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Flood Risk Assessment

ON

Land at
Dodworth Green Road
Dodworth, Barnsley

For

John Whitworth

E16/6705/FR001

August 2016

T. Haigh. BSc.,C.Eng.M.I.C.E.

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1.0 INTRODUCTION

1.1 This report is commissioned to investigate and report on the Flood Risk for this site in accordance Planning Practise Guidance- Flood Risk and Coastal Change April 2015 (PPG-FRCC) and the proposals for drainage of this site when redeveloped as residential land. The report is based on information supplied by the client and from relevant authorities in both written and verbal format. Some of this information is in verbal form only. No liability can be accepted for information supplied by third parties which is subsequently found to be inaccurate or incorrect.

2.0 THE SITE

2.1 The site is located off Dodworth Green Road, Dodworth, Barnsley, and is situated around Ordnance Survey grid reference SE 31265 04930. A site location plan is shown on Figure 1 in Appendix B.

2.2 The site is approximately rectangular in nature, with only a limited frontage to Dodworth Green Road in the north-western corner of the site. The site is partially developed with three large detached houses: two on the northern boundary and another mid-way down the western boundary of the site. The total developable area including the existing houses is approximately 2.22ha.

2.3 From the plans provided the site appears to comprise of a mixture of land uses including three residential buildings. The rest of the land is open paddock and overgrown shrubbery.

2.4 The site is bound by residential development on three sides. To the north and east is existing residential development. The western boundary abuts frontage development to Dodworth Green Road. The southern boundary abuts a Water course that separates the site from open country side to the south west.

2.5 The site is thought to be underlain by coal measures which will be a mixture of mudstones and sandstones in varying thickness layers. It is likely that clays will be found overlying the bedrock which would probably be unsuitable for infiltration techniques. Once a site investigation report is available this could be verified.

2.6 Site levels vary from 133m AOD in the northwest corner down to 113 in the southeast corner. There is a central ridge running through the site that constrains the watercourse crossing the site. Site falls vary from 1 in 13 in the northern part of the site to 1 in 6 in the south. The watercourse abutting the southern site boundary is some 3 4 m below the site levels for much of its length but this reduces to 1.5 at the south-eastern corner of the site.

3.0 EXISTING LAND DRAINAGE

3.1 There are two watercourses on or abutting the site, both are un-named but form part of the Dodworth Dyke catchment. The first watercourse crosses the site from west to east in a diagonal north west to south east direction entering the site from the north west and exiting mid-way along the eastern boundary. The watercourse serves the housing estates and industrial estates to the north of the site. Its estimated catchment is approx 28ha. The water-course runs predominantly in a culvert for most of its length. The channel through the site is very overgrown and it was not possible to determine inlet and outlet pipe sizes at the time of the site visit. The watercourse flows south eastwards off site through another housing estate fronting onto Stafford Walk. It is believed that this connects into the second watercourse 150m from the site boundary.

3.2 The second watercourse abuts the southern boundary and flows south easterly. This runs in a deep cutting with a shallow channel at its base. At its maximum this channel is over 30m wide due to its depth below the site. This reduces as it run away from the site. This watercourse runs into a culvert approx. 800m away from the site through another residential area.

3.3 There are substantial areas of roofed buildings and hard paved or concrete yard areas on site, approx. 2000sqm but we do not have any drainage details showing where these areas drain to.

3.4 The adjacent ground to the north and north-west is slightly higher than the site and the fields to the south west slope towards the site but are separated from it by the watercourse channel. The residential development to the east is generally at lower levels that the site and falls away in a south easterly direction.

3.5 There are foul and combined sewers in Dodworth Green Road with depths up to 4.23m deep. These do not appear to be deep enough to service the whole of the site. There are also foul sewers in the rear gardens of the properties to the east of the site. Whilst these are at shallow depth they may be suitable for foul drainage of the site. Conversely it may be necessary to provide a pumped system for foul water drainage of the site.

4.0 PROPOSED DEVELOPMENT

4.1 We only have a preliminary copy of the proposed development which shows a series of detached, semidetached and terraced houses accessed off Dodworth Green Road in the north western corner of the site. The proposals are therefore for a mixed use residential development. The proposed development is effectively split by the watercourse across the middle on the site and a green open space area is to be provided in this area.

5.0 FLOOD RISK

5.1 There are a number of potential flooding mechanisms that Planning Practise Guidance- Flood Risk and Coastal Change April 2015 now requires are evaluated for each proposed development site. Each method of flooding requires an assessment to be made on its probability relative to the site development. The normal requirement of the document is for no flooding of properties for storms up to a 1% probability or a once in a 100 years storm. The risk assessment also includes for flooding both on site and off site, and the effects of the development on the downstream catchment or the flow regime of the watercourse. Planning Practise Guidance- Flood Risk and Coastal Change April 2015 also requires that the effects of severe storms above the normal 1%

probability are reviewed together with the effects of climatic change relating to the design life of the development. Each Flood Risk mechanism will be discussed in turn.

5.2 PPG-FRCC requires that each flooding mechanism is addressed and levels of risk evaluated. We consider there are three main risks of flooding to the site the alternative mechanisms are not applicable to this site.

a. Inundation from floodwaters leaving watercourses or rivers entering the site. This can include the effects on culverted watercourses and where the risk of blockage can occur and from breach scenarios.

b. Rainwater falling on the site and not being able to leave the site at sufficient rate to prevent flooding on the site.

c. Overland flows from adjacent land sites due to surcharging of sewerage systems or other watercourses.

d. The impact of the developed site on the existing drainage systems and off-site surface water systems must also be assessed as part of this flood risk assessment.

Each will be discussed in turn.

