

FLOODING & DRAINAGE ASSESSMENT FOR A PROPOSED EXTENSION TO BRIDGE HEYWOOD CARAVAN PARK, READ, BURNLEY

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1.0 INTRODUCTION

- 1.01 Following instructions from GVA Hotels & Leisure on behalf of Mr R Hanson on 16 May 2012, CoDA Structures have undertaken an assessment of flooding and drainage issues in relation to a proposed extension to Bridge Heywood Caravan Park, Read, Burnley.
- 1.02 It is proposed to expand the existing caravan park to accommodate 15 additional static caravans and relocating the caravan storage area.
- 1.03 The area for the 15 additional static caravans is currently a caravan storage area. The area for relocation of the caravan storage area is currently a field.
- 1.04 The local authority is Ribble Valley Borough Council (RVBC).

2.0 POLICY CONSIDERATIONS AND OBJECTIVES

2.01 National Planning Policy Framework:

Section 10 of the National Planning Policy Framework (NPPF) published in March 2012 sets out Government policy on development and flood risk for England. It aims to ensure that flood risk is taken into account at all stages of the planning process, to avoid inappropriate developments in areas at risk of flooding, and to direct development away from areas of highest risk. Where new development is thought necessary in areas of flood risk, the NPPF aims to make it safe, without increasing flood risk elsewhere, and, where possible, reduce the overall flood risk.

The NPPF promotes a sequential risk-based approach to determine the suitability of land for development in flood risk areas. The broad aim of the NPPF is to reduce the number of people and properties within the natural and built environment at risk of flooding. To achieve this aim, planning authorities are required to ensure that flood risk is properly assessed during the initial planning stages of any development.

2.02 Consideration and Objectives:

This Flooding and Drainage Assessment Report will consider the following:-

- whether the proposed development is likely to be affected by flooding.
- whether the proposed development will increase flood risk to adjacent properties.

The report will also demonstrate that any existing flood risk or flood risk associated with the proposed development can satisfactorily managed. This will include:-

- whether the proposed development is likely to be affected by flooding and whether it will increase flood risk elsewhere.

- specifying the measures proposed to deal with the identified risks, including, where appropriate, proposals to reduce existing and/or future flood risk levels.
- satisfy the Local Authority that any flood risk to the development or additional risk arising from the proposal will be successfully managed so the site can be developed and occupied safely without risk to adjacent properties.

3.0 FLOODING ISSUES

3.01 The Site:

The site is located to the south of Whalley Road (A671) and is approximately 8.0km to the west of Burnley Town Centre. A site location plan (Fig. 1) attached in Appendix A.

The Ordnance Survey coordinates for the centre of the site are 375700mE and 434040mN.

The caravan park is approximately 5.6 hectares.

The area for the proposed static caravans is approximately 0.7 hectares and generally falls in level to the southwest. Levels on this area of the site vary from 64.95m AOD on the northeast edge of this area to 62.07m AOD adjacent the southern boundary of the caravan park.

The area for the new caravan storage area is also approximately 0.7 hectares and falls in level to the south. Levels on this area of the site vary from typically 69.00m AOD along the northern edge of this area to 63.70m AOD adjacent the southern boundary of the caravan park.

A site topographical is attached in Appendix B.

A site aerial photograph is attached in Appendix C.

Clough Syke Brook is piped through the caravan park and lies in the western sector of the area proposed for the additional static caravans.

The River Calder lies adjacent the south west corner of the site and flows in a westerly direction.

A watercourse lies adjacent the remainder of the southern boundary of the site and flows to the west into the River Calder.

A watercourse lies adjacent the western boundary of the caravan park and flows to the south into the River Calder.

From the inspection of OS maps there are further watercourses in the surrounding area

to the site as follows:-

- Unnamed watercourse approximately 276m to the east
- Unnamed watercourse approximately 350m to the east

There are a number of small lakes and ponds in the surrounding area (within 500m) to the caravan park.

There are a number of groundwater issues and sinks in the surrounding area (within 500m) to the caravan park.

The position of the water courses are indicated on the Site Location Plan (Fig. 1) attached in Appendix A, and the Environment Agency (EA) flood map attached in Appendix D.

3.02 Flood Zone Classification:

The proposed caravan storage area is located within Flood Zone 1 on the EA flood map. This zone comprises land assessed as having less than 1 in 1000 (<0.1%) annual probability of tidal or river flooding in any year.

The majority of the proposed area for the additional static caravans is located within Flood Zone 2 on the EA flood map. This Zone comprises land assessed as having between a 1 in 100 and 1 in 1000 (1% - 0.1%) probability of river flooding or between a 1:200 and 1 in 1000 (0.5% - 0.1%) probability of sea flooding in any year.

A copy of the EA flood map is attached in Appendix D.

Modelled flood levels for the River Calder adjacent the site have also been obtained from the EA and are summarised as follows:

Un defended 1000 year flood level 63.32m AOD.

Un defended 100 year + climate change 62.49m AOD.

The extent of the modelled 1000 year flood (Flood Zone 2) and modelled 100 year + climate change flood (Flood Zone 3a) have been indicated on the site topographical survey attached in Appendix B.

3.03 Sources of Flood Risk:

The following table shows a summary of the forms of flood and the potential issues in relation to the site that require further assessment.

Flood Source	Applicable	Comment
Fluvial	✓	Main river and watercourse adjacent the southern and western boundaries.
Tidal	X	
Run Off	✓	Potential for run off from higher land to the north.
Groundwater	X	Relatively high groundwater levels are unlikely in this location. No groundwater issues are indicated on The site.
Sewers	✓	Public combined sewers cross the caravan park.
Reservoirs, Canals, etc.	✓	There are no such features in close proximity to the site.

