Technical Appendix 9.1: Proposed Varied Development Watercourse Crossing Schedule

Appendix 9.1 Proposed Varied Development - Watercourse Crossing Schedule

Introduction

This Watercourse Crossing Schedule has been produced to highlight the presence of watercourses which are required to be intersected by the Proposed Varied Development access tracks and to provide relevant information on the nature of the crossings, likely crossing type required and design recommendations.

This document updates the Watercourse Crossing Schedule provided in Appendix 9.1 of the 2022 Additional Information Report (AIR) for the Consented Development. The updates reflect changes to watercourse crossings required as a result of the revised turbine positions and realignment of some sections of access track for the Proposed Varied Development (red and green highlighted text has been used within the schedule to visually distinguish). A comparison of the Consented vs Proposed Varied Development layouts and crossing locations is illustrated on **Figure 9.2: Hydrological Constraints & Watercourse Crossings - Consented Vs Varied Development**.

The locations of the watercourse crossings required for the Proposed Varied Development are shown on **Figure 9.3: Hydrological Constraints & Watercourse Crossings - Proposed Varied Development.**

The number of watercourse crossings required has been minimised as far as practicable possibly as part of the design evolution of the Site, through focussed liaison within the project team.

The basis of the Watercourse Crossing Schedule and recommendations is around the following design guidance:

- The Construction Industry Research and Information Association (CIRIA) "Culvert, Screen and Operation Manual" (CIRIA,2019);
- Scottish Environment Protection Agency (SEPA) Good Practice Guide, "River Crossings", 2nd Edition (2010a);
- SEPA Good Practice Guide, "Bank Protection Rivers and Lochs", 1st Edition (2010b); and
- *SEPA "Climate change allowances for flood risk assessment in land use planning" guidance, Feb 2025*

A hydrological site survey was conducted in July 2020 by an experienced Chartered Hydrologist of the Red Line Boundary (i.e. where all proposed turbines are to be sited and associated infrastructure) and coordinated with the engineering design team. During this survey, several areas of concern were identified where the proposed track route traversed very boggy ground with a network of braided peat channels that are vital in providing drainage continuity within the catchment and maintaining healthy peatland habitats. Through coordination with the engineering design team the resulting design evolution was able to realign sections of track, where possible, to avoid these areas. The findings of this survey were used during the design review for the Proposed Varied Development to ensure that the features described above were still avoided, where feasible.

The local hydrology of the main body of the Site is governed by the undulating moorland with varying topography. The Site features numerous watercourses and water bodies. The largest water body is Loch a' Chrathaich adjacent to the western edge of the Site, into which the far western and southwestern Site area drains and is outwith the Turbine Development Area (refer to **Figure 9.1: Hydrological Overview**). A series of smaller lochs and lochans are present across the rest of the Site, within complex topography meaning drainage will flow from various high points into these water bodies. A dam associated with the Livishie Hydro Scheme is located at the outflow of Loch a' Chrathaich. Multiple intake locations associated with the Livishie Hydro Scheme are also found in close proximity to the Site.

The majority of the Site drainage, with the exception of the lower access track and the west of the Site, is anticipated to flow to Allt Saigh, either directly or via the Allt Carn Choire Rainich or smaller unnamed watercourses (refer to EIAR **Figure 9.1: Hydrological Overview**). Allt Saigh discharges into Loch Ness.

Watercourse crossings identified on 1:50,000 Ordnance Survey (OS) mapping, referred to as 'major crossings' have been assessed during the Site walkover and the Watercourse Crossing Schedule below outlines the crossing type(s) most likely suitable for each. All crossings are required and unavoidable given the Site setting and other Site constraints. The final designs will require specific surveys and further hydrological assessment.

Of these 'Major Crossings', WXC-01 was already constructed during the Enabling Works phase of the project. The remaining 5 of this type of crossing will be subject to detailed design during the Main Works phase.

The majority of the existing crossings beneath the existing hydro track in the south of the turbine development area are required for drainage continuity, allowing the upgradient areas south of the track to continue draining north to the Allt Saigh. This track will need to be upgraded and realigned to wind farm specification and given the expectant increased loading from construction traffic, the majority of these culverts will also need to be upgraded. The Watercourse Crossing Schedule below outlines the existing crossings identified during the Site survey. Six~~6~~ crossing upgrades (WXC-A to F) have been removed from the scope of the project due to reduction of the access track length / removal of "loaded turning head" beyond T16 from the Proposed Varied Development layout.