5.3.1. Flood Risk from Watercourses, River & Tidal

5.3.1.1 The proposed development site appears not to fall within the 1% probability Flood Risk Maps as published by the Environment Agency and not within the 0.1% Flood Risk Area. The site is therefore adjudges to fall with zone 1. The flood risk maps indicate the extent of the flood plain extends around the watercourse to the south east of the site indicating possible flood risks downstream. The site would fall within Zone 1 of the Environment Agency Designation under PPG-FRCC. The risk of flooding from river or tidal water is therefore considered acceptable for residential development on this site.

5.3.1.2 The difference of bank to bed level of the watercourse to the southern boundary means that the risk of flooding from this source is considered to be very low excepting the very south western corner of the site.

5.3.1.3 The watercourse crossing the site could generate flooding problems if not properly maintained. A blockage of the downstream outlet could result in flooding on site that would build up and eventually flow over its bank to the south. The flows would have to build up to a maximum depth of 2.5m before leaving via the site boundary. It would be more likely that these flows would pass into the adjacent residential development to the east than through this site. This scenario currently exists and is not a result of the proposed development. The development may however alleviate this risk by providing a specially designed inlet structure that would reduce the risk of blockage and allow storm water flows to pass. It would also be possible to provide some cascade ponds within the open space area to regulate flows albeit very slightly. It may be feasible to provide an overflow route through the site to connect into the watercourse to the south to prevent flooding of the development and the existing residential development to the east. If these works are implemented then the flood risk from rivers and watercourses would fall to acceptable levels.

5.3.2 **Risk of Flooding from overland flows from adjacent land**.

5.3.2.1 The site lies on a sloping site with existing residential development on three sides; two sides falling towards the site and the other falling away from the site. These developed areas provide a level of protection due to the existing surface water drainage systems that serve them. They should normally be capable of catering for storms up to the 30 year return period without flooding occurring. For storms in excess of this any surcharge from the sewers would initially flow into Dodworth Green Lane which would channel the flows down to its low point at its junction with Ratten Row to the south west of the site. The majority of the flows would then pass along this road into the watercourse abutting the southern boundary of the site. The risk of overland flooding is therefore considered acceptably low.

5.3.2.2 The open fields to the west are separated from the site by the watercourse and any overland flows from these would be intercepted by it. This would leave only a small catchment that could develop overland flows that would pass through the site. This risk would be substantially lower and deemed acceptable subject to the normal flood routing now required by sewers for adoption. We would suggest that by raising floor levels to 300mm above adjacent road levels will effectively reduce this risk to an acceptable level.

5.3.3. Risk of Flooding from Rainwater Falling on Site

5.3.3.1 The development of the site without any storm-water attenuation would increase flows downstream and increase possible flood risks to downstream properties. It is therefore necessary to eliminate this risk by provision of attenuation systems that will reduce storm water run off to current discharges.

5.3.3.2 The risk of flooding from water falling on site and not being able to leave in sufficient rates can be managed by the use of above ground or underground storage systems and providing a flow control device to restrict discharges to existing levels.

5.3.3.3 The site currently has a limited amount of impermeable areas i.e. roof and hard-paved areas (2000sqm). A full drainage investigation would be required to determine which areas are positively drained to the watercourse to determine an acceptable discharge rate from the development site. Failing this the discharge rate would have to be limited to agricultural rates of discharge.

5.3.3.4 Discussions with Yorkshire water and Barnsley MDC Land Drainage Department will be necessary to agree discharge rates but these should result in an allowable discharge of 5 lit/s/ha. This is still below the existing annual storm discharge from the site from approx. 2000sq.m of paved areas of 26lit/sec.

5.3.3.5 Based on a limited development of approx. 51 housing units with drives the approximate storage volume required would be 600cu.m to cater for a 100 year storm with climate change for a discharge of 11lit/sec. and 361cu.m to cater for a 100 year storm with climate change for a discharge of 20l/sec i.e. 80% of the existing run off from paved or roofed areas. This can be provided in a number of forms, an open swale

or detention basin being the most sustainable option but this would be difficult to provide on such a steep sloping site so underground tanks are the most likely form of storage that can be provided.

5.3.6 Conversely further site investigation may prove the underlying sandstones may be at shallow depth and the use of soak-away's may be acceptable. The utilisation of these will need on site testing before details designs could be submitted. This method of storm-water disposal would also reduce the flood risks to downstream properties due to the site development. Based on local knowledge however and the problems with adoption of such systems for public highways we would suggest that this is unlikely to be an acceptable solution for this site.

5.3.7 It would therefore be necessary to restrict flows from the site to agreed discharge rates and provide storage to cater for storms up to the 1% return probability and add an allowance for climatic change related to the design life of the propose development. This would currently suggest a 30% increase in flood water storage volume requirements.

5.3.8 The development of the site without storm-water attenuation would increase the risk of flooding downstream of the site. There are known problems in the downstream catchment and any increase in discharges to it would accentuate these problems. It is therefore important that on site attenuation is implemented on this site.

5.3.9 We would suggest that detailed drainage designs are submitted at full planning stage, once layouts and extents of development are agreed.

6.0 CONCLUSIONS

6.1 In our opinion the proposed development site is not at risk of flooding from river or tidal water up to a 0.1% return period. The site does not fall the site south does however fall with Zone 3 and therefore not suitable for residential development. We would suggest house levels are set 300mm above ground levels to cater for modelling anomalies.

6.2 There is a very slight risk of flooding from the existing watercourse crossing the site and the inlet to the downstream culvert being blocked or surcharged. We however consider that this can be managed by the use of a new inlet grill and provision of an overflow to the southern watercourse. This should be coupled with managed flood routes and lifting floor levels to 300mm above road centre line levels to ensure no flooding of buildings.

6.3 The risk of flooding from overland flows is considered to be acceptable for residential development.

6.4 The development of the site without any attenuation of storm-water discharges could create further problems on the downstream watercourse, so attenuation of storm-water flows to agreed or agricultural rates will be required.