3.04 Sequential Test:

The Sequential Test should be applied at all stages of planning. Its aim is to steer new development to areas at the lowest probability of flooding.

Table D.2 of the Technical Guidance to the NPPF (which categorises the flood risk vulnerability of land uses) indicates the proposed development (static caravan area) is categorised as 'more vulnerable' land use.

Table D.2 of the Technical Guidance to the NPPF gives no specific guidance for the proposed development (storage area) but this is also considered to be 'more vulnerable' land use as the static caravan area. However, it should be noted that general industry storage and distribution is classed as 'less vulnerable' land use.

From the EA flood map the proposed static caravan area is identified as being in Flood Zone 2.

From the modelled flood levels obtained from the EA the southwest sector of the proposed static caravan area is in Flood Zone 3a, the southern sector is in Flood Zone 2 and the remainder is in Flood Zone 1.

The extent of the modelled 1000 year flood (Flood Zone 2) and modelled 100 year + climate change flood (Flood Zone 3a) have been indicated on the site topographical survey attached in Appendix B.

Table D.3 of the Technical Guidance to the NPPF indicates where the land use is 'more vulnerable' development is:-

- i) appropriate in Flood Zone 1
- ii) appropriate in Flood Zone 2 subject to a Flood Warning and Evacuation Plan.
- iii) appropriate in Flood Zone 3 subject to the exception test.

From the EA flood map and modelled flood levels the proposed storage area is identified as being in Flood Zone 1.

Table 3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'highly vulnerable' development is appropriate in Flood Zone 1. Therefore the Sequential Test has been passed.

3.05 Exception Test:

Table D.3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is considered appropriate in Flood Zone 1 and 2 and the Exception Test is not required. However, sites used for holiday caravans are subject to a Flood Warning and Evacuation Plan.

Table D.3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is only appropriate in Flood Zone 3 subject to the exception test.

The following sections of this report will demonstrate that the proposed development will be safe from flooding and will not increase flood risk elsewhere.

3.06 Flood Risk Assessment:

Proposed Caravan Storage Area:

The proposed caravan storage area is within Flood Zone 1. This zone comprises land assessed as having less than a 1 in 1000 (<0.1%) annual probability of tidal or river flooding in any one year.

From the inspection of the topographical survey and a site walkover the proposed caravan storage area may be at risk from inundation of flood waters from surface water runoff from higher land to the north.

The effect of groundwater as a flood source is not considered to be an issue at this location. Whilst there are a number of groundwater issues in the surrounding area none are indicated as being on or in the near vicinity of the site.

The proposed caravan storage area does not appear to be at risk from the inundation of flood waters from overloaded public sewers.

Proposed Addition Static Caravan Area:

Based on the modelled flood levels provided by the EA a small part of the proposed static caravan area is in Flood Zone 3a and approximately 40% of this area is in Flood Zone 2. The remainder of this area is in Flood Zone 1.

It should be noted the watercourse that crosses the proposed additional static caravan area and the watercourse adjacent the western boundary of the caravan park may be sources of localised fluvial flooding that has not been captured on the EA flood zone map.

From the inspection of the topographical survey and a site walkover the proposed static caravan area may be at risk from inundation of flood waters from surface water runoff from adjacent land to the north.

The effect of groundwater as a flood source is not considered to be an issue at this location. Whilst there are a number of groundwater issues in the surrounding area none are indicated as being on or in the near vicinity of the site.

The proposed static caravan area may be at risk from the inundation of flood waters from an overloaded public combined sewer and a surface water sewer from the existing caravan park that crosses this area.

3.07 Effect of Development on the Wider Catchment:

The proposed development will result in the impermeable area on the site and therefore unattenuated surface water flows from the development, if not addressed, may increase the flood risk to the local catchment.

3.08 Flood Risk Mitigation:

Proposed Caravan Storage Area:

The proposed development is in Flood Zone 1.

The levels in the proposed caravan storage area should be set to route any potential overland flood waters around the caravans towards the river.

Proposed Additional Static Caravan Areas:

It should be noted that the floor level of static caravans are generally set at 0.9m above the supporting concrete base (ground level) and the floor level of the caravans should be set at a minimum level of 63.10m AOD to give a free board of 0.6m above the 100 year plus climate change modelled flood level.

A Flood Warning and Evacuation Plan should be prepared for the additional static caravan area.

The south western sector of this area should be raised to a level of 62.80m. This would result in the removal of approximately 80m³ from the 1:100 + climate change flood plain which is considered to be negligible. This would also provide a 0.3m free board above the modelled flood level of 62.49m AOD.

If the loss of 80m³ from the flood plain is of concern then a small cut and fill exercise should be undertaken along the southern boundary of the proposed additional static caravan area to maintain the flood volume

The external levels around the additional static caravan area should be set to route any potential overland flood waters from higher ground to the north, the proposed watercourse that crosses this area of the site and the public sewer that crosses this area of the site towards the river as the existing situation.

4.0 DRAINAGE

4.01 Public Sewers:

There are two public combined sewers on the caravan park and one of these runs through the proposed area of the additional static caravans. In addition a pumping station is located midway along the southern boundary of the caravan park adjacent the eastern 'boundary' of the proposed additional static caravan area.

An extract from the public sewer record is attached in Appendix E.

4.02 Existing Drainage:

The existing caravan park has a separate foul and surface water system. The foul drainage discharges to the public combined sewer that crosses the caravan park.