Additional 'minor' crossings have been identified along the proposed new track routes originating from minor watercourses (not shown on OS mapping) and discrete watershed pathways which are common in upland areas. The Watercourse Crossing Schedule below describes the solution for each additional ('minor') crossing. For discrete drainage pathways, providing drainage continuity within the track drainage design will suffice in most instances, this is likely to be in the form of closed culverts. For more defined minor watercourses, a specific crossing would be required, some likely to be bottomless arched culverts. A number of these minor crossings have been removed during the development of the Proposed Varied Development design, including WXC-AU (due to shortening of T05 spur), WXC-AS (also on T5 spur) and WXC-BG* (due to realignment of T10 spur). Additionally, a small number of new Additional Crossings have been identified and added to the Schedule based on further review of Aerial imagery, including WXC-BH*, BI* and BJ*

All crossings will be designed to accommodate the 0.5% annual exceedance probability flows with an appropriate allowance for climate change, or information provided to justify smaller structures. Climate change allowances will be assumed per the climate change allowances contained within SEPA's guidance for flood risk assessment in land use planning (SEPA, 2025). This will also be secured through compliance with Planning Condition 14. Furthermore, all necessary measures to allow passage for fish and mammals will be incorporated into the detailed design of any bridge or culvert structures as described in SEPA's Good Practice Guide River Crossings (2010).

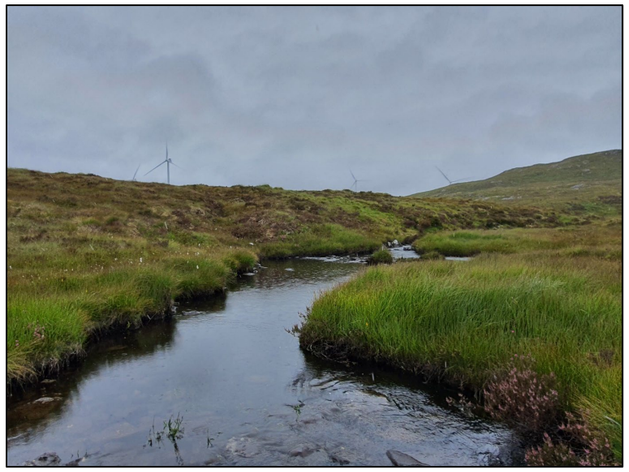
It should be noted that not all potential crossings relating to maintaining drainage continuity will have been identified, as the exact locations will be dependent on the track micrositing, local profile and extent of cut / fill. The precise locations and extent of these drainage continuity crossings will be identified at the detailed design and construction stage and implemented as required.

Watercourse Crossing Schedule

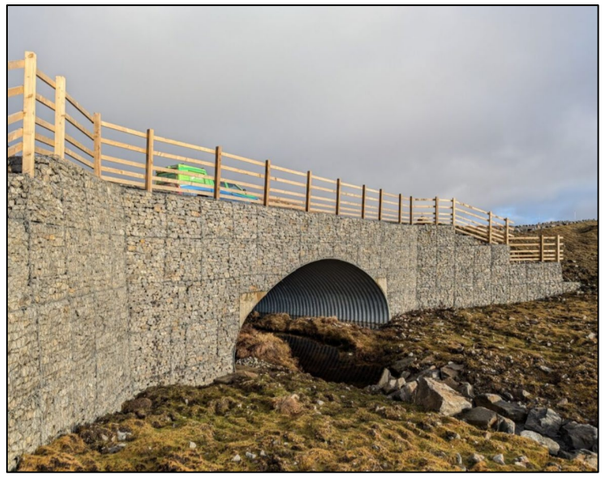
Major Crossings (Major defined as a watercourse identified in 1:50,000 OS mapping, requiring hydraulic analysis for crossing design)

Watercourse Crossing 1 (WXC01) – Constructed during Enabling Works

Location Description	*Located on proposed track between the Operational Development and Turbine 7 approximately 200m west of the spur junction North of Turbine 7.*
Grid Co-ordinates	*238522, 820703*
Watercourse Name	*Unnamed watercourse identified on OS 1:50k mapping*
Watercourse Description	*Varying channel width with braided sections. Moderate Flows Observed. Channel width varies from c.2m - 10m. Steep right-hand overbank (looking downstream)*
Principal Watercourse Catchment	*Drains to Loch Carn Tarsuinn Beag*
Constructed Crossing Type	*Open span crossing to accommodate channel variability, steep right-hand overbank and conveyance within the flood plain extent. Clear arch width = 9m- sized appropriately to avoid works within the bed & banks of the watercourse and to convey flood waters. Constructed as part of Site Enabling Works, crossing design is suitable for Proposed Varied Development.*



