

PM Designs

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Job No. P/App GRP/09/19

Planning Department
The Moray Council
High Street
ELGIN, IV30 1BX

29th November 2020

Dear Sir/Madam

RE. Erect 1.25 Storey Dwelling House at Sourbank, Rafford, Forres, Moray, IV36 2SL

This is a resubmission of Planning Application 19/01599/APP. The original application was withdrawn on 24/03/20 to allow time to address the Local Plan requirements it did not meet and the visibility issues with the vehicle access from the U102E Public Road and the U102E junction with the B9010.

In accordance with The Town and Country Planning (Fees for Applications and Deemed Applications) (Scotland) Regulations 2004, as this application (which is of “the same character or description of development on the same site”), is being submitted within 12 months of its original submission date of 10 December 2019, there is no fee requirement.

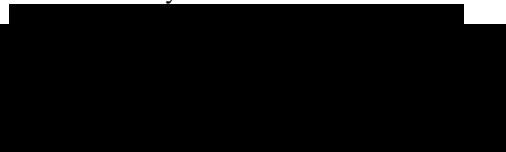
Following the withdrawal, a Planning Consultant was engaged to address the issues identified and any subsequent issues that may arise. The consultations with the Moray Council and other statutory bodies are now complete and we are in a position to resubmit the Planning Application.

The following drawings and supporting documents have been submitted as part of the e-Planning application on behalf of the applicants, G & AG Proctor

- GRP/09/19/001A - Location Plan (A4 size)
- GRP/09/19/002C - Site Plan (A1)
- GRP/09/19/003A – Floor Plans (A1)
- GRP/09/19/004A – Elevations (A1)
- GRP/09/19/005A – Garage Plans (A1)
- GRP/09/19/006A – House Section (A2)
- GRP/09/19/007 – B9010/U102E Junction (A3)
- Visual Impact Photos (A4)
- Client’s Design Statement dated 8th December 2019.
- Agricultural Needs Assessment by Bowlts (TO BE KEPT PRIVATE)
- Planning Supporting Statement Jane Shepherd (TheTownPlanner)
- Site investigation and drainage survey by GMC Surveys
- Culvert Proposal by GMC Surveys

We trust that this is all in order but if you have any queries please do not hesitate to contact this office.

Yours faithfully



Mr. PM Mitchell

For **PM Designs**

PM Designs

Todholes, Dallas
FORRES, IV362RW
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www.pmdesigns.eu

29th November 2019

Job No. P/App GRP/09/19

Re: Proposed Erection of 1.25 Storey Dwelling House at Sourbank, Rafford, Forres, Moray, IV36 2SL

Design Statement on Behalf of The Planning Application Applicants

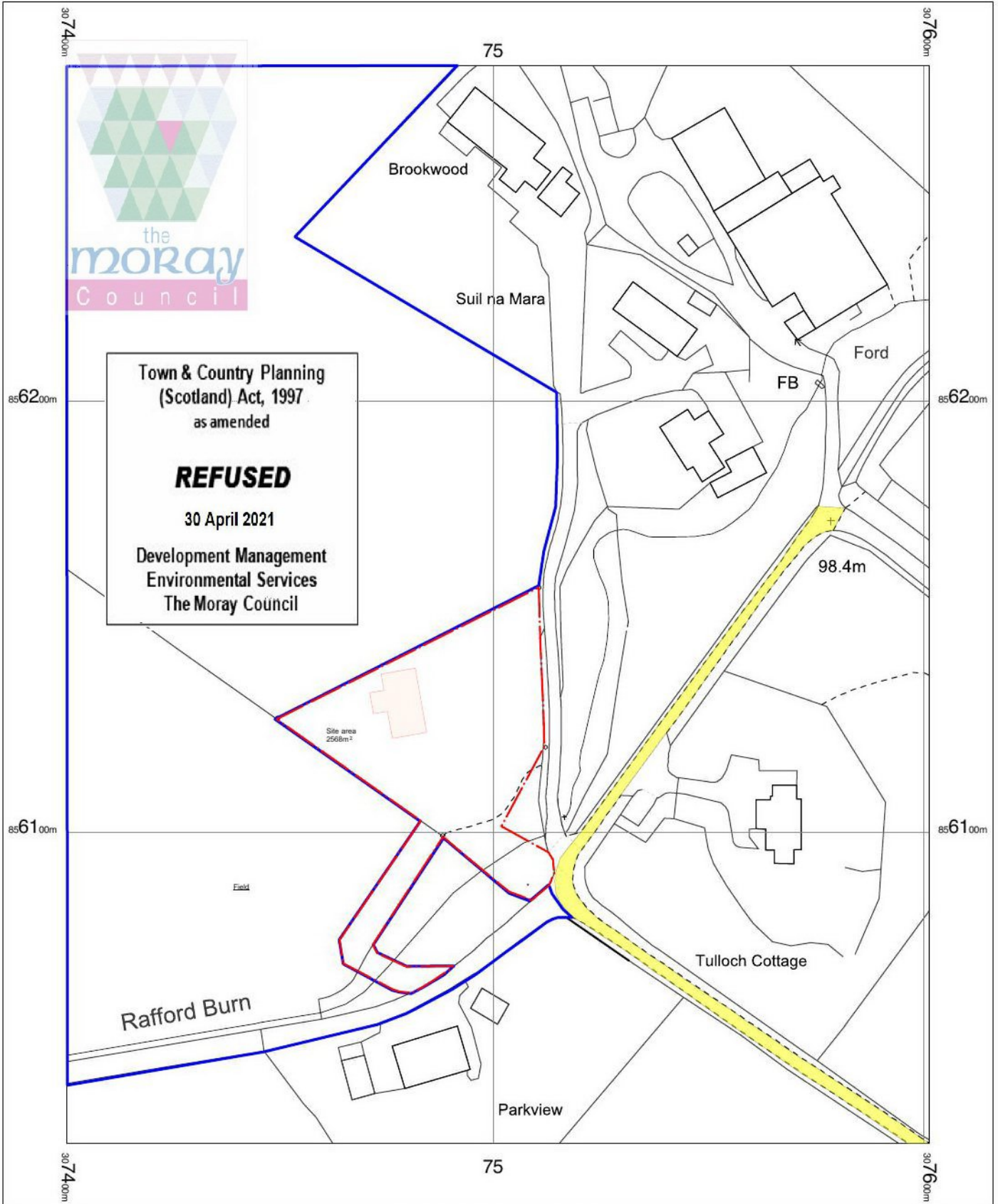
We wish to build an environmentally friendly energy efficient home, whilst keeping it in character with local properties as far as possible, yet still reflecting the era in which it is being built. The house will enable the next generation of the Proctor family to live adjacent to the farmland the family works. The development is sited in the corner of a field owned by our family and is adjacent a cluster of both old and new houses at Sourbank, Rafford.

To achieve a sympathetic appearance and energy efficiency we have incorporated the following design features into the proposed building.

1. Timber frame construction with mainly rendered external walls, with some locally sourced larch cladding to compliment the nearby woodland setting and the proposed tree planting. The colours are indicative only but the final shades are unlikely to differ markedly from those shown.
2. The house is 1¼ storey high with a roof pitch of 40.5 degrees and will be covered with reclaimed welsh slate.
3. A high standard of insulation, along with high specification glazing and an air sourced heating system will make this an energy efficient home for the 21st century. A wood burning stove will supplement the heating system in the winter months and provide a focal point within the property.
4. A woodland area will be created in the northern corner to provide 25% tree cover and will help to screen the proposed house from neighbouring properties, as well as providing wildlife habitat.



Peter M Mitchell, **PM Designs** (Agent)
On behalf of the applicants
G & AG Proctor
Balnageith Farm,
Balnagieth,
Forres,
Moray,
IV36 2SX



Notes



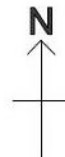
- 1. Land subject to this application is indicated thus:-
- 2. Adjacent land owned by the applicant is indicated thus:-

