Allt a'Mharcaidh – River Restoration
Design Vision Report

May 2021

Allt a'Mharcaidh – River Restoration Design Vision Report

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1 INTRODUCTION

1.1 Terms of Reference

EnviroCentre Ltd was commissioned by Cairngorms Connect to devise a design vision for the restoration of a historically-straightened reach of the Allt a' Mharcaidh near Feshiebridge in the Highlands.

This study was updated in May 2021 to incorporate the results of a high definition 30mm resolution UAV survey, including georeferenced orthographic imagery and a digital terrain model.

1.2 Scope of Report

This report presents details of the baseline hydromorphological review and assessment undertaken to inform development of a restoration design vision, and outlines details of the proposed design vision, and associated technical checks.

1.3 Report Usage

The information and recommendations contained within this report have been prepared in the specific context stated above and should not be utilised in any other context without prior written permission from EnviroCentre.

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2 TECHNICAL ASSESSMENT

2.1 Allt a'Mharcaidh

The Allt a'Mharcaidh is a mountain stream, draining parts of Sgòran Dubh Mòr in the Cairngorms. The watercourse drains to the River Feshie and on to the River Spey. The upper reaches of the watercourse are steep in gradient with exposed bedrock, rapids and waterfalls.

The proposed restoration reach (study reach) lies in the downstream part of the catchment, a short distance upstream of the confluence with the River Feshie. This reach is of a much flatter gradient than the upstream reach and lies within a wide valley floor. This reach of the watercourse has been historically-straightened and flows for a distance of approximately 1km with minimal sinuosity. The study reach is shown in Figure 2-1.

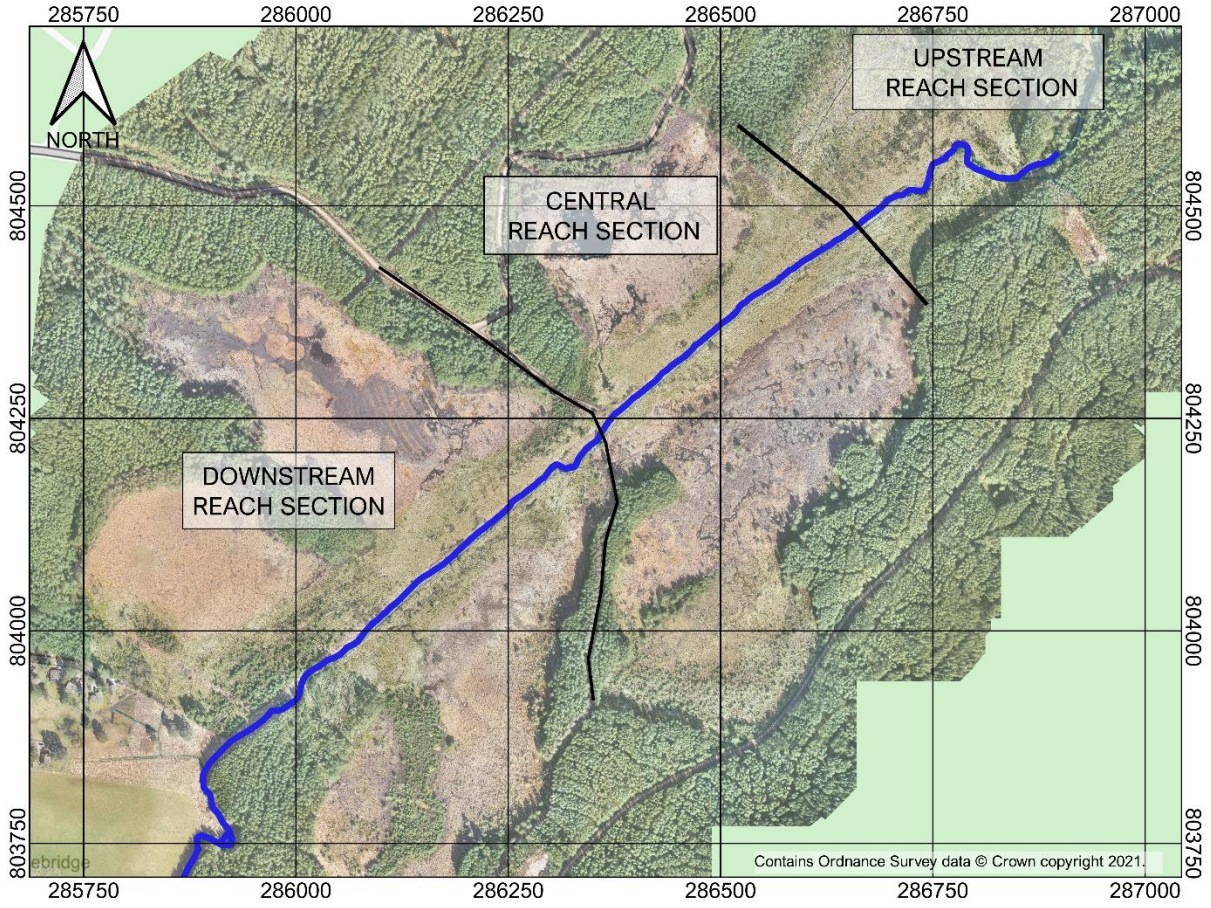

Figure 2-1: Study Reach

2.2 Historic Review

A review of historical mapping suggests that the majority of the study reach was straightened over 150 years ago. Figure 2-2 suggests that the reach has been straight since at least 1869.

There is evidence that suggests that this reach may have been straightened to allow timber to be floated down river. This is known as "Timber rafting" and was extensively practiced in the 18th century in the

highlands to support a growing ship-building industry close to the mouth of the River Spey. There were no roads or railways in this period and so teams of "Spey floaters" would guide rafts of logs down the river. Some river reaches were straightened to aid this process.

