Appendix 7-4 Drainage Report for Turbine T1 Area

EIAR – Volume 3

Knockanarragh Wind Farm

SLR Project No.: 501.V00727.00008

18 January 2024

Revision Record

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Table of Contents

Basis of Report ..... **i**
Acronyms and Abbreviations ..... **iii**
1.0 Introduction **1**
2.0 Site Walkover Findings **2**
3.0 Potential Impacts of Turbine T1 on Local Drainage and Water Quality **4**
3.1 Foundation Excavation 4
3.2 Concrete Handling and Accidental Spillage 4
3.3 Storm Water and Groundwater Inflow 5
4.0 Mitigation Measures **6**
4.1 Foundation Excavations 6
4.2 Concrete Handling 6
4.3 Water Management 6
5.0 Monitoring **9**
6.0 Closure **10**

Tables in Text

Table 5-1 Surface Water Quality Monitoring Parameters 9

Figures in Text

Figure 1-1 Site Context 1
Figure 2-1 Identified Hydrological Features 2
Figure 2-2 Surface Water Runoff Around Proposed Turbine T1 Location 3
Figure 3-1 Turbine Foundation 4
Figure 4-1 Proposed Drainage Mitigation Measures 8

Appendices

Appendix A Site Visit Photos

Acronyms and Abbreviations

1D	One Dimensional (modelling)
2D	Two Dimensional (modelling)
AEP	Annual Exceedance Probability
CFRAM Study	Catchment Flood Risk and Management Study
DEM	Digital Elevation Model
DTM	Digital Terrain Model
DS	Downstream
FRA	Flood Risk Assessment
FSU	Flood Study Update
GIS	Geographical Information System
GSI	Geological Survey of Ireland
HEFS	High-End Future Scenario
LA	Local Authority
LiDAR	Light detection and ranging
mOD	Meters above Ordnance Datum (Malin)
MRFS	Mid- range future scenario
NIFM	National Indicative Fluvial Mapping
OPW	Office of Public Works
OSi	Ordnance Survey Ireland
PFRA	Preliminary Flood Risk Assessment
SFRA	Strategic Flood Risk Assessment
SSFRA	Site Specific Flood Risk Assessment
SuDS	Sustainable Drainage Systems
US	Upstream

1.0 Introduction

SLR Consulting (SLR) has been appointed by Statkraft to assess the surface water drainage on the lands surrounding the proposed Turbine T1 at Knockanarragh. The proposed turbine is located in the proximity of the Killacroy Stream and Annex 1 area, as shown on Figure 1-1 below.

The site is located within the catchment of the Boyne (ID 07). The Darcy Crossroads Stream runs along the north-western boundary of the site. The Killacroy Stream runs along the northern boundary in the east-west direction where it ultimately joins the Darcy Crossroad Stream. Approximately 1.8 km south-west of the confluence, the Darcy Crossroad Stream flows into the River Stonyford. The subject streams form a part of the River Boyne and River Blackwater Special Area of Conservation (SAC) (Code 002299).