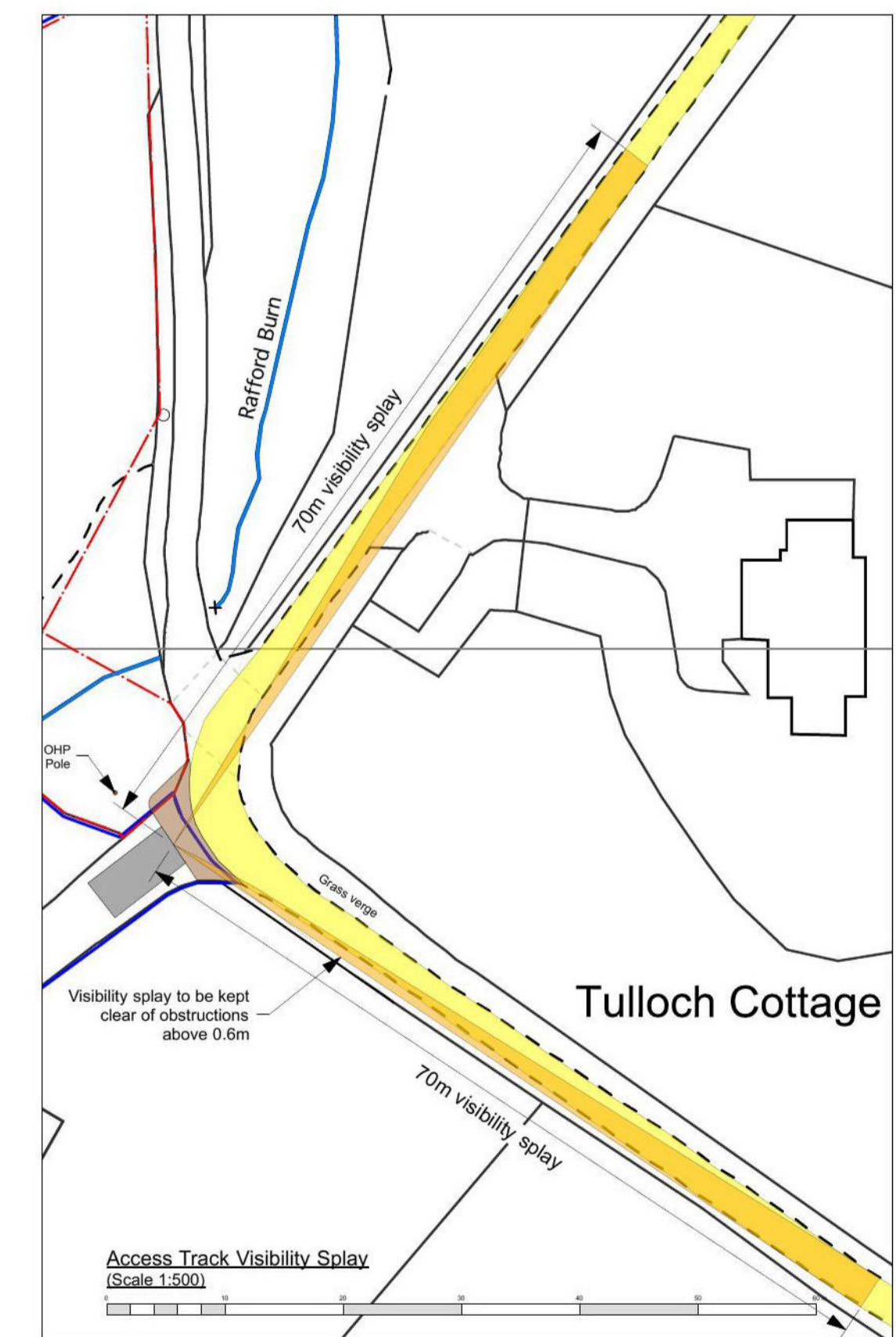
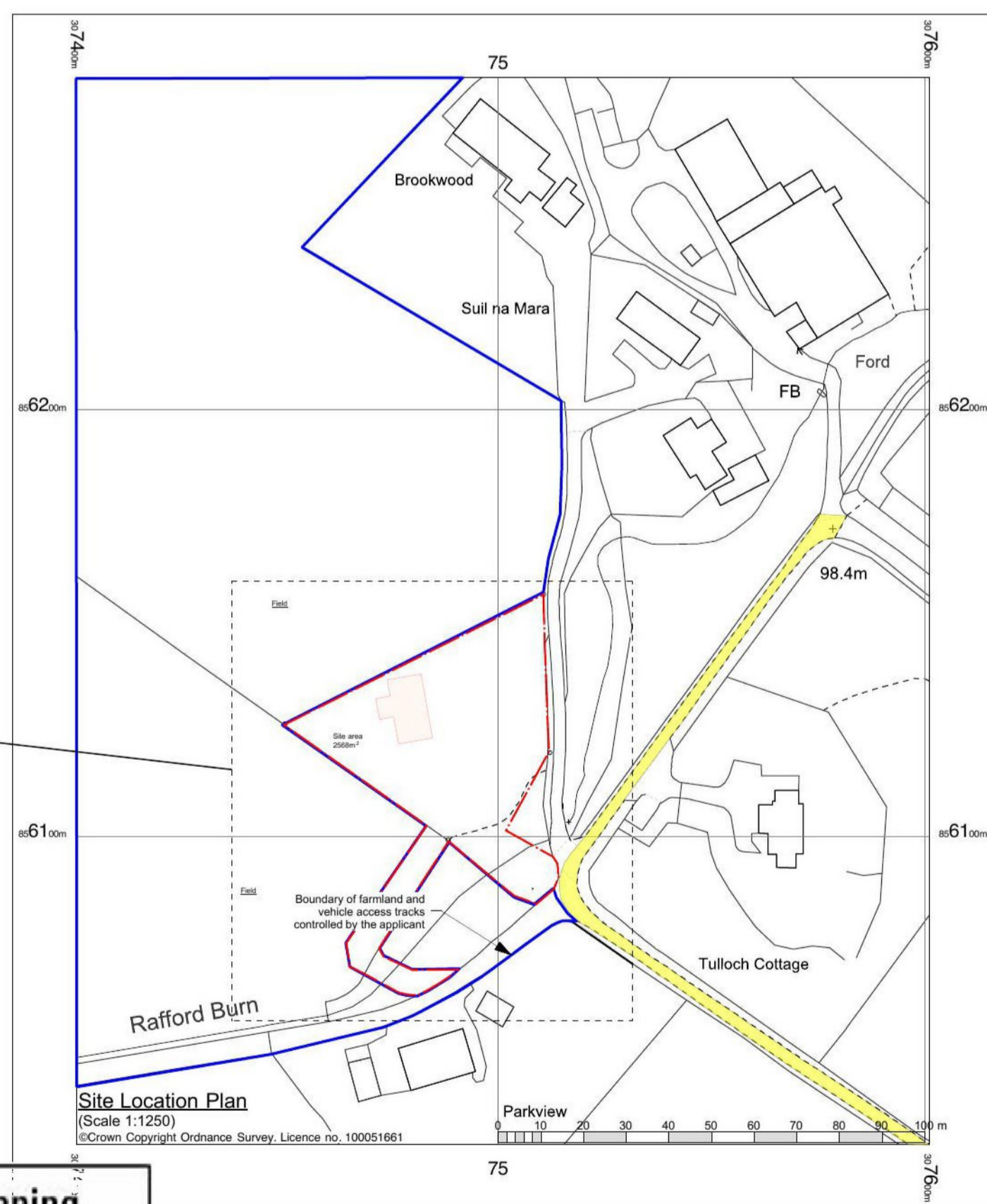
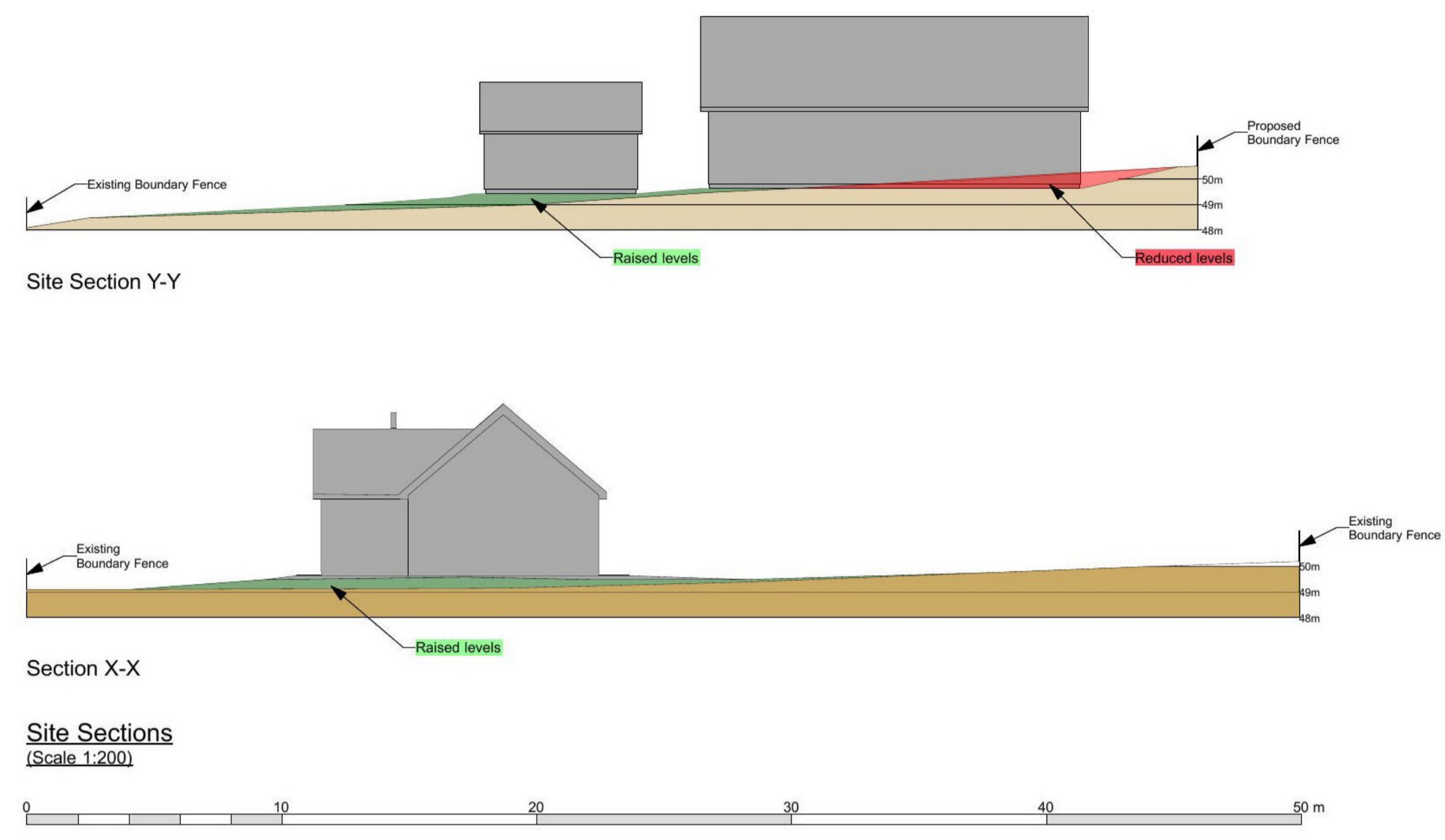
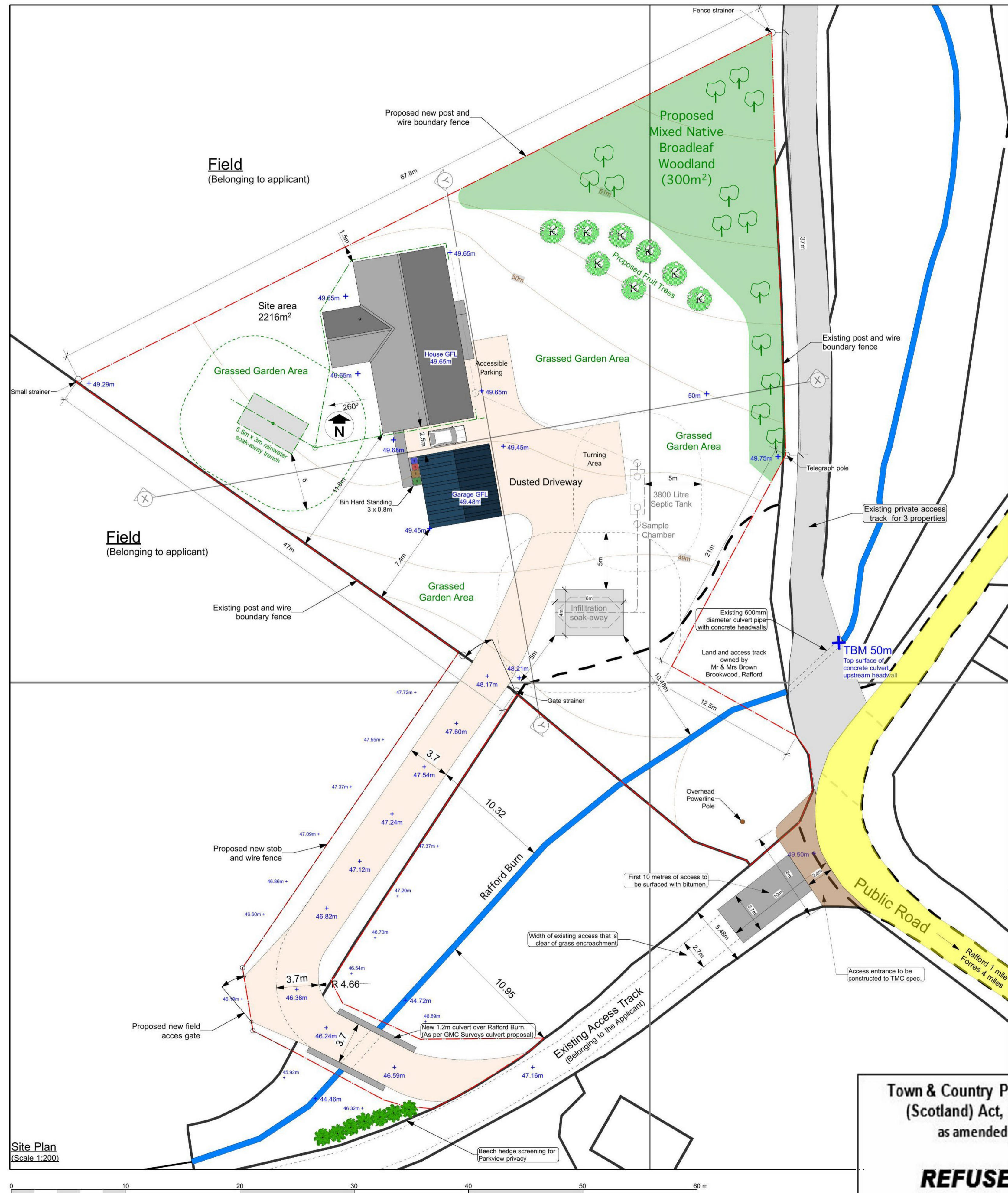
Drawing Title	Date
Location Plan	28/11/20
Drawing No.	Client
GRP 09/19/001A	G & AG Proctor
Location	
Sourbank Farm Site, Rafford, Forres, Moray, IV36 2SL	
Project Title	Scale (A4 print)
Erect 1.25 Storey Detached House	1:1250

OS MasterMap 1250/2500/10000 scale
 Wednesday, November 27, 2019, ID: BLJT-00844098
www.planningapplicationmaps.co.uk

1:1250 scale print at A4, Centre: 307501 E, 856153 N

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Town & Country Planning (Scotland) Act, 1997 as amended

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30 April 2021

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Dallas, Forres,
Moray, IV36 2RW.

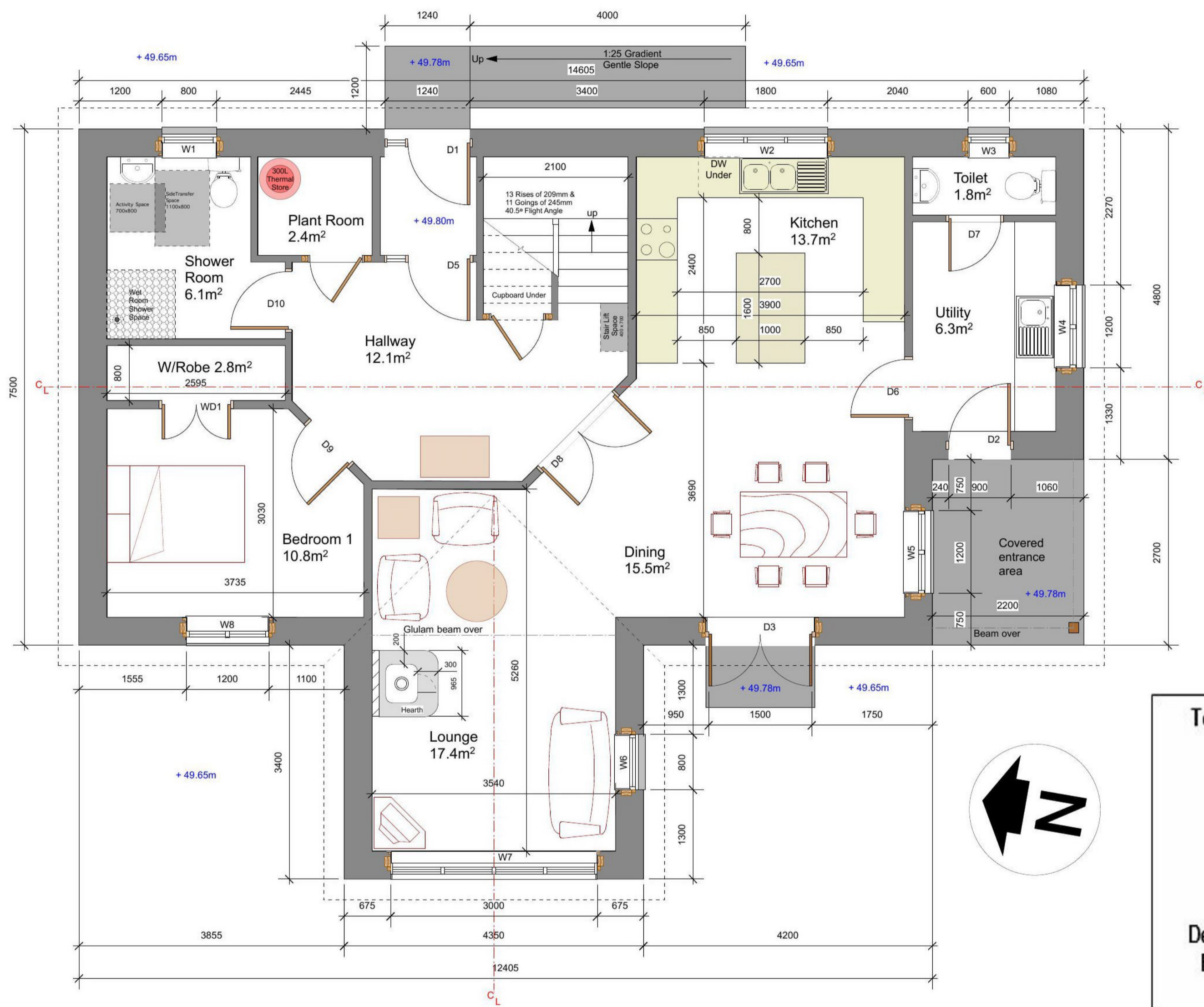
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Tree Planting Proposal
This site was formerly part of a field and there are no existing trees on it. The proposed building site is to have a minimum 25% tree cover, with new plantings made up of native species as follows:
Silver Birch to form part of a 300m² broadleaf woodland area as shown, 0.3 to 1.5m high, at 3m spacing, quantity 50.
Oak to form part of a 300m² broadleaf woodland area as shown, 0.3 to 0.5m high, at 3m spacing, quantity 35.
Apple, Pear, Cherry and Plum trees, are also to be planted to make up additional tree cover, 1.2 to 1.5m high, at 3m spacing, quantity, 2 per species.
Where top soil depths are shallow the ground is to be top dressed to provide a minimum depth of 300mm. To prevent damage, all new plantings are to be supported by stakes with pest guards or shelters provided as appropriate.

