

Your Environment

SURFACE WATER DRAINAGE STRATEGY LAND TO THE REAR OF SUNNYSIDE BARN AND FLINT BARN, BARNHAM

For Manorwood Ltd

Your Environment

Head Office, Unit 2, Woodhorn Business Centre, Oving,
Chichester, Sussex, PO20 2BX

Report Number: YE4281, Date: January 2020

Paul Timmins

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	Name	Position	Signature	Date
Prepared by:	Paul Timmins	Drainage Consultant		January 2020
Reviewed by:	Mat Griffith	Geo Environmental Consultant		January 2020
Approved:	Colin Hiscock	Director		January 2020
For and on behalf of YourEnvironment				

Issue	Date	Description	Prepared	Reviewed	Approved
00	24/01/2020	Draft Report	PT	MG	CH

1.0 Executive Summary

YourEnvironment (YE) was instructed by Manorwood Ltd to provide a Surface Water Drainage Report to describe the proposed drainage strategy for the proposed development within land to the rear of Sunnyside Barn and Flint Barn, Barnham.

The purpose of this report is to provide a drainage layout plan for the revised development layout.

We trust this is sufficient for your requirements and should you have any questions please do not hesitate to contact the undersigned.

For YourEnvironment

Colin Hiscock

Director

2.0 Introduction

YourEnvironment (YE) was instructed by Manorwood Ltd provide a Surface Water Drainage Report to describe the drainage strategy for the proposed development within land to the rear of Sunnyside Barn and Flint Barn, Barnham, PO22 0AZ.

The location of the site is illustrated on Figure 1 (below).



Figure 1: Location of the development site

The development proposes the construction of three dwellings on a site of around 0.54ha.

Plans and elevations of the proposed development are provided in Appendix A.

3.0 Hierarchy of Preference for Surface Water Disposal

Part H3 of the Building Regulations sets out the hierarchy of preference for the disposal of surface water from new development as follows:

Rainwater Drainage

H3... (3) Rainwater from a system provided pursuant to sub-paragraphs (1) and (2) shall discharge to one of the following, listed in order of priority:

- a) An adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable,*
- b) A watercourse, or, where that is not reasonably practicable,*
- c) A sewer.*

Infiltration potential at the site

Investigations to determine whether the underlying soils at the site were suitable for infiltration were carried out in March 2018. These comprised the excavation of two trial pits in order to carry out permeability testing using the BRE365 test procedure.

However, during excavation of the trial pits it was found that the groundwater table was high and prevented the tests from being undertaken.

The trial pit logs and selected photos of the trial pits excavated are provided in [Appendix B](#).

Without permeability test results, it has been concluded that surface water by infiltration means is not possible at the site. Firstly, because of the difficulty of measuring a soil infiltration rate for the underlying soils and secondly because the base of any soakaway structure is likely to be less than 1m above the maximum anticipated groundwater level.

The presence of a watercourse

Inspection of the topographical survey of the site (see [Appendix C](#)) identifies a drainage ditch through the proposed. This drains in a southerly direction towards the watercourse alongside Hill Lane, which eventually feeds into Lidsey Rife and then to Aldborough Rife and out to sea at Bognor Regis¹.

It is proposed that surface water from the site is disposed to the existing watercourse.

¹ Environment.data.gov.uk. (2018). Environment Agency - Catchment Data Explorer. [online] Available at: <http://environment.data.gov.uk/catchment-planning/WaterBody/GB107041011980> [Accessed 6 Jun. 2018].

4.0 Surface Water runoff disposal

SuDS Selection

Surface water runoff shall be managed from roofs, external circulation areas close to the new building and the access roads. Runoff from these areas shall be piped to discharge point and then into the existing watercourse.

The method of surface water disposal has been developed with the guidance (Supplementary Requirements for Surface Water Drainage Proposals) published by Arun District Council².

The ADC guidance document recommends that discharge to a watercourse be restricted to the estimated mean greenfield runoff rate (QBar) by means of a controlled outflow.

Calculations for QBar have been undertaken using the Rural Runoff Calculator module within Microdrainage using the ReFH2 method. The results are provided in Appendix D (the site-specific point descriptors and rainfall depth data were acquired through the Flood Estimation Handbook Web Service³). As the calculated value for QBar is very small (0.5l/s for the developed area of the site (0.1ha)), the total the flow rate from the site is to be limited to 2 litres per second.

As infiltration structures are not feasible due to the high groundwater table and control of runoff impractical due to the low flows, it is proposed that surface water runoff from the hardstanding areas drain to a dry swale for conveyancing and storage purposes.

The proposed drainage design layout is provided in Figure 2 below.

Design Calculations - Plot 2

A landscaped swale is proposed to the south of Plot 1 to provide surface water storage during extreme rainfall events. Where possible, a conveyancing channels (i.e. shallow depressions in the ground with a constant longitudinal gradient) will be used to carry runoff from the parking area, the building and the garden studio to the swale.

The total hardstanding area within Plot 1 is 280m². The surfacing to the parking area can be constructed as a permeable surface using a coarse graded aggregate (MOT Type 3), confined using cellular paving grids. The shallow depth of construction allows the sub-base to discharge to the shallow conveyance channel, although for modelling purposes it is assumed that the parking area is impermeable.

The conveyance channel discharges into a swale located along the southern boundary, at the western end of the swale a flow control chamber restricts flows prior to discharge into the existing watercourse. The swale will incorporate a 25mm orifice at its outlet to control flows from the site and the swale will be sized to provide storage for the 1:100 year event of critical duration plus an allowance of 40% for climate change. From the flow control chamber, runoff will be discharged into the existing watercourse.

² Arun District Council. (2020). Supplementary Requirements for Surface Water Drainage Proposals. [online] Arun.gov.uk. Available at: <https://www.arun.gov.uk/surfacewater> [Accessed 22 January 2020].

³ Fehweb.ceh.ac.uk. (2018). Home Page - FEH Web Service. [online] Available at: <https://fehweb.ceh.ac.uk/> [Accessed 6 Jun. 2018].

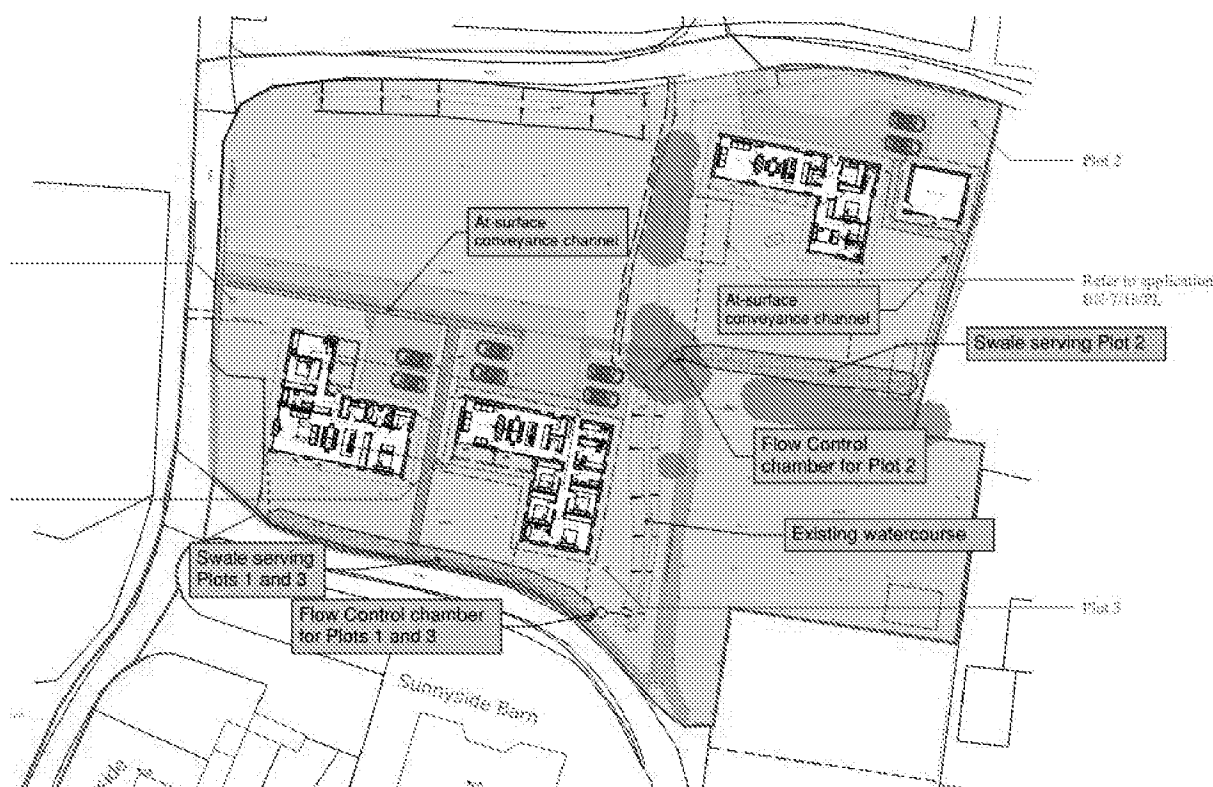


Figure 2: Proposed Drainage Strategy

Hydraulic modelling parameters - Plot 2

The swale shall be formed using the parameters shown in Table 1 below

Plan Area of system (25m long x 1.9m wide at crest)	48m ²
Bed width	300mm
Side Slopes	1:2
Longitudinal Slope	1:200
Crest Level	9.20m
Invert Level	8.40m

Table 1: Design parameters for the swale serving Plot 1

Hydraulic modelling of the drainage design has been undertaken with the Source Control module of the Microdrainage software suite. The results of the modelling are provided in Appendix E. The results demonstrate that no flooding occurs during a 1 in 100 return period event of critical duration including a 40% allowance for climate change.

Design Calculations - Plot 1 and 3

A landscaped swale is proposed to the south of Plots 2 and 3 to provide surface water storage during extreme rainfall events. Where possible, a conveyancing channels (i.e. shallow depressions in the ground with a constant longitudinal gradient) will be used to carry runoff from the access road, the parking areas and the buildings to the swale.

The total hardstanding area within Plot 2 and 3 is 660m². The access road to each plot will be constructed of impermeable tarmac surfacing; the surfacing to the parking area can be

constructed as a permeable surface using a coarse graded aggregate (MOT Type 3), confined using cellular paving grids. The shallow depth of construction allows the sub-base to discharge to the shallow conveyance channel, although for modelling purposes it is assumed that the parking area is impermeable.

The conveyance channel discharges into a swale located along the southern boundary, at the eastern end of the swale a flow control chamber restricts flows prior to discharge into the existing watercourse. The swale will incorporate a 25mm orifice at its outlet to control flows from the site and the swale will be sized to provide storage for the 1:100 year event of critical duration plus an allowance of 40% for climate change. From the flow control chamber, runoff will be discharged into the existing watercourse.