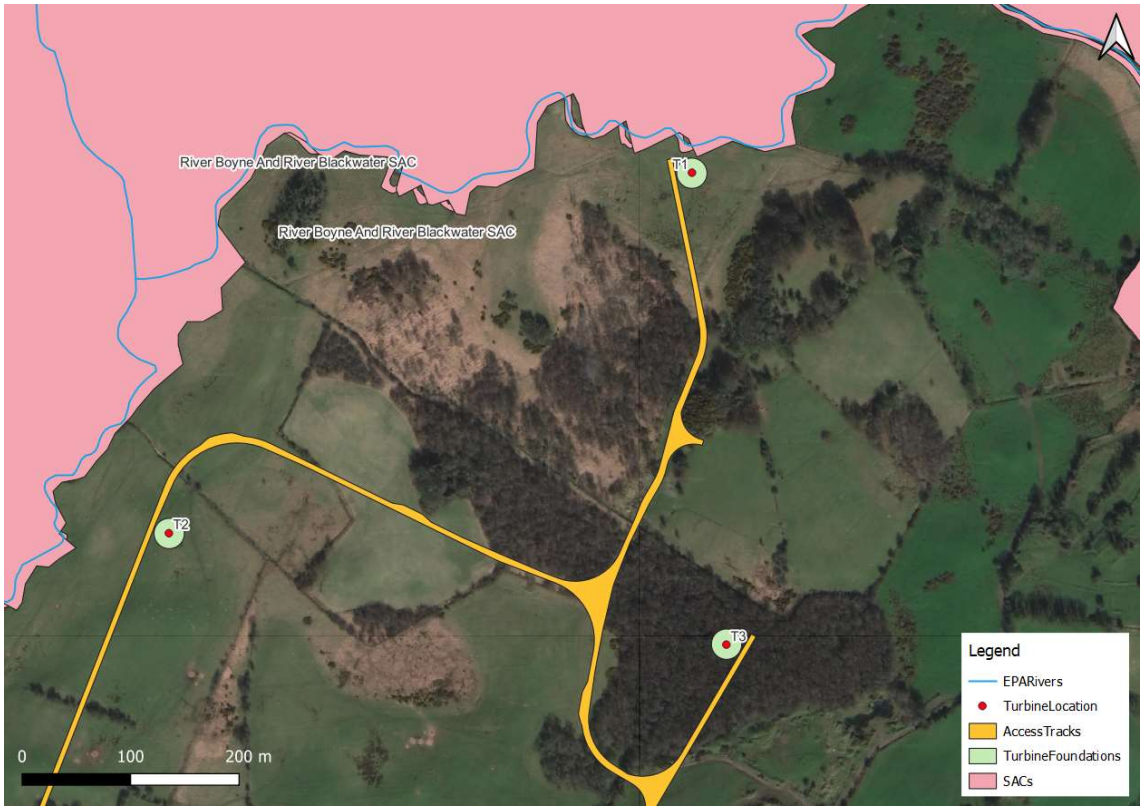
The River Stonyford flows in the south-east direction for approximately 19 km where it joins the River Boyne.

The key objective of this exercise is to determine hydrological connectivity of open drains within the survey area, in particular any drainage features with connectivity to the Annex 1 area.

The purpose of the report is to carry out a baseline drainage survey in the vicinity of proposed location for Turbine T1 (T1) to assess whether there will be any changes in drainage during the construction of T1 which could impact on the drainage to the nearby Annex 1 Habitat areas, and River Boyne and River Blackwater SAC (Code 002299).

The report also outlines protective mitigation measures for nearby surface watercourses and the SAC, which will prevent any deterioration in water quality arising from the proposed development at T1.

Figure 1-1 Site Context



The findings from the site report will feed into the Surface water management plan, Environmental Impact Assessment Report (EIAR) and development of the CEMP. A walkover survey of the surface water drainage at the site was undertaken and photographs of the site taken during the walkover are provided in Appendix A.

2.0 Site Walkover Findings

A detailed site walkover and drainage survey has been carried out in January 2023. The recorded natural and artificial drains around the wider area of turbine T1 are shown on Figure 2 1 below with the proposed site infrastructure in this area.

The Killacroy Stream is located 25 m north of the centre point of T1. The stream flows in the western direction some 550 m where it joins the Darcy Crossroad Stream.

The proposed wind farm access road layout crosses a number of identified existing drains in the vicinity if T1, T2 and T3.

During the site walkover a manmade ditch was identified approximately 90 m to the west of T1. This drain was filled up with a standing water (i.e. no flow in the ditch was observed) water and no connectivity with the Killacroy Stream could be identified.

The lands around T1 slope gently slope towards the Killacroy Stream and this will be the natural drainage direction in this area, toward the stream. No significant ponded areas were identified at the site during the walkover.