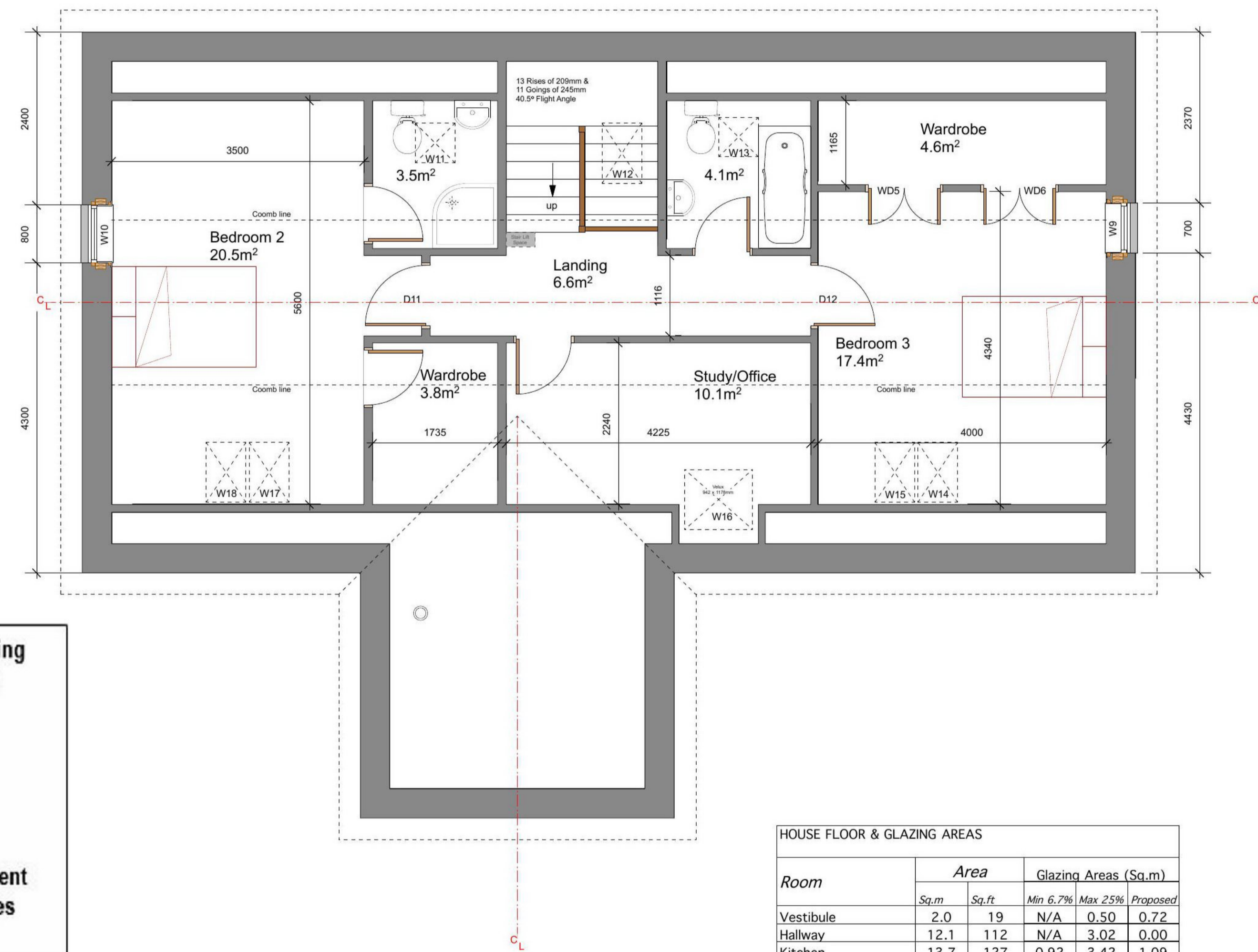
Site Levels
All indicated site levels relate to the Temporary Bench Mark (TBM) datum point located on the top surface of the Rafford Burn concrete culvert upstream headwall adjacent to the access track public road entrance, as shown.

Revisions:
A. Landscape detail added to site plan and drainage layout revised following ground survey.
B. Revisions superceded.
C. New access route and visibility splay

Drawing Title Site & Landscape Plan		Client G & AG Proctor	
Job No. GRP 09/19	Drawing No. GRP 09/19/002	Location Sourbank Farm Site, Rafford, Forres, Moray, IV36 2SL	
All Dimensions In Metres	Revision: C	Job Approved/Designed by Peter M Mitchell	
Scale 1:200	Date 28/11/20	Drawn Pete M	Checked Pete M
SS Title Erect 1.25 Storey Dwelling House			



Ground Floor Plan



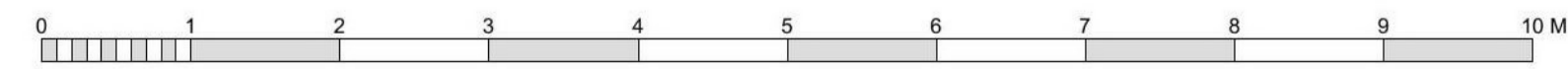
First Floor Plan

Town & Country Planning
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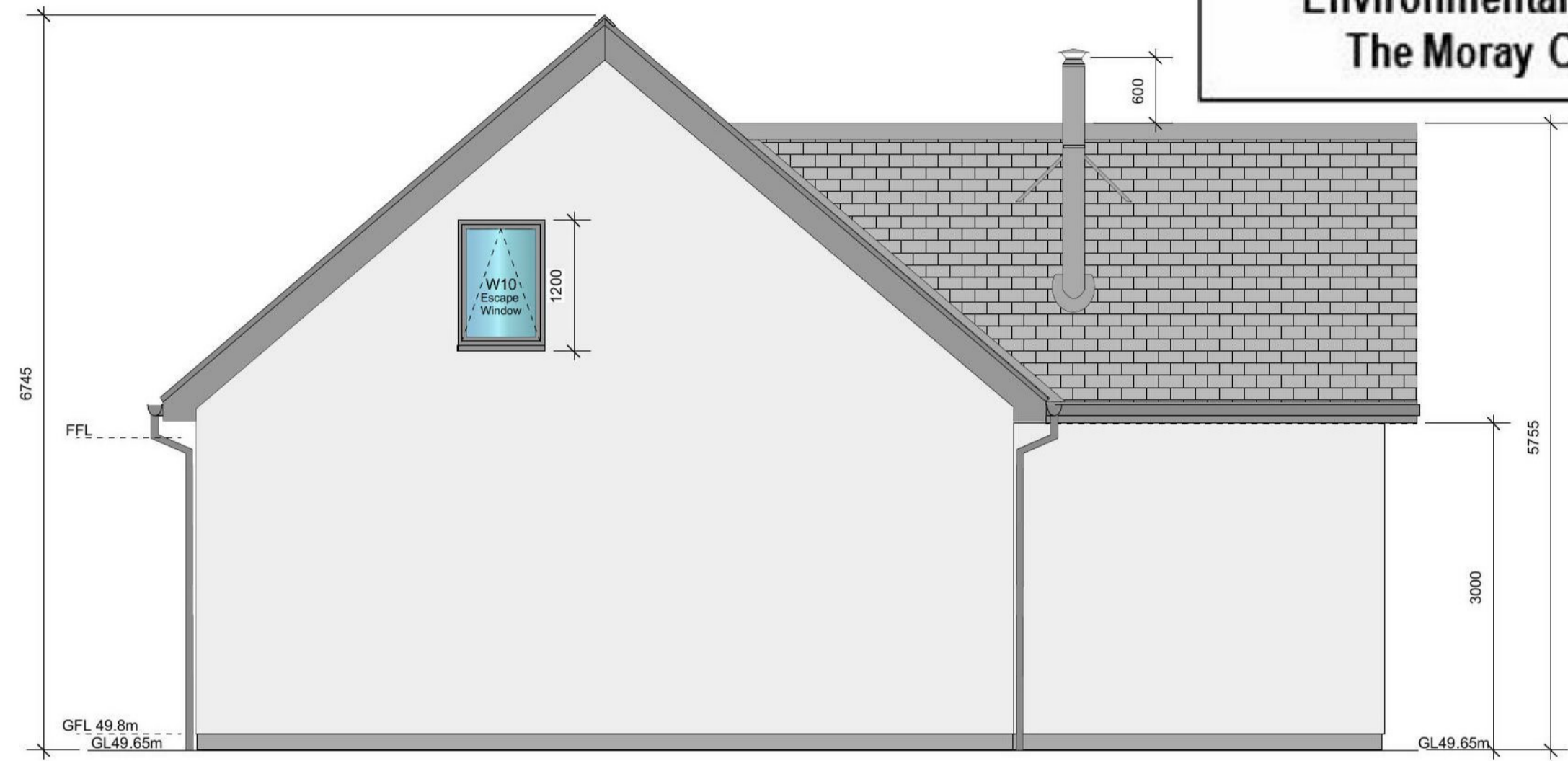
Room	Area		Glazing Areas (Sq.m)	
	Sq.m	Sq.ft	Min 6.7%	Max 25% Proposed
Vestibule	2.0	19	N/A	0.50
Hallway	12.1	112	N/A	3.02
Kitchen	13.7	127	0.92	3.42
Dining Room	13.7	128	0.92	3.43
Utility Room	6.3	59	N/A	1.58
Utility Toilet	1.8	16	N/A	0.44
GF Shower Room	6.1	57	N/A	1.52
Plant Room	2.4	22	N/A	N/A
Lounge	19.1	178	1.28	4.78
Stairwell	5.0	46	N/A	1.24
FF Bathroom	4.1	38	N/A	1.03
FF En-suite	3.6	33	N/A	0.89
Bedroom 1	10.7	100	0.72	2.68
Bedroom 2	20.5	190	1.37	5.12
Bedroom 3	17.4	161	1.16	4.34
FF Landing	6.6	61	N/A	1.64
FF Study	10.1	93	0.67	2.52
Bed 1 Wardrobe	2.1	19	N/A	N/A
Bed 2 Wardrobe	3.9	36	N/A	N/A
Bed 3 Wardrobe	4.7	43	N/A	N/A
TOTALS	157.1	1460	7.0	38.2

Town & Country Planning
(Scotland) Act, 1997
as amended

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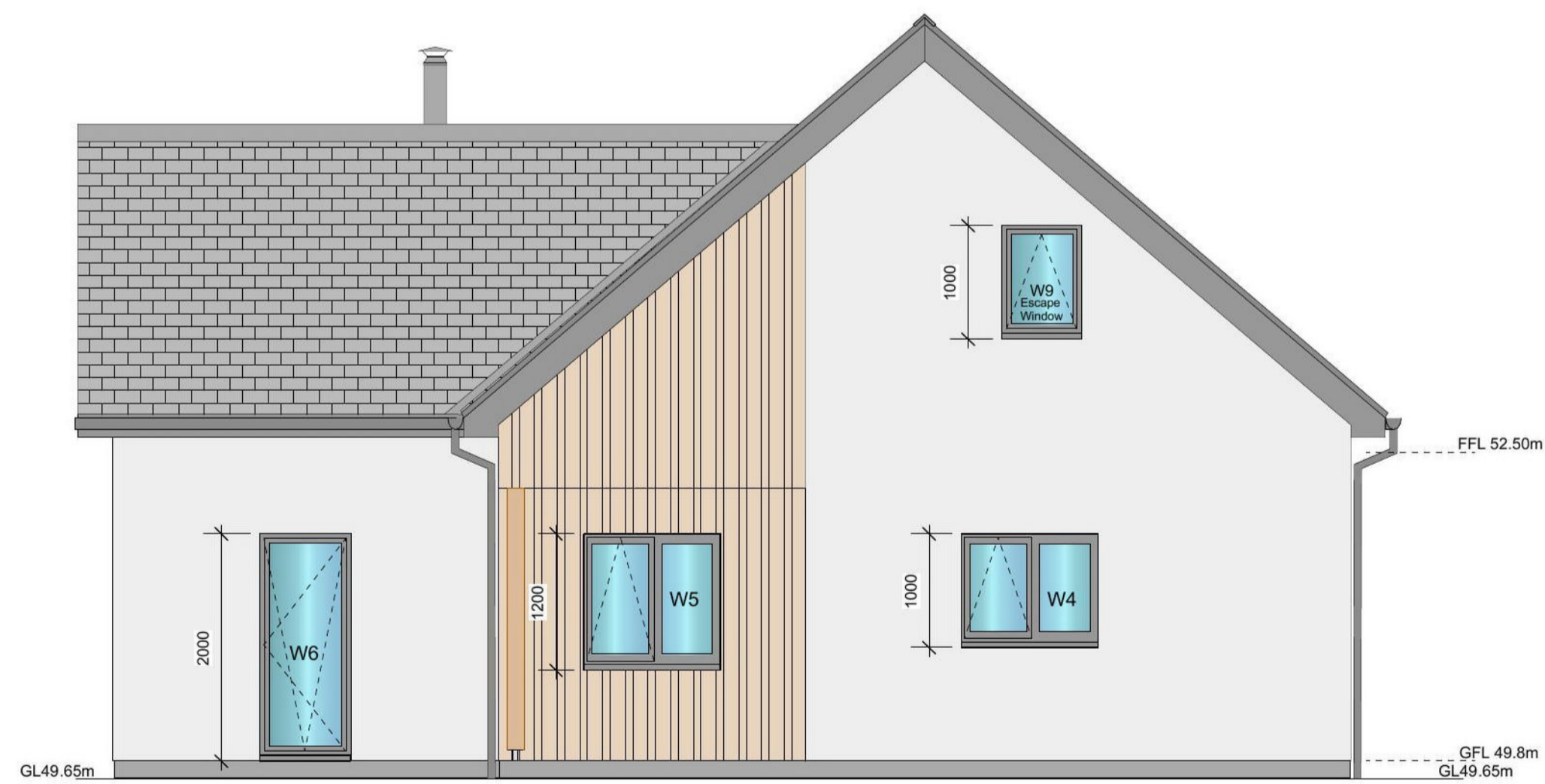