It is likely that the river would have started to silt up by the 1900's following abandonment of the timber rafting practices. Afforestation of many parts of the UK were undertaken after WWI and through into the 1950s, and it is likely that clearing or dredging of the river channel, and further ground preparation such as ploughing or mounding, was undertaken during this time to facilitate afforestation.

Source: Reproduced with the permission of the National Library of Scotland

Figure 2-2: OS Six inch map showing the straightened study reach as surveyed in 1869

2.3 Study Reach Characterisation

A desktop assessment was undertaken to identify the historic condition of the study reach, based on historical mapping, Ordnance Survey (OS) mapping, aerial photography, Digital Surface Model (DSM) data provided by Cairngorms Connect, and OS T5 digital terrain data, supplemented by observations made during a site visit. In May 2021 a detailed UAV survey and additional topographic survey were undertaken to further support this assessment.

2.3.1 Site Visit

The study reach was walked over in November 2019 during freezing conditions. Photos were taken of relevant features. A second walkover was carried out in March 2021 of the surrounding area. Additional photos were taken and the fluvial geomorphology of the watercourse investigated.

A selection of relevant photos and their locations are provided in Drawing 673614-QGIS001, Appendix A.

2.3.2 Topography

In 2021 a new UAV survey was commissioned to cover the study area and some surrounding areas. A digital surface model (DSM) and high-resolution orthophotography was produced as part of this survey, to support the assessment. This survey was undertaken to Ordnance Datum, and superseded a previous UAV survey undertaken to a coarser resolution and to a local datum. In addition to the UAV survey a manual topographic survey was undertaken in May 2021, this included several cross-sections through the watercourse and relic channels, as well as a number of ground control points.

An overview of the DSM and aerial photography are presented in Drawings 673614-QGIS002 & 673614-QGIS003, Appendix A. This DSM data was supplemented by OS T5 terrain data for the surrounding areas. The OS T5 terrain data with contours is provided in Drawing 673614-QGIS004, Appendix A.

Review of the available data provides evidence that the watercourse is likely to have originally meandered through the flat valley floor, prior to historic modifications, with frequent flooding of the surrounding riparian area leading to the formation of adjoining bog or wetland areas. A possible historic channel route has been identified from review of the UAV DSM and aerial imagery, as shown in Drawing 673614-QGIS002, Appendix A, marked as "Relic Channel". A number of other furcated secondary channels are also represented.

Drawing 673614-QGIS005 shows the bed slope of the existing, straightened reach and the relic channel, based on the UAV DSM and OS T5 Terrain data. This information highlights that the existing, straightened channel is both deeper than the relic channel, and shorter, taking a more direct route. The larger cross-sectional area and greater depth of the existing straightened channel has a greater conveyance capacity than the relic channel, meaning that flooding of the riparian area likely occurs less frequently since the reach was straightened. Raised banks, in certain areas, also restrict some surface water from reaching the main channel until further downstream.

The study reach is composed of three distinct areas:

- an upstream section with some forestry coverage at the upstream extent;
- a central section including an existing meandering channel, that gives way to a central; flatter section with a shallow channel bed slope; and
- a downstream section, similar to the central section with a relatively shallow channel bed slope.

The central and downstream sections are separated by a glacial ridge which acts as a topographical control, close to the end of an existing forestry access track, and the location of a historic ford crossing. The UAV DSM and aerial imagery suggest that the relic channel will have had shallower slopes than the current channel in the central and downstream sections of the study reach, although the central section of the reach appears to have been a wetland in places, suggesting shallower gradients than the downstream section of the reach.

The entire reach sits within a relatively flat valley floor, with ground levels rising away to the north-west and south-east of the channel, constraining the watercourse within the wider valley. These observations, derived from topographical data, are supported by observations from the site walkover.

Photo 2-1 shows an eroded bank towards the upstream section of the study reach, showing stratification of the alluvial deposits highlighting historic channel movement within the floodplain, and occurrence of historic flood events. Photo 2-2 shows the existing channel at the boundary between the upstream and central sections of the study reach, with a relic channel perched on the floodplain. The perched position of the relic channel sitting above the current bed level indicates that there has been channel incision in this area over time, likely due to headcut associated with the straightening and deepening of the channel downstream.

Photo 2-1: Photo showing stratification of the bank

Photo 2-2: Photo showing relic channel and difference in bed level

2.3.3 Channel Morphology

The existing channel bed gradient is shallow in the central section of the study reach, with some areas where the bed slope may be limited or negative. The bed slope averages at around 1 in 350. The bed slope is relatively consistent through the straightened reach.

The upper part of the upstream section of the study reach was noted to include some active meandering, with some sediment deposition on the inside of the meander bend, as shown in Photo 2-3. This sinuosity reduces downstream, with the downstream reach generally straight, with only little sediment deposition, as shown in Photo 2-4. Due to its morphology, this lower reach is effectively a transport reach, with limited opportunity for sediment deposition.

Some small scale in-channel works have been undertaken by in recent years, aimed at increasing habitat diversity and encouraging morphological processes. These include placement of wood, boulders and gravel within the channel through the straightened reach.

The bed substrate is composed of coarse sands with some gravels, pebbles and some limited larger cobbles. In the upstream section of the study reach the watercourse appears to have banks formed of gravels and larger cobbles. The presence of forestry in this area appears to act to stabilise the channel banks, preventing the watercourse from eroding and transporting this material (Photo 2-5).

Photo 2-3: Meander at the boundary of the upstream and central reach with sediment deposition

Photo 2-4: Straightened channel

Photo 2-5: Bank composed of gravels and cobbles partially stabilised by vegetation

Stream power was initially calculated for the study reach using the original UAV survey and will be further refined with the recent high-resolution survey. Stream power is a useful metric for understanding the distribution of available energy for transporting coarse sediment. This has been derived through the modelling of the existing reach using the Flood Modeller software platform (see Section 2.3.5). Flood Modeller outputs "stream power per unit width" for each model cross-section based on:

(DENSITY OF WATER x ACCELERATION DUE TO GRAVITY x CURRENT DISCHARGE x BED SLOPE IN THE "DOWNHILL DIRECTION")/ THE CURRENT TOP WIDTH.