Figure 2-1 Identified Hydrological Features

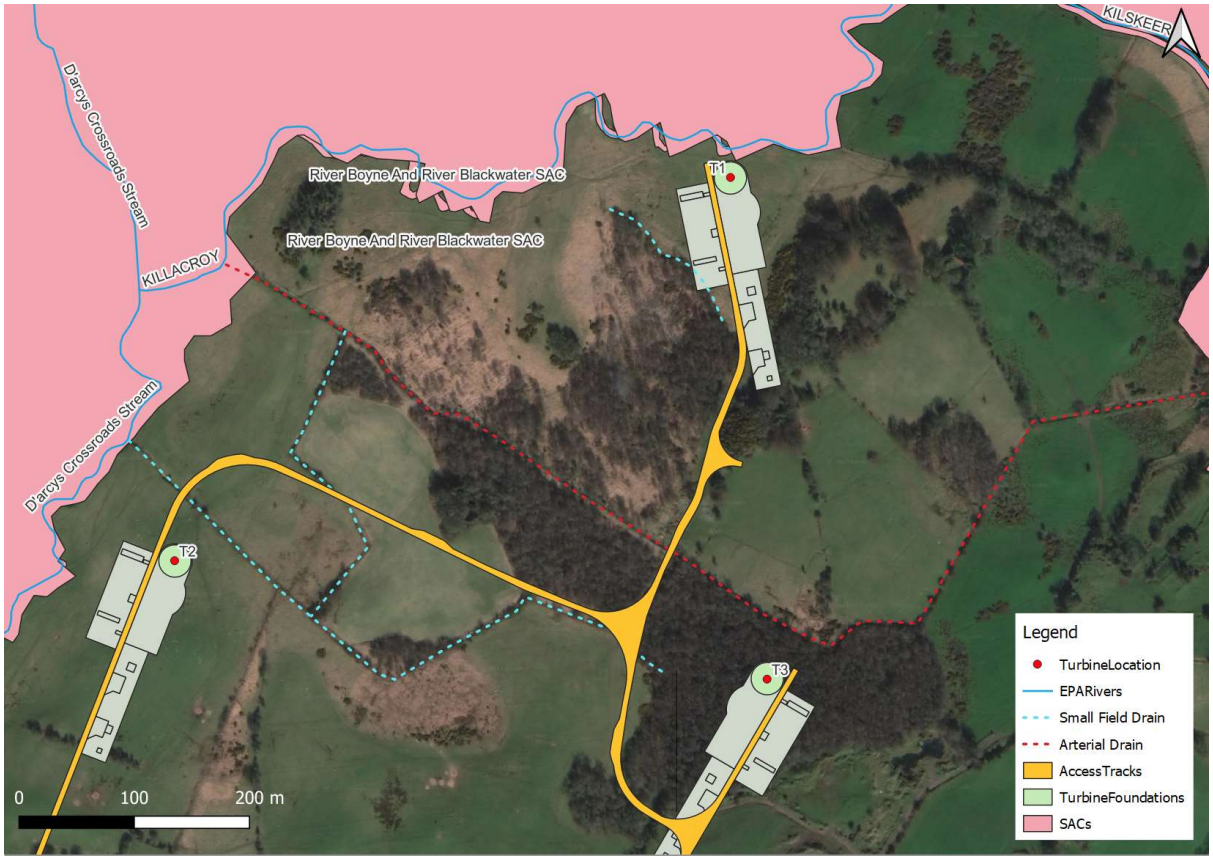
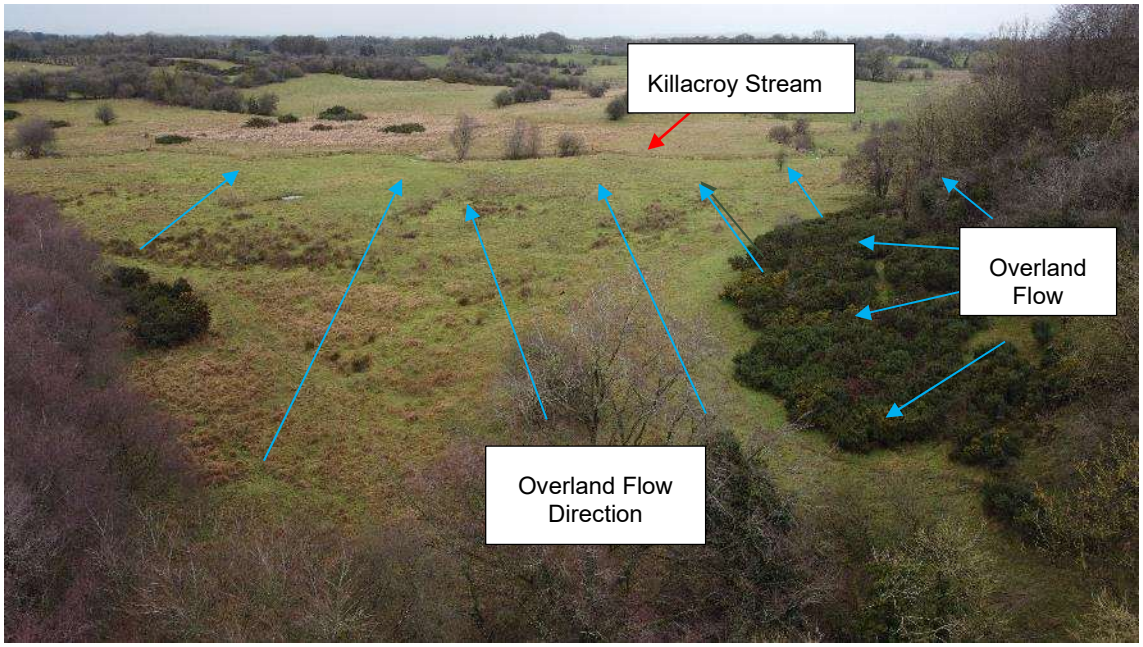