Hydraulic modelling parameters - Plots 1 and 3

The swale shall be formed using the parameters shown in Table 2 below

Plan Area of system (35m long x 2.1m wide at crest)	74m ²
Bed width	500mm
Side Slopes	1:2
Longitudinal Slope	1:200
Crest Level	9.20m
Invert Level	8.40m

Table 2: Design parameters for the swale serving Plots 2 and 3

Hydraulic modelling of the drainage design has been undertaken with the Source Control module of the Microdrainage software suite. The results of the modelling are provided in Appendix E. The results demonstrate that no flooding occurs during a 1 in 100 return period event of critical duration including a 40% allowance for climate change.

It should be noted that the total discharge rate during the 1 in 100 year (+40%) critical duration event is no more than 2.0 litres per second.

Maintenance and Management

The swales shall be maintained in perpetuity by the landowners. The maintenance actions recommended by the CIRIA SuDS Manual 2015 (Table 17.1) are reproduced below.

TABLE 17.1 Operation and maintenance requirements for swales		
Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Re-seed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial actions	Repair erosion or other damage by re-turfing or re-seeding	As required
	Re-level uneven surfaces and reinstable design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

5.0 Limitations

YE have prepared this report with all reasonable skill, care and diligence. The work undertaken to provide the basis of this report comprised a study of available documented information from a variety of sources.

The opinions given in this report have been dictated by the finite data on which are they based and are relevant only to the purpose for which the report was commissioned.

Information reviewed should not be considered exhaustive and has accepted in good faith as providing true and representative data with respect to site conditions. Should additional information become available which may influence the opinion expressed in this report, YE reserves the right to review such information and, if warranted, to alter the opinions accordingly.

It should be noted that any risks identified in this report are perceived risks based on the information reviewed.

The recommendations contained in this report represent our professional opinions. These opinions were arrived at in accordance with currently accepted industry practices at this time and as such are not a guarantee that the study site is free of hazardous conditions.

This report has been prepared solely for the use of the named client, and may not be relied upon by other parties without written consent from YE. YE disclaim any responsibility to the client and others in respect of any matters outside the agreed scope of the work

Appendix A -Proposed Development Layout Plans



Ordinance Survey
Mapcode: 1001



Location Plan
1:1250

Address
Land (to The Rear Of)
Sunnyside Barn And The
Flint Barn

Drawing
Site:
Location Plan

Scale @ A3
1:1250

Date
14.01.2020

Issue Date
14.01.2020

Drawn By MD	Checked By BK
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Job No.
191224

Drawing No.
191224_000

Revision
###

Status
For Comment



Address
Land (to The Rear Of)
Sunnyside Barn And The
Flint Barn

Drawing
Site:
Block Plan

Scale @ A3
1:500

Date
14.01.2020

Issue Date
14.01.2020

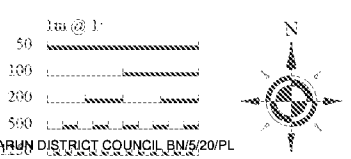
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Job No.
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Drawing No.
191224_001

Revision
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Status
For Comment

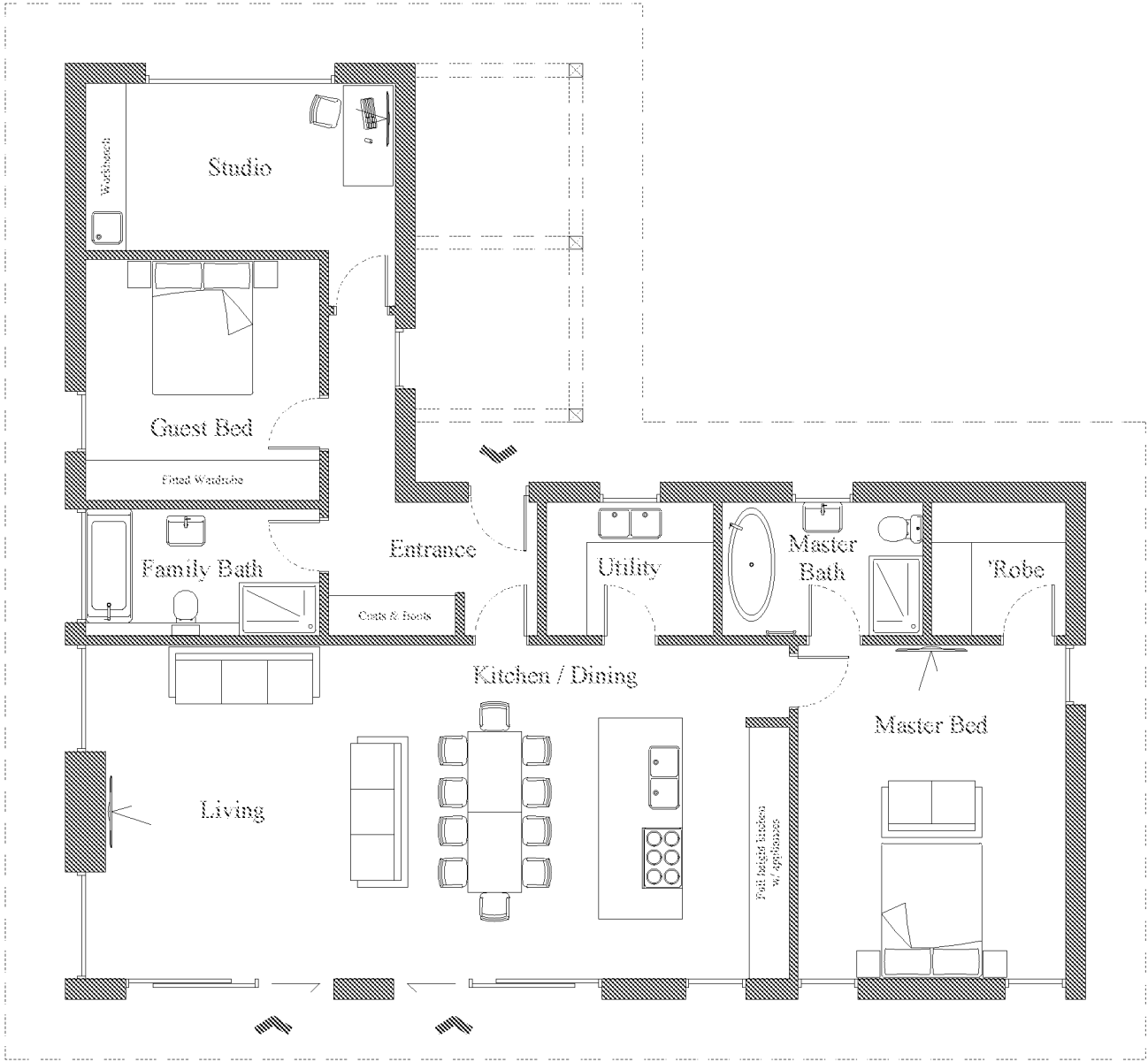


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web: www.manorwood.co.uk

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building on tradition

The Old Surgery
Rimbolds Hall
Midhurst
West Sussex
GU29 9BY

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All dimensions must be checked on site prior to commencement of works



Floor Plan
1:100

Plot 1

FP = 150.62m² - 1621ft²
GIA = 133.44m² - 1436.37ft²

Address
Land (to The Rear Of)
Sunnyside Barn And The
Flint Barn

Drawing
Proposed:
Floor Plan

Scale @ A3
1:100

Date
14.01.2020

Issue Date
14.01.2020

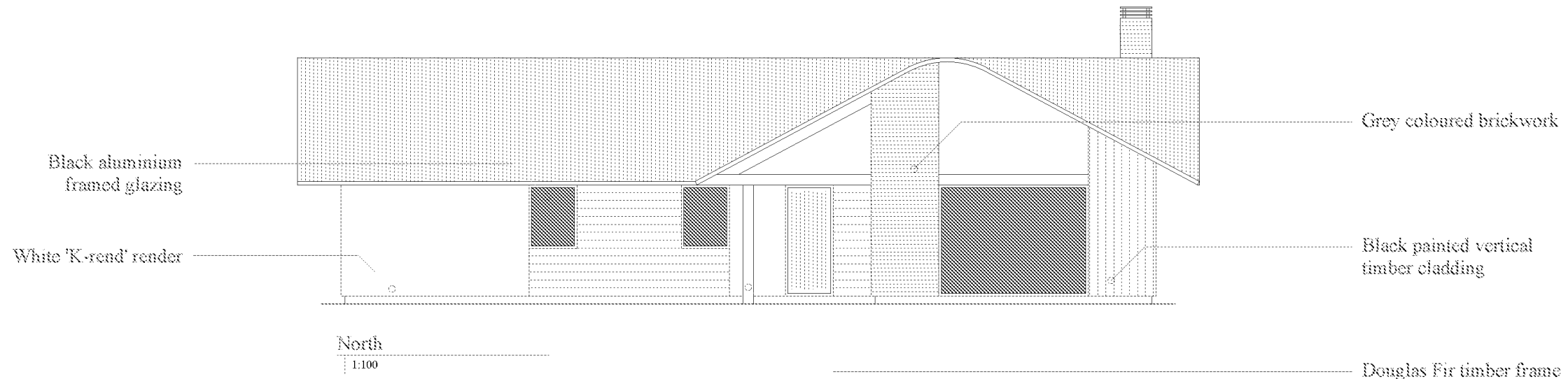
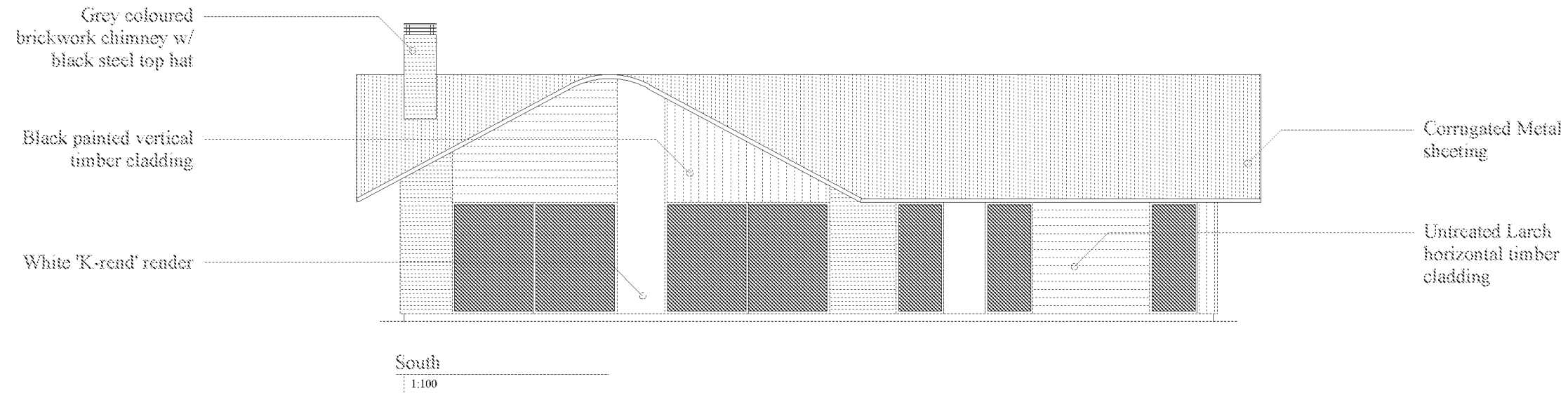
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Job No.
191224