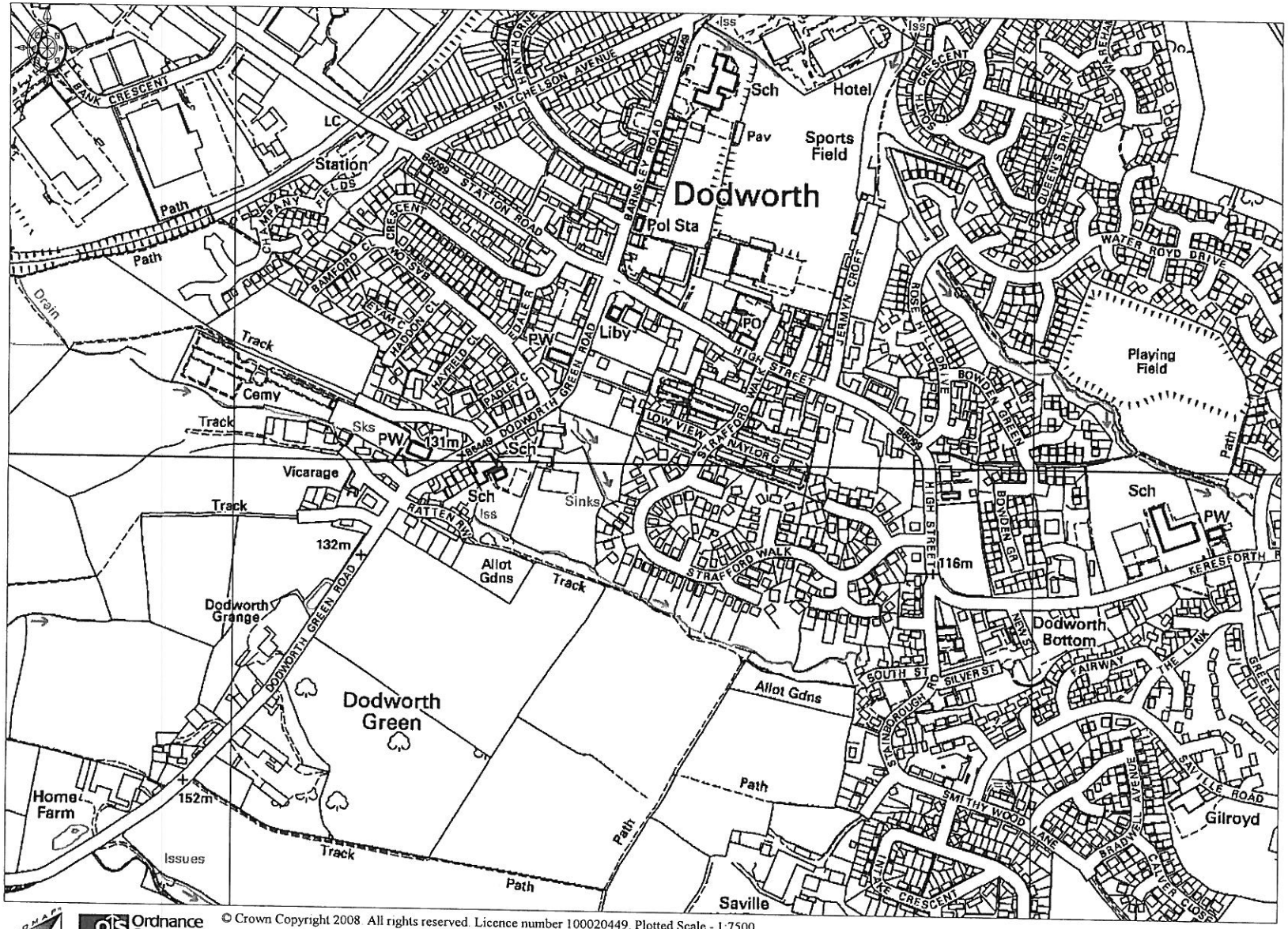
6.5 The use of infiltration systems to serve the development is not thought to be feasible but further site investigations should be carried out to assess their suitability for this site.

6.6 If the measures outlined above are implemented we would consider that the requirements of PPG-FRCC can be satisfied.

T.Haigh B.Sc. C.Eng M.I.C.E.

APPENDIX A

LOCATION PLANS



051

049

4050 00m

4050 00m

Dodworth Methodist Church

Stonehurst

134.0m

DODWORTH GREEN ROAD

132.5m

Hillside

Fieldhouse

PADLEY CLOSE

Brentwood

Travellers Inn (PH)