Figure 2-2 shows the lands at Turbine T1 with the overland surface runoff flow direction shown.

Figure 2-2 Surface Water Runoff Around Proposed Turbine T1 Location



3.0 Potential Impacts of Turbine T1 on Local Drainage and Water Quality

This section lists potential significant impacts related to the construction of turbine T1. Recommended mitigation measures are detailed in Section 2.2. The principal identified impacts centre around the required excavations for the turbine foundation, the handling of concrete product at the site and accidental spillages, and also the management of storm surface water at the site.

The surface runoff at the River Boyne and River Blackwater SAC will not be impacted by the proposed development because there will be no construction activities in this specific area. The existing drainage patterns will remain the same within the SAC.

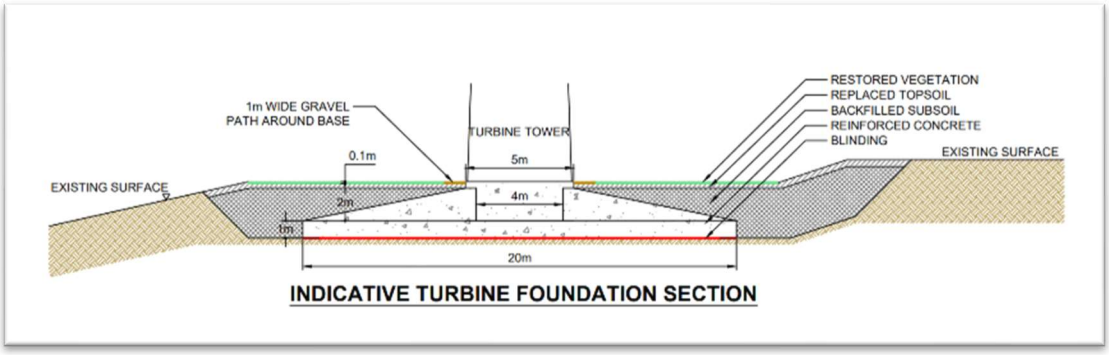
It is proposed to implement specific drainage measures at the proposed turbine T1, which will be located outside of the SAC, that will allow water from the construction area to be processed before it is discharged from the settlement ponds via a diffused outfall. This will allow water to disperse locally and preserve the pre-construction surface runoff pattern.

This is furthered details in the following sections.

3.1 Foundation Excavation

The centre point of turbine T1 is 25 m from the stream. The turbine foundation, as shown on Figure 3-1, is 4 m deep and 28 m in diameter; the foundation excavations required for the base will require an additional area for working to construct the foundations. The additional supplementary area required to be excavated would extend beyond the foundation footprint for T1. There will be no construction activities within the SAC.

Figure 3-1 Turbine Foundation



Excavation and plant movement in close proximity to a river channel have the potential to result in the destabilisation of river banks and cause soil erosion into the watercourse.

If water ingresses from the stream and ground to the excavation area for T1 foundation, then there would be a potential issue with slope stability in the excavated area and dewatering may be required also to allow for construction.

3.2 Concrete Handling and Accidental Spillage

The pouring of concrete near streams requires careful planning and execution to ensure that the surrounding environment is protected from any potential harm. One of the primary concerns when pouring concrete near streams is the potential impact on the ecosystem in the case of a fugitive release; cement based products are highly alkaline and corrosive and can have negative impacts on water quality, in addition any concrete spills may generate very fine, highly alkaline silt that can damage aquatic life.

The entry of cement-based products into the site drainage system, into surface water runoff, and hence to surface watercourse or directly into watercourse represents a risk to the local aquatic environment. Wet concrete and washout of transport and placement machinery are the activities most likely to generate a risk of cement-based pollution to adjoining watercourses.