The results were calculated for the 2-year return period event, roughly equivalent to the bank full flow in a natural river system.

The initial results indicate that the central section of the study reach of the watercourse is predominantly a low energy reach, with most cross-sections exhibiting a low energy stream power. Moving downstream there is a general increase in stream power, with some cross-sections exhibiting a low-medium stream power energy. The downstream section of the study reach generally has a low-medium energy, rising to a medium-high energy in places. This analysis of stream power is consistent with the observations of a slight increase in channel gradient towards the downstream section of the study reach. The initial stream power results are shown in Drawing 673614-QGIS006 in Appendix A, and these will be further refined through the design development using the recent UAV survey.

2.3.4 Design Flows

Catchment descriptors for the Allt a'Mharcaidh were obtained from the FEH Web-service. These suggest that the catchment area draining to the head of the study reach measures around 16.6km². An estimate calculated using the OS T5 data gives a slightly smaller area of 16km². The larger FEH catchment area was used for estimating the flows as a conservative approach. 673614-QGIS007 in Appendix A shows the catchment areas.

A hydrological assessment has been undertaken for the watercourse. A flow duration curve along with flow exceedance percentiles was generated using the Low Flows 2 software flood, while more extreme flood flows were estimated using the ReFH2 method. The results are provided in Table 2-1.

Table 2-1: Design Flows derived using LowFlows 2 and ReFH2

Flow Condition	Design Flow (m^3/s)	Comment
GENERAL FLOWS (flow percentiles)		
Qn90	0.10	Typical of low flow conditions
Qmean	0.45	Mean annual flow conditions
Qn10	0.95	High flow conditions
FLOOD FLOW (return period)		
2-year	4.51	Approximately a bankfull flow for natural channels
5-year	5.25	
10-year	7.83	
20-year	9.76	
30-year	11.72	
50-year	12.93	
100-year	16.71	
200-year	19.05	Flow to define functional floodplain for planning

Qn10 is a flow that is likely to be equalled or exceeded 10% of the time. Qn90 is a lower flow that is likely to be equalled or exceeded 90% of the time. Qmean is an annual mean flow based on the low flow results and is roughly equivalent to a flow that would occur more than 30% of the time (Qn30). The 1 in 2-year return period is a flood flow with a 50% chance of being exceeded in any one year. The 1 in 100-year return period flow is of a large magnitude and has a 1% chance of being exceeded in any one year. These design flows were taken forward for use in the river model, as outlined in the following section.

The UK Environmental Change Network (ECN) have a study site in the Cairngorms which included a logger on the Allt a'Mharcaidh between 2003 and 2006. The gauge was located upstream of the study reach by around 1km, upstream of the confluence with the Allt Core Follais. This would give an estimated catchment area of around $10km^2$. Limited flow information is available from the ECN with the exception of a mean annual discharge value of 0.3 m^3/s. This is slightly lower than the Qmean calculated as part of this study but does correspond when the difference in catchment area is taken into consideration.

2.3.5 Existing Channel Hydraulic Model

A 1D-2D Flood Modeller hydraulic model was initially developed to represent the study reach using the original UAV survey. Cross-sections were extracted from the DSM, which was first adjusted to Ordnance Datum (See Limitations). Cross-sections were used to develop a 1D model representing the main channel. The floodplain areas, outwith the main channel, were represented by a 2D model. Both models were linked using link-lines. The linked model was run for a number of design flows detailed in Section 2.3.4.

The results suggest that under existing conditions flows would be maintained predominantly in bank up to the 5-year event, with some limited flooding at the head of the reach.

Drawing 673614-QGIS008 in Appendix A shows the predicted flood extents for a 1 in 5-year event.

This model will be updated using the data from the recent UAV survey as part of the design refinement.

3 REFERENCE CONDITION & OPTIONS APPRAISAL

3.1 Reference Condition

The reference condition is the assumed original, natural state of the study reach. This "baseline" can be used to compare to the improvements that could be achieved through different restoration options.

Based on the analysis of available data presented in the preceding sections of this report, the Allt a'Mharcaidh reference condition for the study reach can be divided into three sub-reaches:

- The upstream section of the study reach which would have experienced active processes of erosion, deposition and transport. These processes are currently restricted by the commercial forestry plantation.
- The lower gradient central section of the study reach which would have exhibited sinuous, possibly braided, channels, peatland bog habitat and areas of standing water. This has been disconnected by the creation of the present day straightened channel.
- The slightly steeper downstream section of the study reach which would have meandered through the valley floor, possibly via a series of riffles and pools, towards the River Feshie. This has also been replaced by the present day straightened channel.

3.2 High-Level Options Appraisal

Consideration was given to the following options as part of a high-level appraisal.

3.2.1 Do Nothing

The existing channel has been heavily modified over time and is far from its original, natural state. Due to the stabilisation of the riverbanks and surrounding area and the straightening of the channel, reducing the scope for active sediment processes, the channel is lacking in significant sediment transport, disconnected from the floodplain, and would be unlikely to recover without intervention. Historical maps suggest that there has been little change in the channel planform over the past 150-years and there is no reason to believe that this will change without intervention. Therefore, this option would not permit the study reach to return to the reference condition.

3.2.2 Instream Enhancements

A number of targeted instream enhancements have been undertaken in the Allt a'Mharcaidh over the past few years. These include the introduction of sections of gravel substrate, and the placement of large woody material within the study reach.

These have resulted in localised improvements to instream habitat, by creating a greater variety in flow regime, and a greater substrate diversity. There have also been some minor, localised increases in channel sinuosity. However, whilst providing some localised improvements, these enhancements are restricted to the straightened channel environment, and do not influence larger scale morphological processes more significantly. Such options would not enable the restoration of the reach to its natural state, the reference condition.