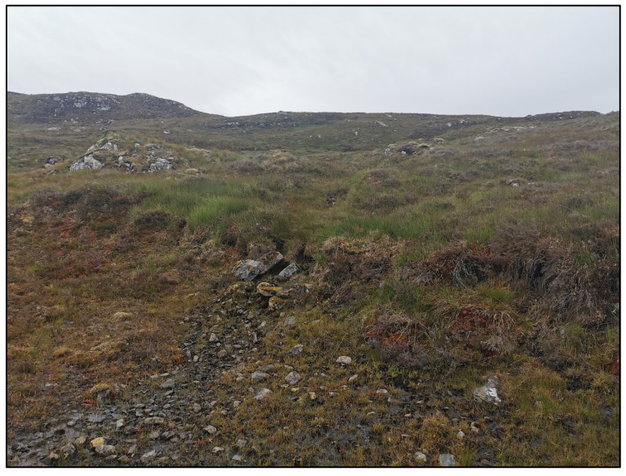
Looking upstream, pre-construction. Note varying channel width and steep right-hand overbank



As-Built view on WXC-01 open-span arch structure with gabion basket spandrel walls and timber post-&-rail fencing

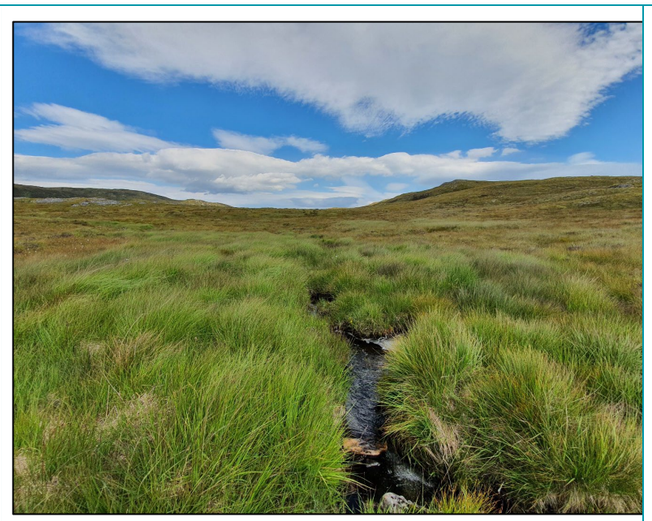
Watercourse Crossing 2 (WXC02) – Confirmed (no change from Consented Development)