North Elevation

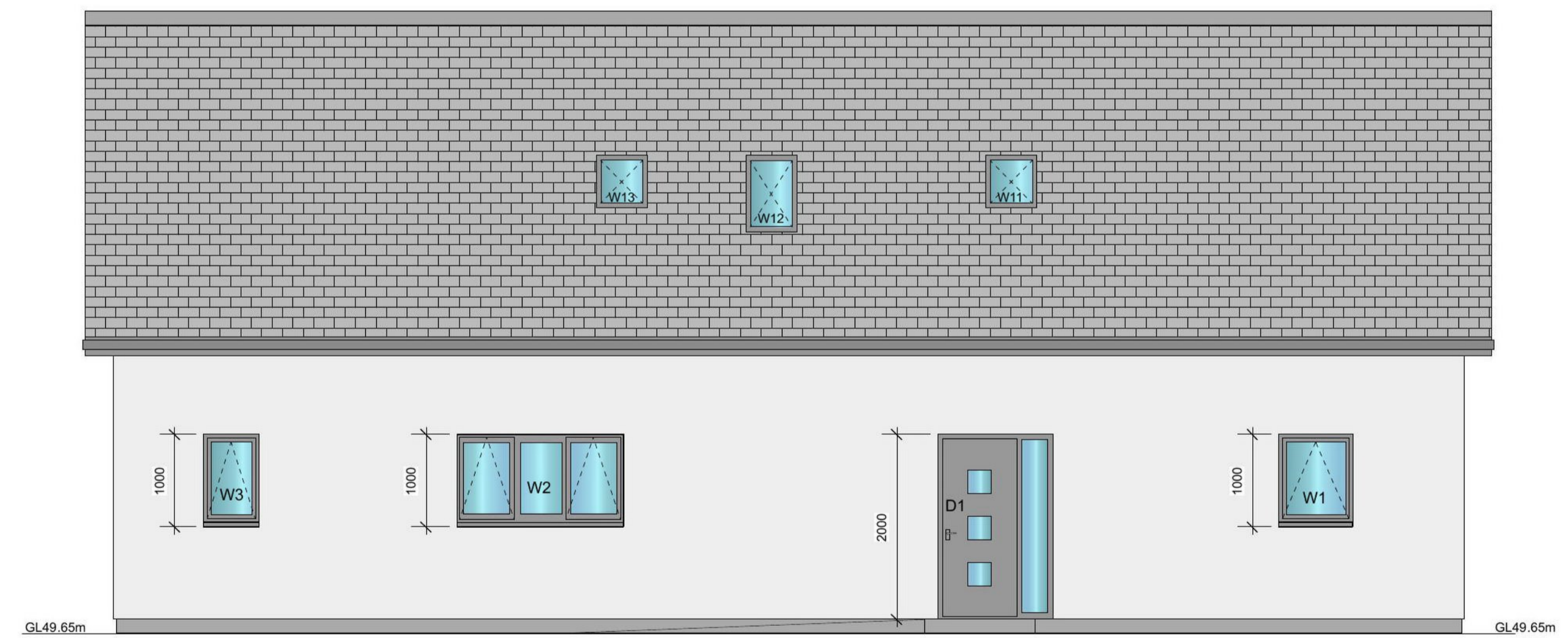


West Elevation

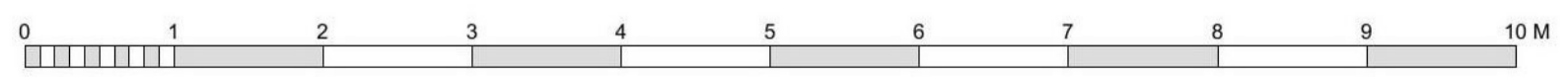
Elevations



South Elevation



East Elevation



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COLOUR SCHEME

WALLS:
White K-render and T&G larch timber cladding as shown.

ROOF:
Reclaimed welsh slates with grey ridge tiles as shown for the house.

RAINWATER COLLECTION:
Pipes and guttering to be grey as shown.

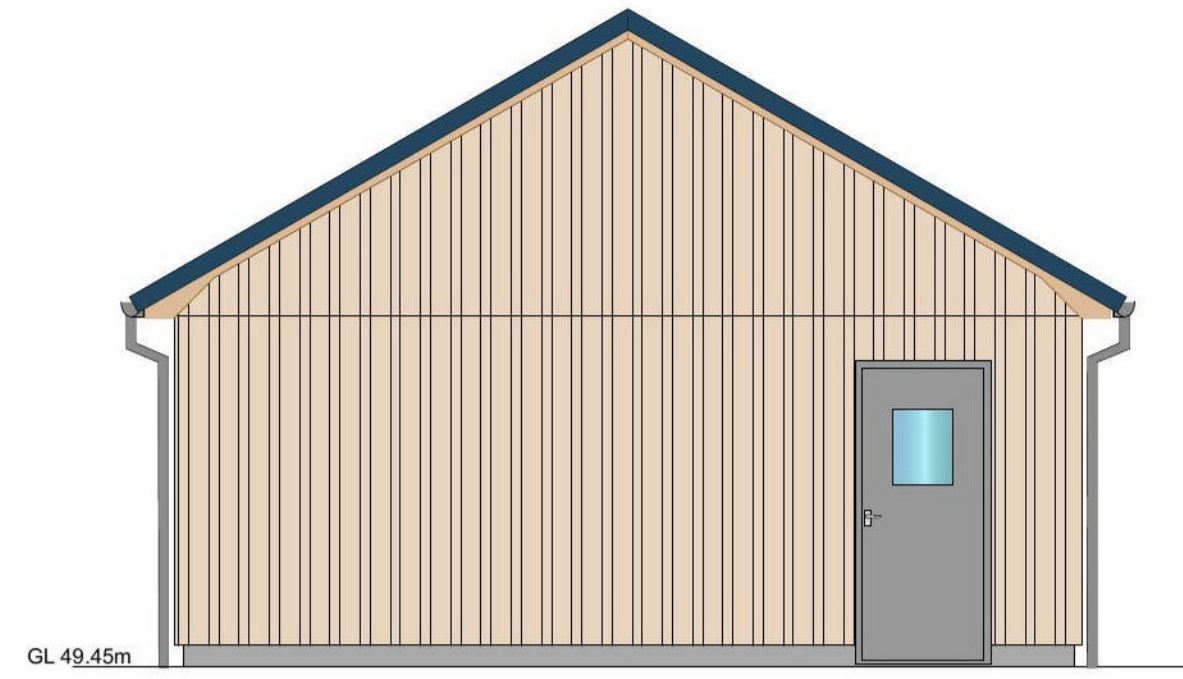
WINDOWS & DOORS:
Grey uPVC doors and windows as shown

FASCIA & BARGE BOARDS:
Grey uPVC as shown.

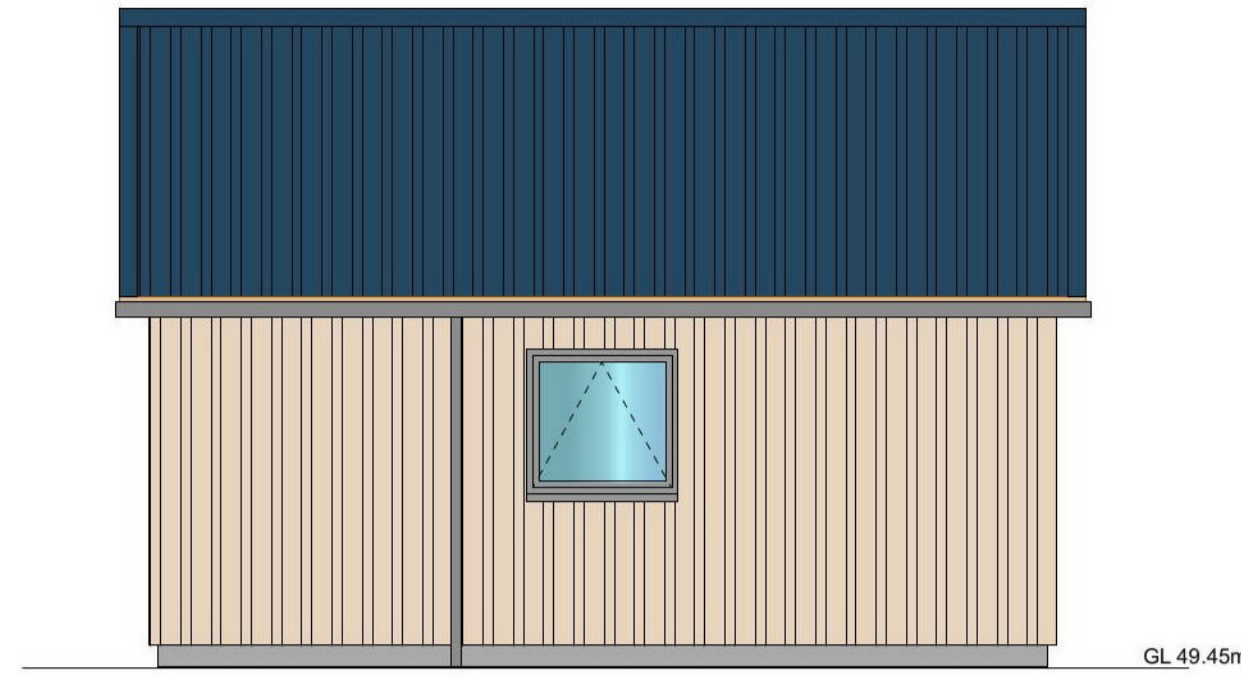
Related Drawings and Documents
GRP/09/19/001 Location Plan
GRP/09/19/002 Site Plan
GRP/09/19/003 Floor Plans
GRP/09/19/005 Garage Plans
GRP/09/19/006 House Section

Revisions
A. Change roof pitch to 40.5° (25/08/20).

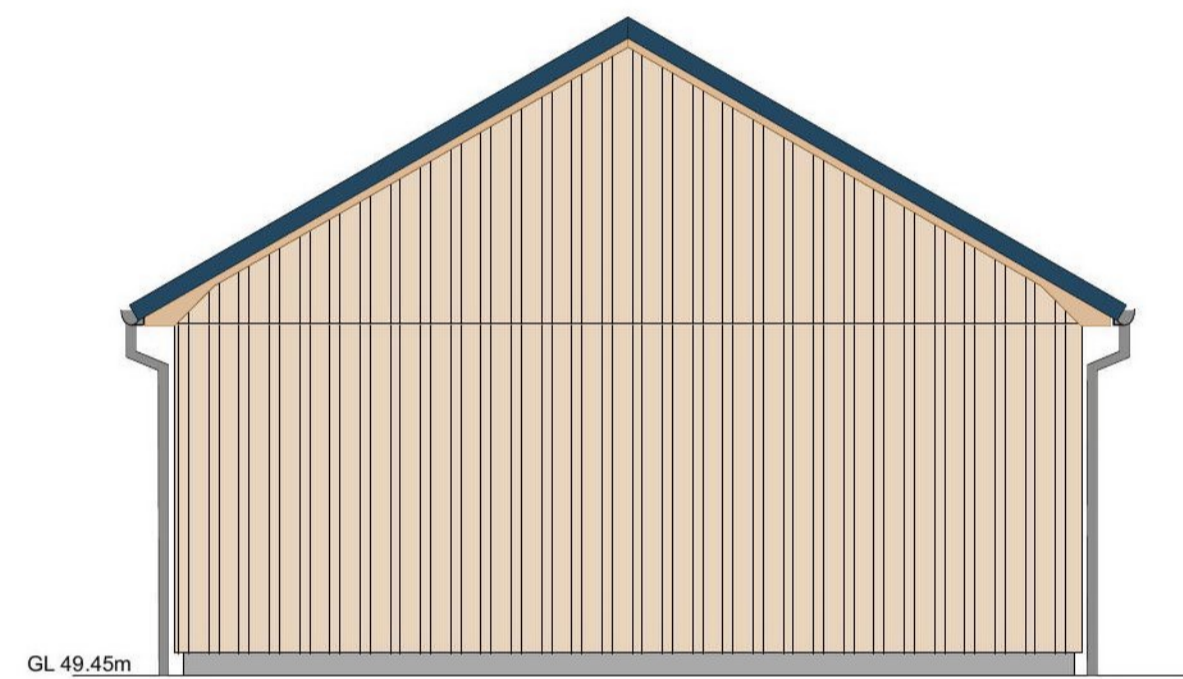
Drawing Title Elevations		Client G & AG Proctor	
Job No. GRP/09/19	Drawing No. GRP/09/19/004	Location Sourbank Farm Site, Rafford, Forres, Moray, IV36 2SL	
All Dimensions In Millimetres	Revision: A	Job Author/Designer Peter M Mitchell	
Scale 1:50	Date 29/11/20	Drawn Pete M	Checked Job Title Erect 1.25 Storey Dwelling House