3.2.3 Re-meandering

A popular approach to river restoration is "re-meandering". This focuses on either encouraging the existing stream to re-meander itself, using in-channel deflectors (e.g. large woody material) and other works, or formally blocking short reaches of the channel and encouraging flows to spill into new, more sinuous channels. This approach has been employed across the UK in support of restoration projects and flood mitigation measures. While this approach does encourage a river channel to take a more natural form, it works on the assumption that the watercourse will have originally had a single-thread channel, which is not necessarily the case. In other words, this option does not necessarily return the watercourse to the reference condition, just something that might be similar.

3.2.4 Stage Zero Approach – Return to Natural State

This approach aims to work with natural processes to rehabilitate a modified channel, by re-connecting historic channel paths and processes, and restoring the connection to its floodplain. Earth works are undertaken to reconnect relic channels and to disconnect the straightened channel. In channel and riparian interventions encourage the release of sediment into the system, and kick-start morphological processes. These works would encourage flows to form a wetland-floodplain system with a meandering, possibly braided, channel network forming in areas where there is a suitable gradient. The aim of this approach is to allow the watercourse to return its natural state. This approach is considered the most likely to return the Allt a'Mharcaidh to its reference state. This option has therefore been taken forward as the proposed Design Vision.

4 DESIGN VISION

4.1 Overview

It is proposed to undertake a Stage Zero approach to encourage the study reach to return to its reference condition. To achieve this, it is proposed to break up riparian areas of forestry plantation to encourage active morphological processes, including channel migration. In-channel measures to encourage sediment release would include the use of felled trees, and large woody structures. The reconnection of relic channels would enable greater floodplain connectivity, and the enhancement of wetland and bog habitat, restoring areas of standing water.

4.2 Design Vision Proposals

A Design Vision was produced guided by the technical assessment undertaken detailed in Section 2.

The Design Vision is provided in Drawing 673614-QGIS009 in Appendix A.

The Design Vision proposes the following:

1. Removal of plantation trees including root plates, in upstream study reach to allow the channel to migrate.
2. Position felled trees, some with root plates intact, in the channel to encourage sediment release.
3. Disconnect the existing straightened channel from the new channel within the study reach, through partial infill along with retention and enhancement of open water habitat.
4. Develop a new, sinuous, connecting channel, at a gradient of approximately 1 in 250, to connect the existing main channel into the relic channels to restore channel planform and floodplain connectivity.
5. Encourage the restoration of wetland and standing water in flat areas.

4.3 Design Vision Hydraulic Model

The existing 1D-2D Flood Modeller hydraulic model, based on the original UAV survey was amended to better represent the design vision. This was achieved by infilling the existing channel and representing the relic channel (shown in Drawing 673614-QGIS002) as the main channel in the 1D model. This channel was formalised in the model in places, by cutting a channel shape into the DSM. This model was re-run with the same design flows.

The results suggest that, due to the reduction in channel capacity, flows would start to spill out of bank during smaller return periods, equivalent to around the Qmean. This would result in frequent and widespread flooding of the riparian area. These frequent out of bank flows would result in the development of areas standing water in parts of the riparian area, considered to be the reference conditions. The results show that the left bank of the watercourse (looking downstream) is likely to flood more often and to a greater extent. This is because this area is lower than areas on the right bank and flows are likely to spread throughout the riparian area instead of returning to the channel.

During extreme return period events flood extents are likely to be more comparable to present day conditions, although greater flood extents would still be expected in the proposed scenario.

Through the design refinement stage, this model will be updated to incorporate the most recent UAV survey information.

4.4 Limitations

The Design Vision has been prepared based on the information available at this stage. The original UAV survey was identified as a source of uncertainty in terms of confidence in levels expressed to Ordnance Datum, this has been addressed through undertaking a recent UAV survey update.

The DSM represents all features on the ground, including vegetation such as trees and bushes. Some of these features were filtered out during processing of the data, but it is likely that many remain. The river models were developed based on this information. It is preferable to undertake modelling based on a topographic survey of known ground levels. However, the model serves to show overland flow pathways and indicative flood extents. The detailed design for construction should relate these ground levels to Ordnance Datum.

5 SUMMARY AND FORWARD ACTIONS

5.1 Summary

EnviroCentre were commissioned by Cairngorms Connect to produce a Design Vision for the restoration of a historically-straightened reach of the Allt a' Mharcaidh near Feshiebridge in the Highlands.

EnviroCentre were provided with digital surface data covering the riparian area, obtained from a UAV survey. This data was supplemented by OS T5 terrain data for the surrounding areas. An updated UAV survey was obtained in May 2021.

A desktop assessment was undertaken to identify the historic condition of this reach of the watercourse. The results suggested that the watercourse was likely to have originally meandered through the flat low lying areas to the south-east of the present day channel, with frequent flooding of the surrounding riparian area leading to the formation of adjoining bog or wetland areas. Historic maps were reviewed, and the available elevation data interrogated. A site walkover was undertaken to ground truth the information.

The study reach was identified to be composed of three distinct areas: an upstream section with some initial forestry coverage and an existing meandering channel that gives way to a central mostly flat section with a shallow channel bed slope; and a downstream section where the gradient of both the channel bed and surrounding ground become a little steeper. The topographical control, between the central section and the downstream section, is close to the location of the existing access track, and appears to be associated with glacial landforms. The entire reach sits within a relatively flat valley floor, with ground levels rising away to the north and south of the reach. The reference condition of the study reach was determined, and a high-level options appraisal was undertaken.

A Design Vision has been proposed based on the preferred restoration option. This is based on the Stage Zero approach of encouraging the study reach to return to its natural state, its reference condition.

5.2 Forward Actions

The next steps to delivering this vision are set out as follows:

- Consult on this design vision;
- Agree and update the vision;
- Prepare and submit the Controlled Activities Regulations licence application to SEPA;
- Refinement of design details;
- Establish any baseline monitoring;
- Arrange for delivery of the works; and
- Manage the construction process.