131.68m

LOW VIEW

132.6m

Church Terrace

Victoria Cottage

The Hawthorns

Lambert Fold

The Old Stables

BM 133.89m

131.4m

Dodworth C of E School

Track

Chatsworth Rise

Church

Works

Dodworth C of E School

CHATSWORTH RISE

Sinks

BM 128.15m

RATTEN ROW

Issues

Woodside

STRAFFORD WALK

Allotment Gardens

Track

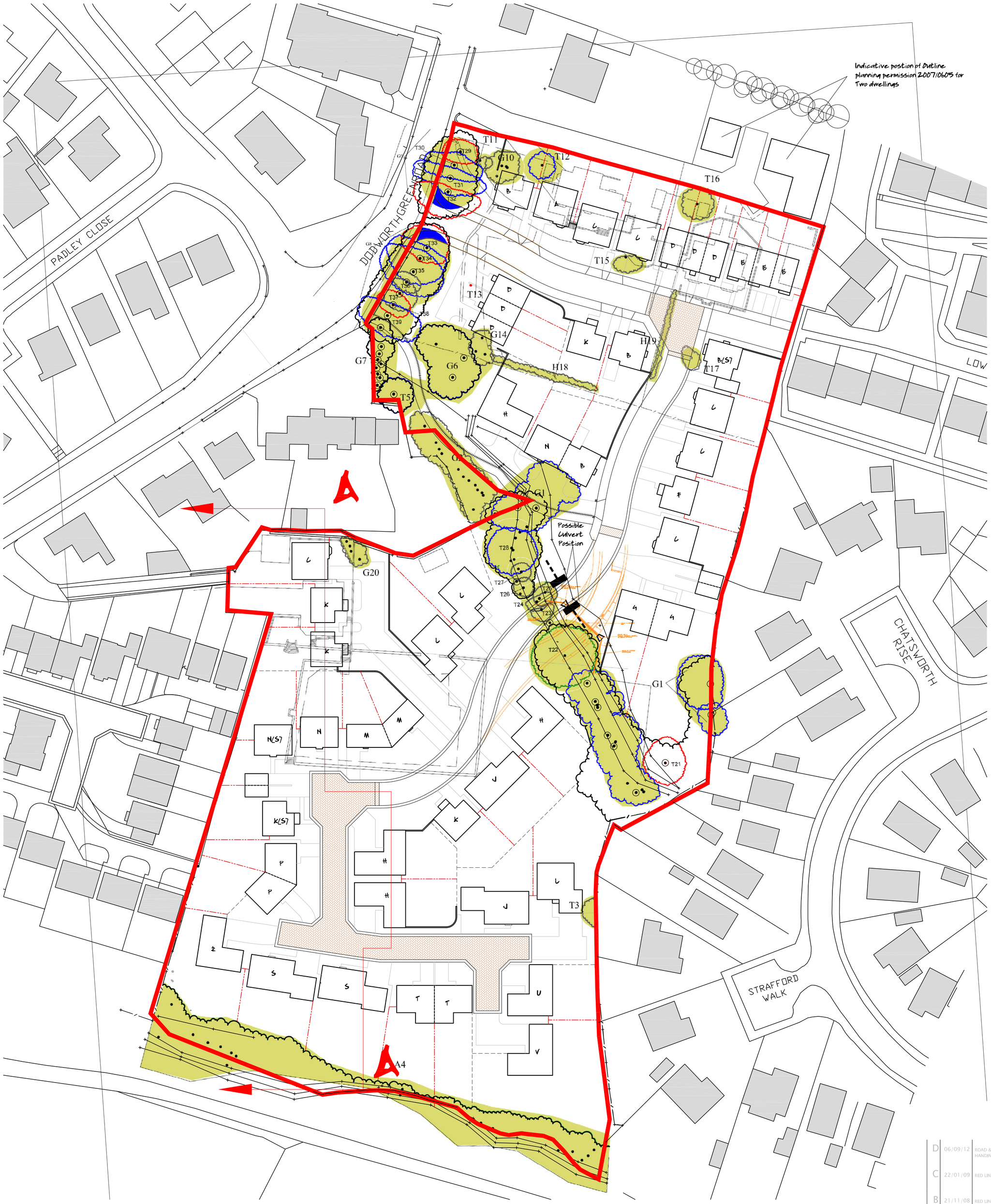
Path

APPENDIX B

DEVELOPMENT PLAN

GREEN ROAD, DODWORTH

PLANNING LAYOUT

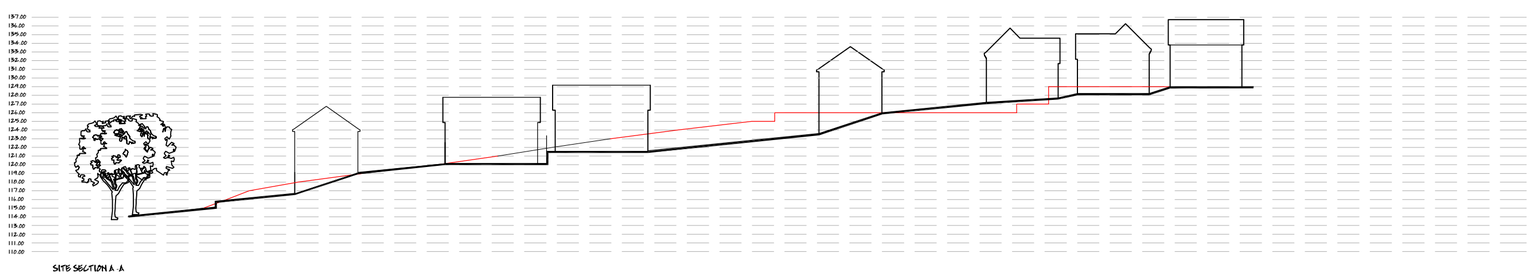


51 No of Units

ROOT PROTECTION AREA

TREES & CANOPY TO BE RETAINED

TREES & CANOPY TO BE REMOVED



REV	DATE	AMENDMENTS	BY	CHKD
D	06/09/12	ROAD & CULVERT MOVED TO RETAIN TREE 'T22', HANDING REVERSED ON 2 QTY 'L' HOUSTYPES	KM	LM
C	22/01/09	RED LINE BOUNDARY AMENDED	IH	LM
B	21/11/08	RED LINE BOUNDARY ADDED TO LAYOUT	RAN	CAH
A	19/11/08	ROAD LAYOUT AMENDED, POSSIBLE CULVERT POSITION SHOWN & VARIOUS HOUSETYPES REARRANGED/HANDED	RAN	CAH

architectural design
town planning
landscape architecture

John R Paley Associates

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CLIENT
GREEN ROAD DEVELOPMENTS