Drawing No.
191224_200

Revision
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Status
For Comment



Plot 1

FP = 150.62m² - 1621ft²
GIA = 133.44m² - 1436.37ft²

Address
Land (to The Rear Of)
Sunnyside Barn And The
Flint Barn

Drawing
Proposed:
North & South Elevations

Scale @ A3
1:100

Date
14.01.2020

Issue Date
14.01.2020

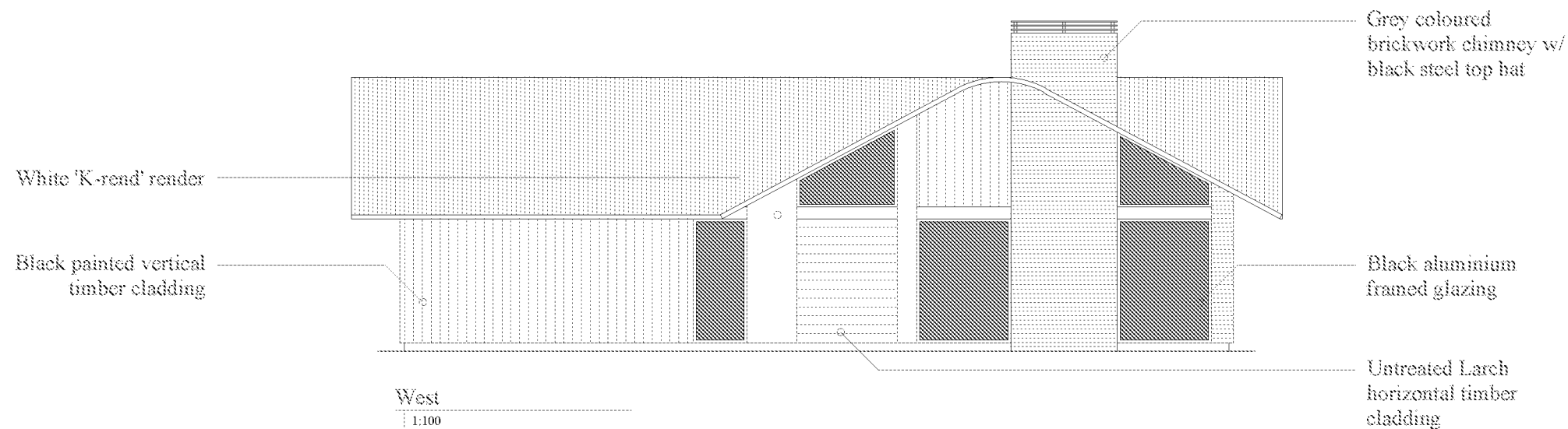
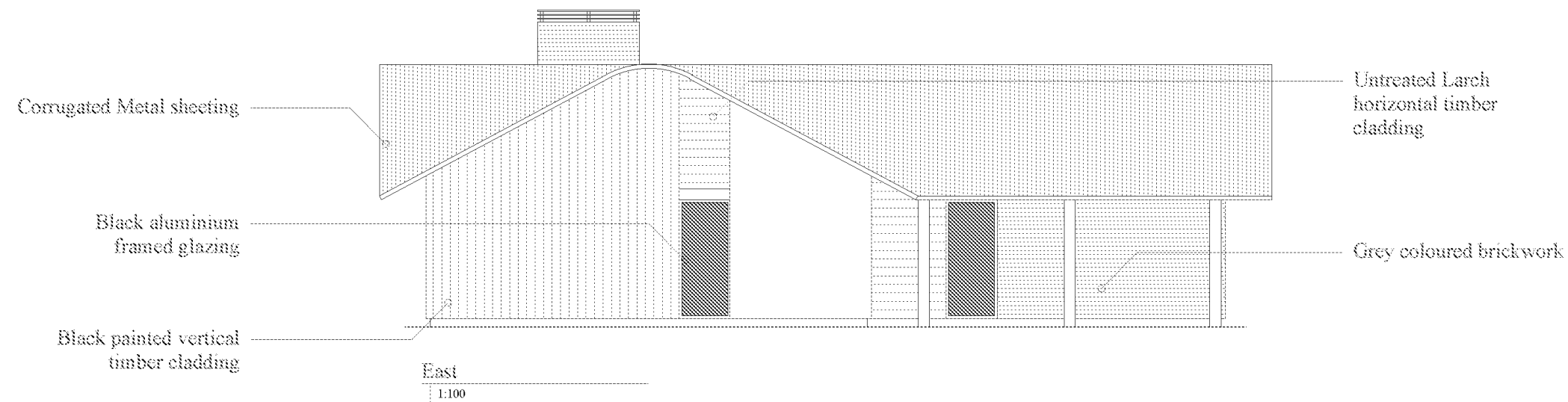
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Drawing No.
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Revision
###

Status
For Comment



Plot 1

FP = 150.62m² - 1621ft²
GIA = 133.44m² - 1436.37ft²

Address
Land (to The Rear Of)
Sunnyside Barn And The
Flint Barn

Drawing
Proposed:
East & West Elevations

Scale @ A3
1:100

Date
14.01.2020

Issue Date
14.01.2020

Drawn By MD	Checked By BK
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Job No.
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Drawing No.
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Revision
###

Status
For Comment

1m @ 1"

50

100

200

500

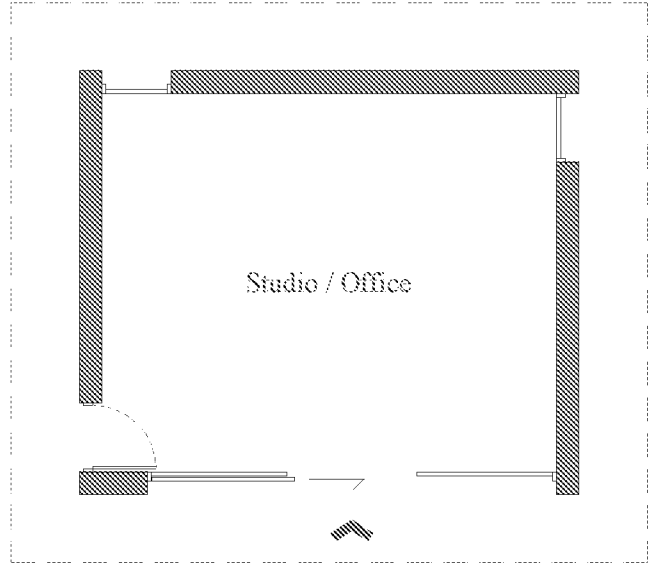
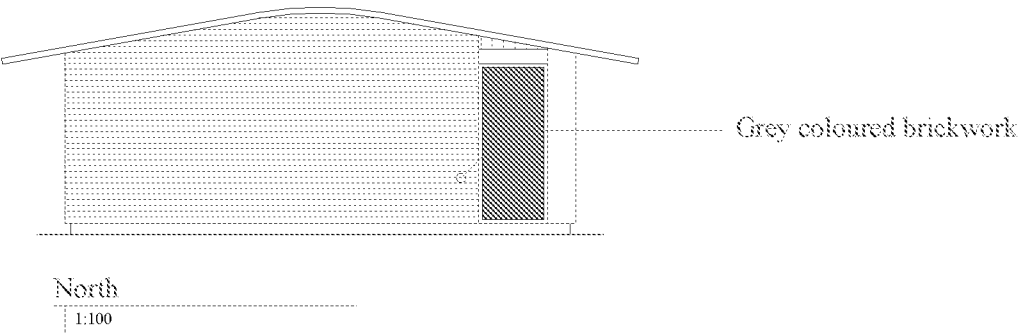
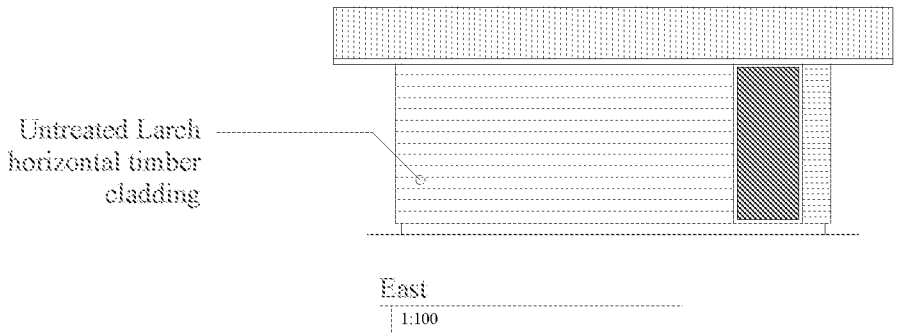
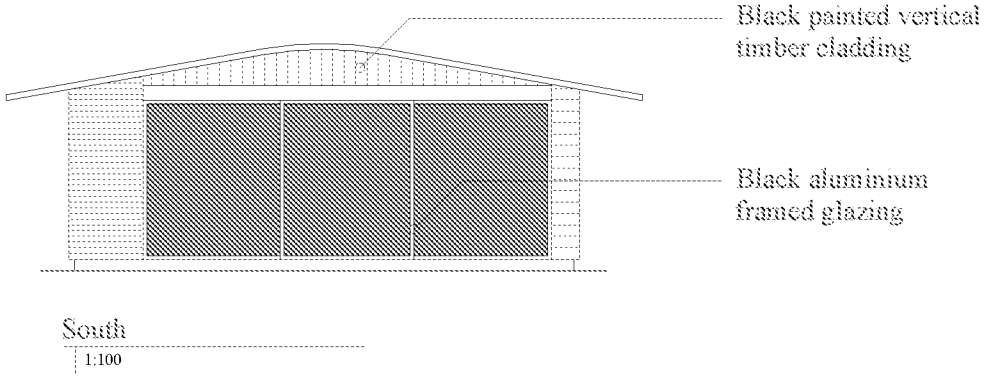
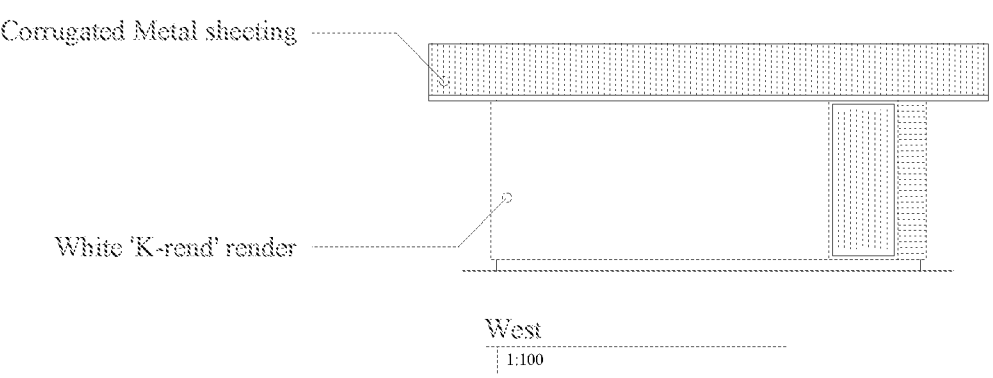
ARUN DISTRICT COUNCIL BN/5/20/PL

