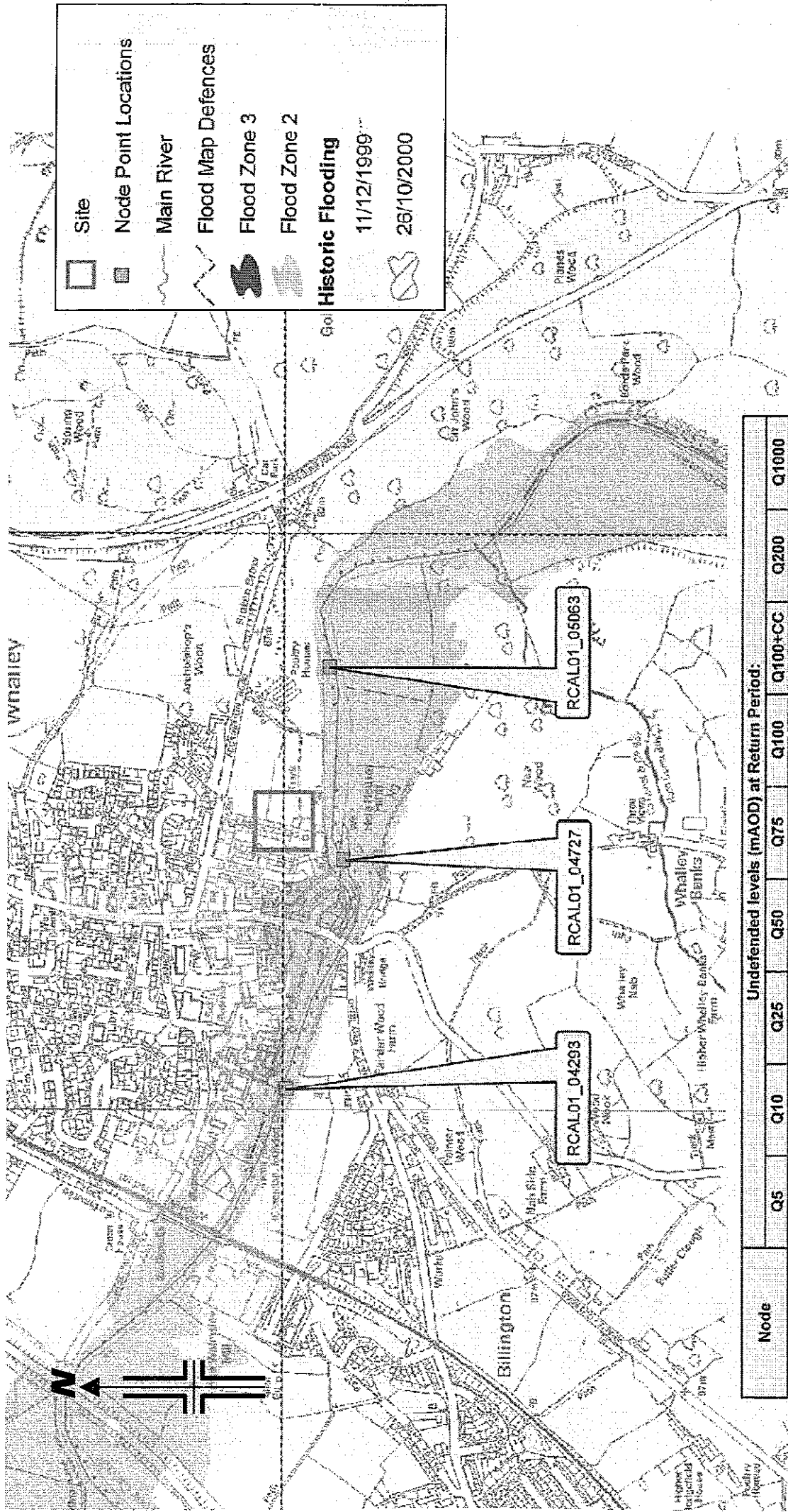
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Scale	NTS