The surface water drainage either discharges into the piped watercourse that crosses the centre of the caravan park or the site drainage system in the western sector of the part that has an outfall to the water course adjacent the southern boundary of the park.

4.03 Foul Water:

Proposed Additional Static Caravan Area:

It is proposed that a separate foul water drainage system is provided on the proposed additional static caravan area discharging to the 225mm diameter public combined sewer that crosses this area of the site. It would appear a gravity system can be adopted.

Proposed Caravan Storage Area:

A foul drainage system will not be required in the proposed caravan storage area.

4.04 Surface Water Drainage:

Proposed Additional Static Caravan Area:

A separate surface water drainage system comprising of cut off drains adjacent hardcover areas should be provided on the proposed additional static caravan area.

The use of soakaways and porous paving will be considered on the development subject to ground conditions and the results of falling head permeability testing in accordance with BRE 363: Soakaways. The site owner has advised that the near surface soils in this area of the site are sandy so it would appear the use of soakaways on the site may be feasible.

The caravan park has an established connection to the watercourse adjacent the southern boundary. In addition the caravan park slopes towards the River Calder. Therefore if soakaways ultimately prove not be an option it is proposed to discharge surface water to the watercourse adjacent the southern boundary of the park at greenfield run off. This has been calculated using a greenfield run off of 5.0 l/sec/ha and equates to $0.7 \times 5.0 = 3.5$ l/s. for the site.

The following estimation of stormwater storage requirements for the proposed additional static caravan area has been based on the following:

Proposed discharge rate:	3.5 l/sec
Proposed hardcover area:	2400m ²
Stormwater storage requirements:	122.9m ³

(Based on a 1:100 year storm return period and a 30% increase in rainfall intensity for climate change).

It appears a gravity system can be adopted on the site and the stormwater storage should be provided in the form of oversized or pipes or tanks.

Stormwater storage calculations are attached in Appendix F.

Proposed Caravan Storage Area:

A surface water drainage system will not be provided in the proposed caravan storage area.

4.05 Proposals:

It is proposed that a separate foul water drainage system is provided on the proposed additional static caravan area discharging to the 225mm diameter public combined sewer that crosses this area of the site.

A foul drainage system will not be required in the proposed caravan storage area.

A separate surface water drainage system comprising of cut off drains adjacent hardcover areas should be provided on the development.

The use of soakaways and porous paving will be considered on the development subject to ground conditions and the results of falling head permeability testing in accordance with BRE 365: Soakaways.

If surface water is discharged to watercourse adjacent the southern boundary of the caravan park, based on a proposed drained hardcover area of 2400m^2 and a discharge rate of 3.5 l/sec a storage volume of 122.9m^3 should be provided on the development, based on a 1:100 year storm return period with a 30% increase on rainfall intensity to cater for climate change.

A surface water drainage system will not be provided in the proposed caravan storage area.

5.0 SUMMARY

The Site	The site is located to the south of Whalley Road (A671) and is approximately 8.0km to the west of Burnley Town Centre. The Ordnance Survey coordinates for the centre of the site are 375700mE and 434040mN. The caravan park is approximately 5.6 hectares. The area for the proposed static caravans is approximately 0.7 hectares and generally falls in level to the southwest. Levels on this area of the site vary from 64.95m AOD on the northeast edge of this area to 62.07m AOD adjacent the southern boundary of the caravan park. The area for the new caravan storage area is also approximately 0.7 hectares and falls in level to the south. Levels on this area of the site vary from typically 69.00m AOD along the northern edge of this area to 63.70m AOD adjacent the southern boundary of the caravan park. Clough Syke Brook is piped through the caravan park and lies in the western sector of the area proposed for the additional static caravans. The River Calder lies adjacent the south west corner of the site and flows in a westerly direction. A watercourse lies adjacent the remainder of the southern boundary of the site and flows to the west into the River Calder. A watercourse lies adjacent the western boundary of the caravan park and flows to the south into the River Calder. From the inspection of OS maps there are further watercourses in the surrounding area to the site as follows:- Unnamed watercourse approximately 276m to the east Unnamed watercourse approximately 350m to the east There are a number of small lakes and ponds in the surrounding area (within 500m) to the caravan park. There are a number of groundwater issues and sinks in the surrounding area (within 500m) to the caravan park.
Flooding Issues	Proposed Caravan Storage Area: The proposed caravan storage area is within Flood Zone 1. This zone comprises land assessed as having less than a 1 in 1000 (<0.1%) annual probability of tidal or river flooding in any one year. From the inspection of the topographical survey and a site walkover the proposed caravan storage area may be at risk from inundation of flood waters from surface water runoff from higher land to the north. The effect of groundwater as a flood source is not considered to be an issue at this location. Whilst there are a number of groundwater issues in the surrounding area none are indicated as being on or in the near vicinity of the site. The proposed caravan storage area does not appear to be at risk from the inundation of flood waters from overloaded public sewers. Proposed Addition Static Caravan Area: Based on the modelled flood levels provided by the EA a small part of the proposed static caravan area is in Flood Zone 3a and approximately 40% of this area is in Flood Zone 2. The remainder of this area is in Flood Zone 1. It should be noted the watercourse that crosses the proposed additional static caravan area and the watercourse adjacent the western boundary of the caravan park may be a source of localised fluvial flooding that has not been captured on the EA flood zone map. From the inspection of the topographical survey and a site walkover the proposed static caravan area may be at risk from inundation of flood waters from surface water runoff from adjacent land to the north. The effect of groundwater as a flood source is not considered to be an issue at this location. Whilst there are a number of groundwater issues in the surrounding area none are indicated as being on or in the near vicinity of the site. The proposed static caravan area may be at risk from the inundation of flood waters from