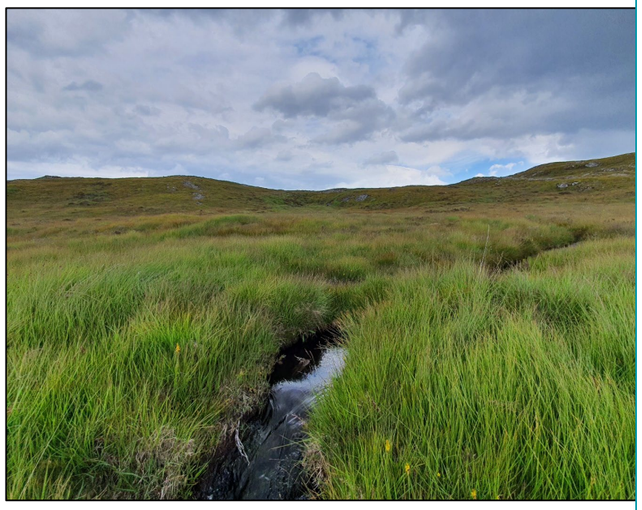
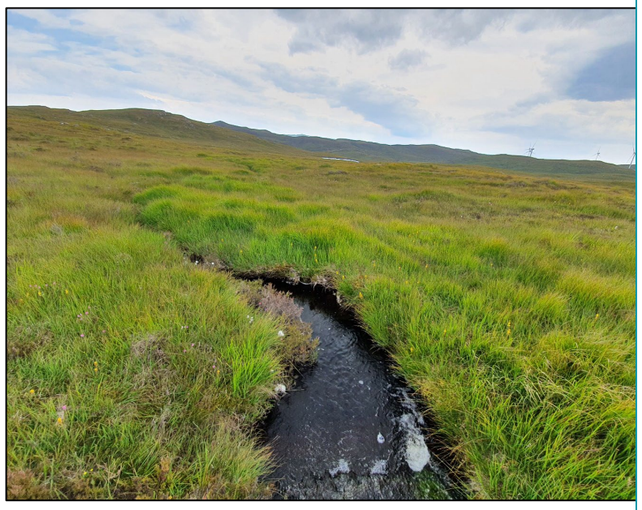
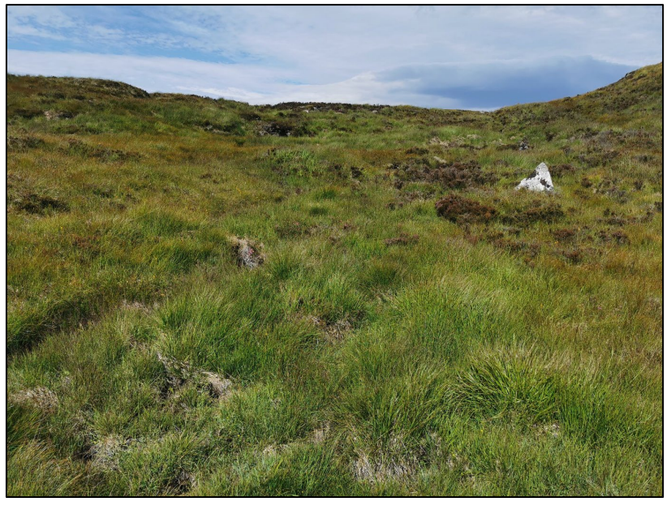
Location Description	*Located on existing track between Operational Development and Turbine 9. Crossing is located approximately 120m southwest of SSE LIDAR and approximately 480m southwest of Turbine 9.*
Grid Co-ordinates	*238939, 819850*
Watercourse Name	*Unnamed watercourse identified on OS 1:50k mapping*
Watercourse Description	*Existing crossing on hydro track. 300mmØ clay pipe. Small catchment originating from Carn an Tuairneir upgradient, draining into a valley feature with discrete channel upgradient of track. Additional runoff within catchment collected in existing track side ditches.*
Principal Watercourse Catchment	*Drains to Allt Saigh via Loch an Dubhair*
Proposed Crossing Type(s)	*Pipe to be replaced to accommodate road widening. Diameter to be assessed relative to predicted design flows*



Looking upstream, valley feature draining to central discrete channel. Deposition of stones indicate potential of moderate to high flows

Looking downstream towards discharge location of connecting watercourse between loch Carn Tarsuinn Beag and Loch an Dubhair

Watercourse Crossing 3 (WXC03) – Confirmed (no change from Consented Development)			
Location Description	*Located on proposed track between Turbine 4 and Turbine 5 approximately 260m northeast of Turbine 4*	 View upstream, note discarded brush on overbanks indicating out of bank flows	 View downstream towards Loch Liath (not visible)
Grid Co-ordinates	*239607, 821453*		
Watercourse Name	*Unnamed watercourse identified on OS 1:50k mapping*		
Watercourse Description	*Well-formed channel connecting Loch nam Brathain and Loch Liath*		
Principal Watercourse Catchment	*Watercourse eventually draining to Allt Saigh*		
Proposed Crossing Type(s)	*Bottomless Arch culvert likely required to accommodate channel and floodplain extent*		
Watercourse Crossing 4 (WXC04) – Confirmed (no change from Consented Development)			
Location Description	*Located on proposed track leading to Turbine 15 and Turbine 12 approximately 355m southwest of Turbine 12.*	 View upstream towards WCX03 (not visible)	 View downstream towards Loch Liath
Grid Co-ordinates	*239701, 821210*		
Watercourse Name	*Unnamed watercourse identified on OS 1:50k mapping*		
Watercourse Description	*Same channel as WXC03 approximately 260m further downstream. Well-formed straight section of channel, fast flowing*		
Principal Watercourse Catchment	*Watercourse eventually draining to Allt Saigh*		
Proposed Crossing Type(s)	*Bottomless Arch culvert likely required to accommodate channel and floodplain extent*		