Drawing No.	Figure
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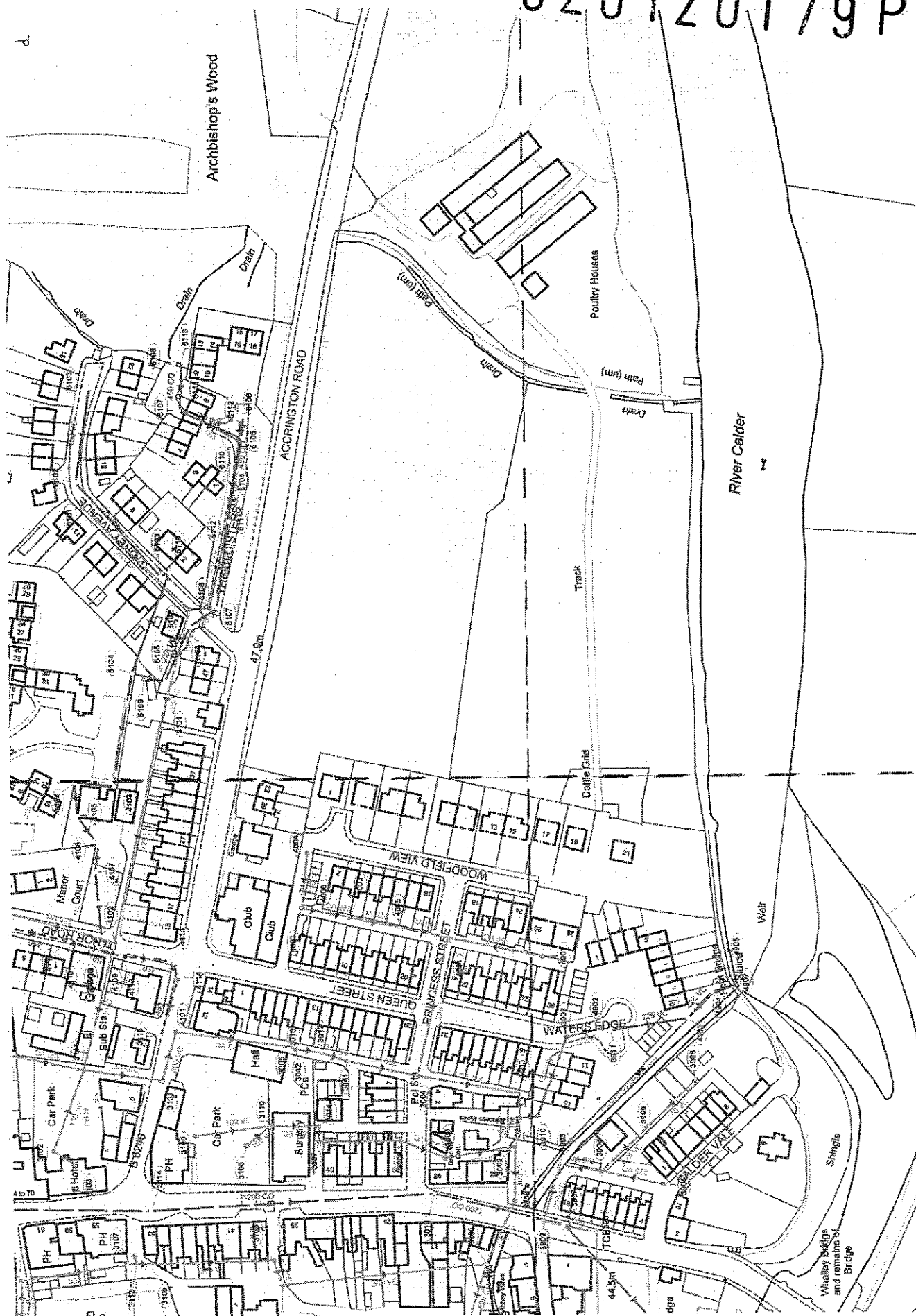
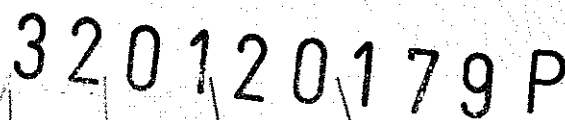