**FLOODING & DRAINAGE ASSESSMENT
FOR A PROPOSED EXTENSION TO BRIDGE
HEYWOOD CARAVAN PARK, READ, BURNLEY**

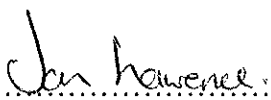
	an overloaded public combined sewer and a surface water sewer from the existing caravan park that crosses this area.
Sequential Test	The Sequential Test should be applied at all stages of planning. Its aim is to steer new development to areas at the lowest probability of flooding. Table D.2 of the Technical Guidance to the NPPF (which categorises the flood risk vulnerability of land uses) indicates the proposed development (static caravan area) is categorised as 'more vulnerable' land use. Table D.2 of the Technical Guidance to the NPPF gives no specific guidance for the proposed development (storage area) but this is also considered to be 'more vulnerable' land use as the static caravan area. However it should be noted that general industry storage and distribution is classed as 'less vulnerable' land use. From the EA flood map the proposed static caravan area is identified as being in Flood Zone 2. From the modelled flood levels obtained from the EA the southwest sector of the proposed static caravan area is in Flood Zone 3a, the southern sector is in Flood Zone 2 and the remainder is in Flood Zone 1. Table D.3 of the Technical Guidance to the NPPF indicates where the land use is 'more vulnerable' development is:- - Appropriate in Flood Zone 1 - Appropriate in Flood Zone 2 subject to a Flood Warning and Evacuation Plan. - Appropriate in Flood Zone 3 subject to the exception test. From the EA flood map and modelled flood levels the proposed storage area is identified as being in Flood Zone 1. Table 3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'highly vulnerable' development is appropriate in Flood Zone 1. Therefore the Sequential Test has been passed.
Exception Test	Table D.3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is considered appropriate in Flood Zone 1 and 2 and the Exception Test is not required. However, sites used for holiday caravans are subject to a Flood Warning and Evacuation Plan. Table D.3 of the Technical Guidance to the NPPF indicates where the proposed land use is 'more vulnerable' development is only appropriate in Flood Zone 3 subject to the exception test. The following sections of this report will demonstrate that the proposed development will be safe from flooding and will not increase flood risk elsewhere.
Flood Risk Mitigation	Proposed Caravan Storage Area: The proposed development is in Flood Zone 1. The levels in the proposed caravan storage area should be set to route any potential overland flood waters around the caravans towards the river. Proposed Additional Static Caravan Area: It should be noted that the floor level of static caravans are generally set at 0.9m above the supporting concrete base (ground level) and the floor level of the caravans should be set at a minimum level of 63.10m AOD to give a free board of 0.6m above the 100 year plus climate change modelled flood level. A Flood Warning and Evacuation Plan should be prepared for the additional static caravan area. The south western sector of this area should be raised to a level of 62.80m. This would result in the removal of approximately 80m³ from the 1:100 + climate change flood plain which is considered to be negligible. This would also provide a 0.3m free board above the modelled flood level of 62.49m AOD. If the loss of 80m³ from the flood plain is of concern then a small cut and fill exercise could be undertaken along the southern boundary of the proposed additional static caravan area to maintain the flood volume The external levels around the additional static caravan area should be set to route any potential overland flood waters from higher ground to the north, the proposed watercourse that crosses this area of the site and the public sewer that crosses this area of the site around the caravan towards the river.

Foul Drainage	It is proposed that a separate foul water drainage system is provided on the proposed additional static caravan area discharging to the 225mm diameter public combined sewer that crosses this area of the site. A foul drainage system will not be required in the proposed caravan storage area.
Surface Water	A separate surface water drainage system comprising of cut off drains adjacent hardcover areas should be provided on the development. The use of soakaways and porous paving will be considered on the development subject to ground conditions and the results of falling head permeability testing in accordance with BRE 365: Soakaways. If surface water is discharged to watercourse adjacent the southern boundary of the caravan park, based on a proposed drained hardcover area of 2400m ² and a discharge rate of 3.5 l/sec a storage volume of 122.9m ³ should be provided on the development, based on a 1:100 year storm return period with a 30% increase on rainfall intensity to cater for climate change. A surface water drainage system will not be provided in the proposed caravan storage area.

6.0 CAVEATS

- 6.01 The comments given in this report and recommendations made are based on the information that could be obtained from reasonably accessible sources. Detailed discussions have not yet been held with statutory bodies and the local authority.
- 6.02 This report has been prepared for the sole use of Mr R Hanson unless agreed otherwise in writing by CoDA Structures.

Signed:



 J Lawrence B Eng C Eng M I Struct E

APPENDIX A

SITE LOCATION PLAN (FIG. 1)

CoDa+ Structures

Consulting Civil & Structural Engineers

No 2 Harewood Yard

Harewood

Leeds LS17 9LF

Tel: 0113 288 6766

Fax: 0113 288 6765

Project Bridge Heywood Craavan Park Read

Title Site Location Plan

Drawn JL

Date 08.12

Drg. No.