Watercourse Crossing 5 (WXC05) – Confirmed (no change from Consented Development)			
Location Description	*Located on proposed track leading to Turbine 15 and Turbine 12 approximately 250m southwest of Turbine 12.*	 View upstream	 View downstream towards Loch Liath
Grid Co-ordinates	*239842, 821234*		
Watercourse Name	*Unnamed watercourse identified on OS 1:50k mapping*		
Watercourse Description	*Similar channel to WCX03 and WCX04, slightly smaller, also discharging to Loch Liath. Well-formed meandering channel*		
Principal Watercourse Catchment	*Watercourse eventually draining to Allt Saigh*		
Proposed Crossing Type(s)	*Bottomless Arch culvert likely required to accommodate channel and floodplain extent*		
Watercourse Crossing 6 (WXC06) – Confirmed (no change from Consented Development)			
Location Description	*Located on proposed track leading to Turbine 17, approximately 240m west of Turbine 17*	 View upstream (channels not discernible). Note discarded brush indicating flood plain extents. Track to stick to higher ground	
Grid Co-ordinates	*240132, 821246*		
Watercourse Name	*Unnamed watercourse identified on OS 1:50k mapping*		
Watercourse Description	*Incised, braided meandering channel at top of a well-defined valley feeding down to the Allt Saigh. Low channel capacities and evidence of wider regular flood plain extent*		
Principal Watercourse Catchment	*Watercourse eventually draining to Allt Saigh*		
Proposed Crossing Type(s)	*Provided the track keeps to the high ground, Bottomless Arch culvert will suffice*		

Existing Crossings

ID	X	Y	Rating[1]	Description
~~WXC-A~~	~~240248~~	~~820131~~	~~Discrete~~	~~300Ø corrugated steel pipe~~
~~WXC-B~~	~~240209~~	~~820139~~		~~450Ø corrugated steel pipe~~
~~WXC-C~~	~~240189~~	~~820136~~	~~Discrete~~	~~300Ø corrugated steel pipe~~
~~WXC-D~~	~~240157~~	~~820109~~	~~Discrete~~	~~300Ø corrugated steel pipe~~
~~WXC-E~~	~~240133~~	~~820091~~	~~Discrete~~	~~300Ø corrugated steel pipe~~
~~WXC-F~~	~~240084~~	~~820109~~	~~Discrete~~	~~300Ø corrugated steel pipe~~
WXC-G	240027	820113	Discrete	300Ø corrugated steel pipe
WXC-H	239983	820115	Discrete	300Ø corrugated steel pipe
WXC-I	239961	820098	Discrete	300Ø corrugated steel pipe
WXC-J	239822	820091	Discrete	300Ø corrugated steel pipe
WXC-K	239766	820076	Discrete	300Ø corrugated steel pipe
WXC-L	239701	820061	Minor	500Ø corrugated steel pipe
WXC-M	239658	820053	Minor	500Ø corrugated steel pipe
WXC-N	239643	820054	Discrete	300Ø corrugated steel pipe
WXC-O	239586	820059	Discrete	300Ø corrugated steel pipe
WXC-P	239462	820070	Discrete	300Ø corrugated steel pipe Repositioned due to track realignment- will require new culvert (existing culvert to be removed)
WXC-Q	239343	820032	Discrete	300Ø corrugated steel pipe
WXC-R	239270	819983	Minor	500Ø corrugated steel pipe Repositioned due to track realignment- will require new culvert (existing culvert to be retained)
WXC-S	239252	819969	Discrete	500Ø corrugated steel pipe Repositioned due to track realignment- will require new culvert (existing culvert to be retained)
WXC-T	239141	819879	Discrete	300Ø corrugated steel pipe
WXC-U	239080	819858	Minor	500Ø corrugated steel pipe

General Comments

The majority of existing crossings beneath the hydro track are for drainage continuity, allowing the upgradient areas south of the track to continue draining north to the Allt Saigh. This track will need to be upgraded to wind farm specification and given the expectant increased loading from construction traffic, the majority of these culverts will also need to be upgraded. Most requiring replacement due to condition (see images below).

WXC-A to F removed from the Proposed Varied Development layout due to shortening of T16 spur.