Excavating near a stream can also result in water infiltration, which can be problematic for the stability of the excavation. If water is allowed to enter the excavation, it can destabilize the soil and cause a collapse.

A detailed flood risk assessment (FRA) has been undertaken for the site. The FRA report is included with this EIAR. The FRA indicated that the area around Turbine T1 is within Flood Zone A and Flood Zone B. Fluvial flooding from the stream could cause the excavation to fill with water and damage equipment and cause delays in the project timeline.

Excavation works close to a stream are often subject to strict regulation and permitting requirements. It is important to liaise with the Office of Public Works (OPW) to receive their opinion on the matter.

3.3 Storm Water and Groundwater Inflow

Any storm water or groundwater inflow to the turbine foundation excavation will need to be managed, treated and discharged. This water is likely to contain suspended solids from the excavation and will need to be treated prior to discharge to local drains and/or the nearby stream. The discharge of suspended solids in water is likely to have an adverse impact on local surface water quality.

4.0 Mitigation Measures

4.1 Foundation Excavations

Given the proximity of the proposed T1 to the stream channel and requirements for foundation excavation then plant and machinery will be operation in close proximity to the channel bank for the stream. A detailed Construction Environmental Management Plan (CEMP) including excavation works will be required for any construction at this location.

4.2 Concrete Handling

Given the proximity of the proposed T1 to the stream channel and requirements for foundation construction then concrete will be poured close to the stream channel. A detailed CEMP must include the handling of concrete for construction at this location.

4.3 Water Management

Surface water runoff attenuation and drainage management are key elements in terms of mitigation against any potential impacts on surface water bodies and water quality.

Two distinct methods should be employed in the management of construction surface water runoff. The first method involves keeping clean water clean by avoiding disturbance to natural drainage features, minimising any works in or around drainage features, and diverting clean surface water flow around excavations and construction areas.

The second method involves collecting any drainage water from works areas within the site that might carry silt or sediment, and to route them towards settlement ponds for treatment to remove suspended solids prior to controlled diffuse release over vegetated natural surfaces. There should be no direct discharge to surface water.

The following mitigation measures are recommended to protect surface water quality:

i. Clean water is separated from ‘dirty’ water utilising interceptor drains. The interceptor drains should be installed on the upslope side of the construction area. This would reduce the amount of water from the construction area that will need to be treated before it can be safely discharged into the environment. Collected clean water would be carried under wind farm infrastructures by cross drains at regular intervals to ensure the original hillside flow is not impeded.

ii. The proposed access tracks should be constructed from a permeable material to allow the majority of storm water runoff to infiltrate underground. Any excess water should drain into the swales, which would be connected, during the construction stage, to the settlement ponds. The settlement pond should have a diffuse outfall which would disperse the flow across the site. On completion of the works the settlement ponds should be filled in and the swales should be connected to a diffuse outfall.

iii. The proposed access roads and associated drainage infrastructure should follow the local ground gradient as much as possible. This will reduce velocities within the swales, and consequently erosion.

iv. The settlement ponds should be designed in the accordance with CIRIA C648. The volume of a settlement pond is determined by the area draining into it. Any upslope runoff from site would be diverted from ponds. This is achieved by interceptor drains as discussed above.

v. Suspended solids will settle out only when the water is still. It is necessary to retain the water in the settlement pond for several hours to allow the suspended solids to

settle out. Retention time depends on the particle size, disturbance of the water, depth of water, temperature and particle density. Appropriate retention time should be applied for designing the ponds as suggested in CIRIA C648.

vi. CIRIA C648 recommends designing the outfall from the ponds to accommodate a 1 in 10 years storm event. The settlement ponds should be up to 1.5m deep.

vii. Drainage and settlement pond details including sizing should be included in a site Surface Water Management Plan.

The proposed drainage plan is shown on Figure 4-1 which is based on the methodology detailed above. Surface runoff to the east of the proposed road is intercepted by a drain and dispersed to the east of the turbine. Water from construction area, including from the turbine foundation excavation, should be collected by a swale which connects to a settlement pond for treatment.