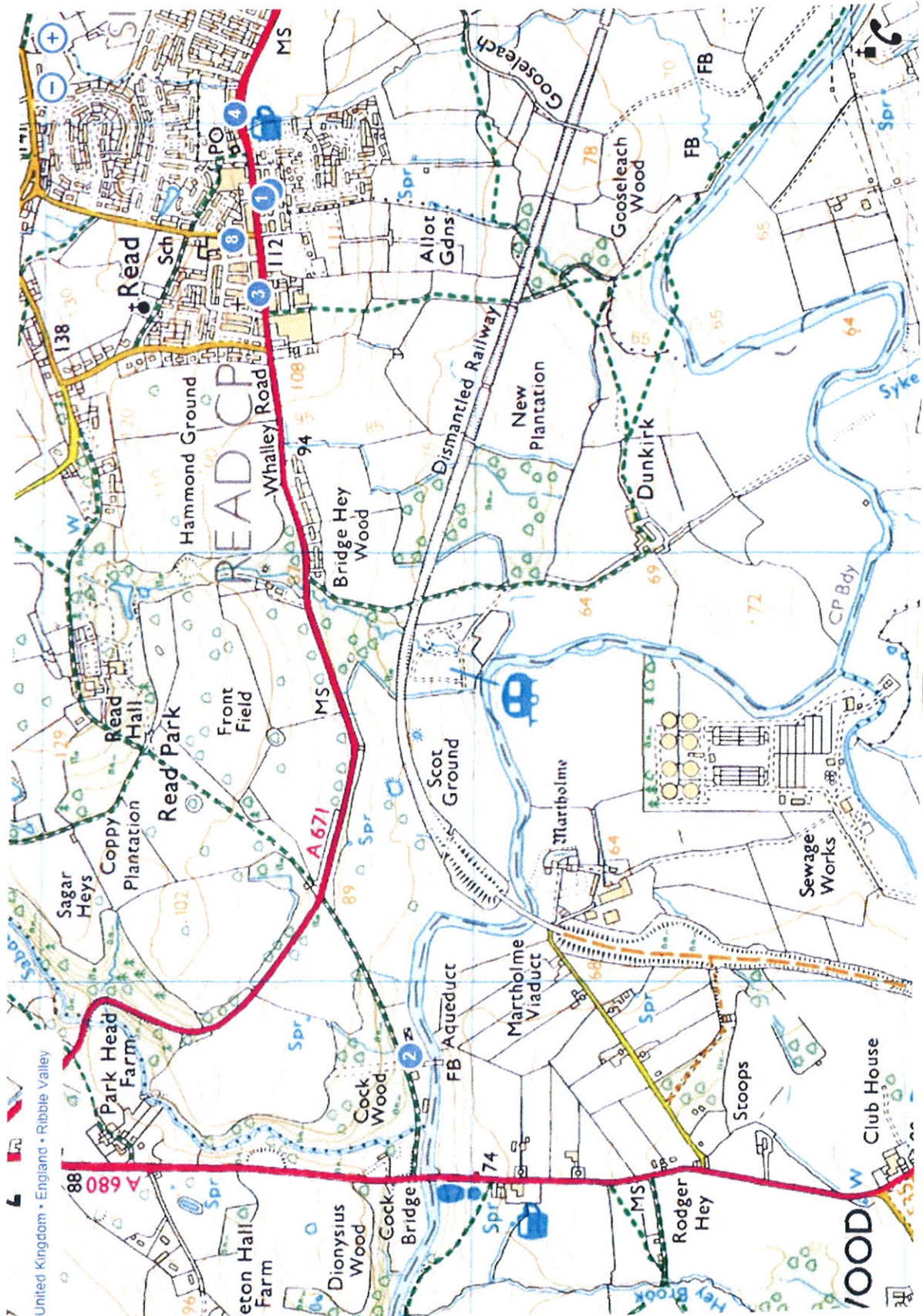
Rev.

Scale nts

Checked JL

7119/Fig1

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APPENDIX B

SITE TOPOGRAPHICAL SURVEY (FIG. 2)



APPENDIX C

SITE AERIAL PHOTOGRAPH

APPENDIX D

ENVIRONMENT AGENCY FLOOD MAP AND MODELLED FLOOD LEVELS FOR THE RIVER CALDER ADJACENT THE SITE

Node Point	Undefended Level (mAOD)										100-year Defended (mAOD)
	2-year	5-year	10-year	25-year	50-year	75-year	100-year	200-year	1000-year	100-year + Climate Change	
RCAL2A_1503	61.22	61.51	61.65	61.88	62.06	62.17	62.25	62.47	63.32	62.49	62.28
RCAL2A_1483	61.25	61.56	61.71	61.92	62.08	62.17	62.24	62.43	63.20	62.46	62.27
RCAL2A_1402	61.13	61.46	61.63	61.87	62.06	62.17	62.25	62.46	63.25	62.49	62.28

Table 01

Data from Burnley, Nelson & Colne Strategy (2010)

Node Point	Undefended Flow (cumecs)										100-year Defended (Cumecs)
	2-year	5-year	10-year	25-year	50-year	75-year	100-year	200-year	1000-year	100-year + Climate Change	
RCAL2A_1503	121.74	155.57	175.33	209.54	238.86	256.33	268.81	301.26	415.28	304.62	273.22
RCAL2A_1483	121.73	156.59	177.28	212.80	243.14	261.20	274.18	308.31	433.23	311.95	278.78
RCAL2A_1402	121.73	152.79	168.52	195.13	218.06	232.11	242.41	271.14	390.10	274.39	246.14

Table 02

Data from Burnley, Nelson & Colne Strategy (2010)