West Elevation



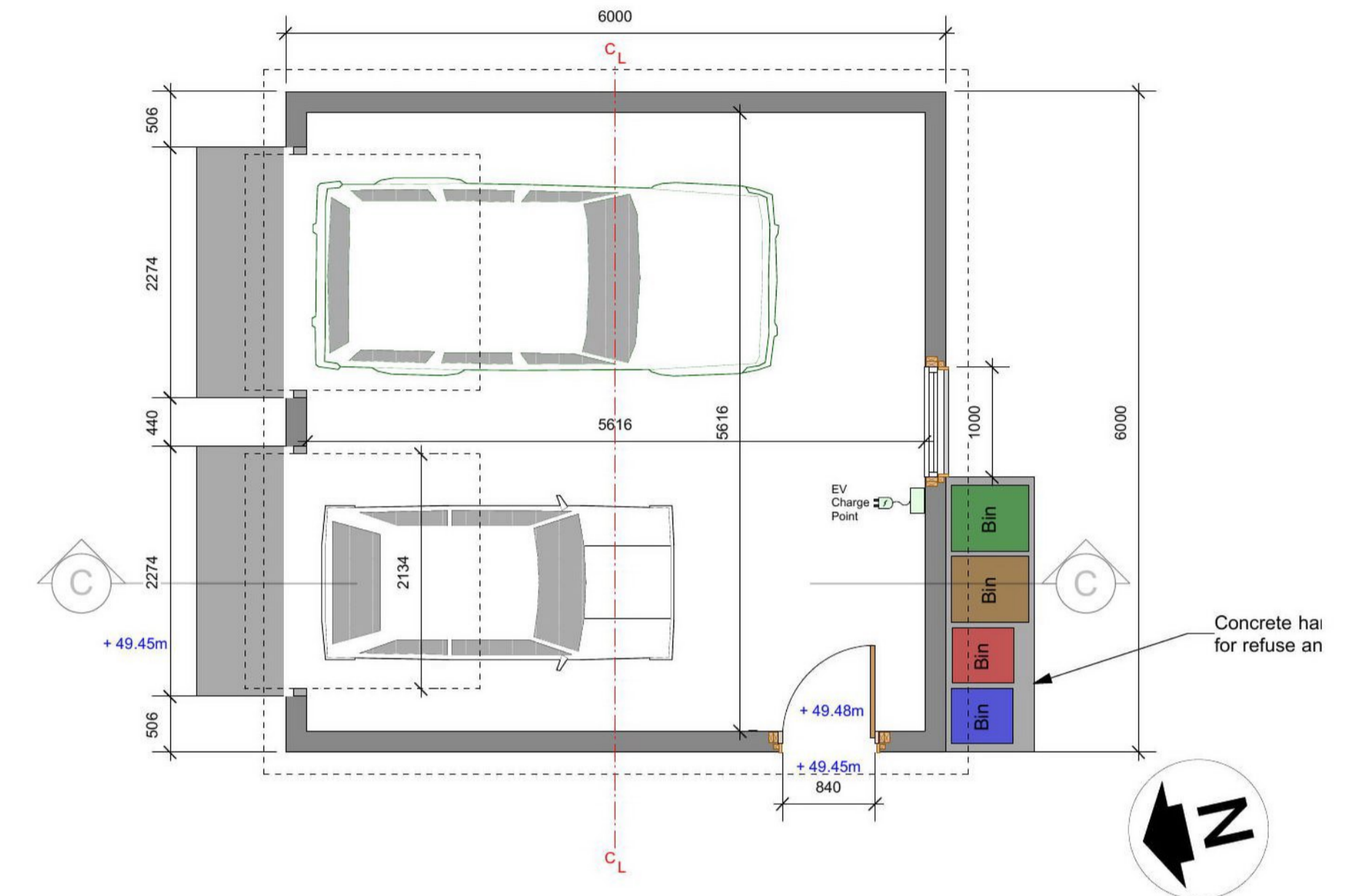
South Elevation



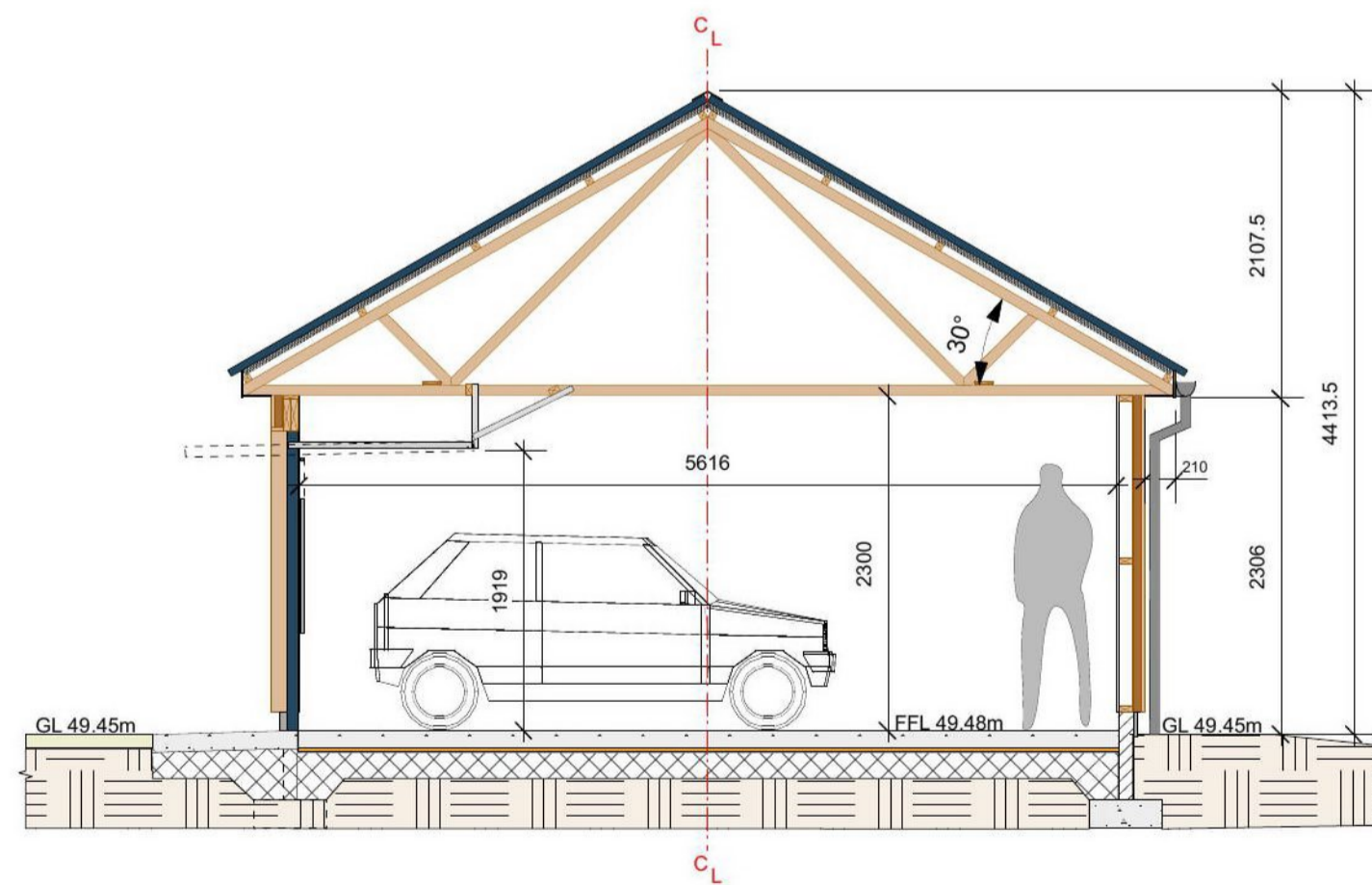
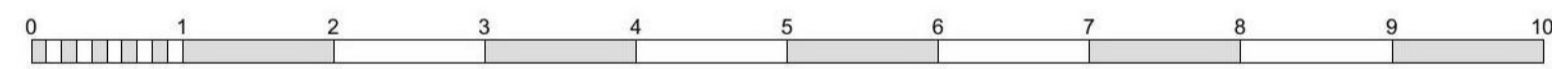
East Elevation



North Elevation



Garage Floor Plan



Cross Section C-C

Town & Country Planning (Scotland) Act, 1997 as amended

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COLOUR SCHEME

WALLS:
T & G larch timber cladding as shown.

ROOF:
Slate blue planwell profile sheets.

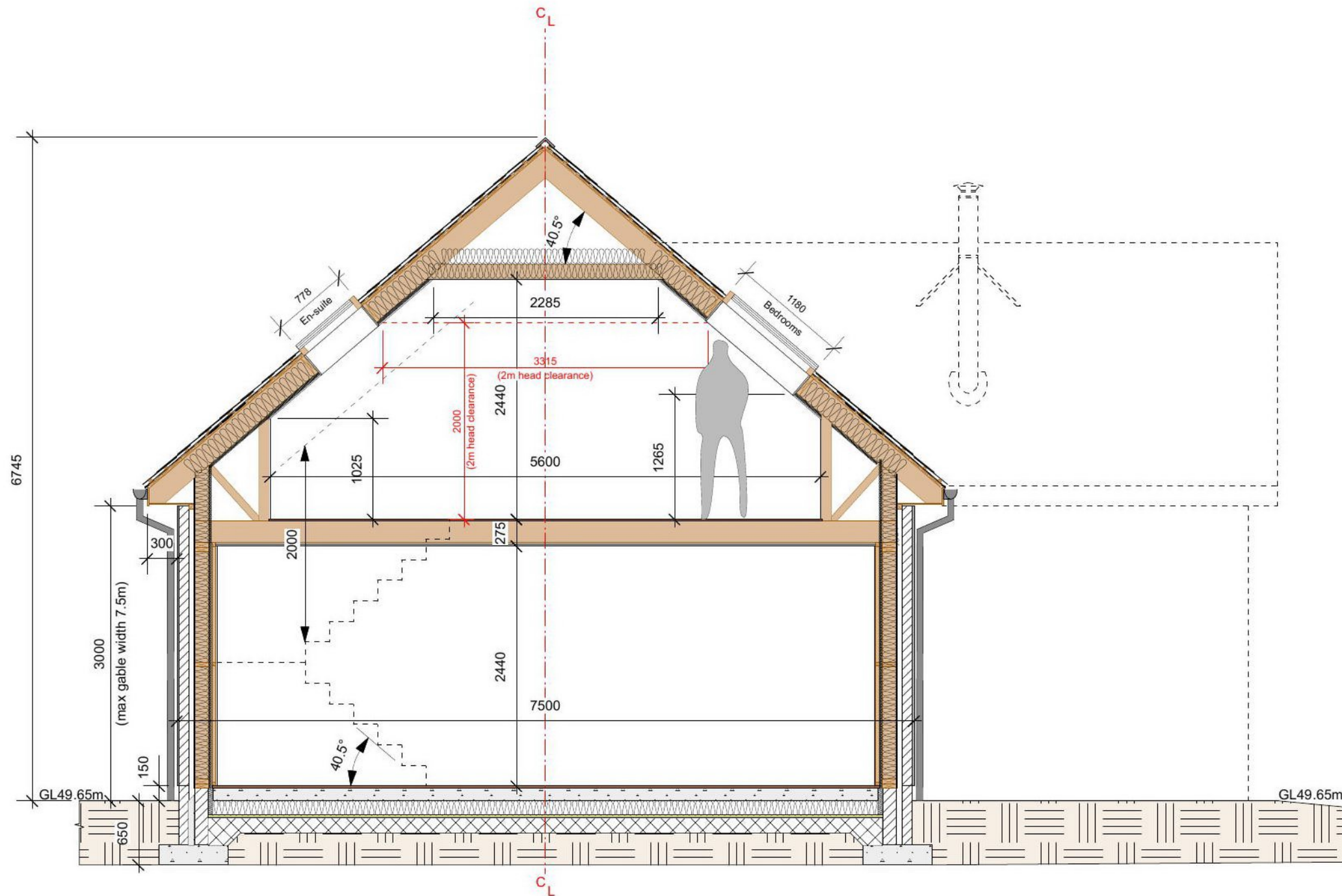
RAINWATER COLLECTION:
Pipes and guttering to be grey as shown.

WINDOWS & DOORS:
Grey uPVC doors and windows as shown

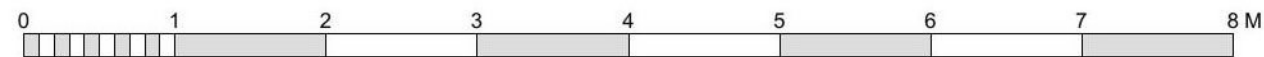
FASCIA & BARGE BOARDS:
Natural timber as shown.

Revisions
 A. Planning Application revisions 22/11/20

Drawing Title Timber Garage Plans		Client G & AG Proctor	
Job No. GRP/09/19	Drawing No. GRP/09/19/005	Location Sourbank Farm Site, Rafford, Forres, Moray, IV36 2SL	
All Dimensions In Millimetres		Revision A	Job Author/Designer Peter M Mitchell
Scale 1:50	Date 28/11/20	Drawn Pete M	Checked Job Title Erect 1.25 Storey Dwelling House