PROJECT
RESIDENTIAL DEVELOPMENT
GREEN ROAD, DODWORTH

DRAWING OF
PLANNING LAYOUT

MARKETING NAME

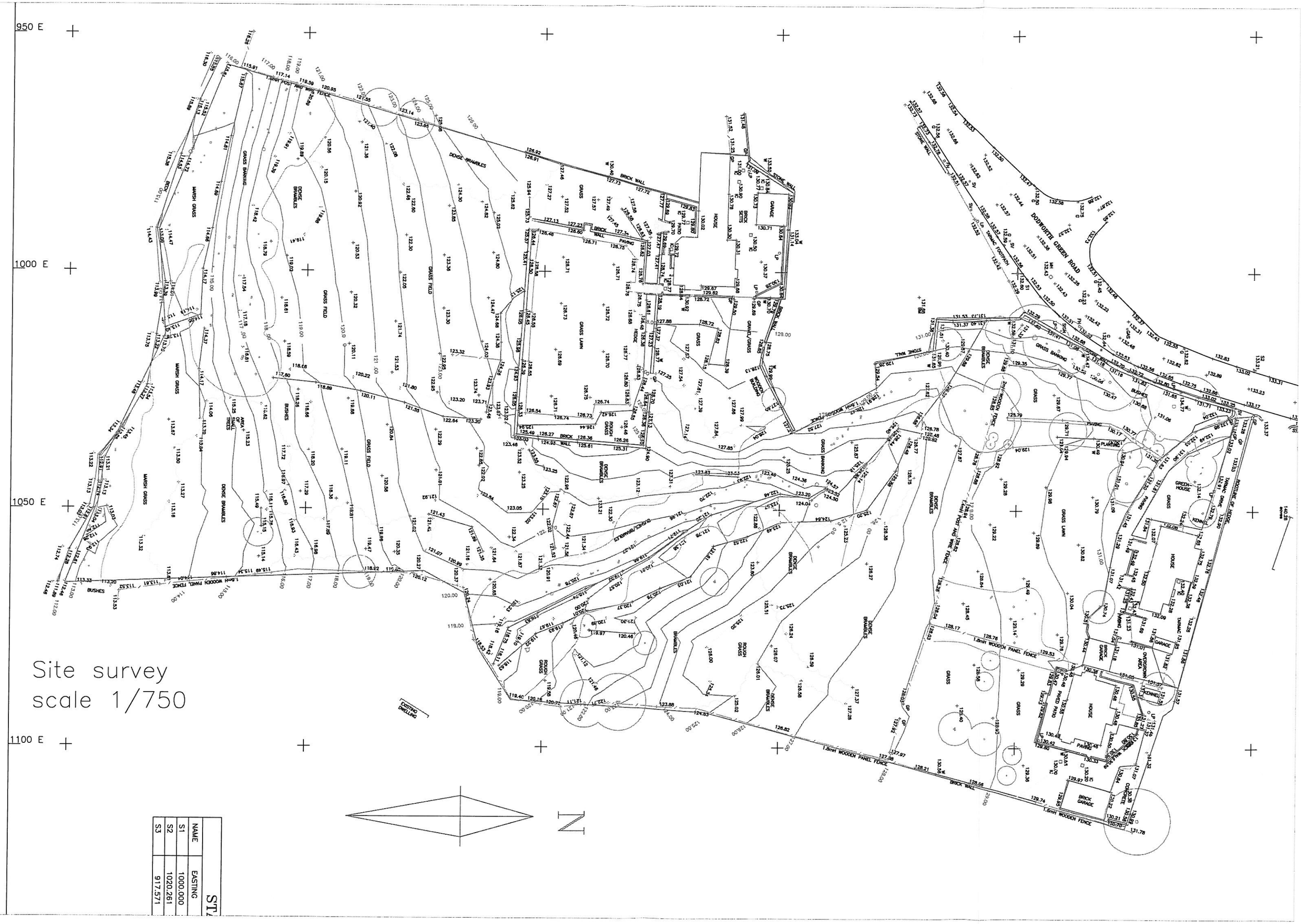
drawing no	rev	date
P05:3544:02	D	JULY 08