Flood Level Map centred on Bridge Heywood Caravan Park

Produced: 11 June 2012

Key

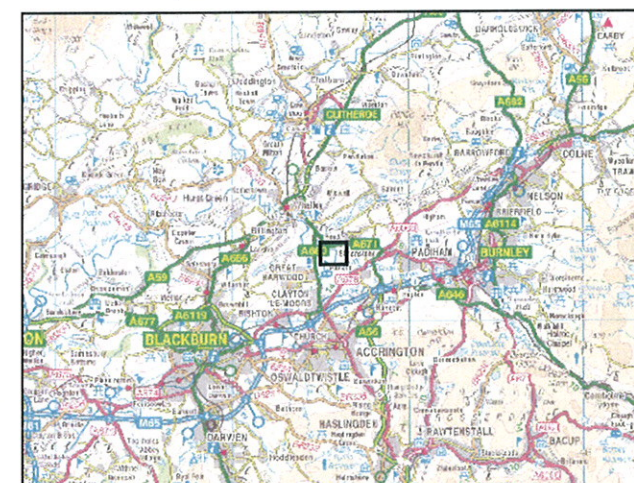
-  Bridge Heywood Caravan Park
-  Main River
-  Historic Flooding
-  ABDs
-  Flood Zone 3
-  Flood Zone 2

Flood Zone 3 shows the area that could be affected by flooding:

- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

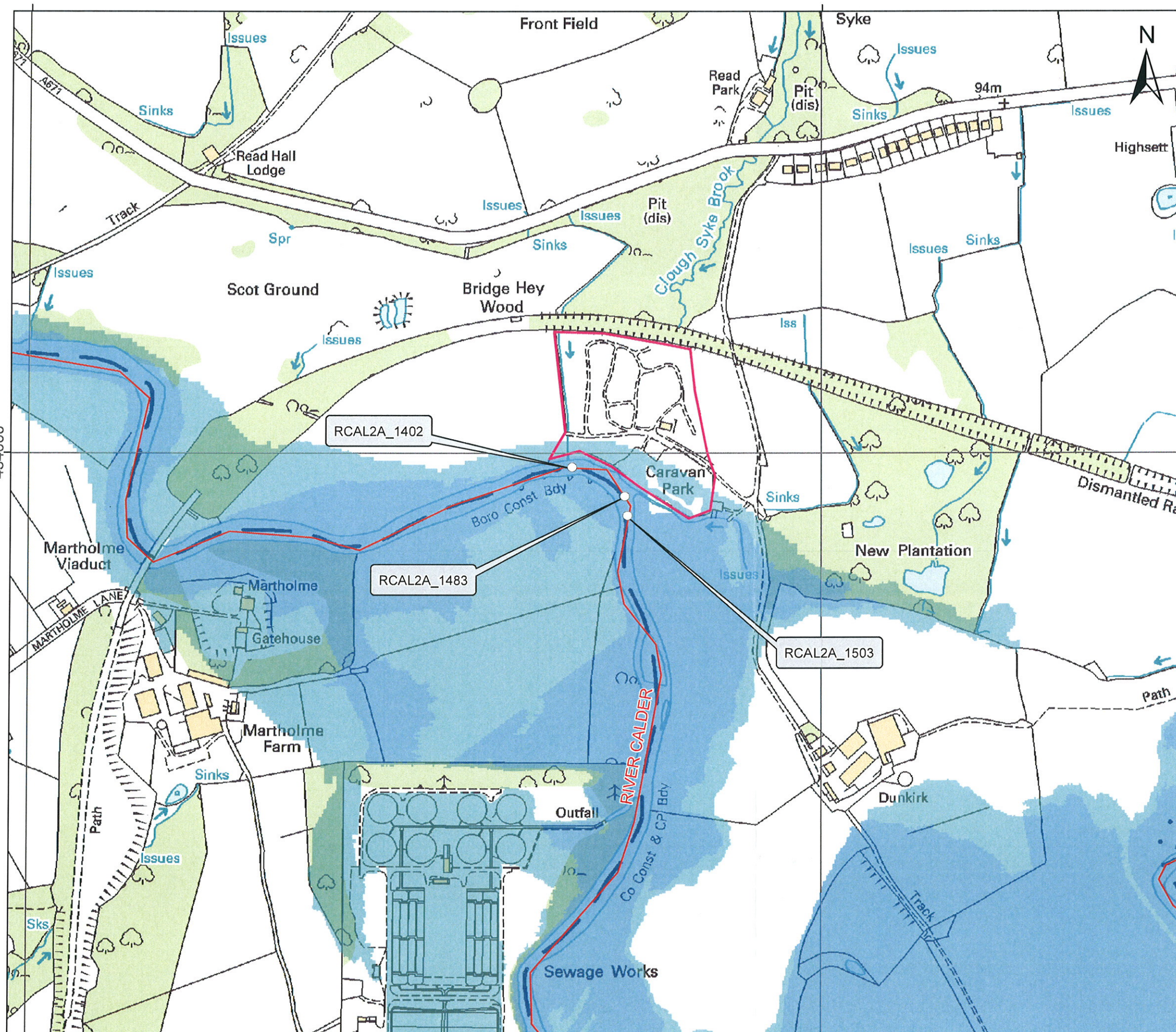
Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

ABDs (Areas Benefiting from Defences) show the area benefiting from defences during a 1 in 200 tidal, or 1 in 100 fluvial flood event.



434000

375000



376000

APPENDIX E

EXTRACT FROM THE PUBLIC SEWER RECORD

Extract From Map of Public Sewers

The position of underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available.

The actual positions may be different from those shown on the plan and private pipes, sewers or drains may not be recorded.

United Utilities will not accept any liability for any damage caused by the actual positions being different from those shown.

© United Utilities 2001
The plan is based upon the Ordnance Survey Map with the sanction of the Controller of H.M. Stationery Office. Crown and United Utilities copyrights are reserved. Unauthorised reproduction will infringe these copyrights.