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	Job Accrington Road, Whalley		Checked		Scale NTS		NTS		Date		Drawing No.	
	Title Aerial Photograph		Approved		Scale		Date		Drawing No.		Figure 2	



Node	Undefended levels (mAOD) at Return Period:									
	Q5	Q10	Q25	Q50	Q75	Q100	Q100+CC	Q200	Q1000	
RCAL01_05063	45.65	45.70	45.75	45.80	45.85	45.89	46.20	46.17	46.95	
RCAL01_04727	44.15	44.41	44.77	45.04	45.22	45.34	45.86	45.82	46.89	
RCAL01_04293	43.04	43.24	43.51	43.73	43.86	43.98	44.44	44.40	45.28	

Table 01
Data from Whalley SFRM (2009)

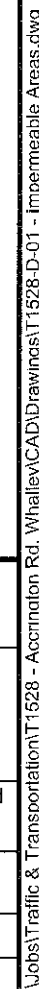


Drawings

T1528-D-01 – Impermeable Areas Drawing

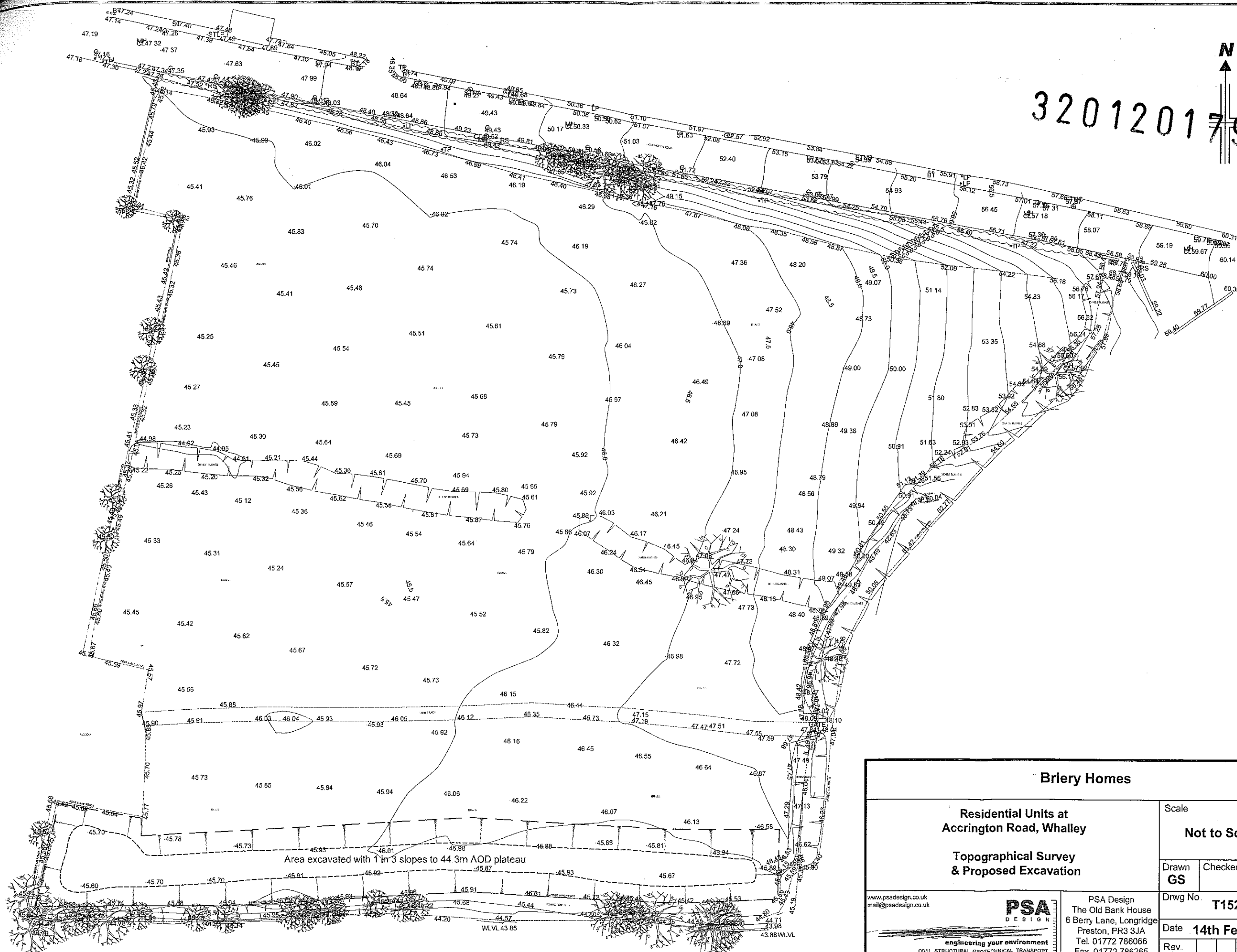
T1528-D-02 – Topographical Survey & Proposed Excavation