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Rimbolds Hill
Midhurst
West Sussex
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Plot 2 - Studio

FP = 36.96m² - 397.83ft²
GIA = 30m² - 322.91ft²

Address
Land (to The Rear Of)
Sunnyside Barn And The
Flint Barn

Drawing
Proposed Studio:
Elevations

Scale @ A3
1:100

Date
14.01.2020

Issue Date
14.01.2020

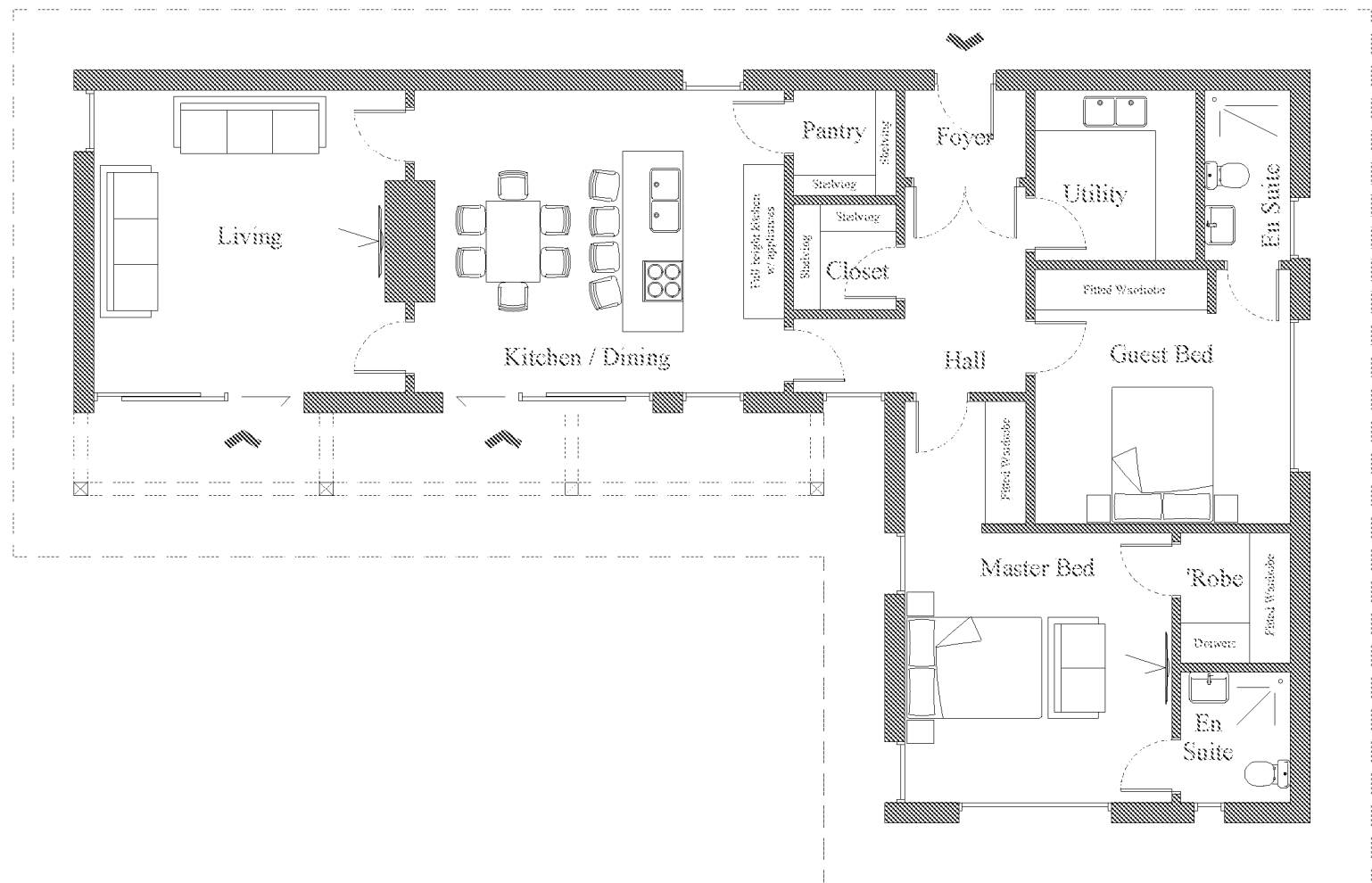
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Job No.
191224

Drawing No.
191224_203

Revision
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Status
For Comment



Floor Plan

1:100

Plot 2

FP = 131.46m² - 1415ft²
GIA = 114.12m² - 1228.4ft²

Address

Land (to The Rear Of)
Sunnyside Barn And The
Flint Barn

Drawing

Proposed:

Floor Plan

Scale @ A3

1:100

Date

14.01.2020

Issue Date

14.01.2020

Drawn By

MD

Checked By

BK

Job No.

191224

Drawing No.

191224_204

Revision

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Status

For Comment

1m @ 1"

50

100

200

500

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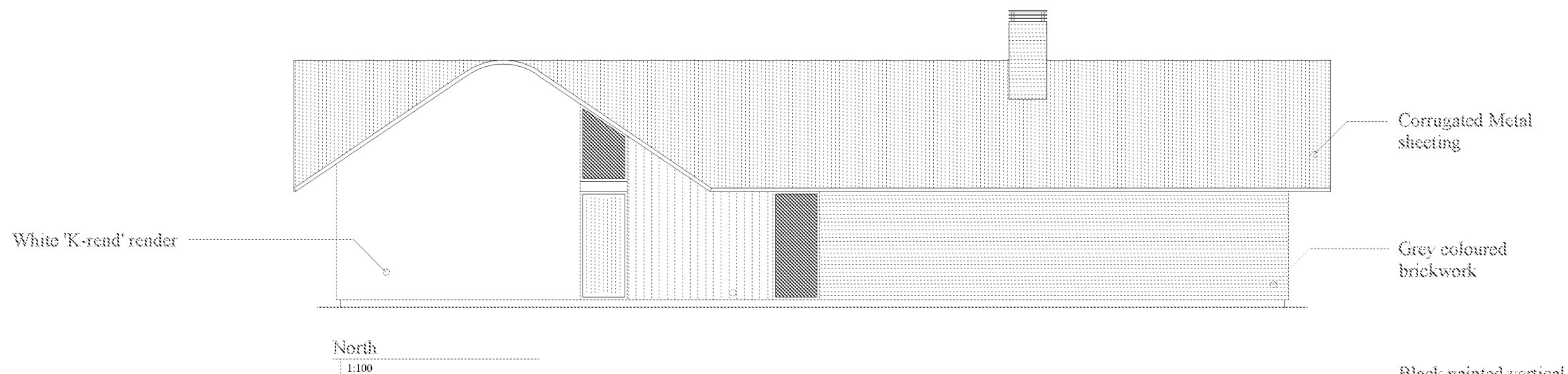
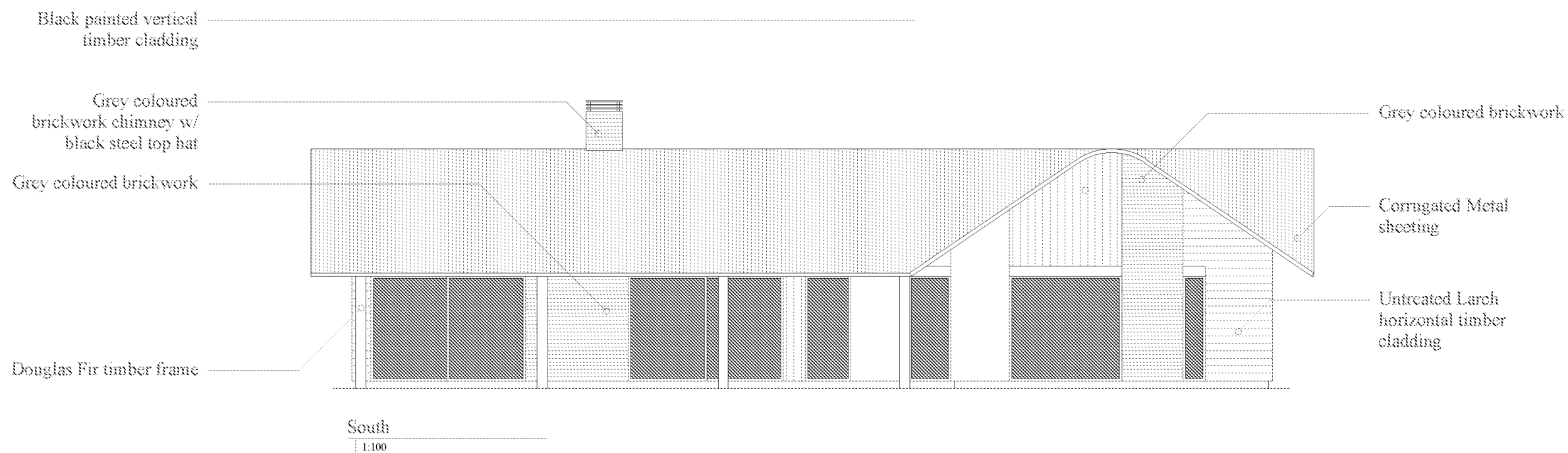
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Plot 2