APPENDICES

A STUDY DRAWINGS

Drawing Name	Drawing Number	Description
Photos & Locations	673614-QGIS001	Drawing showing a sample of photos and locations
UAV Aerial	673614-QGIS002	Drawing showing Aerial Photography derived from UAV data
UAV DSM	673614-QGIS003	Drawing showing the Digital Surface Model derived from UAV data
OST5 Contours	673614-QGIS004	Drawing showing contours and hillshading derived from OS T5
Bed Profile	673614-QGIS005	Drawing showing existing and relic channel and bed slope
Stream Power	673614-QGIS006	Drawing showing results of the Stream Power calculations (Original UAV data)
Catchment	673614-QGIS007	Drawing showing comparison of catchment areas
Flood Map	673614-QGIS008	Drawing showing comparison of existing and proposed 5-year flood map (Original UAV data)
Design Vision	673614-QGIS009	Design Vision Plan showing restoration proposals

286000

287000

805000

804000

Allt a' Mharcaidh

NORTH

286000

287000

Do not scale this map

Legend

Photos

Location of Photos

Client
Cairngorms Connect

Project
Allt a'Mharcaidh

Title
Photos & Locations (2019 & 2021)

Scale
1:6000 @ A3

0 50 100 150 m

Status
FINAL

Drawing No.	Revision	Date
673614-QGIS001	REV02	21 MAY 2021
Drawn	**Checked**	**Approved**
GPL	MN	KMD

Rev	Date	Amendment	Initials
REV01	29/01/2021	FINAL	GPL
REV02	21/05/2021	FINAL - UPDATE	GPL

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805000 804500 804000 803500

NORTH

Allt a' Mharcaidh

iebridge

Do not scale this map

Legend

- River Centreline
- Main Relic Channel
- Secondary Channels

Client
Cairngorms Connect

Project
Allt a'Mharcaidh

Title
UAV Aerial Photography with Relic Channel Mark-up

Scale
1:5000 @ A3
0 50 100 m

Status
FINAL

Drawing No.	Revision	Date
673614-QGIS002	REV03	21 MAY 2021
Drawn	**Checked**	**Approved**
GPL	MN	KMD

Rev	Date	Amendment	Initials
REV01	29/01/2021	DRAFT	GPL
REV02	25/02/2021	FINAL	GPL
REV03	21/05/2021	FINAL - UPDATED UAV SURVEY	GPL

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NORTH

SL_258.303m
CP_258.576m
CP_258.382m
SL_257.971m
CP_256.765m
SL_256.402m
CP_256.571m
SL_256.175m
SL_255.107m
CP_255.457m
SL_254.675m
CP_254.979m

Do not scale this map

Legend

UAV DSM (2021) m AOD

250.8
255.4
256.2
257.1
257.7
258.6
260.2
262.5
264.8
266.5
268.0
269.6
271.7
274.3
277.6
281.4
292.8

Allt a Mharcaidh GCP Levels

Surveyed Cross-section Locations

Client
Cairngorms Connect

Project
Allt a'Mharcaidh

Title
UAV Digitial Surface Model (2021 UAV) & Topographical survey information

Scale
1:5000 @ A3
0 50 100 m

Status
FINAL

Drawing No.	Revision	Date
673614-QGIS003	REV02	27 MAY 2021
Drawn	**Checked**	**Approved**
GPL	MN	KMD

Rev	Date	Amendment	Initials
REV01	29/01/2021	DRAFT	GPL
REV02	27/05/2021	FINAL - UPDATED UAV SURVEY	GPL

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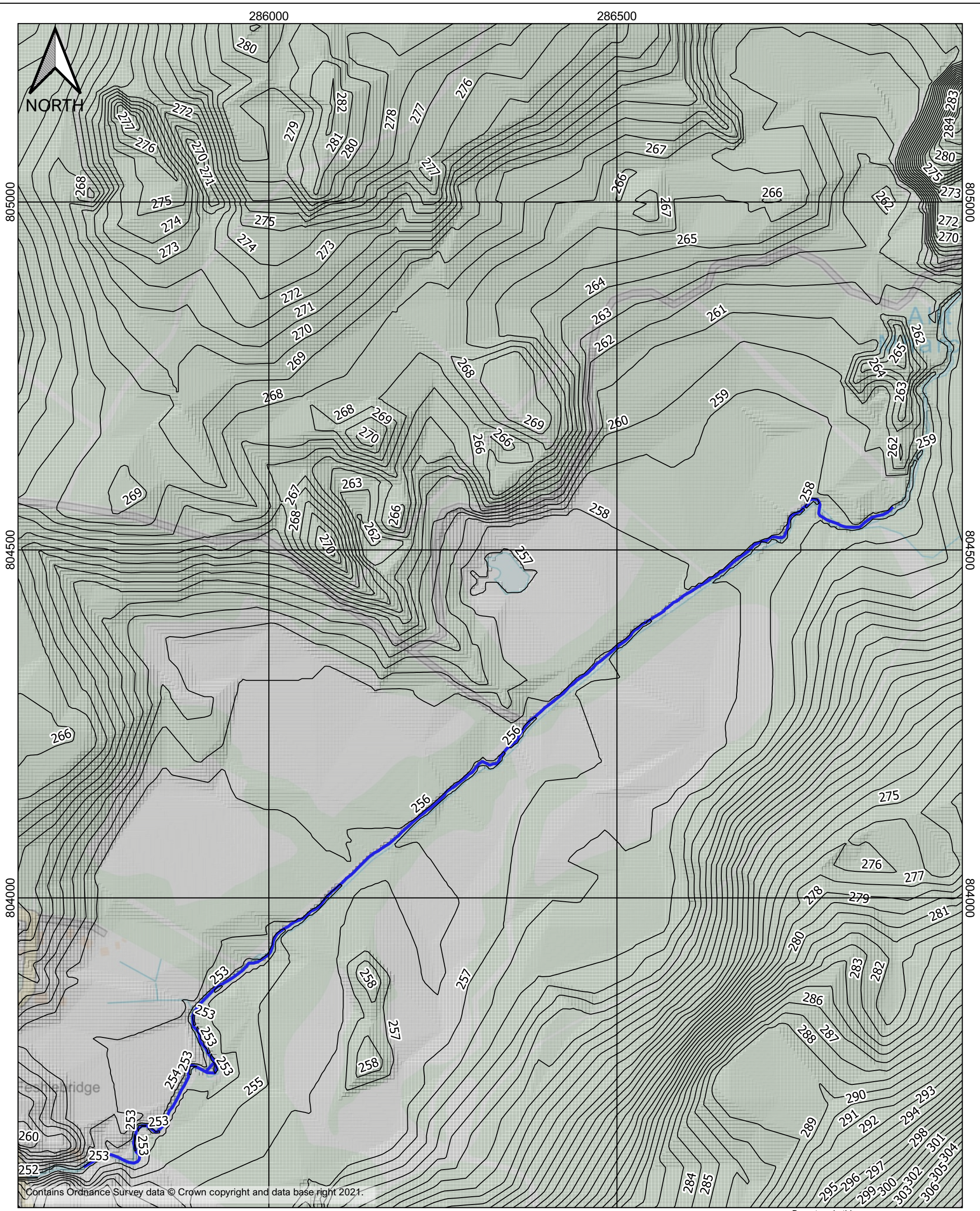