1637-040 P3 - Architects Proposed Site Plan



Briery Homes	
Residential Units at Accrington Road, Whalley Impermeable Areas Drawing	Scale Not to Scale
	Drawn GS Checked Approved
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Area excavated with 1 in 3 slopes to 44.3m AOD plateau

Briery Homes

Residential Units at
Accrington Road, Whalley

Topographical Survey
& Proposed Excavation

Scale

Not to Scale

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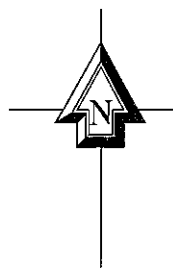
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0 25m 50m
Scale 1:500

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Bungalow Type A- 29 Units
Bungalow Type B- 6 Units
Bungalow Type C- 3 Units

TOTAL 38 Units

Units denoted * are to be
affordable units

C 16/02/12 Site sections removed and annotation to sewage treatment plant changed
B 03/02/12 Affordable note changes for the apartments
A 02/02/12 Plot numbers added

Revisions
Not to be scaled © Harrison & Pitt Architects Ltd

Project Outline Planning Application for 38No. Elderly
Person's Bungalows & 40No. Retirement Apartments
Sited at Accrington Road, Whalley
for Briery Homes

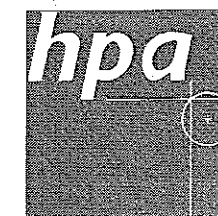
Title PROPOSED INDICATIVE
SITE PLAN

Drawing number 1637-040 C 1:500 @ A2 01/12

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Appendix A

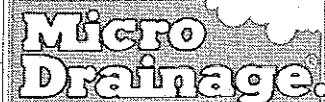
Existing Greenfield Runoff Rates

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Date 13 February 2012 17:05
File

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Source Control W.11.2



Micro Drainage

IH 124 Mean Annual Flood

Input

Return Period (years)	1	SAAR (mm)	1065.000	Urban	0.000
Area (Ha)	2.880	Soil	0.450	Region Number	10

Results 1/s

QBAR Rural 28.3
QBAR Urban 28.3

Q	1 year	24.6
Q	1 year	24.6
Q	2 years	26.4
Q	5 years	33.7
Q	10 years	39.1
Q	20 years	44.5
Q	25 years	46.4
Q	30 years	48.0
Q	50 years	52.4
Q	100 years	58.9
Q	200 years	66.8
Q	250 years	69.3
Q	1000 years	86.0

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Appendix B

Attenuation Requirement Calculations

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Page 3



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Micro Drainage

Source Control W.11.2

Rainfall Details

Region	ENG+WAL	Cv (Summer)	0.750	Summer Storms	Yes
Return Period (years)	30	Cv (Winter)	0.840	Winter Storms	Yes
M5-60 (mm)	19.000	Shortest Storm (mins)	15	Climate Change %	+30
Ratio-R	0.300	Longest Storm (mins)	10080		

Time / Area Diagram

Total Area (ha) = 0.996

Time (mins)	Area (ha)
from:	to:

0	4	0.996
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Micro Drainage

Source Control-W.11.2

Circular Pipe Details

Diameter (m) 2.000 Length (m) 200.000 Cover Level (m) 103.000
Slope (1:x) 200.0 Invert Level (m) 100.000