Example of existing pipe with insufficient cover and deformation

Example of partially blocked pipe

Existing Crossings					
ID	**X**	**Y**	**Rating[1]**	**Description**	**General Comments**
WXC-V	238835	819839	Minor	500Ø corrugated steel pipe	The majority of existing crossings beneath the hydro track are for drainage continuity, allowing the upgradient areas south of the track to continue draining north to the Allt Saigh. This track will need to be upgraded to wind farm specification and given the expectant increased loading from construction traffic, the majority of these culverts will also need to be upgraded. Most requiring replacement due to condition.
WXC-W	238779	819833	Discrete	Culvert not visible, assumed buried but still some through-flow	
WXC-X	238691	819884	Discrete	300Ø corrugated steel pipe	
WXC-Y	238554	819943	Minor	500Ø corrugated steel pipe	
WXC-Z	238436	819922	Discrete	300Ø corrugated steel pipe	
WXC-AA	238383	819912	Minor	Twin 300Ø clay pipes with concrete surround	
WXC-AB	238260	819776	Discrete	300Ø corrugated steel pipe	
WXC-AC	238219	819790	Minor	500Ø corrugated steel pipe	
WXC-AD	238176	819810	Minor	750Ø reinforced concrete pipe	

Notes: [1]Minor rating defined as smaller channels not identified in OS 1:50,000 mapping, possible hydraulic analysis required. Discrete rating defined as discrete channels / drainage paths, requiring hydrological continuity crossings.

Additional Crossings					
ID	**X**	**Y**	**Rating[1]**	**Description**	**Proposed Crossing**
WXC-AE	238451	820687	Discrete	Minor drainage path flowing west to east	To be incorporated cut-off drainage design and piped beneath track to maintain drainage continuity
WXC-AF	238675	820707	Minor	Minor boggy braided channel in the vicinity of the track junction to T07	Dependent on final track locations and hardstanding, drainage continuity to be maintained
WXC-AG	238684	820780	Minor	Defined channel adjacent to more boggy ground to East	Bottomless Arch culvert likely required
WXC-AH	238699	820871	Minor	Pproposed at head of watercourse identified on OS 1:50k mapping. Small channel at this location with small contributing catchment	To be incorporated cut-off drainage design and piped beneath track to maintain drainage continuity. Re-alignment largely avoids valley feature
WXC-AI	238698	820984	Discrete	Discrete channel feature likely to convey flow during prolonged rainfall	Likely to be impacted / re-routed due to proposed borrow pit directly upgradient. Drainage continuity to maintained with cut-off ditches and piped culverts as above
WXC-AJ	238643	821009	Discrete	Minor braided channel in boggy area, steep upgradient catchment	Bottomless Arch culvert likely required and combined with cut-off ditches
WXC-AK	237997	822006	Minor	Boggy area in valley feature with 2 defined braided channels, likely subsurface flow	Bottomless Arch culverts over both channels
WXC-AL	238222	822132	Minor	50-100m stretch of boggy section with numerous minor/discrete channels	Drainage continuity to be maintained, upgradient flows to be redirected around infrastructure where required and discharged at a location matching the existing hydrological regime once clear of all infrastructure.
WXC-AM	238312	822090	Discrete	Discrete drainage path with narrow upgradient valley feature	To be incorporated cut-off drainage design and piped beneath track to maintain drainage continuity
WXC-AN	238401	821837	Minor	Two separate braided meandering minor channels flowing predominantly east to west, spaced c.20m apart on proposed track alignment north/south Repositioned due to track realignment – no change in proposed solution	Bottomless Arch culverts over both channels
WXC-AO	238353	821741	Minor	Single braided meandering minor channel similar to WXC-AM	Drainage continuity to be maintained, upgradient flows to be redirected around infrastructure where required and discharged at a location matching the existing hydrological regime once clear of all infrastructure.
WXC-AP	238916	821052	Discrete	Discrete incised channels on steep slope Repositioned due to track realignment – no change in proposed solution	To be incorporated cut-off drainage design and piped beneath track to maintain drainage continuity
WXC-AQ	239383	821284	Minor	Sluggish braided channel Repositioned due to track realignment – no change in proposed solution	Drainage continuity to be maintained, upgradient flows to be redirected around infrastructure where required and discharged at a location matching the existing hydrological regime once clear of all infrastructure.
WXC-AR	239565	821371	Minor	Very boggy and extensive braided channels	To be incorporated cut-off drainage design and piped beneath track to maintain drainage continuity