FP = 131.46m² - 14156²
GFA = 114.12m² - 1228.40²

Address
Land (to The Rear Of)
Sunnyside Barn And The
Flint Barn

Drawing
Proposed:
North & South Elevations

Scale @ A3
1:100

Date
14.01.2020

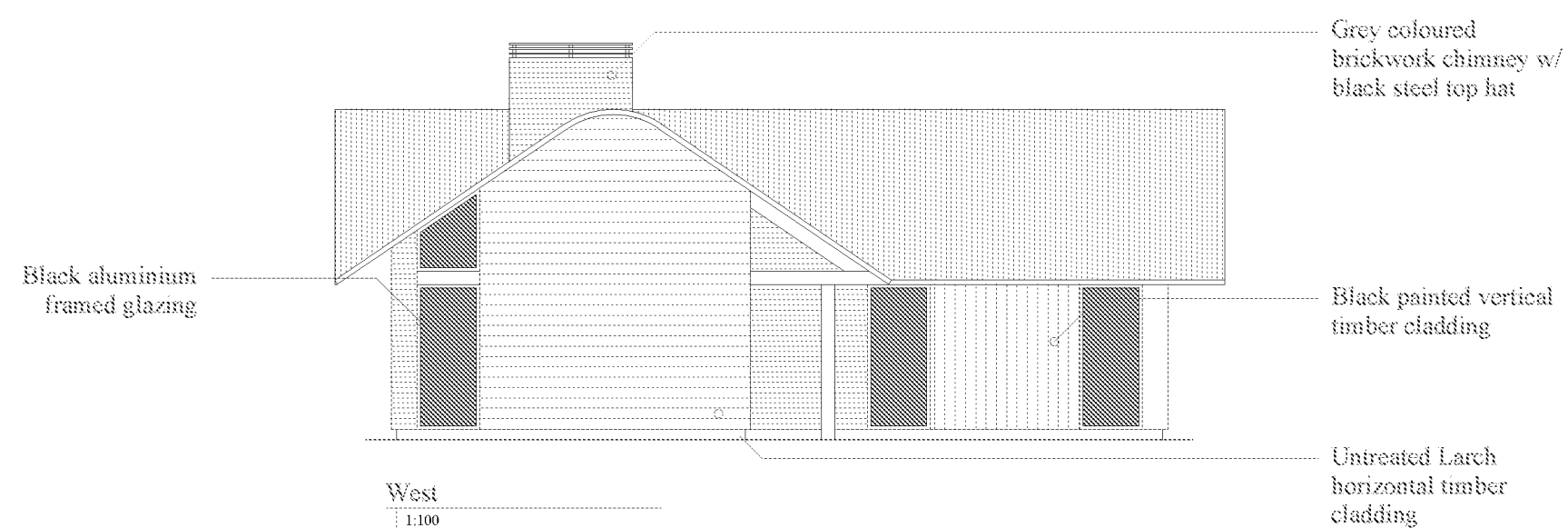
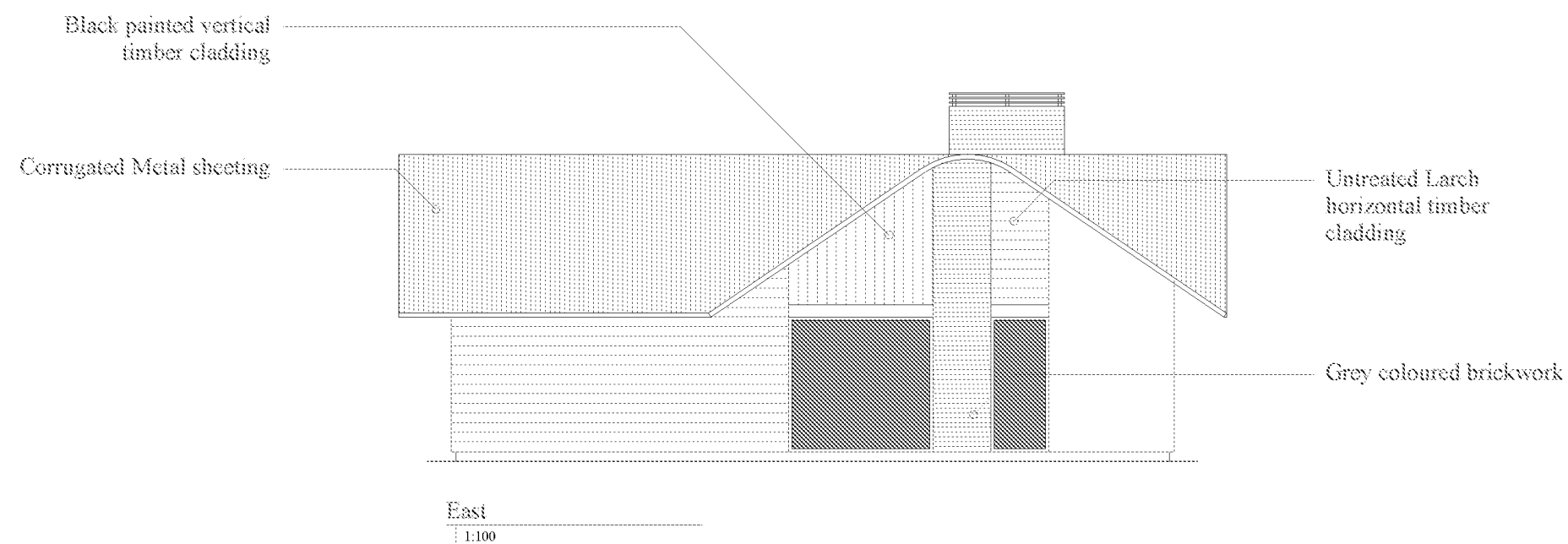
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Job No. 191224	

Drawing No.
191224_205

Revision
###

Status
For Comment



Plot 2

FP = 131,46m² - 14156²
GIA = 114,12m² - 1228,40²

Address
Land (to The Rear Of)
Sunnyside Barn And The
Flint Barn

Drawing
Proposed:
East & West Elevations

Scale @ A3
1:100

Date
14.01.2020

Issue Date
14.01.2020

Drawn By MD	Checked By BK
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Job No.
191224

Drawing No.
191224_206

Revision
###

Status
For Comment



Floor Plan
1:100

Plot 3

FP = 164.39m² - 1769.5ft²
GIA = 145.73m² - 1568.6ft²

Address
Land (to The Rear Of)
Sunnyside Barn And The
Flint Barn

Drawing
Proposed:
Floor Plan

Scale @ A3
1:100

Date
14.01.2020

Issue Date
14.01.2020

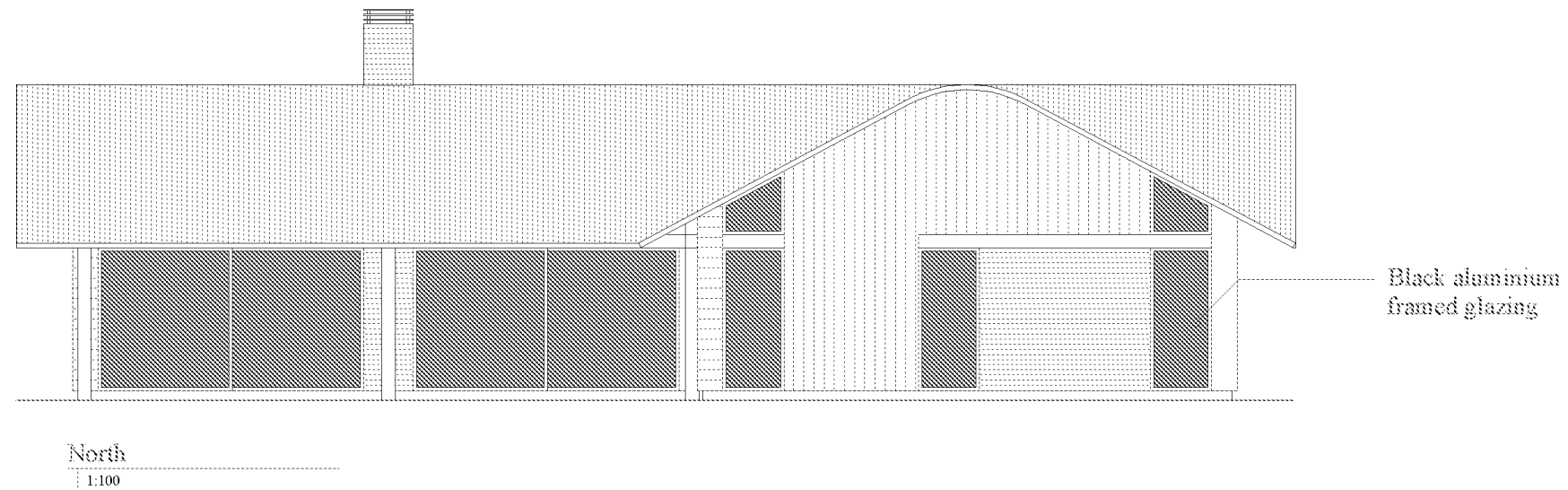
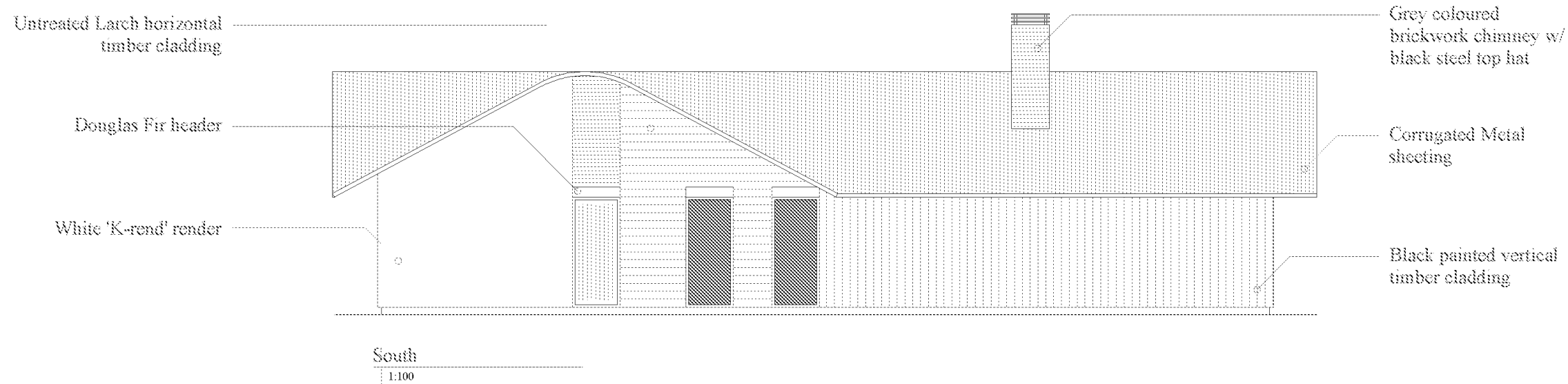
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Job No.
191224