Hydro-Brake Outflow Control

Design Head (m) 1.325 Hydro-Brake Type MD6 Invert Level (m) 100.000
Design Flow (l/s) 24.6 Diameter (mm) 192

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	6.4	0.60	23.3	1.60	26.7	2.60	33.8	5.00	46.9	7.50	57.5
0.20	16.2	0.80	22.3	1.80	28.2	3.00	36.3	5.50	49.2	8.00	59.4
0.30	22.8	1.00	22.7	2.00	29.7	3.50	39.3	6.00	51.4	8.50	61.2
0.40	24.2	1.20	23.7	2.20	31.1	4.00	42.0	6.50	53.5	9.00	63.0
0.50	24.1	1.40	25.2	2.40	32.5	4.50	44.5	7.00	55.5	9.50	64.7

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Micro Drainage

Source Control W.11.2



Summary of Results for 30 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 (m³)	Status
15 Summer	24.2	24.2	101.0068	1.0068	136.5	O K
30 Summer	24.2	24.2	101.1223	1.1223	175.0	O K
60 Summer	24.2	24.2	101.2008	1.2008	203.0	O K
120 Summer	24.2	24.2	101.2243	1.2243	211.5	O K
180 Summer	24.2	24.2	101.2183	1.2183	209.3	O K
240 Summer	24.2	24.2	101.2023	1.2023	203.5	O K
360 Summer	24.2	24.2	101.1628	1.1628	189.3	O K
480 Summer	24.2	24.2	101.1158	1.1158	172.8	O K
600 Summer	24.2	24.2	101.0658	1.0658	155.7	O K
720 Summer	24.2	24.2	101.0138	1.0138	138.7	O K
960 Summer	24.2	24.2	100.9038	0.9038	105.8	O K
1440 Summer	24.2	24.2	100.6628	0.6628	50.6	O K
2160 Summer	23.7	23.7	100.3637	0.3637	11.9	O K
2880 Summer	20.4	20.4	100.2632	0.2632	5.5	O K
4320 Summer	15.2	15.2	100.1892	0.1892	2.5	O K
5760 Summer	12.3	12.3	100.1602	0.1602	1.7	O K
7200 Summer	10.5	10.5	100.1413	0.1413	1.3	O K
8640 Summer	9.2	9.2	100.1283	0.1283	1.0	O K
10080 Summer	8.2	8.2	100.1182	0.1183	0.8	O K
15 Winter	24.2	24.2	101.0653	1.0653	155.6	O K
30 Winter	24.2	24.2	101.1968	1.1968	201.5	O K
60 Winter	24.4	24.4	101.2957	1.2957	237.9	O K
120 Winter	24.6	24.6	101.3262	1.3262	249.5	O K
180 Winter	24.6	24.6	101.3142	1.3142	244.9	O K
240 Winter	24.4	24.4	101.2878	1.2877	235.0	O K
360 Winter	24.2	24.2	101.2218	1.2218	210.6	O K
480 Winter	24.2	24.2	101.1453	1.1453	183.1	O K
600 Winter	24.2	24.2	101.0643	1.0643	155.3	O K
720 Winter	24.2	24.2	100.9793	0.9793	127.9	O K
960 Winter	24.2	24.2	100.7833	0.7833	75.4	O K
1440 Winter	23.6	23.6	100.3562	0.3562	11.3	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	84.94	18
30 Summer	57.99	32
60 Summer	38.01	60
120 Summer	24.17	96
180 Summer	18.30	130
240 Summer	14.95	164
360 Summer	11.23	234
480 Summer	9.16	302
600 Summer	7.81	368
720 Summer	6.86	434
960 Summer	5.58	560
1440 Summer	4.16	794
2160 Summer	3.10	1104
2880 Summer	2.51	1468
4320 Summer	1.86	2188
5760 Summer	1.51	2880
7200 Summer	1.28	3608
8640 Summer	1.12	4352
10080 Summer	1.00	4960
15 Winter	84.94	17
30 Winter	57.99	31
60 Winter	38.01	60
120 Winter	24.17	110
180 Winter	18.30	140
240 Winter	14.95	178
360 Winter	11.23	254
480 Winter	9.16	326
600 Winter	7.81	398
720 Winter	6.86	464
960 Winter	5.58	588
1440 Winter	4.16	762