Additional Crossings					
ID	**X**	**Y**	**Rating[1]**	**Description**	**Proposed Crossing**
WXC-AS	239590	821652	Discrete	Discrete braided drainage paths running northeast to south west on moderate slope down to Loch nam Brathain	To be incorporated cut-off drainage design and piped beneath track to maintain drainage continuity
WXC-AT	239571	821889	Discrete	Discrete braided drainage paths running northeast to south west on moderate slope down to Loch nam Brathain	To be incorporated cut-off drainage design and piped beneath track to maintain drainage continuity
~~WXC-AU~~	~~239506~~	~~822025~~	~~Minor~~	~~Minor braided channel downgradient of T05 location~~	~~Infrastructure cut-off drainage to discharge to this location to ensure upgradient catchment is not lost.~~ Removed from the Proposed Varied Development due to shortening of T05 spur
WXC-AW	240285	821238	Discrete	Discrete drainage paths flowing north to south	To be incorporated cut-off drainage design and piped beneath track to maintain drainage continuity
WXC-AX	240415	821160	Discrete	Discrete drainage path flowing north to south	To be incorporated cut-off drainage design and piped beneath track to maintain drainage continuity
WXC-BC	239595	821176	Discrete	Discrete drainage path flowing north to south	To be incorporated cut-off drainage design and piped beneath track to maintain drainage continuity
WXC-BD	239228	821091	Minor	Multiple discrete drainage channels flowing north to south	To be incorporated cut-off drainage design and piped beneath track to maintain drainage continuity
WXC-BE*	238761	820393	Minor	Minor braided outflow channel from lochan, small contributing catchment	To be incorporated cut-off drainage design and piped beneath track to maintain drainage continuity
WXC-BF*	238914	821591	Minor	Final approach to T03 (c.200m) crossing numerous small channels	Drainage continuity to be maintained, upgradient flows to be redirected around infrastructure where required and discharged at a location matching the existing hydrological regime once clear of all infrastructure.
~~WXC-BG*~~	~~239510~~	~~821011~~	~~Minor~~	~~30m stretch of boggy section with multiple braided minor channels draining east to Loch Liath~~	~~Drainage continuity to be maintained, upgradient flows to be redirected around infrastructure where required and discharged at a location matching the existing hydrological regime once clear of all infrastructure.~~ Removed from Proposed Varied Development Layout due to realignment of T10 spur.
WXC-BH*	238839	821057	Minor	Two discrete minor braided channels flowing West to East on realigned track section on approach to T11	To be incorporated cut-off drainage design and piped beneath track to maintain drainage continuity
WXC-BI*	237920	821818	Minor	Multiple discrete drainage channels flowing West to East at transition of new track with track at existing operational Bhlaraidh Wind Farm T26	To be incorporated cut-off drainage design and piped beneath track to maintain drainage continuity
WXC-BJ*	238755	820316	Minor	Boggy ground in valley feature on peak of T08 ridgeline	Boggy ground will be overlaid by T08 hardstand – catchment on hardstand will be directed towards retained outfall path.

Notes: [1] *Minor* rating defined as smaller channels not identified in OS mapping, possible hydraulic analysis required. *Discrete* rating defined as discrete channels / drainage paths, requiring hydrological continuity crossings.
* Denotes crossing location based on review of satellite imagery

Conclusions and Recommendations

This Watercourse Crossing Schedule has been produced to highlight the presence of watercourses which are required to be intersected by the proposed wind farm tracks and to provide relevant information on the nature of the crossings, likely crossing type required and design recommendations.

Ultimately the recommendations set out in the Watercourse Crossing Schedule are compliant with best practice design guidance and proportionate to the hydrological regimes encountered during the site survey.

Previously watercourse crossings were subject to authorisation from SEPA under the Water Environment (Controlled Activities) (Scotland) Regulations 2011; however, it is noted that from the 1 November 2025, water, waste management and industrial activities will now be regulated under the Environmental Authorisations (Scotland) Regulations 2018 (EASR). Following planning permission for the Proposed Varied Development, the final watercourse crossings will be designed in compliance with all EASR requirements. All watercourse crossings will be designed to ensure free passage for mammals and fish and to limit disturbance to the natural channel bed and embankment geomorphology and habitat as far as possible. All engineering activities authorised under EASR will be carried out in accordance with good practice and in compliance with environmental standards.

References

Construction Industry Research and Information Association (2019). Culvert, screen and outfall manual (C786). Available at: https://www.thenbs.com/PublicationIndex/documents/details?Pub=CIRIA&DocID=328474

Scottish Environment Protection Agency (2010a). Good Practice Guide, River Crossings, 2nd Edition. Available at: https://www.sepa.org.uk/media/151036/wat-sg-25.pdf

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