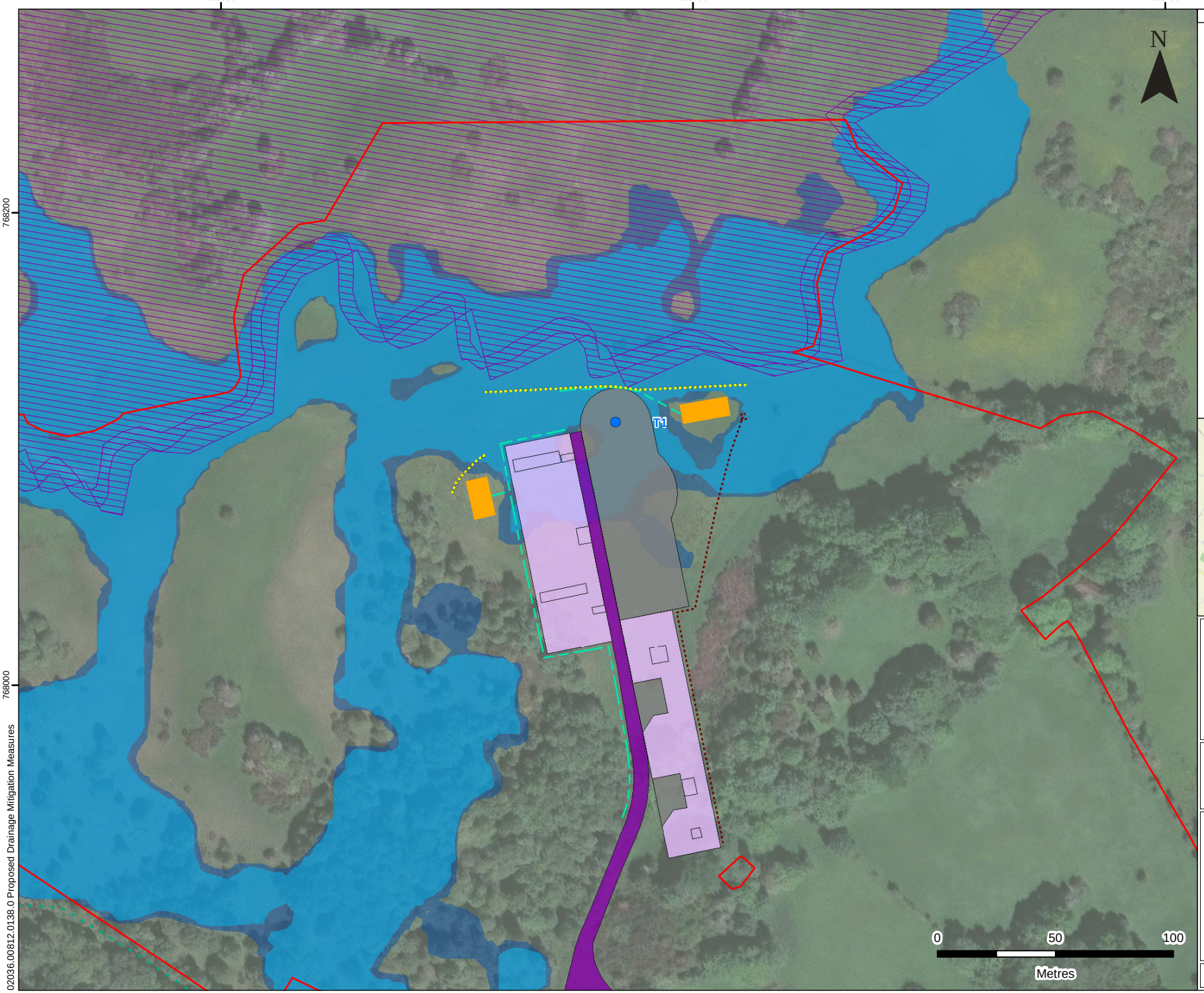
The clean treated water from the settlement ponds will be discharged from the ponds via a diffused outfall (e.g. weir). This will allow water to disperse locally and preserve the pre-construction surface runoff pattern. The settlement ponds will be installed above the ground level with the top 300 mm of topsoil being stripped off and retained for restoration. Installing above ground level settlement ponds will prevent any flushing of the settled particles into the stream in the event of fluvial flooding at the site. Water from the turbine excavation and storm water runoff will be pumped into the settlement pond.

In addition to the settlement lagoons silt buster type treatment technology for suspended solids may be used on the site to treat runoff water before it goes to the stream.

Along the Killacroy Stream it is recommended to install a silt fencing to prevent fugitive silt material in runoff around the site from entering the SAC and stream. An additional measure to enhance this would be to install straw bales for protection measures, if required at the site.