Legend

-  Public Sewer
-  Highway Drain
-  Private Sewer
-  Pumping Main
-  Section 104 Sewers
-  Abandoned Sewer

Refer to colour guide for content of pipe

Red or Brown - Foul Sewers
Blue - Surface Water Sewers

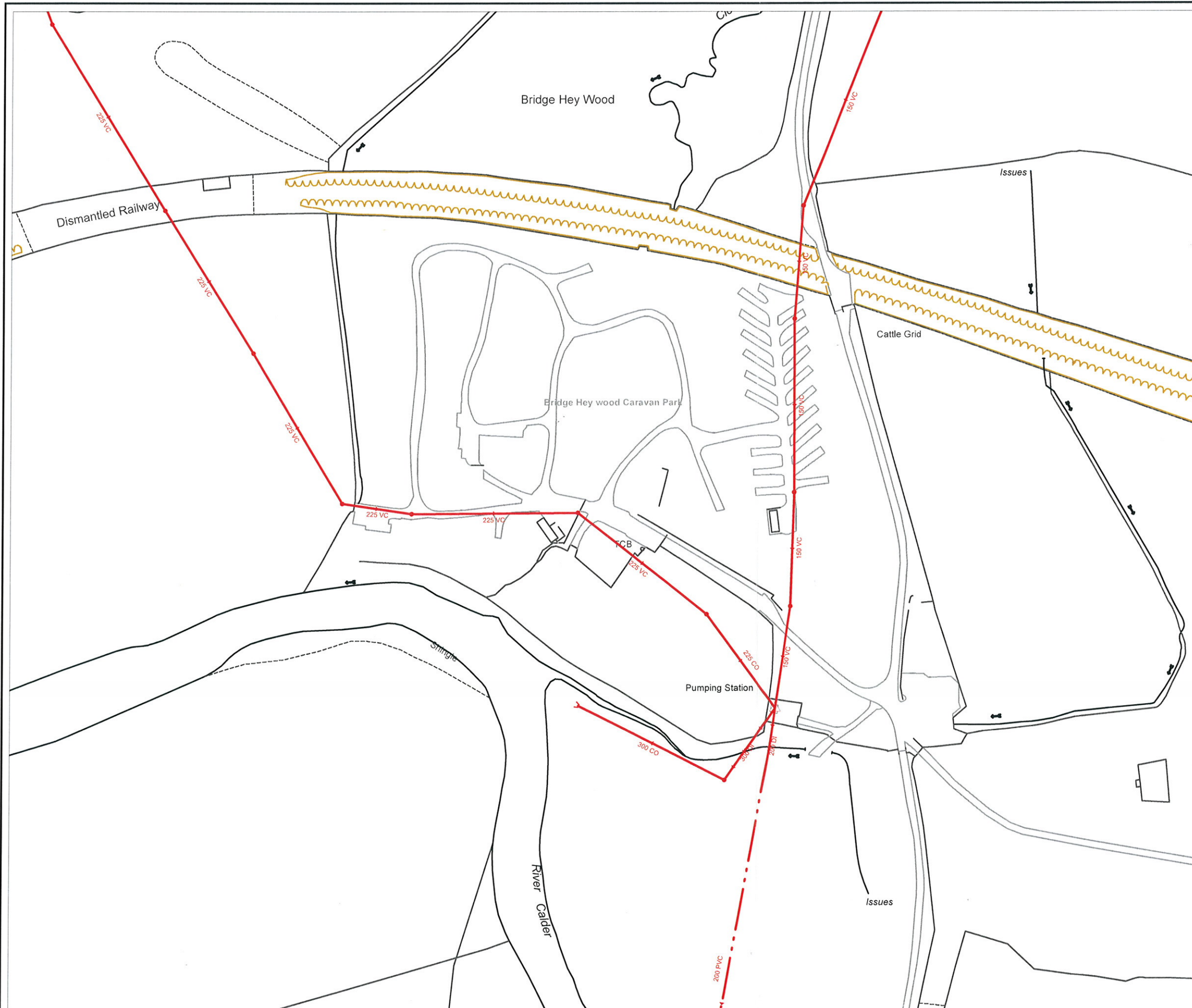
Bridge Heywood Caravan Park

Printed By: JA

Date: 26/06/2012

DO NOT SCALE

Approximate Scale 1:2500



APPENDIX F

DRAINAGE CALCULATIONS

DESIGN SYNOPSIS

Storage has been designed to accommodate design flows of a 1 in 100 year Return Period + 30% for climatic change with a pass forward flow of no greater than 3.5 lt/sec for drainage run-off from the proposed impermeable areas, which demonstrates the requirement for an on-site storage volume of 122.9m³.

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3. Source Control 3.5lt/sec – 1 in 100 year +30% CC Return Period Summary of Results 2/2
4. Source Control 3.5lt/sec – 1 in 100 year +30% CC Return Period Rainfall Details
5. Source Control 3.5lt/sec – 1 in 100 year +30% CC Return Period Notional Storage Structure and Outflow Control Details

CODA		Page 2
2 Harewood Yard	7119 Read, Burnley	
Harewood	SW Draft Storage	
Leeds LS17 9LF	100yr + 30%CC - 3.5 l/s	
Date 09.08.12	Designed by AB	
File 7119 ReadBurnley...	Checked by	
Elstree Computing Ltd	Source Control W.12.6.1	