Typical Cross Section Detail
Scale 1:50



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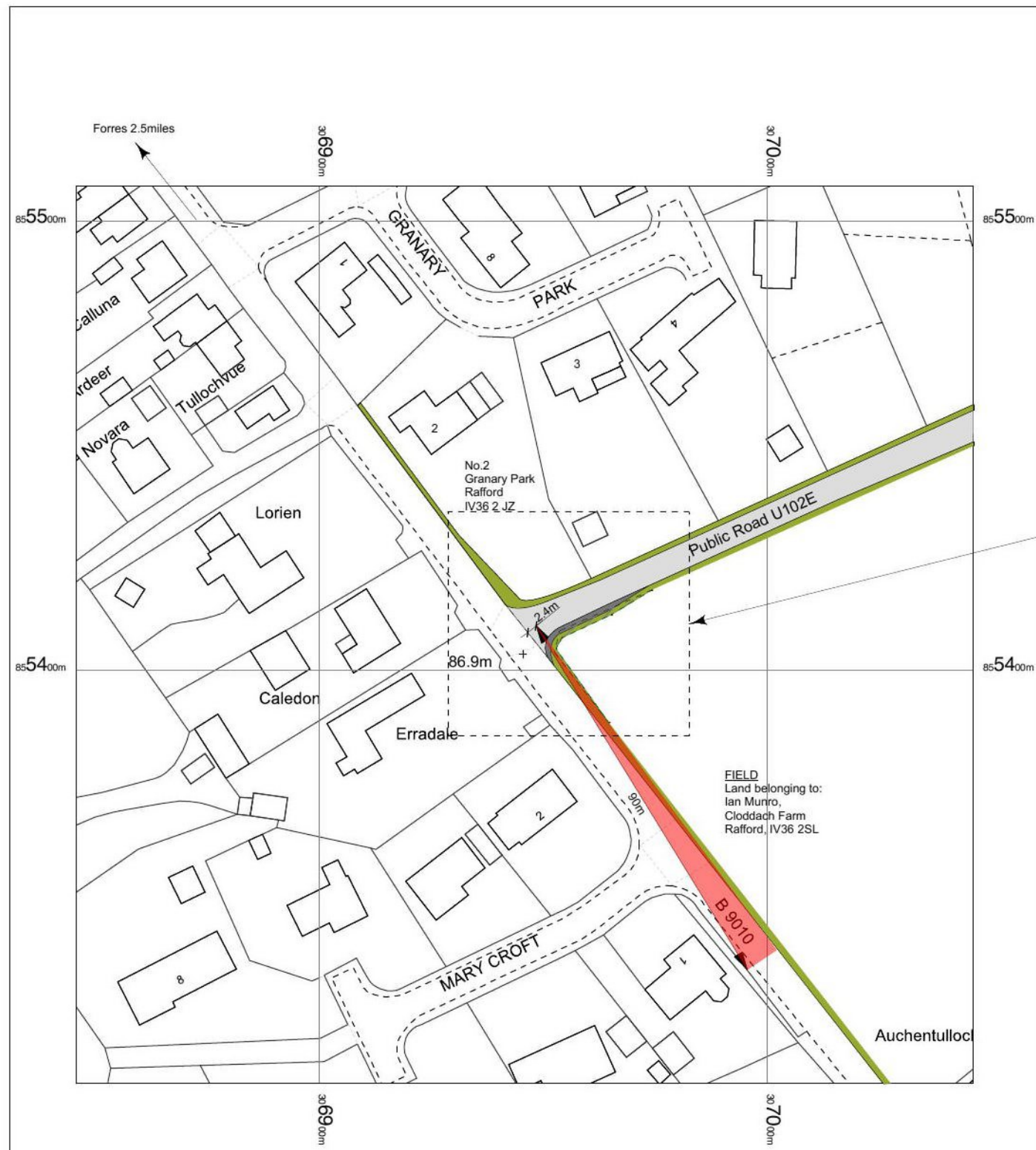
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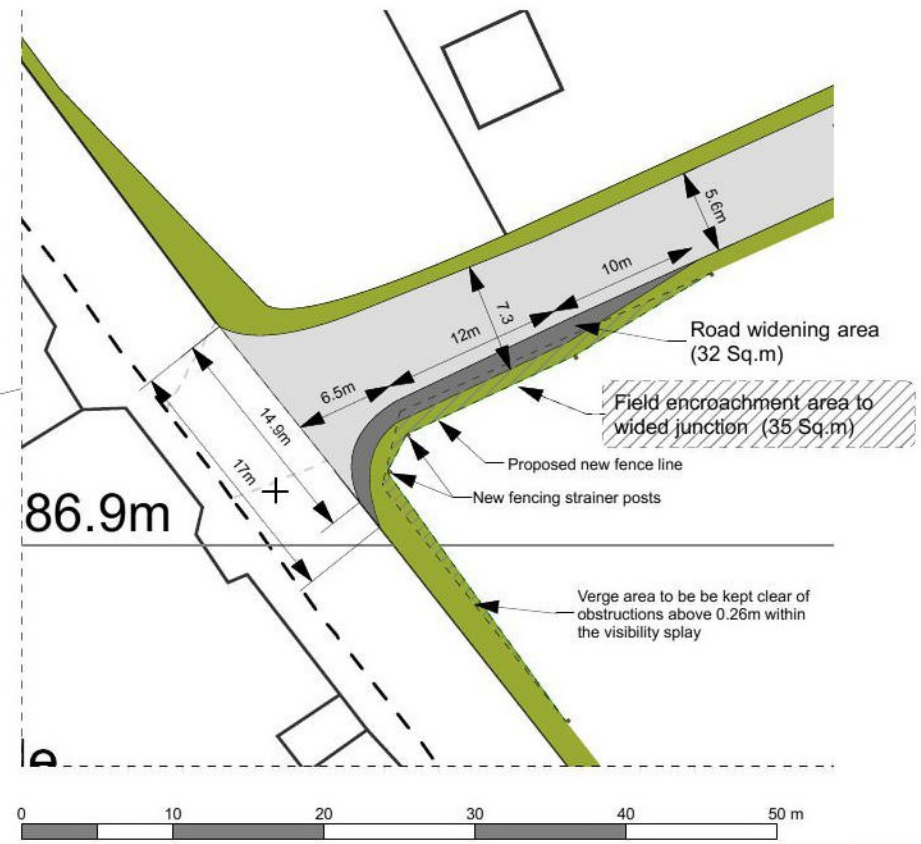
Revisions

A. Change roof pitch to 40.5° (25/08/20).

Drawing Title House Section				Client G & AG Proctor	
Job No. GRP/09/19		Drawing No. GRP/09/19/006		Location Sourbank Farm Site, Rafford, Forres, Moray, IV36 2SL	
All Dimensions In Millimetres		Paper Size A3	Revision: A		Job Architect/Designer Peter M Mitchell
Scale 1:50	Date 25/08/20	Drawn Pete M	Checked	Job Title Erect 1.25 Storey Dwelling House	



Proposed Junction Improvements at B9010/U102E Junction



Proposed Widening Detail of B9010/U102E Road Junction
 Scale 1:200

Town & Country Planning
 (Scotland) Act, 1997
 as amended

REFUSED

30 April 2021

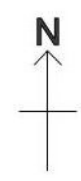
Development Management
 Environmental Services
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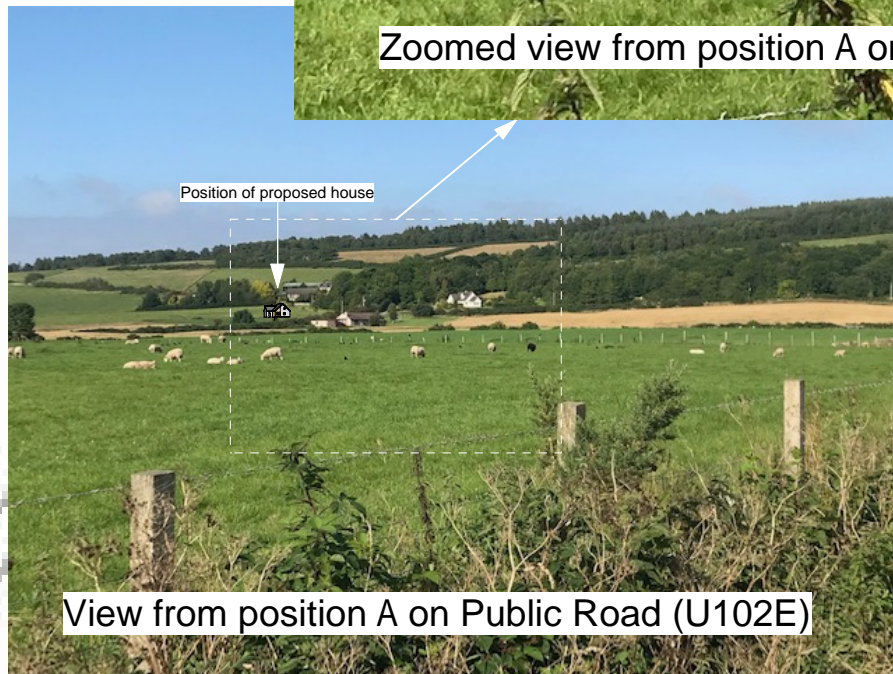
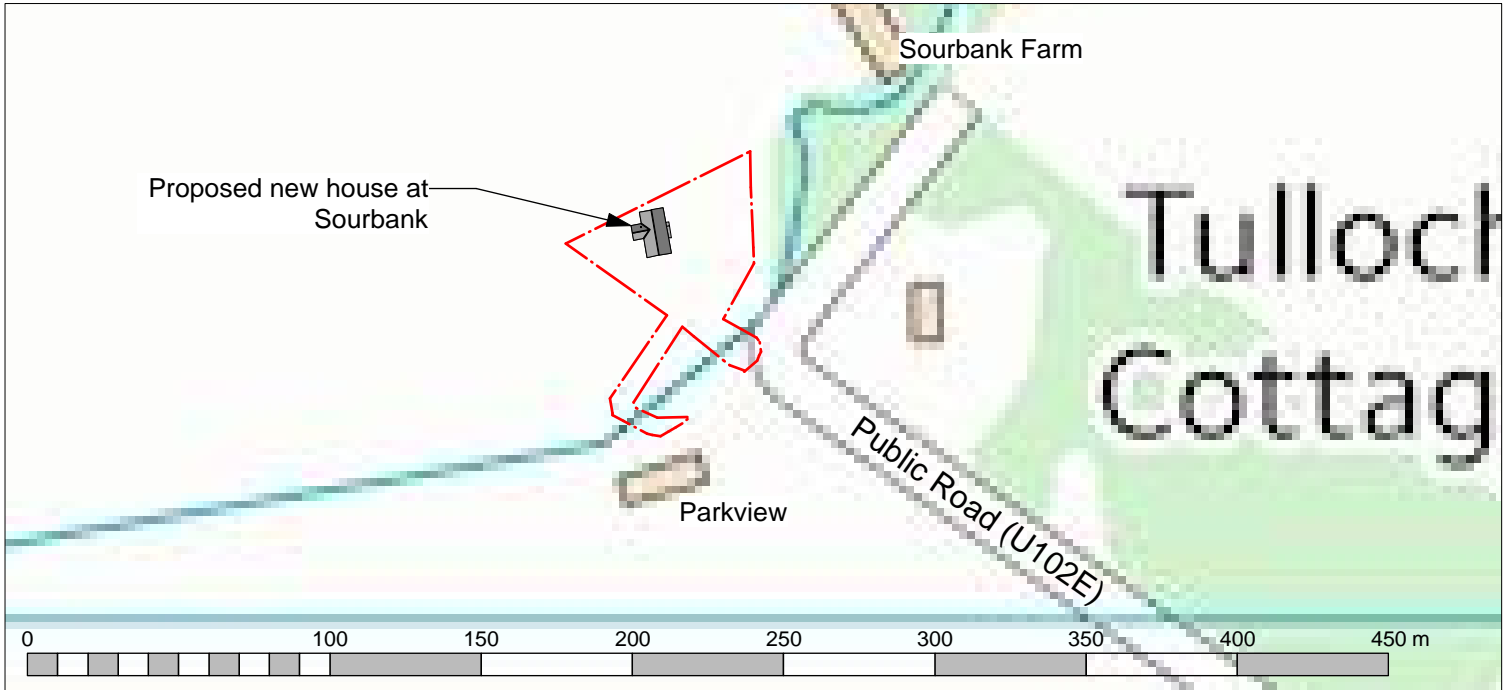
Notes			
Client		G & AG Proctor	
Location		Sourbank Farm Site, Rafford, Forres, Moray, IV36 2SL	
Job Architect/Designer		Peter M Mitchell	
Job Title		Erect 1.25 Storey Dwelling House	
Drawing Title B9010/U102E Junction			
Job No. GRP/09/19		Drawing No. GRP/09/19/007	
All Dimensions In Metres		Paper Size A3	Revision:
Scale As Shown	Date 22/11/20	Drawn Pete M	Checked

OS MasterMap 1250/2500/10000 scale
 Wednesday, June 10, 2020, ID: BLJT-00880942
 www.planningapplicationmaps.co.uk

1:1250 scale print at A4, Centre: 306946 E, 855408 N

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583m to proposed new house from position A

A

Visual Impact of Proposed New House From Public Road Access Near Cloddach Farm
Scale 1:2500

Gary Mackintosh
Email: gmsurveys@gmail.com
Tel: 07557 431 702

gmsurveys

Surveys, Setting-Out Civil Engineering Design

Site Investigation & Drainage Assessment

SOURBANK, RAFFORD

Gary Mackintosh BSc
gmsurveys@gmail.com

Client:

Mr R Proctor

Site Address:

Sourbank
Rafford

Planning Reference:

N/A

Date:

18th December 2019

Job Number:

0956C

Company Information:

Assessment completed by:

Gary Mackintosh

GMCSurveys

34 Castle Street

Forres

Moray

IV36 1PW

Email: gmcsurveys@gmail.com

Telephone: 07557 431 702

Introduction:

The proposed site is located on farmland at Sourbank, Rafford. The site is currently bounded by agricultural land to the north and west boundaries and the access road to the remaining boundaries. The proposals are to erect a 3 bed domestic dwelling and supporting infrastructure.

The SEPA Flood Maps have been consulted which indicate that the site lies outwith any areas of fluvial or pluvial flooding up to a 1:200year event.

GMC Surveys have been asked to carry out a site investigation in order to assess the suitability of the site and provide a drainage solution.

Soil Conditions:

Excavations were carried out using a mechanical digger on 14th December 2019 to assess the existing ground conditions and carry out infiltration and percolation testing for the dispersal of foul and surface waters.

The trial pits were excavated to depths of 1.5m and no ground water was encountered at this depth.

The excavations provided existing ground conditions 250 – 350mm TOPSOIL overlying light red/brown medium to dense sand to a depth of the excavations.

Percolation/Soakaway Testing:

Percolation testing was carried out in full accordance with BS6297: 2007 + A1: 2008 and as described in Section 3.9 of the Scottish Building Standards Technical Handbook (Domestic). The results can be found in the table below.

	1 st	2 nd	3 rd	Mean
Date of Test	14/12/2019	14/12/2019	14/12/2019	
TP01	2400s	2520s	2580s	2500s
TP02	2520s	2580s	2760s	2620s
Average Soil Vp	17.07s/mm			

Infiltration testing:

Infiltration testing was carried out in full accordance with BRE digest 365. The results can be found in the table below.

Infiltration Test	Pit Dimensions (w/l)	Test Zone (mbgl)	Infiltration Rate (m/s)
INF01	0.8mx 1.0m	0.5 – 1.5	1.9×10^{-5}

Conclusion and Recommendations:

The natural ground is suitable for Traditional strip foundations designed in accordance with BS8110 – Structural use of Concrete.