Drawing No.
191224_207

Revision
###

Status
For Comment



Plot 3

FP = 164.39m² - 1769.5ft²
GIA = 145.73m² - 1568.6ft²

Address
Land (to The Rear Of)
Sunnyside Barn And The
Flint Barn

Drawing
Proposed:
North & South Elevations

Scale @ A3
1:100

Date
14.01.2020

Issue Date
14.01.2020

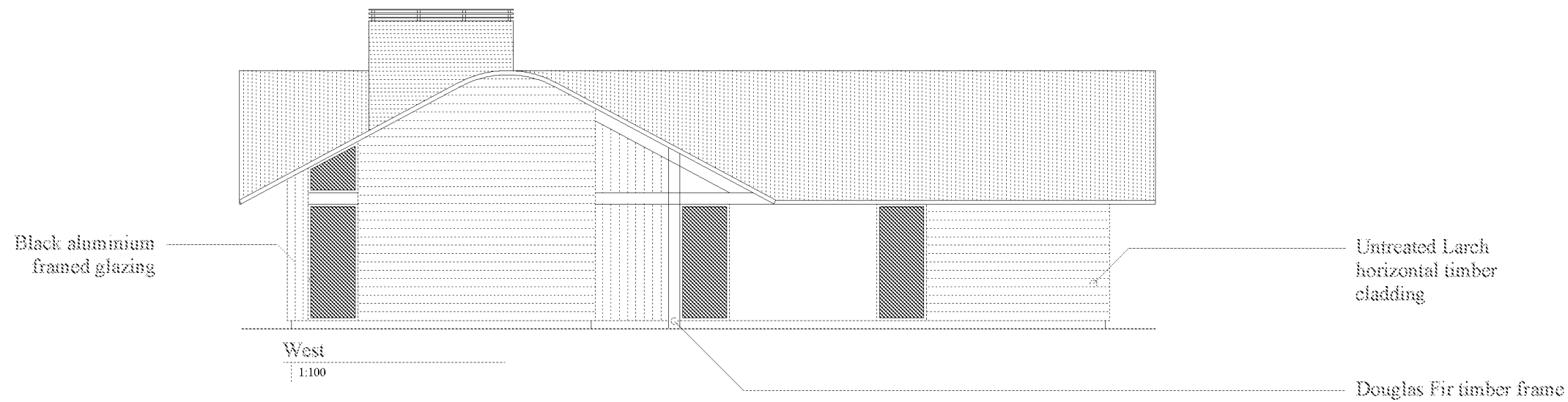
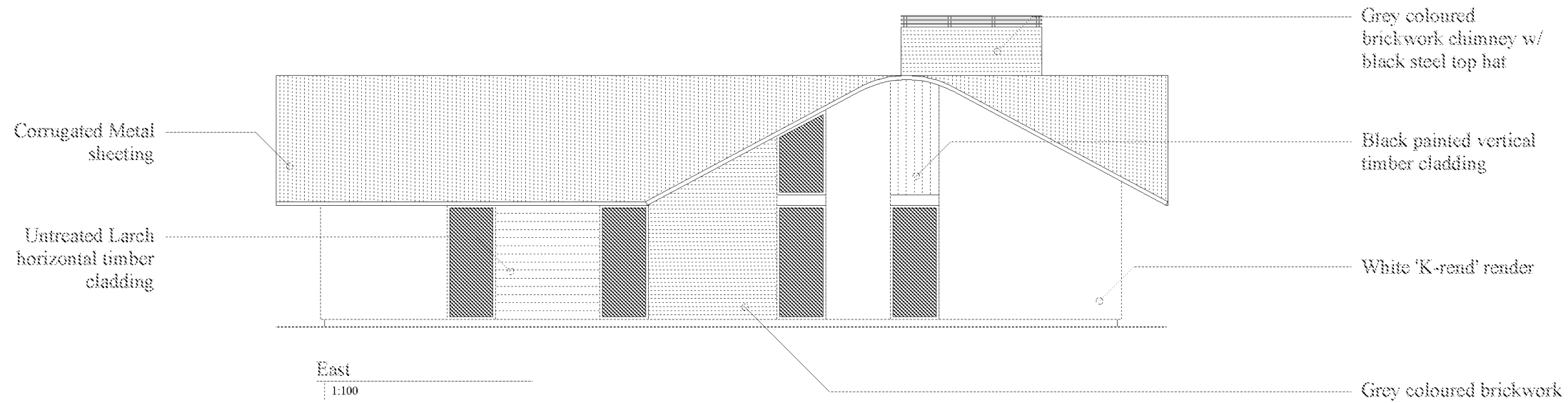
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Job No.
191224

Drawing No.
191224_208

Revision
###

Status
For Comment



Plot 3

FP = 164.39m² - 1769.5ft²
GIA = 145.73m² - 1568.6ft²

Address
Land (to The Rear Of)
Sunnyside Barn And The
Flint Barn

Drawing
Proposed:
East & West Elevations

Scale @ A3
1:100

Date
14.01.2020

Issue Date
14.01.2020

Drawn By MD	Checked By BK
----------------	------------------

Job No.
191224

Drawing No.
191224_209

Revision
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Status
For Comment

1m @ 1"

50

100

200

500

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Appendix B - Trial pit logs and photos



Name

ID

YE4281

Client

Engineer

Nick H

Location

Land to rear of Flint Barn, Barnham

Contractor

Tim Splihurst

Date

21.03.2018

Remarks

Trial Pit Information

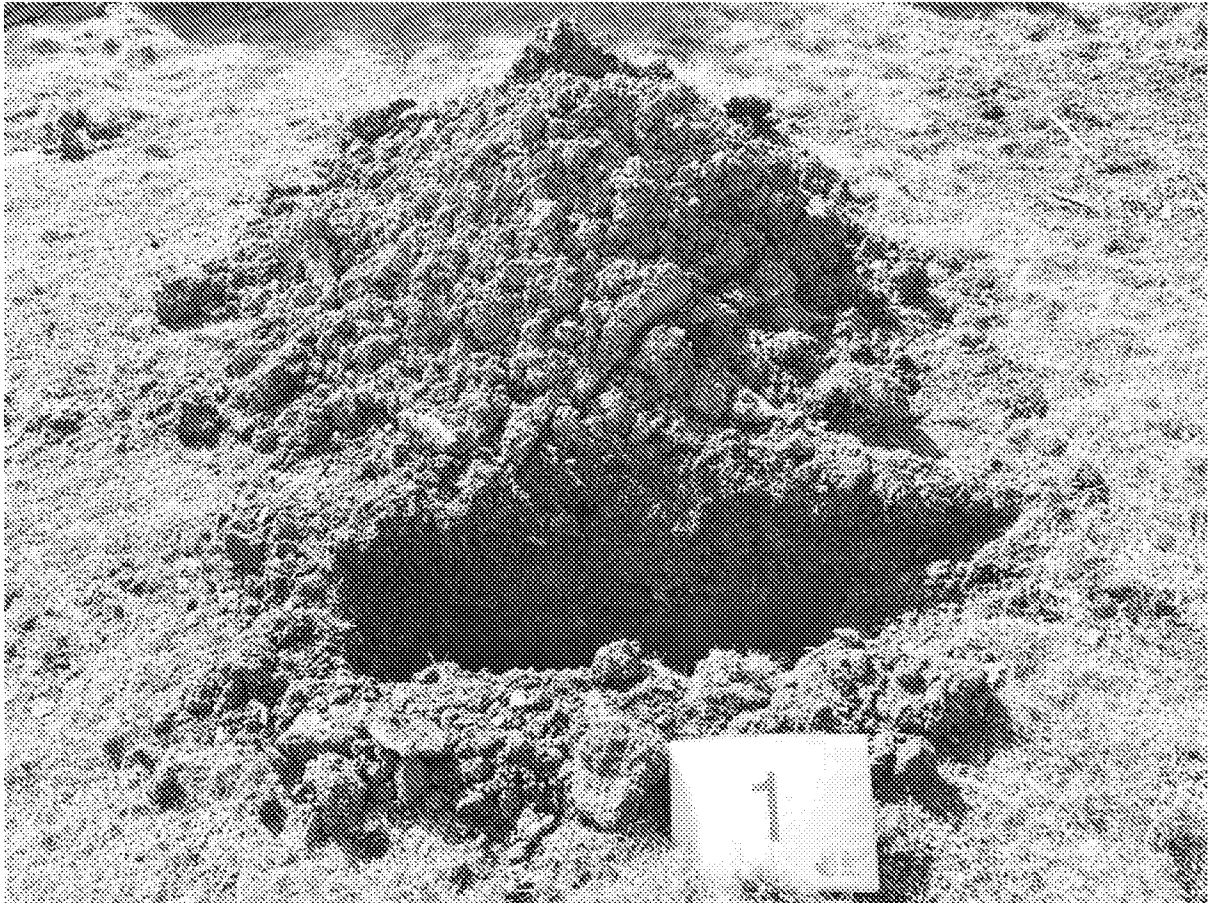
[illegible]

Geology Information

Hole ID	Geology Code	Legend Code	Top Depth	Base Depth	General Description of Stratum	Stratum Reference
TP1			0.000	0.250	Made ground - soft medium dark grey SILT with rubble and rubbish	
TP1			0.250	0.850	Dark grey very soft medium SILT	
TP1			0.850	1.700	Light brown stiff CLAY	
TP1			1.700	2.000	Light brown medium sand and stiff clay with loose medium GRAVEL	
TP2			0.000	0.450	Made ground - soft medium dark grey SILT with rubble and rubbish	
TP2			0.450	0.850	Dark grey very soft medium SILT	
TP2			0.850	1.050	Light brown stiff CLAY	
TP2			1.050	2.000	Light brown medium sand and stiff clay with loose medium GRAVEL	



Record Photo of Trial Pit 1



Record Photo of Trial Pit 1



Record Photo of Trial Pit 2



Record Photo of Trial Pit 2

Appendix C - Topographical Survey

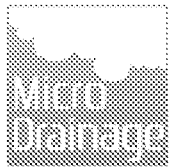




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Appendix D - Microdrainage modelling outputs: QBar calculation



KPT Properties		Page 1
19 Lonsdale Avenue Hutton Essex CM13 1NH		
Date 24/01/2020 12:11 File Plot2and3_S_ swale_1%+2...	Designed by Paul Checked by	
XP Solutions Source Control 2019.1		

ReFH2 Rural Runoff Peak Flows

Input

Return Period (Years)	100
FEH Rainfall Version	2013
Site Location	GB 496538 104129
Data Type	Point
Season	Winter
Country	England/Wales/Northern Ireland
Area (ha)	0.100
SAAR (mm)	757
BFIHOST	0.661
FARL	0.000
SPRHOST	0.000
URBEXT (2000)	0.0000

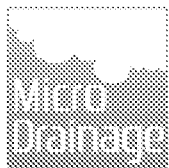
Results

Return Period (Years)	Rural (l/s)	Urban (l/s)
User	0.5	0.5
Q1	0.2	0.2
Q2	0.2	0.2
Q5	0.3	0.3
Q10	0.3	0.3
Q30	0.4	0.4
Q50	0.5	0.5
Q75	0.5	0.5
Q100	0.5	0.5
Q200	0.6	0.6
Q1000	0.9	0.9

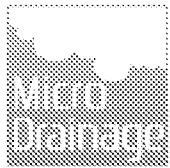
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Appendix E - Microdrainage modelling outputs: Swale