scale @ A1	drawn	check	date
1:500	SSH		

GREEN ROAD DEVELOPMENTS

APPENDIX C

SITE SURVEY



Site survey
scale 1/750

STA		
NAME	EASTING	
S1	1000.000	
S2	1020.261	
S3	917.571	

APPENDIX D

ENVIRONMENT AGENCY FLOOD PLAIN MAPS

Environment Agency

Enter a postcode or place name: Go

Other topics for this area... Groundwater

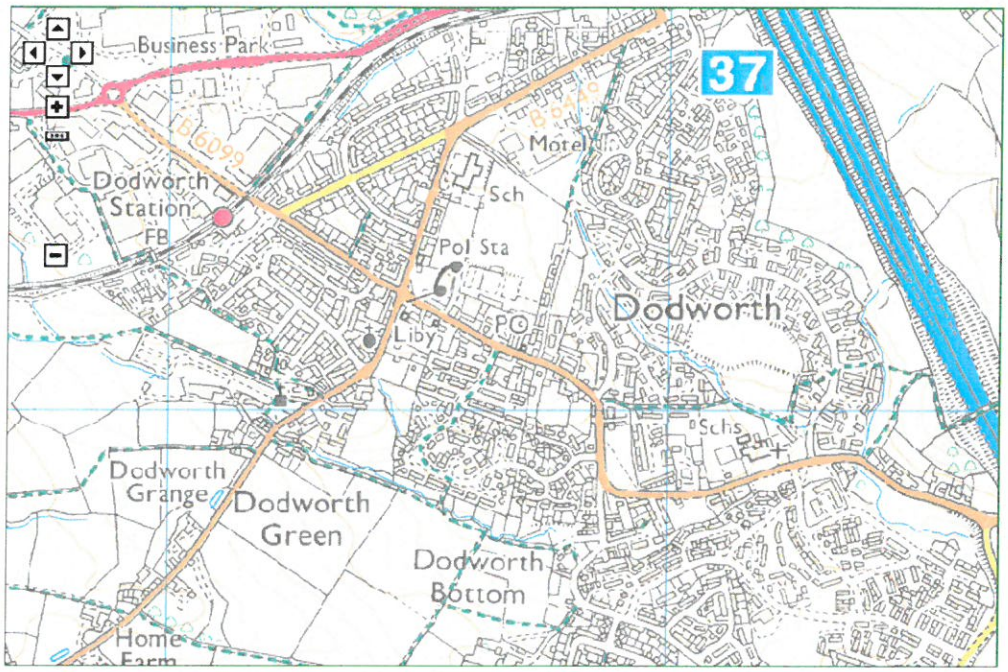
Groundwater

Map legend

Map of X: 431,673; Y: 405,146 at scale 1:10,000

Other maps | Data search | Text only version

- Groundwater source protection zones
  - Inner zone (Zone 1)
  - Inner zone - subsurface activity only (Zone 1c)
  - Outer zone (Zone 2)
  - Outer zone - subsurface activity only (Zone 2c)
  - Total catchment (Zone 3)
  - Total catchment - subsurface activity only (Zone 3c)
  - Special interest (Zone 4)
- BGS Aquifer Maps - Superficial Deposits Designation
  - Principal
  - Secondary A
  - Secondary B
  - Secondary (undifferentiated)
  - Unknown (lakes and landslip)
- BGS Aquifer Maps - Bedrock Designation
  - Principal
  - Secondary A
  - Secondary B
  - Secondary (undifferentiated)
- Groundwater Vulnerability Zones
  - Major Aquifer High
  - Major Aquifer Intermediate
  - Major Aquifer Low
  - Minor Aquifer High
  - Minor Aquifer Intermediate
  - Minor Aquifer Low
- Other national environmental organisations
  - Natural Resources Wales Area of responsibility
  - Scottish Environment Protection Agency Area of responsibility



More about Groundwater

Groundwater Source Protection Zones:

Groundwater provides a third of our drinking water. We ensure that your water is safe to drink defining Source Protection Zones. These zones help to monitor the risk of contamination from any activities that might cause pollution in the area.

The Source Protection Zones are not displayed at scales greater than 1:20,000 (Ordnance Survey 1:50,000 scale) as the data was only modelled to this level and is not accurate pass this. They should not be compared against field boundaries.

Understanding Groundwater Source Protection Zones maps

British Geological Survey's Aquifer Maps:

From 1st April 2010 new aquifer designations replace the old system of classifying aquifers as Major, Minor and Non-Aquifer. This new system is in line with our Groundwater Protection Policy (GP3) and the Water Framework Directive (WFD) and is based on British Geological Survey mapping.

The Aquifer Extents are not displayed at scales greater than 1:75,000 (Ordnance Survey 1:250,000 scale) as the data was only modelled to this level and is not accurate pass this.

Understanding the British Geological Survey's Aquifer maps

Groundwater Vulnerability Maps:

Ww are currently updating our groundwater vulnerability maps to reflect improvements in data mapping and understanding of the factors affecting vulnerability. The new maps will be released later in 2016.

The 'New groundwater vulnerability mapping methodology' report provides technical information about how the new maps have been created.
The user guide outlines the kinds of activities the new maps can be used for.
These reports have been published on GOV.UK in advance of the release of the new maps to give users time to understand the new approach and how this differs from the previous groundwater vulnerability maps.

Understanding Groundwater Vulnerability maps

Environment Agency

Enter a postcode or place name: Go

Other topics for this area... Flood Map for Planning (Rivers and Sea)

Flood Map for Planning (Rivers and Sea)

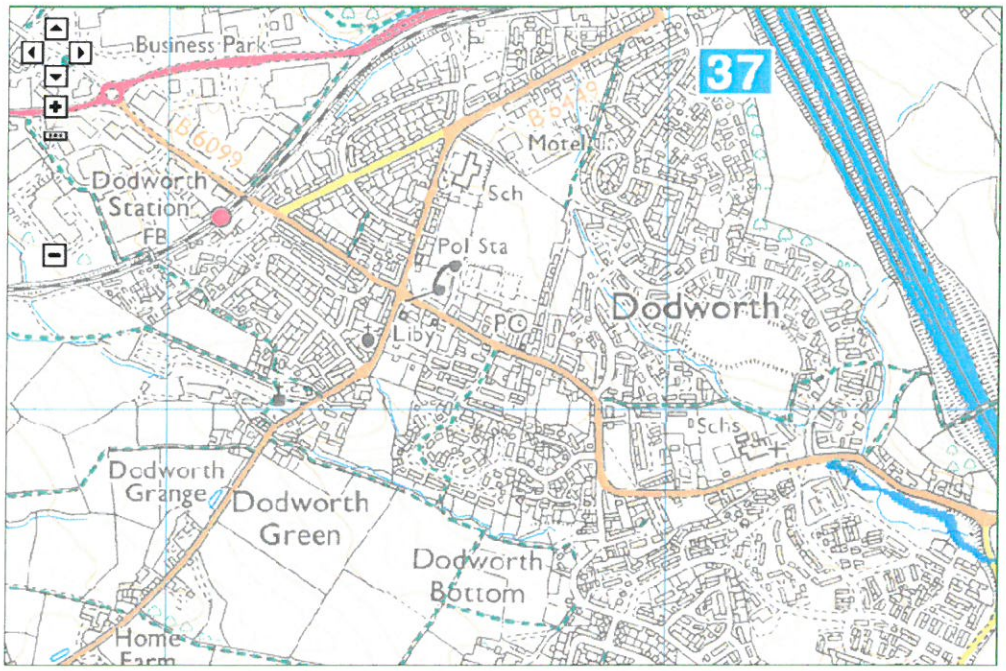
Map legend

Click on the map to see what Flood Zone (National Planning Policy Guidance definitions) the proposed development is in.