Based on the onsite investigations it can be confirmed that the underlying soils are suitable for the use of standard stonefilled soakaways as a drainage solution for foul waters.

Foul Water Discharge via Soakaway:

Soil Percolation Value – 17.07s/mm

No of Persons (3bed) – 5PE

Min Base Area ($A=V_p \times PE \times 0.25$) = **21.34m²**

This area can be provided with soakaway plan dimensions 6.0m x 4.0m at a depth of 0.45m below invert level, alternative dimensions may be used ensuring that the minimum base area of **21.34m²** is maintained.

The minimum required volume for the treatment plant can be estimated as:

PE x 180 + 2000

= 5 x 180 + 2000 = 2900Litres (from Flows and Loads Volume 4)

Surface Water Dispersal:

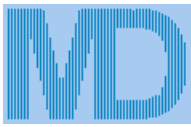
Please see attached surface water calculations detailing the requirement and suitability for soakaway dimensions of **5.5m x 3.0m at a depth of 1.5m** below the invert level based on the proposed contributing area of 160m² (roof area of house and garage) up to a 1 in 30 year event with 35% allowance for climate change.

Soakaway Details can be found in Appendix.

SEPA consent will be required prior to the installation of the proposed drainage.

SEPA and Building Regulations require that infiltration systems (soakaways) are located at least:

- ☞ 50m from any spring, well or borehole used as drinking water supply
- ☞ 10m horizontally from any water course and any inland and coastal waters, permeable drain (including culvert), road or railway
- ☞ 5m from a building or boundary



gmcsurveys
Surveys, Setting Out Civil Engineering Design

Shireen Villa, 34 Castle Street
Forres IV36 1FN
email: gmcsurveys@gmail.com
Mobile: 07557 431 702

Job No. 956C
Sheet no. 1
Date 30/11/20
By GM
Checked
Approved

MasterDrain
SW 16.12

Project **Sourbank**
Title **BRE365 Trench calculations for Forres**

Rectangular pit design data:-

Pit length = 5.5 m	Pit width = 3 m
Depth below invert = 1.5 m	Percentage voids = 30.0%
Imperm. area = 160 m ²	Infiltr. factor = 0.000019 m/s
Return period = 30 yrs	Climate change = 35%

Calculations :-

Surface area of soakaway to 50% storage depth (not inc. base):-

$$a_{s50} = 2 \times (\text{length} + \text{width}) \times \text{depth}/2 = 12.8 \text{ m}^2$$

Outflow factor : $O = a_{s50} \times \text{Infiltration rate} = 0.0002422 \text{ m/s}$

Soakaway storage volume : $S_{\text{actual}} = \text{length} \times \text{width} \times \text{depth} \times \% \text{voids}/100 = 7.4 \text{ m}^3$

Duration	Rainfall mm/hr	Inflow m ³	Depth (hmax) m	Outflow m ³	Storage m ³
5 mins	93.4	1.2	0.24	0.07	1.17
10 mins	72.3	1.9	0.36	0.14	1.78
15 mins	60.3	2.4	0.44	0.22	2.19
30 mins	42.6	3.4	0.60	0.44	2.97
1 hrs	28.8	4.6	0.75	0.87	3.73
2 hrs	18.8	6.0	0.86	1.74	4.27
4 hrs	12.1	7.7	0.86	3.49	4.25
6 hrs	9.3	8.9	0.75	5.23	3.70
10 hrs	6.7	10.7	0.40	8.72	1.96
24 hrs	3.8	14.4	0.00	20.93	0.00

Actual volume : $S_{\text{actual}} = 7.425 \text{ m}^3$

Required volume : $S_{\text{reqd.}} = 4.270 \text{ m}^3$

Soakaway volume storage OK.

Minimum required a_{s50} : 7.33 m²

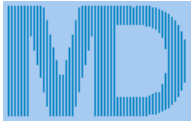
Actual a_{s50} : 12.75 m²

Minimum depth required: 0.86 m

Time to maximum 2 hrs

Emptying time to 50% volume = $t_{s50} = S_{\text{reqd}} \times 0.5 / (a_{s50} \times \text{Infiltration rate}) = 02:26 \text{ (hr:min)}$

Soakaway emptying time is OK.



MasterDrain
SW 16.12

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Job No. 956C		
Sheet no. 2		
Date 30/11/20		
By GM	Checked	Approved

Project **Sourbank**

Title **BRE365 Trench calculations for Forres**

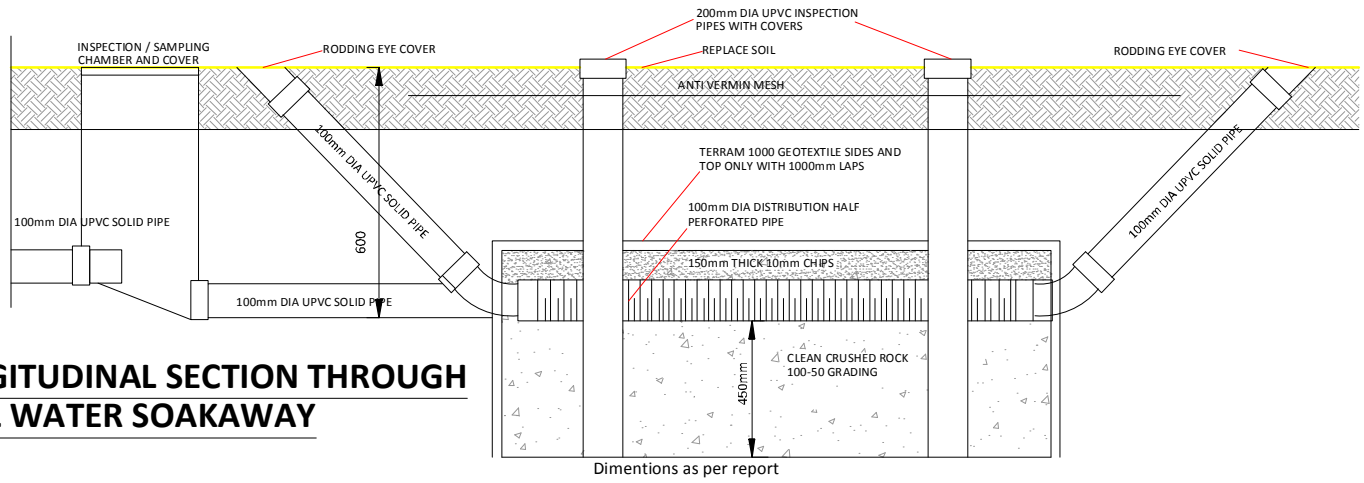
Location hydrological data (FSR) :-

Location	= Forres	Grid reference	=
M5-60 (mm)	= 14	r	= 0.24
Soil index	= 0.15	SAAR (mm/yr)	= 720

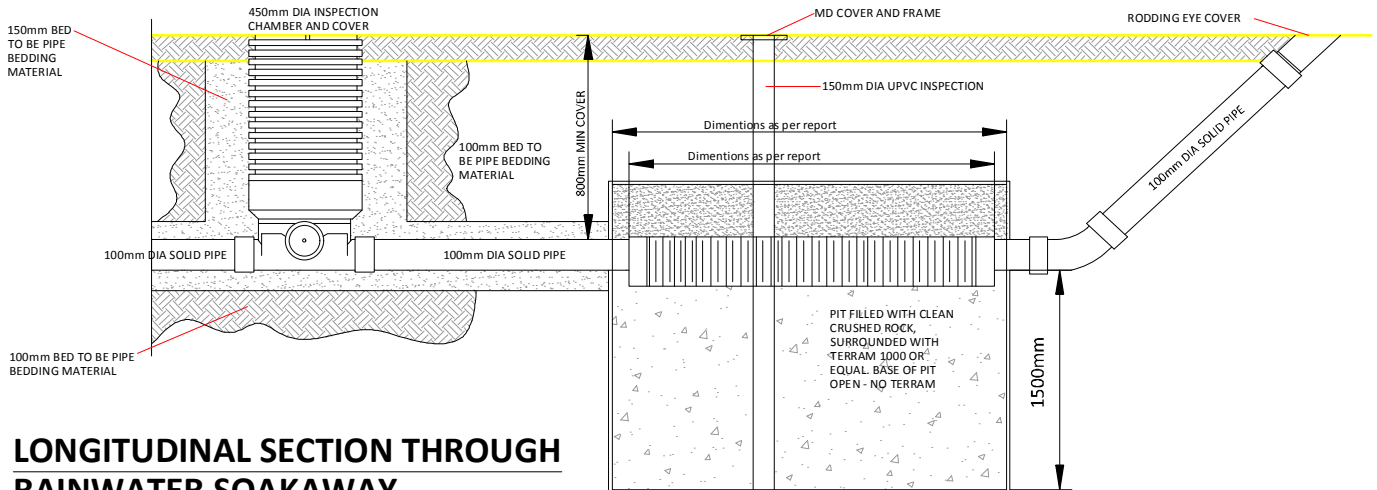
Soil classification for WRAP type 1

- i) Well drained permeable sandy or loam soils and shallower analogues over highly permeable limestone, chalk, sandstone or related drifts;
- ii) Earthy peat soils drained by dykes and pumps;
- iii) Less permeable loamy over clayey soils on plateaux adjacent to very permeable soils in valleys.

N.B. The rainfall rates are calculated using the location specific values above in accordance with the Wallingford procedure.



LONGITUDINAL SECTION THROUGH FOUL WATER SOAKAWAY



LONGITUDINAL SECTION THROUGH RAINWATER SOAKAWAY

REV:	DESCRIPTION:	BY:	DATE:
STATUS: ISSUE			

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SCALE AT A4: NTS	DATE: NOV2020	DRAWN: GM	CHECKED:
PROJECT NO: 0956C	DRAWING NO: Appendix	REVISION:	-

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Surveys, Setting-Out Civil Engineering Design

Culvert Proposals

SOURBANK, RAFFORD

Gary Mackintosh Bsc
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Client:

Mr G Proctor

Site Address:

Proposed New Access

Sourbank

Rafford

Planning Reference:

N/A

Date:

3rd November 2020

Job Number:

RBo1

Company Information:

Assessment completed by:

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Introduction:

It is proposed to construct a new access to a new private dwelling house located at Sourbank to the south east of Rafford, By Forres.

The proposed crossing is to be located opposite existing property 'Parkview and the final surfacing of the access is to be confirmed. The proposed access width as shown within Appendix B is to be 3.75m in width.

There is an existing culverted access to 'Brookwood' located approximately 50m to the north east with a diameter of 700mm.

GMC Surveys have been asked to provide suitable calculations demonstrating the required culvert sizing for the proposed new access.

Description of Works:

The crossing as measured from top of bank to top of bank is approximately 6.8m in width at the widest point with a depth of 1.9m to the invert level of the channel.

The preferred option is to install a short span bridge to provide a crossing. Due to the width of the span taking in to account the additional length required to provide structural integrity, the installation of a short span bridge has been deemed not practical in the delivery of the single house development.

The Calculation sheet within Appendix A indicates the suitability of a 1200mm x 1200mm box culvert to be installed at a length of 4.5m which would be adequate to manage peak flows up to a 1:200year event.

The culvert is to be set in to the channel of the burn at a level of 200mm below the existing invert, the internal base of the culvert is to be made up to existing burn levels using bed material to act similar to an open channel culvert. The use of a box culvert has been proposed to provide the structural integrity required for the potential access of larger vehicles.

The Proposed Culvert details have been provided in Appendix B and the suitability of the details are to be confirmed by SEPA.

APPENDIX A

Culvert Sizing Calculations

Culvert Capacity Estimation - Rafford Burn

Mean Velocity and maximum flow through a 1.2 metre x 0.6 metre concrete box culvert with a total length of 17.4 metres.
Inlet level of culvert 10.51 metres and outlet level of culvert 10.341 metres.

Method used based on standard Manning's equations

Water Density, Dynamic and Kinematic Viscosity Estimates
(Based on mean water temperature)

Temperature of water: $T := 7.82 \text{ }^\circ\text{C}$ or $T = 980.97\text{K}$

Density of Water Estimates

The density of water calculated for the given temperature above using the Thiesen Equation

Constants used for water in Thiesen Equation

$a^1 := -3.983035$ $a^2 := 301.797$ $a^3 := 522528.9$ $a^4 := 69.34881$ $a^5 := 999.974950 \text{ kg m}^3$

Density of water at given temperature $\rho := a^5 \cdot \frac{(1 - (T + a^1)^2 \cdot (T + a^2))}{a^3 \cdot (T + a^4)}$ 998.862 kg m^3

Dynamic Viscosity Estimates

The dynamic viscosity calculated using the Vogel equation parameters

$$a := -3.7188 \quad b := 578.919 \quad c := -137.546 \quad \text{Temperature in Kelvin} \quad T^k = 280.97$$

$$\text{Dynamic viscosity at specified temperature } \mu := e^{\left(a + \frac{b}{c + T^k} \right)} \quad 0.001374 \text{ N s m}^{-2}$$

Kinematic Viscosity Estimates

$$\nu := \frac{\mu}{\rho} = (1.374 \cdot 10^{-6}) \text{ m}^2 \text{ s}^{-1}$$

Kinematic viscosity of water at specified temperature

$$\begin{array}{ll} \text{Metric constant} & u := 1 \\ \text{Width of box culvert} & B := 1.2\text{m} \quad \text{Depth of box culvert} \quad D := 1.2\text{m} \end{array}$$

Manning's Coefficient based on concrete constructed channel

$$\left(\frac{1}{n} \right)$$

$$\text{Coefficient range between 0.011 and 0.025 mean value:} \quad n := 0.0180 \text{ s m}$$

$$\text{Total cross-sectional area of culvert} \quad A := B \cdot D = 1.44 \text{ m}^2$$

$$\text{Total wetted perimeter of culvert} \quad P^w := 2 \cdot (B + D) = 4.8\text{m}$$

Hydraulic radius

$$R^h := \frac{A}{P^w} = 0.300\text{m}$$

Vertical drop along culvert

$$d := 46.60\text{m} - 46.43\text{m} = 0.170\text{m}$$

Length of culvert

$$l := 4.5\text{m}$$

Longitudinal slope of culvert

$$S^o := \frac{d}{l} = 0.037$$

Mean velocity through the culvert at full capacity:

$$V := \frac{u}{n} \cdot R^h^{\frac{2}{3}} \cdot S^o^{\frac{1}{2}} = 4.789 \text{ m s}^{-1}$$

The maximum flow that the culvert can pass:

$$Q := V \cdot A = 6.896 \text{ m}^3 \text{ s}^{-1}$$

Since the peak flow rate generated during a rainfall event with a specified annual probability is known the depth of water of water in the channel during the event can be estimated as follows:

Time taken to flow through the culvert:

$$\text{time} := \frac{l}{V} = 0.809\text{s}$$

Peak flow estimated for 1 in 200 year return period:

$$Q_{200} := 1.59 \text{ m}^3 \text{ s}^{-1}$$

Cross-sectional area of partially full culvert:

$$A_{par} := \frac{Q_{200} \cdot time}{l} := 0.285 \text{m}^3$$

Total depth of water in culvert:

$$D_{par} := \frac{A_{par}}{B} = 0.237 \text{m}$$

Flow inertia to gravity or Froude number:

$$F := \frac{V}{\sqrt{g \cdot D_{par}}} = 3.140$$

Since the depth of water during a 1 in 200 year return period is less than would occur during a pipe full the reduction in frictional loss will temporarily increase the flow in the culvert.