There should be no machinery located between excavation area and riverbank during construction works.

All mitigation measures for T1 should be included in a site-specific CEMP for construction at this location due to the proximity to the Killacroy Stream.

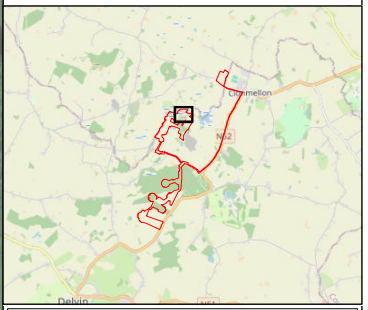


LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Location
- Proposed Access Track

Proposed Crane Hardstanding

- Permanent
- Temporary
- Swale
- Arterial Drain
- Interceptor Drain
- Silt Fencing
- Settlement Pond
- Flood Zone A
- Flood Zone B
- Special Area of Conservation (SAC)



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KNOCKANARRAGH WIND FARM ENVIRONMENTAL IMPACT ASSESSMENT REPORT

DRAINAGE REPORT FOR TURBINE T1 AREA

PROPOSED DRAINAGE MITIGATION MEASURES

FIGURE 4-1

Scale	Date
1:1,500 @ A3	MARCH 2024

02036.00812.0138.0 Proposed Drainage Mitigation Measures

5.0 Monitoring

During the construction phase the quality of water in the Killacroy Stream should be monitored on a regular basis before during and after construction at T1 to determine if the mitigation measures are working and if any remedial measures are required during the construction period.

A water quality monitoring programme will need to be established to ensure that water quality is maintained throughout the construction phase. This programme will ensure that designed measures including settlement ponds are working, existing water quality maintained, and also to determine if additional remedial mitigation measures are required to protect the local water quality.

An Ecology Clerk of Work (ECoW) should be on-site during construction to monitor water quality. Turbidity meters should be installed prior to construction upstream and downstream of the site. Levels of turbidity should be monitored approximately one to two weeks prior to construction at turbine T1 to determine pre-construction levels in the waterbodies. A visual check of turbidity of watercourses should be carried out daily during construction. Should the turbidity levels measured during construction be higher than the existing levels or daily visual inspection show high level of turbidity, construction should be stopped, and remediation measures should be put in place immediately. A management procedure should be prepared for such events.

Surface water quality samples from the Killacroy Stream should be taken on a weekly basis during construction works and should include measurement of the parameters provided in Table 5-1 below.

Table 5-1 Surface Water Quality Monitoring Parameters

Parameter	Water Quality Assessment Criteria
Turbidity	No change from baseline
pH (pH Units)	6.0 < pH < 9.0 *
BOD (mg/l)	High Status < 1.3 (mean) *
Total Suspended Solids (mg/l)	<25
Total Ammonia (mg/l N)	High Status < 0.04 (mean) *
* Ph, BOD and Total Ammonia assessment criteria are from the Surface Water Regs.	

6.0 Closure

This report has been prepared by SLR Environmental Consulting (Ireland) Ltd. with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

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Appendix A Site Visit Photos

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Plate 1 Wider Area of Turbine T1