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The Old Bank House
6 Berry Lane, Longridge
Preston, PR3 3JA

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Summary of Results for 30 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
2160 Winter	18.2	18.2	100.2298	0.2297	3.9	O K
2880 Winter	14.8	14.8	100.1852	0.1852	2.4	O K
4320 Winter	11.0	11.0	100.1468	0.1468	1.4	O K
5760 Winter	8.9	8.9	100.1257	0.1258	1.0	O K
7200 Winter	7.6	7.6	100.1117	0.1118	0.7	O K
8640 Winter	6.6	6.6	100.1022	0.1023	0.6	O K
10080 Winter	5.9	5.9	100.0928	0.0928	0.5	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
2160 Winter	3.10	1100
2880 Winter	2.51	1448
4320 Winter	1.86	2152
5760 Winter	1.51	2896
7200 Winter	1.28	3568
8640 Winter	1.12	4384
10080 Winter	1.00	5048

PSA Design

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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)	19.000	Shortest Storm (mins)	15	Climate Change %	+30
Ratio-R	0.300	Longest Storm (mins)	10080		

Time / Area Diagram

Total Area (ha) = 0.996

Time	(mins)	Area
from:	to:	(ha)
0	4	0.996

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Circular Pipe Details

Diameter (m) 2.000 Length (m) 200.000 Cover Level (m) 103.000
Slope (1:x) 200.0 Invert Level (m) 100.000

Hydro-Brake Outflow Control

Design Head (m) 1.325 Hydro-Brake Type MD6 Invert Level (m) 100.000
Design Flow (l/s) 24.6 Diameter (mm) 192

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	6.4	0.60	23.3	1.60	26.7	2.60	33.8	5.00	46.9	7.50	57.5
0.20	16.2	0.80	22.3	1.80	28.2	3.00	36.3	5.50	49.2	8.00	59.4
0.30	22.8	1.00	22.7	2.00	29.7	3.50	39.3	6.00	51.4	8.50	61.2
0.40	24.2	1.20	23.7	2.20	31.1	4.00	42.0	6.50	53.5	9.00	63.0
0.50	24.1	1.40	25.2	2.40	32.5	4.50	44.5	7.00	55.5	9.50	64.7