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	10.643	0.643	2.2	47.3	O K
30 min Summer	10.804	0.804	2.5	64.1	O K
60 min Summer	10.974	0.974	2.8	81.7	O K
120 min Summer	11.136	1.136	3.0	97.4	O K
180 min Summer	11.204	1.204	3.1	103.5	O K
240 min Summer	11.225	1.225	3.1	105.3	O K
360 min Summer	11.234	1.234	3.1	106.1	O K
480 min Summer	11.225	1.225	3.1	105.3	O K
600 min Summer	11.208	1.208	3.1	103.9	O K
720 min Summer	11.189	1.189	3.0	102.2	O K
960 min Summer	11.150	1.150	3.0	98.7	O K
1440 min Summer	11.074	1.074	2.9	91.6	O K
2160 min Summer	10.967	0.967	2.7	80.9	O K
2880 min Summer	10.870	0.870	2.6	70.9	O K
4320 min Summer	10.708	0.708	2.4	54.1	O K
5760 min Summer	10.580	0.580	2.1	40.9	O K
7200 min Summer	10.470	0.470	2.0	30.2	O K
8640 min Summer	10.366	0.366	2.0	20.6	O K
10080 min Summer	10.248	0.248	2.0	11.1	O K
15 min Winter	10.700	0.700	2.3	53.2	O K
30 min Winter	10.883	0.883	2.6	72.3	O K
60 min Winter	11.083	1.083	2.9	92.4	O K
120 min Winter	11.295	1.295	3.2	111.0	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	109.649	19
30 min Summer	75.673	33
60 min Summer	49.937	62
120 min Summer	31.760	122
180 min Summer	23.941	180
240 min Summer	19.434	240
360 min Summer	14.501	300
480 min Summer	11.758	362
600 min Summer	9.982	430
720 min Summer	8.726	498
960 min Summer	7.050	638
1440 min Summer	5.206	912
2160 min Summer	3.834	1320
2880 min Summer	3.080	1728
4320 min Summer	2.259	2468
5760 min Summer	1.816	3232
7200 min Summer	1.533	3968
8640 min Summer	1.335	4752
10080 min Summer	1.188	5352
15 min Winter	109.649	18
30 min Winter	75.673	33
60 min Winter	49.937	62
120 min Winter	31.760	120

CODA		Page 3
2 Harewood Yard Harewood Leeds LS17 9LF	7119 Read, Burnley SW Draft Storage 100yr + 30%CC - 3.5 l/s	
Date 09.08.12	Designed by AB	
File 7119 ReadBurnley...	Checked by	
Elstree Computing Ltd		Source Control W.12.6.1

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
180 min Winter	11.408	1.408	3.3	118.8	O K
240 min Winter	11.465	1.465	3.4	121.7	O K
300 min Winter	11.488	1.488	3.4	122.9	O K
480 min Winter	11.476	1.476	3.4	122.2	O K
600 min Winter	11.440	1.440	3.4	120.5	O K
720 min Winter	11.397	1.397	3.3	118.1	O K
960 min Winter	11.315	1.315	3.2	112.6	O K
1440 min Winter	11.178	1.178	3.0	101.3	O K
2160 min Winter	11.007	1.007	2.8	85.0	O K
2880 min Winter	10.867	0.867	2.6	70.6	O K
4320 min Winter	10.645	0.645	2.3	47.6	O K
5760 min Winter	10.468	0.468	2.0	29.9	O K
7200 min Winter	10.245	0.245	2.0	10.9	O K
8640 min Winter	10.116	0.116	1.9	2.8	O K
10080 min Winter	10.095	0.095	1.7	1.9	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
180 min Winter	23.941	176
240 min Winter	19.434	232
300 min Winter	14.501	334
480 min Winter	11.758	378
600 min Winter	9.982	456
720 min Winter	8.726	534
960 min Winter	7.050	690
1440 min Winter	5.206	984
2160 min Winter	3.834	1408
2880 min Winter	3.080	1820
4320 min Winter	2.259	2596
5760 min Winter	1.816	3400
7200 min Winter	1.533	4104
8640 min Winter	1.335	4408
10080 min Winter	1.188	5136

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2 Harewood Yard	7119 Read, Burnley	
Harewood	SW Draft Storage	
Leeds LS17 9LF	100yr + 30%CC - 3.5 l/s	
Date 09.08.12	Designed by AB	
File 7119 ReadBurnley...	Checked by	
Elstree Computing Ltd	Source Control W.12.6.1	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time / Area Diagram

Total Area (ha) 0.240

Time	Area
(mins)	(ha)

0-4 0.240

CODA		Page 5
2 Harewood Yard	7119 Read, Burnley	
Harewood	SW Draft Storage	
Leeds LS17 9LF	100yr + 30%CC - 3.5 l/s	
Date 09.08.12	Designed by AB	
File 7119 ReadBurnley...	Checked by	
Elstree Computing Ltd	Source Control W.12.6.1	

Model Details

Storage is Online Cover Level (m) 13.000

Double Pipe Structure

Diameter (m) 1.500 Length (m) 34.200
Slope (1:X) 500.000 Invert Level (m) 10.000

Hydro-Brake® Outflow Control

Design Head (m) 1.500 Hydro-Brake® Type Md6 SW Only Invert Level (m) 10.000
Design Flow (l/s) 3.5 Diameter (mm) 70

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.7	1.200	3.1	3.000	4.8	7.000	7.4
0.200	1.9	1.400	3.3	3.500	5.2	7.500	7.7
0.300	1.8	1.600	3.5	4.000	5.6	8.000	7.9
0.400	1.9	1.800	3.8	4.500	5.9	8.500	8.2
0.500	2.0	2.000	4.0	5.000	6.3	9.000	8.4
0.600	2.2	2.200	4.1	5.500	6.6	9.500	8.6
0.800	2.5	2.400	4.3	6.000	6.8		
1.000	2.8	2.600	4.5	6.500	7.1		