KPT Properties							Page 1																																																																																																																																																																																																																																																																																	
19 Lonsdale Avenue Hutton Essex CM13 1NH			Land to the rear of Sunnyside Barn and Flint Barn Barnham																																																																																																																																																																																																																																																																																					
Date 24/01/2020 13:30 File PLOT2SWALE_1%+40%.SRCX			Designed by Paul Checked by																																																																																																																																																																																																																																																																																					
XP Solutions			Source Control 2019.1																																																																																																																																																																																																																																																																																					
<u>Summary of Results for 100 year Return Period (+40%)</u> Half Drain Time : 193 minutes. <table><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Control (l/s)</th><th>Max Σ Outflow (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr><tr><td>15 min Summer</td><td>8.760</td><td>0.360</td><td>0.0</td><td>0.6</td><td>0.6</td><td>6.7</td><td>○ K</td></tr><tr><td>30 min Summer</td><td>8.813</td><td>0.413</td><td>0.0</td><td>0.6</td><td>0.6</td><td>8.8</td><td>○ K</td></tr><tr><td>60 min Summer</td><td>8.857</td><td>0.457</td><td>0.0</td><td>0.6</td><td>0.6</td><td>10.8</td><td>○ K</td></tr><tr><td>120 min Summer</td><td>8.870</td><td>0.470</td><td>0.0</td><td>0.6</td><td>0.6</td><td>11.4</td><td>○ K</td></tr><tr><td>180 min Summer</td><td>8.868</td><td>0.468</td><td>0.0</td><td>0.6</td><td>0.6</td><td>11.3</td><td>○ K</td></tr><tr><td>240 min Summer</td><td>8.862</td><td>0.462</td><td>0.0</td><td>0.6</td><td>0.6</td><td>11.0</td><td>○ K</td></tr><tr><td>360 min Summer</td><td>8.846</td><td>0.446</td><td>0.0</td><td>0.6</td><td>0.6</td><td>10.3</td><td>○ K</td></tr><tr><td>480 min Summer</td><td>8.829</td><td>0.429</td><td>0.0</td><td>0.6</td><td>0.6</td><td>9.5</td><td>○ K</td></tr><tr><td>600 min Summer</td><td>8.814</td><td>0.414</td><td>0.0</td><td>0.6</td><td>0.6</td><td>8.9</td><td>○ K</td></tr><tr><td>720 min Summer</td><td>8.799</td><td>0.399</td><td>0.0</td><td>0.6</td><td>0.6</td><td>8.3</td><td>○ K</td></tr><tr><td>960 min Summer</td><td>8.771</td><td>0.371</td><td>0.0</td><td>0.6</td><td>0.6</td><td>7.1</td><td>○ K</td></tr><tr><td>1440 min Summer</td><td>8.721</td><td>0.321</td><td>0.0</td><td>0.5</td><td>0.5</td><td>5.3</td><td>○ K</td></tr><tr><td>2160 min Summer</td><td>8.659</td><td>0.259</td><td>0.0</td><td>0.5</td><td>0.5</td><td>3.5</td><td>○ K</td></tr><tr><td>2880 min Summer</td><td>8.610</td><td>0.210</td><td>0.0</td><td>0.5</td><td>0.5</td><td>2.2</td><td>○ K</td></tr><tr><td>4320 min Summer</td><td>8.539</td><td>0.139</td><td>0.0</td><td>0.4</td><td>0.4</td><td>0.9</td><td>○ K</td></tr><tr><td>5760 min Summer</td><td>8.493</td><td>0.093</td><td>0.0</td><td>0.4</td><td>0.4</td><td>0.4</td><td>○ K</td></tr><tr><td>7200 min Summer</td><td>8.458</td><td>0.058</td><td>0.0</td><td>0.3</td><td>0.3</td><td>0.1</td><td>○ K</td></tr><tr><td>8640 min Summer</td><td>8.430</td><td>0.030</td><td>0.0</td><td>0.3</td><td>0.3</td><td>0.0</td><td>○ K</td></tr><tr><td>10080 min Summer</td><td>8.410</td><td>0.010</td><td>0.0</td><td>0.3</td><td>0.3</td><td>0.0</td><td>○ K</td></tr><tr><td>15 min Winter</td><td>8.783</td><td>0.383</td><td>0.0</td><td>0.6</td><td>0.6</td><td>7.6</td><td>○ K</td></tr></table> <table><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Discharge Volume (m³)</th><th>Time-Peak (mins)</th></tr><tr><td>15 min Summer</td><td>141.327</td><td>0.0</td><td>7.4</td><td>25</td></tr><tr><td>30 min Summer</td><td>94.752</td><td>0.0</td><td>10.0</td><td>39</td></tr><tr><td>60 min Summer</td><td>60.960</td><td>0.0</td><td>12.8</td><td>66</td></tr><tr><td>120 min Summer</td><td>36.131</td><td>0.0</td><td>15.2</td><td>122</td></tr><tr><td>180 min Summer</td><td>26.513</td><td>0.0</td><td>16.7</td><td>160</td></tr><tr><td>240 min Summer</td><td>21.191</td><td>0.0</td><td>17.8</td><td>190</td></tr><tr><td>360 min Summer</td><td>15.297</td><td>0.0</td><td>19.3</td><td>256</td></tr><tr><td>480 min Summer</td><td>12.091</td><td>0.0</td><td>20.3</td><td>324</td></tr><tr><td>600 min Summer</td><td>10.057</td><td>0.0</td><td>21.1</td><td>392</td></tr><tr><td>720 min Summer</td><td>8.643</td><td>0.0</td><td>21.8</td><td>460</td></tr><tr><td>960 min Summer</td><td>6.791</td><td>0.0</td><td>22.8</td><td>592</td></tr><tr><td>1440 min Summer</td><td>4.841</td><td>0.0</td><td>24.4</td><td>846</td></tr><tr><td>2160 min Summer</td><td>3.471</td><td>0.0</td><td>26.2</td><td>1212</td></tr><tr><td>2880 min Summer</td><td>2.758</td><td>0.0</td><td>27.8</td><td>1564</td></tr><tr><td>4320 min Summer</td><td>2.027</td><td>0.0</td><td>30.6</td><td>2256</td></tr><tr><td>5760 min Summer</td><td>1.649</td><td>0.0</td><td>33.2</td><td>2944</td></tr><tr><td>7200 min Summer</td><td>1.419</td><td>0.0</td><td>35.8</td><td>3672</td></tr><tr><td>8640 min Summer</td><td>1.264</td><td>0.0</td><td>38.2</td><td>4400</td></tr><tr><td>10080 min Summer</td><td>1.152</td><td>0.0</td><td>40.7</td><td>5064</td></tr><tr><td>15 min Winter</td><td>141.327</td><td>0.0</td><td>8.3</td><td>25</td></tr></table>								Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status	15 min Summer	8.760	0.360	0.0	0.6	0.6	6.7	○ K	30 min Summer	8.813	0.413	0.0	0.6	0.6	8.8	○ K	60 min Summer	8.857	0.457	0.0	0.6	0.6	10.8	○ K	120 min Summer	8.870	0.470	0.0	0.6	0.6	11.4	○ K	180 min Summer	8.868	0.468	0.0	0.6	0.6	11.3	○ K	240 min Summer	8.862	0.462	0.0	0.6	0.6	11.0	○ K	360 min Summer	8.846	0.446	0.0	0.6	0.6	10.3	○ K	480 min Summer	8.829	0.429	0.0	0.6	0.6	9.5	○ K	600 min Summer	8.814	0.414	0.0	0.6	0.6	8.9	○ K	720 min Summer	8.799	0.399	0.0	0.6	0.6	8.3	○ K	960 min Summer	8.771	0.371	0.0	0.6	0.6	7.1	○ K	1440 min Summer	8.721	0.321	0.0	0.5	0.5	5.3	○ K	2160 min Summer	8.659	0.259	0.0	0.5	0.5	3.5	○ K	2880 min Summer	8.610	0.210	0.0	0.5	0.5	2.2	○ K	4320 min Summer	8.539	0.139	0.0	0.4	0.4	0.9	○ K	5760 min Summer	8.493	0.093	0.0	0.4	0.4	0.4	○ K	7200 min Summer	8.458	0.058	0.0	0.3	0.3	0.1	○ K	8640 min Summer	8.430	0.030	0.0	0.3	0.3	0.0	○ K	10080 min Summer	8.410	0.010	0.0	0.3	0.3	0.0	○ K	15 min Winter	8.783	0.383	0.0	0.6	0.6	7.6	○ K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	15 min Summer	141.327	0.0	7.4	25	30 min Summer	94.752	0.0	10.0	39	60 min Summer	60.960	0.0	12.8	66	120 min Summer	36.131	0.0	15.2	122	180 min Summer	26.513	0.0	16.7	160	240 min Summer	21.191	0.0	17.8	190	360 min Summer	15.297	0.0	19.3	256	480 min Summer	12.091	0.0	20.3	324	600 min Summer	10.057	0.0	21.1	392	720 min Summer	8.643	0.0	21.8	460	960 min Summer	6.791	0.0	22.8	592	1440 min Summer	4.841	0.0	24.4	846	2160 min Summer	3.471	0.0	26.2	1212	2880 min Summer	2.758	0.0	27.8	1564	4320 min Summer	2.027	0.0	30.6	2256	5760 min Summer	1.649	0.0	33.2	2944	7200 min Summer	1.419	0.0	35.8	3672	8640 min Summer	1.264	0.0	38.2	4400	10080 min Summer	1.152	0.0	40.7	5064	15 min Winter	141.327	0.0	8.3	25
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																																																																																																	
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KPT Properties							Page 2
19 Lonsdale Avenue Hutton Essex CM13 1NH			Land to the rear of Sunnyside Barn and Flint Barn Barnham				
Date 24/01/2020 13:30 File PLOT2SWALE_1%+40%.SRCX			Designed by Paul Checked by				
XP Solutions			Source Control 2019.1				
<u>Summary of Results for 100 year Return Period (+40%)</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	8.840	0.440	0.0	0.6	0.6	10.0	O K
60 min Winter	8.888	0.488	0.0	0.6	0.6	12.3	O K
120 min Winter	8.906	0.506	0.0	0.6	0.6	13.2	Flood Risk
180 min Winter	8.906	0.506	0.0	0.6	0.6	13.2	Flood Risk
240 min Winter	8.899	0.499	0.0	0.6	0.6	12.9	O K
360 min Winter	8.881	0.481	0.0	0.6	0.6	11.9	O K
480 min Winter	8.860	0.460	0.0	0.6	0.6	10.9	O K
600 min Winter	8.838	0.438	0.0	0.6	0.6	10.0	O K
720 min Winter	8.818	0.418	0.0	0.6	0.6	9.1	O K
960 min Winter	8.779	0.379	0.0	0.6	0.6	7.4	O K
1440 min Winter	8.708	0.308	0.0	0.5	0.5	4.9	O K
2160 min Winter	8.621	0.221	0.0	0.5	0.5	2.5	O K
2880 min Winter	8.554	0.154	0.0	0.4	0.4	1.2	O K
4320 min Winter	8.467	0.067	0.0	0.3	0.3	0.2	O K
5760 min Winter	8.417	0.017	0.0	0.3	0.3	0.0	O K
7200 min Winter	8.400	0.000	0.0	0.2	0.2	0.0	O K
8640 min Winter	8.400	0.000	0.0	0.2	0.2	0.0	O K
10080 min Winter	8.400	0.000	0.0	0.2	0.2	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
30 min Winter	94.752	0.0	11.1	39			
60 min Winter	60.960	0.0	14.3	66			
120 min Winter	36.131	0.0	17.0	120			
180 min Winter	26.513	0.0	18.7	174			
240 min Winter	21.191	0.0	19.9	202			
360 min Winter	15.297	0.0	21.6	276			
480 min Winter	12.091	0.0	22.8	352			
600 min Winter	10.057	0.0	23.7	426			
720 min Winter	8.643	0.0	24.4	498			
960 min Winter	6.791	0.0	25.5	636			
1440 min Winter	4.841	0.0	27.3	894			
2160 min Winter	3.471	0.0	29.4	1256			
2880 min Winter	2.758	0.0	31.1	1588			
4320 min Winter	2.027	0.0	34.3	2216			
5760 min Winter	1.649	0.0	37.2	2936			
7200 min Winter	1.419	0.0	40.1	0			
8640 min Winter	1.264	0.0	42.8	0			
10080 min Winter	1.152	0.0	45.5	0			
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KPT Properties		Page 3
19 Lonsdale Avenue Hutton Essex CM13 1NH	Land to the rear of Sunnyside Barn and Flint Barn Barnham	
Date 24/01/2020 13:30 File PLOT2SWALE_1%+40%.SRCX	Designed by Paul Checked by	
XP Solutions Source Control 2019.1		