The following estimates are to determine if this increase in flow would exceed the maximum capacity of the box culvert.

Total wetted perimeter of a partially full culvert:

$$P_{par} := B + 2 \cdot (D_{par}) = 1.674 \text{m}$$

Hydraulic radius of a partially full culvert:

$$R_{par} := \frac{A_{par}}{P_{par}} = 0.170 \text{m}$$

Hydraulic diameter of a partially full culvert:

$$D_h := \frac{4 \cdot A_{par}}{P_{par}} = 0.681 \text{ m}$$

Renolds number:

$$Re := \frac{\rho \cdot V \cdot D_h}{\mu} = 2373259.781$$

d'Arcy friction coefficient for turbulent flow:

$$f := \frac{0.316}{Re^{0.25}} = 0.00851$$

Mean velocity of water in partially full culvert:

$$V_{par} := \left(\frac{2 \cdot g \cdot S_0 \cdot 4 \cdot R_{par}}{f} \right)^{\frac{1}{2}} = 7.616 \text{ m s}^{-1}$$

The peak flow that the partially full culvert will pass:

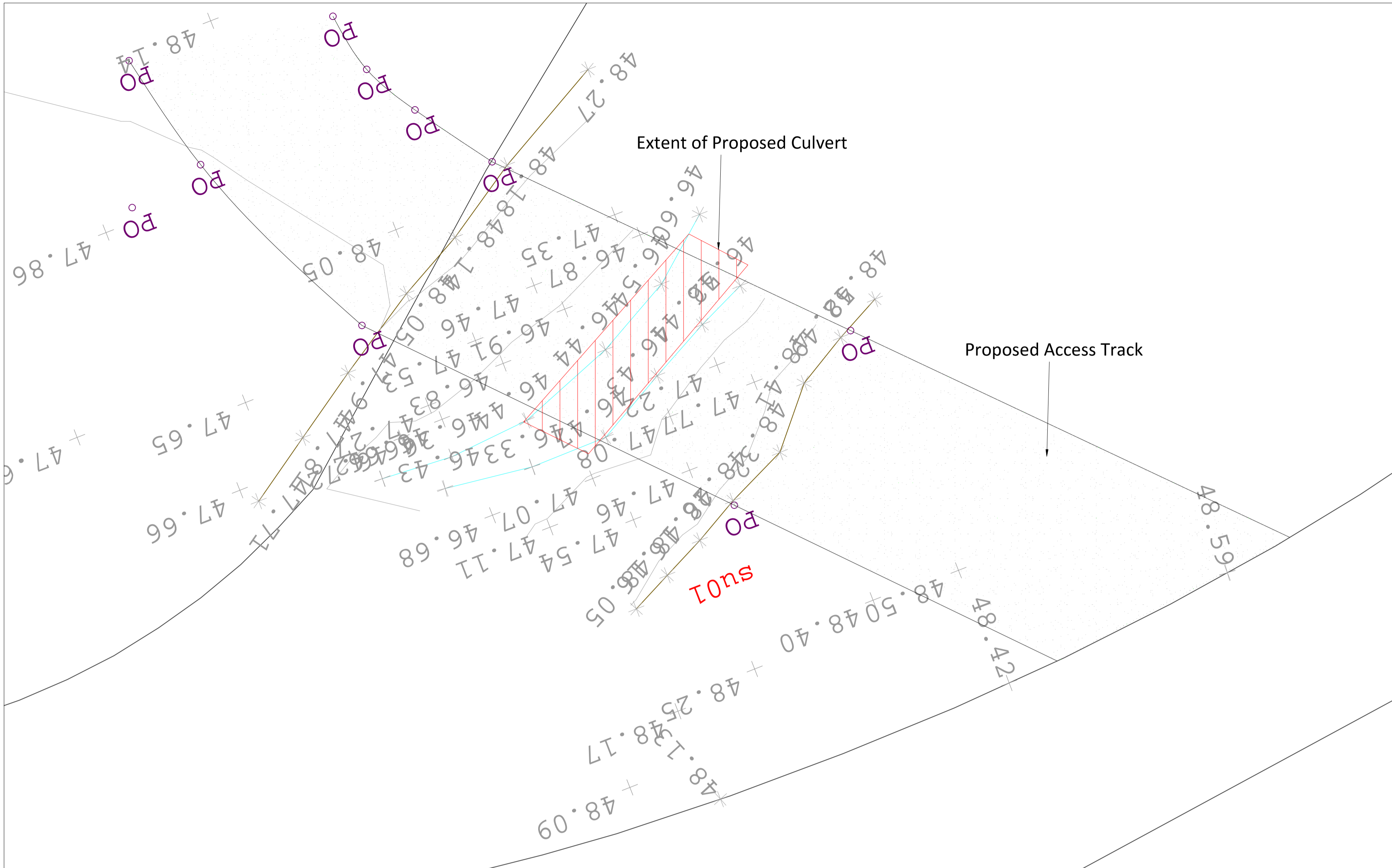
$$Q_{par} := V_{par} \cdot A_{par} = 2.170 \text{ m}^3 \text{ s}^{-1}$$

The maximum flow of water that the box culvert can pass is 4.789 cubic metres per second and the peak flow during a 1 in 200 year return period is only 1.59 cubic metres per second and even when partially full the peak flow will increase to 2.170 cubic metres per second temporarily due to a higher velocity caused by a decrease in the wetted perimeter. The proposed 1.2m x 1.2m box culvert would therefore be adequate.

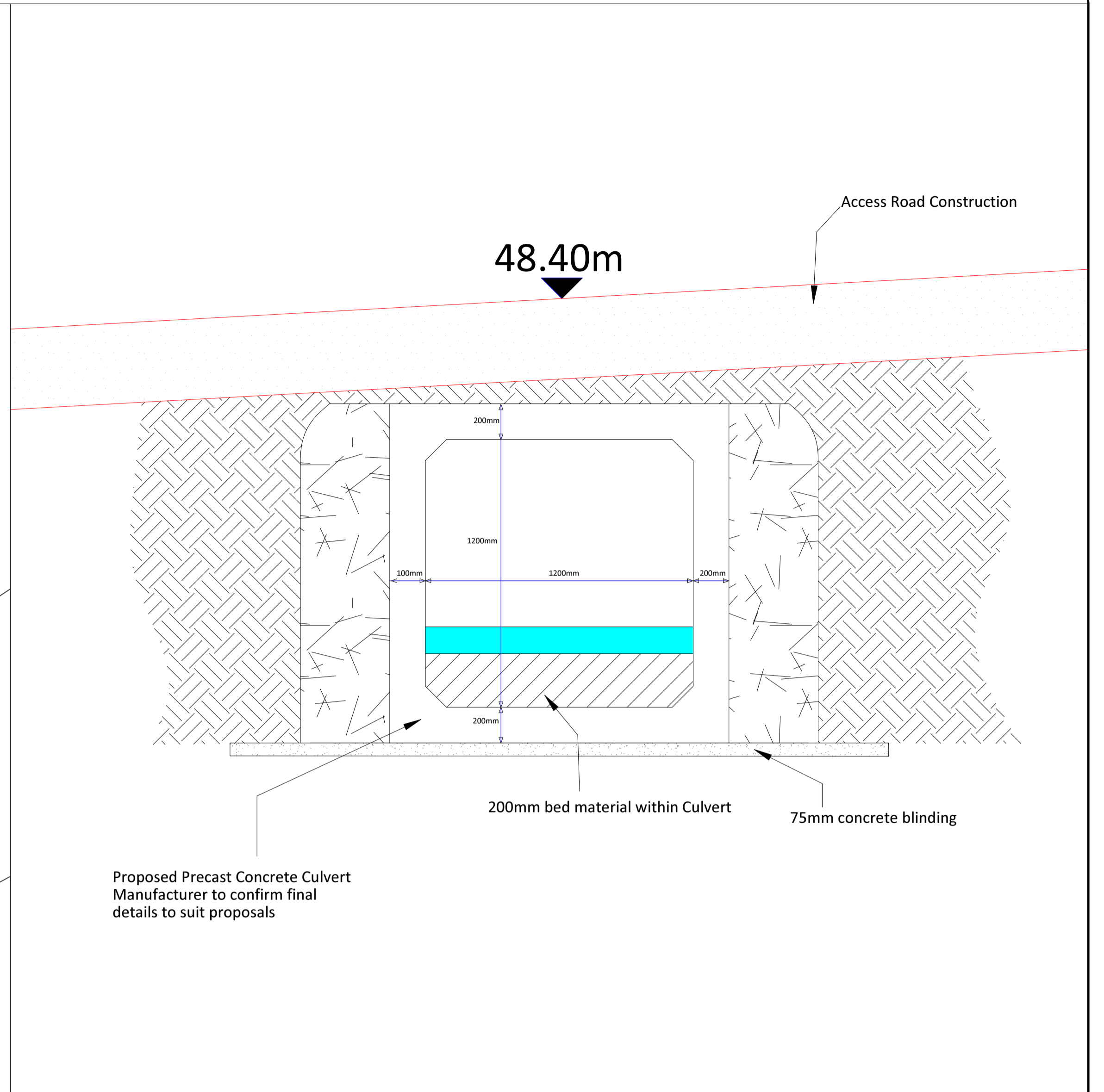
During partially full culvert conditions the Renolds is greater than 4000 and the Froude number is greater than 1 therefore the flow will be supercritical and turbulent.

APPENDIX B

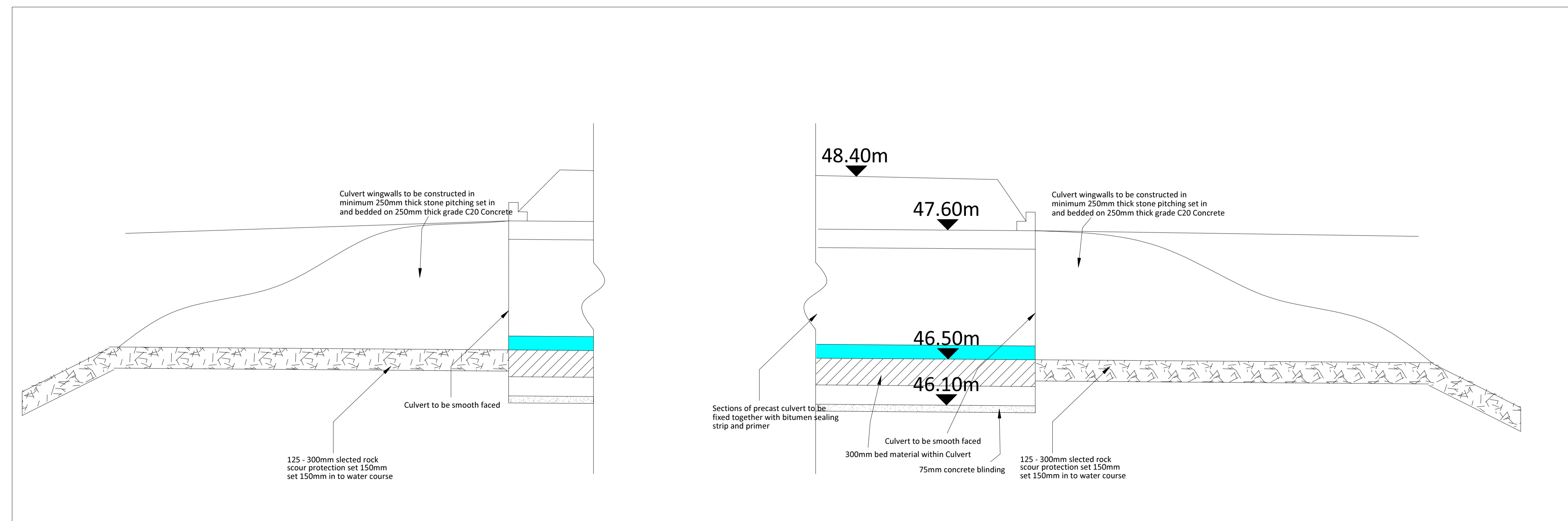
Culvert Details



Culvert Location/Plan View 1:50



Culvert Cross Sectional View NTS



Culvert Inlet Outlet Detail NTS

REV.	DESCRIPTION:	STATUS:

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SITE: **Proposed new Access Sourbank, Rafford**
 TITLE: **Culvert Details**

SCALE AT A1:	DATE:	DRAWN:	CHECKED:
SHOWN	NOV20	GM	
PROJECT NO:	DRAWING NO:	REVISION:	
RB01	900		