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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 (m³)	Status
15 Summer	24.2	24.2	101.1418	1.1418	181.9	O K
30 Summer	24.4	24.4	101.2992	1.2992	239.2	O K
60 Summer	25.4	25.4	101.4262	1.4262	287.4	O K
120 Summer	25.8	25.8	101.4802	1.4802	308.0	O K
180 Summer	25.7	25.7	101.4747	1.4747	305.9	O K
240 Summer	25.6	25.6	101.4567	1.4567	299.1	O K
360 Summer	25.3	25.3	101.4182	1.4182	284.3	O K
480 Summer	25.0	25.0	101.3727	1.3727	267.0	O K
600 Summer	24.6	24.6	101.3237	1.3237	248.5	O K
720 Summer	24.3	24.3	101.2738	1.2738	229.7	O K
960 Summer	24.2	24.2	101.1728	1.1728	192.9	O K
1440 Summer	24.2	24.2	100.9723	0.9723	125.8	O K
2160 Summer	24.2	24.2	100.6438	0.6438	47.2	O K
2880 Summer	23.9	23.9	100.3742	0.3742	12.8	O K
4320 Summer	18.4	18.4	100.2322	0.2322	4.0	O K
5760 Summer	14.8	14.8	100.1852	0.1852	2.4	O K
7200 Summer	12.5	12.5	100.1618	0.1617	1.7	O K
8640 Summer	10.9	10.9	100.1458	0.1458	1.3	O K
10080 Summer	9.7	9.7	100.1332	0.1333	1.1	O K
15 Winter	24.2	24.2	101.2103	1.2103	206.5	O K
30 Winter	25.1	25.1	101.3907	1.3907	273.8	O K
60 Winter	26.3	26.3	101.5467	1.5467	333.5	O K
120 Winter	26.9	26.9	101.6287	1.6287	364.8	O K
180 Winter	26.8	26.8	101.6157	1.6157	360.0	O K
240 Winter	26.6	26.6	101.5887	1.5887	349.7	O K
360 Winter	26.1	26.1	101.5262	1.5262	325.7	O K
480 Winter	25.6	25.6	101.4522	1.4522	297.4	O K
600 Winter	25.0	25.0	101.3747	1.3747	267.7	O K
720 Winter	24.4	24.4	101.2962	1.2962	238.1	O K
960 Winter	24.2	24.2	101.1398	1.1398	181.2	O K
1440 Winter	24.2	24.2	100.7908	0.7908	77.1	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	109.65	18
30 Summer	75.67	32
60 Summer	49.94	62
120 Summer	31.76	106
180 Summer	23.94	138
240 Summer	19.43	172
360 Summer	14.50	242
480 Summer	11.76	310
600 Summer	9.98	380
720 Summer	8.73	446
960 Summer	7.05	578
1440 Summer	5.21	826
2160 Summer	3.83	1168
2880 Summer	3.08	1472
4320 Summer	2.26	2200
5760 Summer	1.82	2888
7200 Summer	1.53	3624
8640 Summer	1.34	4384
10080 Summer	1.19	5032
15 Winter	109.65	18
30 Winter	75.67	32
60 Winter	49.94	60
120 Winter	31.76	116
180 Winter	23.94	146
240 Winter	19.43	184
360 Winter	14.50	262
480 Winter	11.76	338
600 Winter	9.98	410
720 Winter	8.73	480
960 Winter	7.05	616
1440 Winter	5.21	866

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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
2160 Winter	22.5	22.5	100.2947	0.2947	7.2	O K
2880 Winter	18.1	18.1	100.2282	0.2282	3.9	O K
4320 Winter	13.3	13.3	100.1702	0.1703	1.9	O K
5760 Winter	10.7	10.7	100.1438	0.1438	1.3	O K
7200 Winter	9.0	9.0	100.1267	0.1268	1.0	O K
8640 Winter	7.9	7.9	100.1152	0.1153	0.8	O K
10080 Winter	7.0	7.0	100.1062	0.1063	0.7	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
2160 Winter	3.83	1100
2880 Winter	3.08	1468
4320 Winter	2.26	2152
5760 Winter	1.82	2864
7200 Winter	1.53	3544
8640 Winter	1.34	4264
10080 Winter	1.19	4960

Appendix C

Foul Discharge Calculations

320120179P

Foul Discharge Estimates Accrington Road, Whalley

Subject to detailed design

1/2/3 Bed

Appliance

Total No. Discharge Units per appliance (l/s)

Sink	1	0.8	0.8
Bath	1	0.8	0.8
WC	1	2.0	2.0
Wash Hand Basin	1	0.5	0.5
Washing Machine (6kg)	1	0.8	0.8

Discharge Units per House Type **4.9**

No. of house's of this type **88**

Total Discharge Units **431.2**

Total Discharge units into system (ΣDU) **431.2**

Waste water flowrate = $Q_{ww} = K \sqrt{\Sigma DU}$
Based on Frequent use, $K = 0.5$

Peak Run-off

$Q_{ww} =$ litres / second **10.38 l/s**

Note - Above calculations undertaken in accordance with BS EN 12056-2:2000

British Water Code of Practice - Flows and Loads - 3

3 bed house = 5P

2 bed house = 4P

1 bed flat = 3P

Population

6 No. 3 Bed Units = $5P \times 6 = 30P$

32 No. 2 Bed Units = $4P \times 32 = 128P$

40 No. 1 Bed Units = $3P \times 40 = 120P$

Total P 278P

Reduction Factor (0.8) $278p \times 0.8 = 223p$

Estimated Average Flow

$223 \times 180 \text{ l/p/d} =$

40,140 l/day

27.88 l/min

0.47 l/s