Rainfall Details

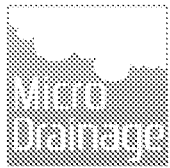
Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 496538 104129	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.028

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.009	4 8	0.009	8 12	0.010

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KPT Properties		Page 4
19 Lonsdale Avenue Hutton Essex CM13 1NH	Land to the rear of Sunnyside Barn and Flint Barn Barnham	
Date 24/01/2020 13:30 File PLOT2SWALE_1%+40%.SRCX	Designed by Paul Checked by	
XP Solutions Source Control 2019.1		

Model Details

Storage is Online Cover Level (m) 9.200

Swale Structure

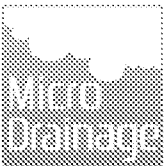
Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	25.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	2.0
Safety Factor	2.0	Slope (1:X)	200.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	8.400	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.3		

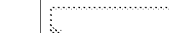
Orifice Outflow Control

Diameter (m) 0.020 Discharge Coefficient 0.600 Invert Level (m) 8.300

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KPT Properties							Page 1
19 Lonsdale Avenue Hutton Essex CM13 1NH			Land tro rear of Sunnyside Barn and Flint Barn Barnham				
Date 24/01/2020 13:31 File Plotland3_S_swale_1%+4...			Designed by Paul Checked by				
XP Solutions			Source Control 2019.1				
<u>Summary of Results for 100 year Return Period (+40%)</u> Half Drain Time : 274 minutes.							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (1/s)	Max Control (1/s)	Max Σ Outflow (1/s)	Max Volume (m³)	Status
15 min Summer	8.856	0.456	0.0	1.0	1.0	16.1	O K
30 min Summer	8.927	0.527	0.0	1.0	1.0	21.4	Flood Risk
60 min Summer	8.989	0.589	0.0	1.1	1.1	26.6	Flood Risk
120 min Summer	9.018	0.618	0.0	1.1	1.1	29.1	Flood Risk
180 min Summer	9.024	0.624	0.0	1.1	1.1	29.7	Flood Risk
240 min Summer	9.020	0.620	0.0	1.1	1.1	29.4	Flood Risk
360 min Summer	9.006	0.606	0.0	1.1	1.1	28.1	Flood Risk
480 min Summer	8.990	0.590	0.0	1.1	1.1	26.6	Flood Risk
600 min Summer	8.974	0.574	0.0	1.1	1.1	25.2	Flood Risk
720 min Summer	8.958	0.558	0.0	1.0	1.0	23.9	Flood Risk
960 min Summer	8.930	0.530	0.0	1.0	1.0	21.6	Flood Risk
1440 min Summer	8.879	0.479	0.0	1.0	1.0	17.7	O K
2160 min Summer	8.814	0.414	0.0	0.9	0.9	13.4	O K
2880 min Summer	8.761	0.361	0.0	0.9	0.9	10.2	O K
4320 min Summer	8.680	0.280	0.0	0.8	0.8	6.1	O K
5760 min Summer	8.621	0.221	0.0	0.7	0.7	3.8	O K
7200 min Summer	8.579	0.179	0.0	0.7	0.7	2.4	O K
8640 min Summer	8.547	0.147	0.0	0.6	0.6	1.5	O K
10080 min Summer	8.522	0.122	0.0	0.6	0.6	1.0	O K
15 min Winter	8.885	0.485	0.0	1.0	1.0	18.2	O K
Storm Event		Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)		
15 min Summer		141.327	0.0	17.5	29		
30 min Summer		94.752	0.0	23.5	43		
60 min Summer		60.960	0.0	30.2	70		
120 min Summer		36.131	0.0	35.8	126		
180 min Summer		26.513	0.0	39.4	182		
240 min Summer		21.191	0.0	42.0	222		
360 min Summer		15.297	0.0	45.4	282		
480 min Summer		12.091	0.0	47.9	346		
600 min Summer		10.057	0.0	49.8	414		
720 min Summer		8.643	0.0	51.3	482		
960 min Summer		6.791	0.0	53.8	618		
1440 min Summer		4.841	0.0	57.5	884		
2160 min Summer		3.471	0.0	61.8	1264		
2880 min Summer		2.758	0.0	65.5	1628		
4320 min Summer		2.027	0.0	72.2	2344		
5760 min Summer		1.649	0.0	78.4	3056		
7200 min Summer		1.419	0.0	84.3	3752		
8640 min Summer		1.264	0.0	90.1	4424		
10080 min Summer		1.152	0.0	95.8	5152		
15 min Winter		141.327	0.0	19.6	29		
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KPT Properties							Page 2
19 Lonsdale Avenue Hutton Essex CM13 1NH			Land tro rear of Sunnyside Barn and Flint Barn Barnham				
Date 24/01/2020 13:31 File Plotland3_S_swale_1%+4...			Designed by Paul Checked by				
XP Solutions			Source Control 2019.1				
<u>Summary of Results for 100 year Return Period (+40%)</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	8.961	0.561	0.0	1.1	1.1	24.2	Flood Risk
60 min Winter	9.029	0.629	0.0	1.1	1.1	30.2	Flood Risk
120 min Winter	9.063	0.663	0.0	1.1	1.1	33.4	Flood Risk
180 min Winter	9.073	0.673	0.0	1.1	1.1	34.4	Flood Risk
240 min Winter	9.071	0.671	0.0	1.1	1.1	34.3	Flood Risk
360 min Winter	9.055	0.655	0.0	1.1	1.1	32.6	Flood Risk
480 min Winter	9.037	0.637	0.0	1.1	1.1	30.9	Flood Risk
600 min Winter	9.017	0.617	0.0	1.1	1.1	29.1	Flood Risk
720 min Winter	8.997	0.597	0.0	1.1	1.1	27.3	Flood Risk
960 min Winter	8.958	0.558	0.0	1.0	1.0	23.9	Flood Risk
1440 min Winter	8.887	0.487	0.0	1.0	1.0	18.3	O K
2160 min Winter	8.796	0.396	0.0	0.9	0.9	12.2	O K
2880 min Winter	8.721	0.321	0.0	0.8	0.8	8.1	O K
4320 min Winter	8.610	0.210	0.0	0.7	0.7	3.4	O K
5760 min Winter	8.538	0.138	0.0	0.6	0.6	1.3	O K
7200 min Winter	8.488	0.088	0.0	0.5	0.5	0.5	O K
8640 min Winter	8.455	0.055	0.0	0.5	0.5	0.2	O K
10080 min Winter	8.431	0.031	0.0	0.4	0.4	0.1	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
30 min Winter	94.752	0.0	26.3	43			
60 min Winter	60.960	0.0	33.8	70			
120 min Winter	36.131	0.0	40.0	124			
180 min Winter	26.513	0.0	44.1	180			
240 min Winter	21.191	0.0	47.0	234			
360 min Winter	15.297	0.0	50.9	298			
480 min Winter	12.091	0.0	53.6	372			
600 min Winter	10.057	0.0	55.7	448			
720 min Winter	8.643	0.0	57.5	524			
960 min Winter	6.791	0.0	60.2	670			
1440 min Winter	4.841	0.0	64.4	946			
2160 min Winter	3.471	0.0	69.3	1332			
2880 min Winter	2.758	0.0	73.4	1700			
4320 min Winter	2.027	0.0	80.9	2384			
5760 min Winter	1.649	0.0	87.8	3056			
7200 min Winter	1.419	0.0	94.4	3688			
8640 min Winter	1.264	0.0	100.9	4408			
10080 min Winter	1.152	0.0	107.3	5128			
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KPT Properties		Page 3
19 Lonsdale Avenue Hutton Essex CM13 1NH	Land tro rear of Sunnyside Barn and Flint Barn Barnham	
Date 24/01/2020 13:31	Designed by Paul	
File Plotland3_S_swale_1%+4...	Checked by	
XP Solutions	Source Control 2019.1	

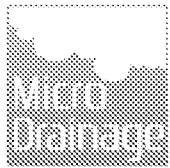
Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 496538 104129	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.066

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To:	(ha)	From: To:	(ha)	From: To:	(ha)	From: To:	(ha)
0 4	0.016	4 8	0.016	8 12	0.017	12 16	0.017

KPT Properties		Page 4
19 Lonsdale Avenue Hutton Essex CM13 1NH	Land tro rear of Sunnyside Barn and Flint Barn Barnham	
Date 24/01/2020 13:31 File Plotland3_S_ swale_1%+4...	Designed by Paul Checked by	
XP Solutions Source Control 2019.1		

Model Details

Storage is Online Cover Level (m) 9.200

Swale Structure

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	35.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	2.0
Safety Factor	2.0	Slope (1:X)	200.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	8.400	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.5		

Orifice Outflow Control

Diameter (m) 0.025 Discharge Coefficient 0.600 Invert Level (m) 8.300

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