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Legend

River Centreline

Contours

Contours 1m (m AOD)

Client	Cairngorms Connect
Project	Allt a'Mharcaidh
Title	OST5 Contours 1m with Hillshade/Slope
Scale	1:5000 @ A3 — 0 50 100 m

Status	FINAL	
Drawing No. 673614-QGIS004	**Revision** REV02	**Date** 27 MAY 2021
Drawn GPL	**Checked** MN	**Approved** KMD

Rev	Date	Amendment	Initials
REV01	27/01/2021	FINAL	GPL
REV02	27/05/2021	FINAL - UPDATED MAY 21	GPL

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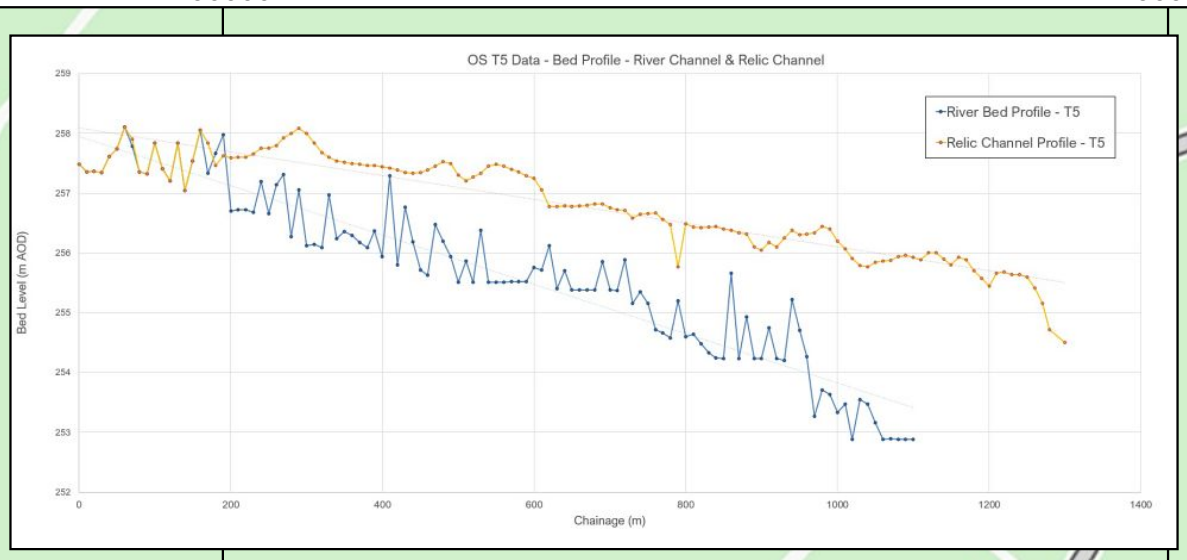
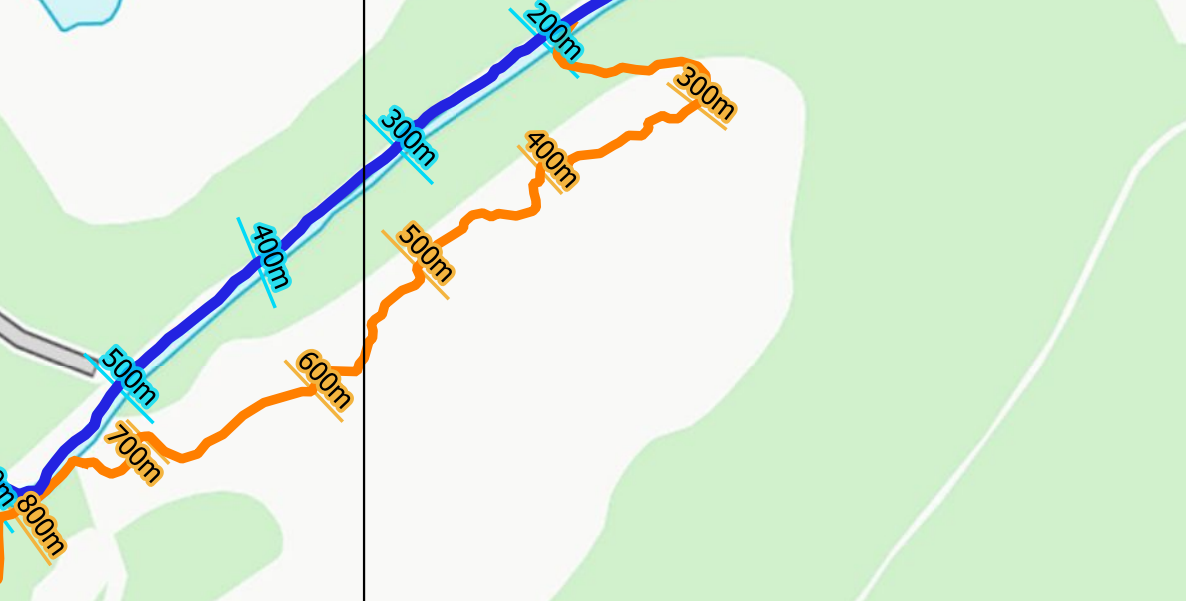