- Flood Map for Planning (Rivers and Sea)
  - Flood Zone 3
  - Flood Zone 2
  - Flood defences (Not all may be shown*)
  - Areas benefiting from flood defences (Not all may be shown*)
- Main River Line
  - Main River Line
- Other national environmental organisations
  - Natural Resources Wales Area of responsibility
  - Scottish Environment Protection Agency Area of responsibility

Map of X: 431,673; Y: 405,146 at scale 1:10,000

Other maps Data search Text only version



More about flooding:

Understanding the Flood Map for Planning (Rivers and Sea)

A more detailed explanation to help you understand the flood map shown above.

Current flood warnings

We provide flood warnings online 24 hours a day. Find out the current flood warning status in your local area.

*** Legend Information:** Flood defences and the areas benefiting from them are gradually being added through updates. Please contact your **local environment agency office** for further details.

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Author: Environment Agency | **wiybysupport@environment-agency.gov.uk**
Last updated: 9th June 2016

Enter a postcode or place name: Other topics for this area...

Go | Risk of Flooding from Reservoirs | View other Interactive Maps

Risk of Flooding from Reservoirs

Try our new **flood information service** and find out the potential flood risk for anywhere in England.

Reservoir flooding is extremely unlikely to happen.

The shading on the map shows the area that could be flooded if a large reservoir were to fail and release the water it holds. A large reservoir is one that holds over 25,000 cubic metres of water, equivalent to approximately 10 Olympic sized swimming pools. Since this is a worst case scenario, it's unlikely that any actual flood would be this large.

Click on the shading to see details of reservoirs that could cause flooding in this area.

Map legend

- ☑ Risk of Flooding from Reservoirs
- Maximum extent of flooding
- ☑ Other national environmental organisations
- Natural Resources Wales Area of responsibility
- Scottish Environment Protection Agency Area of responsibility

Map of X: 431,673; Y: 405,146 at scale 1:10,000 **Data search**

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Environment Agency

Enter a postcode or place name: Other topics for this area...

Go | Risk of Flooding from Rivers and Sea | View other Interactive Maps

Risk of Flooding from Rivers and Sea

Try our new **flood information service** and find out the potential flood risk for anywhere in England.

River flooding happens when a river cannot cope with the amount of water draining into it from the surrounding land. Sea flooding happens when there are high tides and stormy conditions.

The shading on the map shows the risk of flooding from rivers and the sea in this particular area.

Click on the map for a more detailed explanation.

Map legend

- ☑ Risk of Flooding from Rivers and Sea
  - High
  - Medium
  - Low
  - Very Low
- ☑ Other national environmental organisations
  - Natural Resources Wales Area of responsibility
  - Scottish Environment Protection Agency Area of responsibility

Map of X: 431,673; Y: 405,146 at scale 1:10,000

Data search

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Last updated: 23 August 2016

Environment Agency

Enter a postcode or place name: **Other topics for this area...**

Go | Risk of Flooding from Surface Water | View other Interactive Maps

Risk of Flooding from Surface Water

Try our new **flood information service** and find out the potential flood risk for anywhere in England.

Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead.

The shading on the map shows the risk of flooding from surface water in this particular area.

Click on the map for a more detailed explanation.

Map of X: 431,673; Y: 405,146 at scale 1:10,000

Data search

Map legend

- ☑ Risk of Flooding from Surface Water
  - High
  - Medium
  - Low
  - Very Low
- ☑ Other national environmental organisations
  - Natural Resources Wales Area of responsibility
  - Scottish Environment Protection Agency Area of responsibility

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APPENDIX E

STORMWATER STORAGE CALCULATIONS

Client

Site Dodworth Green Lane

Design storm 100 M5-60 19 mm
r 0.35
Site area sq m. 22200
Imp Area sq m. 10000
T of Conc min 4 Time to Flow
Allow Discharge 11 Lit / sec Imp Ratio 0.45

Storm Duration Mins	Intensity mm/hr	Depth mm	Vol In cu.m	Vol Out cu.m	Storage cu.m.	Q	t
10	81.8	13.63	136.33	9.11	127.22	227.40	0.2
20	59.8	19.93	199.33	15.67	183.67	166.24	0.3
30	47.6	23.80	238.00	22.22	215.78	132.33	0.3
50	34.4	28.67	286.67	35.34	251.33	95.63	0.5
60	30.3	30.30	303.00	41.90	261.10	84.23	0.5
120	18.7	37.40	374.00	81.28	292.72	51.99	0.8
180	14.1	42.30	423.00	120.70	302.30	39.20	1.1
240	11.5	46.00	460.00	160.13	299.87	31.97	1.4
300	9.8	49.00	490.00	199.57	290.43	27.24	1.6
360	8.7	52.20	522.00	239.04	282.96	24.19	1.8
420	7.9	55.30	553.00	278.52	274.48	21.96	2.0
480	7.5	60.00	600.00	318.05	281.95	20.85	2.1
540	6.9	62.10	621.00	357.53	263.47	19.18	2.3
600	6.38	63.80	638.00	397.00	241.00	17.74	2.5
				Storage	302.30		

Length of 1800 118.80
Length of 1500 171.08 Culvert 2.4*1.5m 83.97
Length of 1200 267.29 culvert 3.6*1.8m 46.65
Length of 1050 349.08 490.48
Length of 900 475.32 667.85
Length of 750 683.94 960.98