NORTH

Al
Mha

0m 100m 200m 300m 400m 500m 600m 700m 800m 900m 1000m 1100m 1300m

1000m 900m 800m 700m 600m 500m 400m 300m 200m



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Legend

Bed Profile
- River Bed Profile
- Relic Channel Profile

Chainage
- River Chainage
- Relic Channel Chainage

Client
Cairngorms Connect

Project
Allt a'Mharcaidh

Title
Bed Profile of River & Relic Channel based on OST5 DTM & Lastest 2021 UAV

Scale
1:4000 @ A3
0 50 100 m

Status
FINAL

Drawing No.	Revision	Date
673614-QGIS005	-	27 JAN 2021
Drawn	**Checked**	**Approved**
GPL	MN	KMD

Rev	Date	Amendment	Initials
REV01	27/01/2021	FINAL	GPL
REV02	21/05/2021	FINAL - UPDATED UAV SURVEY	GPL

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286000

286500

804500

804000

M

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Do not scale this map

Legend

Stream Power (2-Year Flow)

- Low Energy (<10 kg s^(-3))
- Low-Medium Energy (10-150 kg s^(-3))
- Medium-High Energy (150 - 300 kg s^(-3))

Client
Cairngorms Connect

Project
Allt a'Mharcaidh

Title
Stream Power for the 2-year event

Scale
1:4000 @ A3

0 50 100 m

Status
FINAL

Drawing No.	Revision	Date
673614-QGIS006	-	29 JAN 2021
Drawn	**Checked**	**Approved**
GPL	MN	KMD

Rev	Date	Amendment	Initials
-	-	-	-

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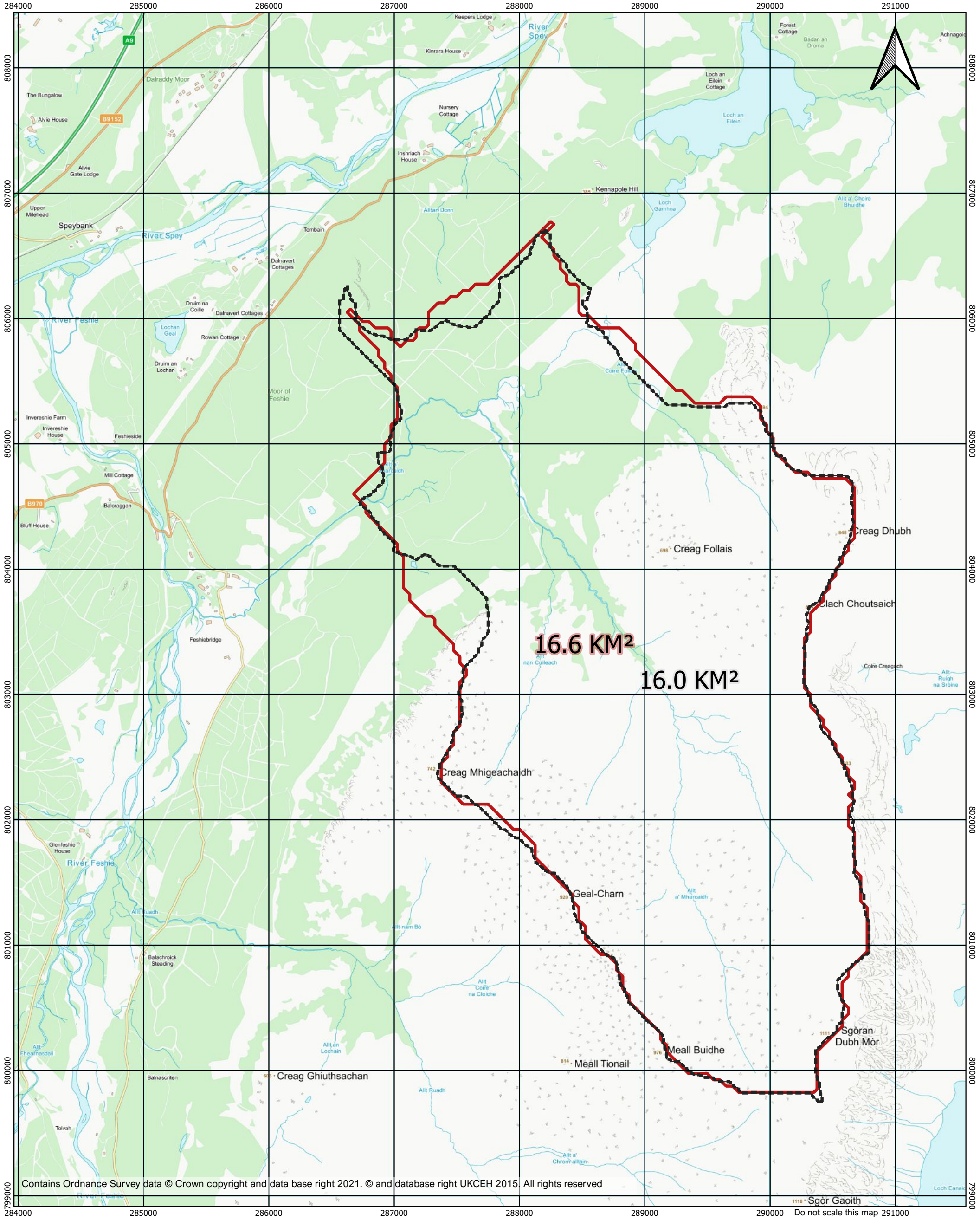