100 year storm

Intensit mm/hr	Depth mm	Vol In cu.m	Vol Out cu.m	Storage cu.m.
101.27	16.88	168.78	9.11	159.67
74.03	24.68	246.77	15.67	231.11
58.93	29.46	294.64	22.22	272.42
42.59	35.49	354.89	35.34	319.56
37.51	37.51	375.11	41.90	333.22
23.15	46.30	463.01	81.28	381.73
17.46	52.37	523.67	120.70	402.97
14.24	56.95	569.48	160.13	409.35
12.13	60.66	606.62	199.57	407.05
10.77	64.62	646.24	239.04	407.20
9.78	68.46	684.61	278.52	406.10
9.29	74.28	742.80	318.05	424.75
8.54	76.88	768.80	357.53	411.27
7.90	78.98	789.84	397.00	392.84
			Storage	424.75

Pond 900mm deep 335.89 30 year
471.948 100 year
553.281 100 year plus climatic

100year plus climate

Intensity mm/hr	Depth mm	Vol In cu.m	Vol Out cu.m	Storage cu.m.
111.25	18.54	185.41	9.11	176.30
81.33	27.11	271.09	15.67	255.43
64.74	32.37	323.68	22.22	301.46
46.78	38.99	389.87	35.34	354.53
41.21	41.21	412.08	41.90	370.18
25.43	50.86	508.64	81.28	427.36
19.18	57.53	575.28	120.70	454.58
15.64	62.56	625.60	160.13	465.47
13.33	66.64	666.40	199.57	466.83
11.83	70.99	709.92	239.04	470.88
10.74	75.21	752.08	278.52	473.56
10.20	81.60	816.00	318.05	497.95
9.38	84.46	844.56	357.53	487.03
8.68	86.77	867.68	397.00	470.68
			Storage	497.95

Client

Site Dodworth Green Lane

Design storm 100 M5-60 19 mm
r 0.35
Site area sq m. 22200
Imp Area sq m. 10000
T of Conc min 4 Time to Flow
Allow Discharge 20 Lit / sec Imp Ratio 0.45

Storm Duration Mins	Intensity mm/hr	Depth mm	Vol In cu.m	Vol Out cu.m	Storage cu.m.	Q	t
10	81.8	13.63	136.33	16.38	119.96	227.40	0.4
20	59.8	19.93	199.33	28.22	171.11	166.24	0.5
30	47.6	23.80	238.00	40.07	197.93	132.33	0.6
50	34.4	28.67	286.67	63.80	222.87	95.63	0.8
60	30.3	30.30	303.00	75.66	227.34	84.23	0.9
120	18.7	37.40	374.00	146.95	227.05	51.99	1.5
180	14.1	42.30	423.00	218.35	204.65	39.20	2.0
240	11.5	46.00	460.00	289.80	170.20	31.97	2.5
300	9.8	49.00	490.00	361.28	128.72	27.24	2.9
360	8.7	52.20	522.00	432.83	89.17	24.19	3.3
420	7.9	55.30	553.00	504.43	48.57	21.96	3.6
480	7.5	60.00	600.00	576.20	23.80	20.85	3.8
540	6.9	62.10	621.00	647.80	-26.80	19.18	4.2
600	6.38	63.80	638.00	719.39	-81.39	17.74	4.5
				Storage	227.34		

Length of 1800 89.34
Length of 1500 128.66 Culvert 2.4*1.5m 63.15
Length of 1200 201.01 culvert 3.6*1.8m 35.08
Length of 1050 262.52 364.96
Length of 900 357.45 496.95
Length of 750 514.34 715.06

100 year storm

Intensit mm/hr	Depth mm	Vol In cu.m	Vol Out cu.m	Storage cu.m.
101.27	16.88	168.78	16.38	152.40
74.03	24.68	246.77	28.22	218.55
58.93	29.46	294.64	40.07	254.57
42.59	35.49	354.89	63.80	291.10
37.51	37.51	375.11	75.66	299.45
23.15	46.30	463.01	146.95	316.06
17.46	52.37	523.67	218.35	305.32
14.24	56.95	569.48	289.80	279.68
12.13	60.66	606.62	361.28	245.34
10.77	64.62	646.24	432.83	213.41
9.78	68.46	684.61	504.43	180.19
9.29	74.28	742.80	576.20	166.60
8.54	76.88	768.80	647.80	121.00
7.90	78.98	789.84	719.39	70.46
			Storage	316.06

Pond 900mm deep 252.6 30 year
351.176 100 year
401.874 100 year plus climatic

100year plus climate

Intensity mm/hr	Depth mm	Vol In cu.m	Vol Out cu.m	Storage cu.m.
111.25	18.54	185.41	16.38	169.04
81.33	27.11	271.09	28.22	242.87
64.74	32.37	323.68	40.07	283.61
46.78	38.99	389.87	63.80	326.07
41.21	41.21	412.08	75.66	336.42
25.43	50.86	508.64	146.95	361.69
19.18	57.53	575.28	218.35	356.93
15.64	62.56	625.60	289.80	335.80
13.33	66.64	666.40	361.28	305.12
11.83	70.99	709.92	432.83	277.09
10.74	75.21	752.08	504.43	247.65
10.20	81.60	816.00	576.20	239.80
9.38	84.46	844.56	647.80	196.76
8.68	86.77	867.68	719.39	148.29
			Storage	361.69

APPENDIX F

DRAINAGE RECORDS

051

4050 00m

049

051

4050 00m

049

Dodworth Methodist Church

Stonehurst

DODWORTH GREEN ROAD

PADLEY CLOSE

Hillside

Fieldhouse

LOW VIEW

Brentwood

Church Terrace

Victoria Cottage

Javelin Inn (PH)

BM 131.68m

132.6m

132.5m

The Hawthorns

Lambert Fold

The Old Stables

Track

BM 133.89m

131.4m

Dodworth C of E School Lane

Church

Chatsworth Rise

CHATSWORTH RISE

Works

Dodworth C of E School

BM 128.13m

RATTEN ROW

Woodside

STRAFFORD WALK

Allotment Gardens

Track

Path

TO BARNSLEY