Do not scale this map

Legend

- Catchment Area (Est. OS T5 Data)
- Catchment Area (FEH Web-service)

Client	Cairngorms Connect
Project	Allt a'Mharcaidh
Title	Catchment Area Estimates
Scale	1:28000 @ A3

0 250 500 750 m

Status		
FINAL		
Drawing No. 673614-QGIS007	Revision -	Date 27 JAN 2021
Drawn GPL	Checked MN	Approved KMD

Rev	Date	Amendment	Initials
-	-	-	-

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286000 286500 287000

804500 804000 803500 803000

1 in 100-Year Existing & Proposed Flood Map

Do not scale this map

Legend

Flood Map

Proposed Flood Map Outline

Existing Flood Map Depth (m)

0.01-0.15

0.15-0.3

>0.3

Client
Cairngorms Connect

Project
Allt a'Mharcaidh

Title
1 in 5-year Existing & Proposed Flood Map
100-year Existing & Proposed Flood Map (Inset)

Scale
1:5000 @ A3
0 50 100 m

Status
FINAL

Drawing No.	Revision	Date
673614-QGIS008	-	28 JAN 2021
Drawn	**Checked**	**Approved**
GPL	MN	KMD

Rev	Date	Amendment	Initials
-	-	-	-

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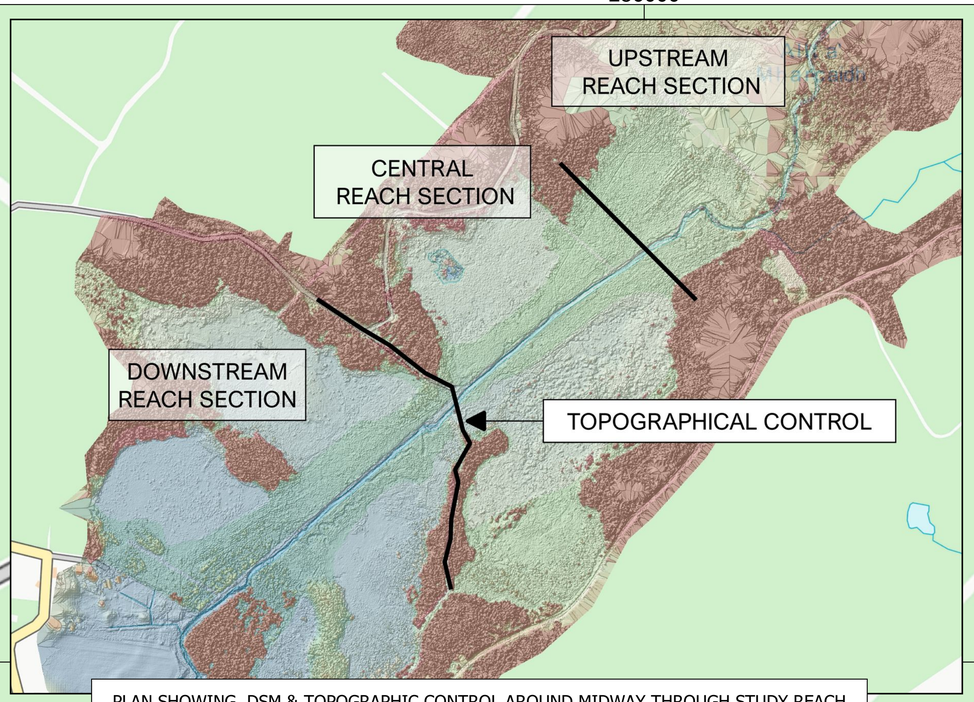
286000
286500
287000
804500
804000



PLAN SHOWING DSM & TOPOGRAPHIC CONTROL AROUND MIDWAY THROUGH STUDY REACH

1 - FELLING OF PLANTATION TREES TO ALLOW THE CHANNEL TO MIGRATE

2 - POSITION FELLED TREES IN CHANNEL TO ENCOURAGE SEDIMENT RELEASE

3A - PLUG RIVER TO DIVERT FLOWS INTO NEW CHANNEL

4 - RECONNECT THE RELIC CHANNELS TO RESTORE CHANNEL PLANFORM AND FLOODPLAIN CONNECTIVITY

3B - FILL IN EXISTING STRAIGHTENED CHANNEL AS PART OF STAGE ZERO APPROACH LEAVING OPEN WATER REACHES AND USE LOCAL MATERIAL TO FORM PONDS

5 - ENCOURAGE RECREATION OF WETLAND AND STANDING WATER IN FLAT AREAS

6 - FORMALISE AND RECONNECT TO RELIC CHANNEL

NORTH

Legend

Design Vision

Design Vision Features

- TREE FELLING
- TREES IN CHANNEL
- WETLAND
- POND FORMATION
- NEW CONNECTING CHANNEL
- ROUTE THROUGH WETLAND
- REMEANDERED CHANNEL
- RIVER PLUG >20M LONG
- INFILLED CHANNEL

Cairngorms Connect

rspb

Do not scale this map

Client
Cairngorms Connect

Project
Allt a'Mharcaidh

Title
Design Vision

Status
FINAL

Drawing No.	Revision	Date
673614-QGIS009	REV02	27 MAY 2021
Drawn	**Checked**	**Approved**
GPL	MN	KMD

Scale 1:2000 @ A1 — 0 25 50 75 m

Rev	Date	Amendment	Initials
REV01	28/01/2021	FINAL	GPL
REV02	27/05/2021	FINAL - UPDATED UAV	GPL

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