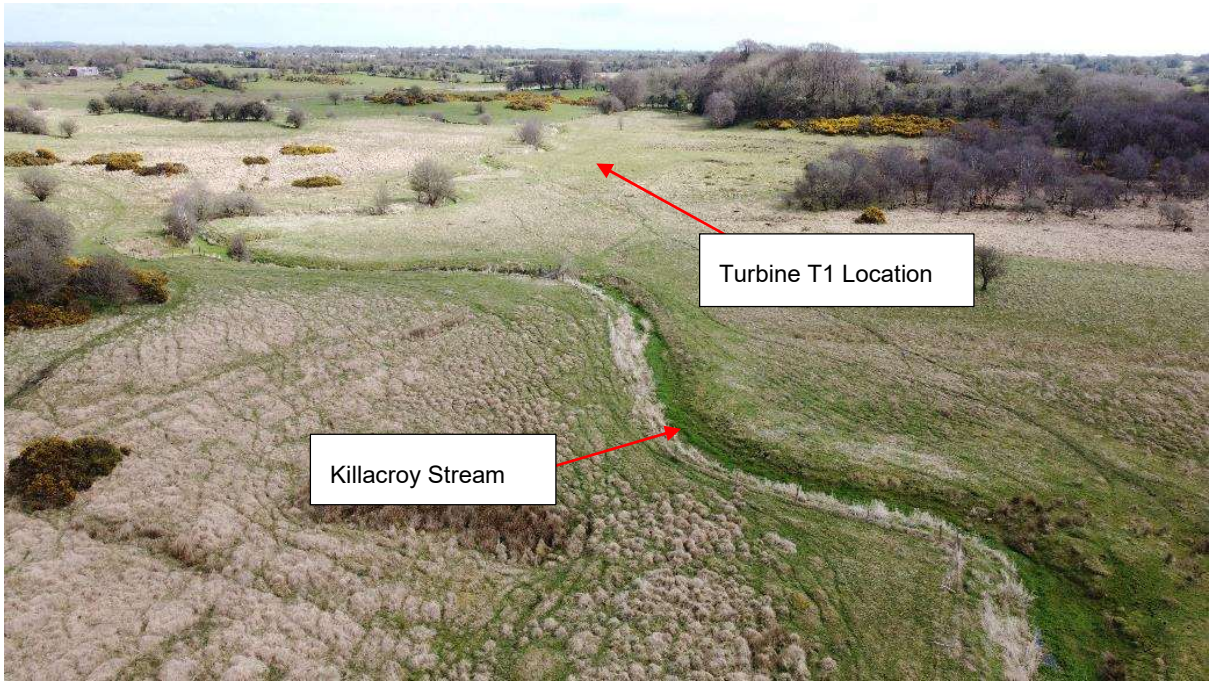


Plate 2 Trees at Annex 1

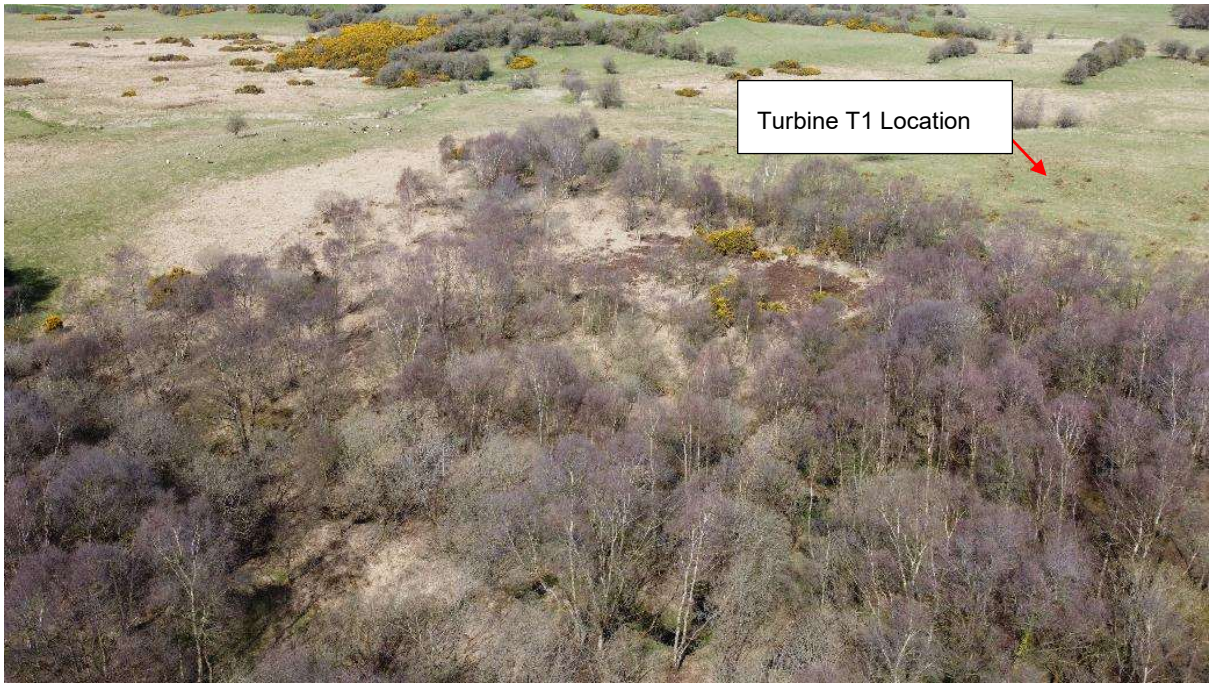
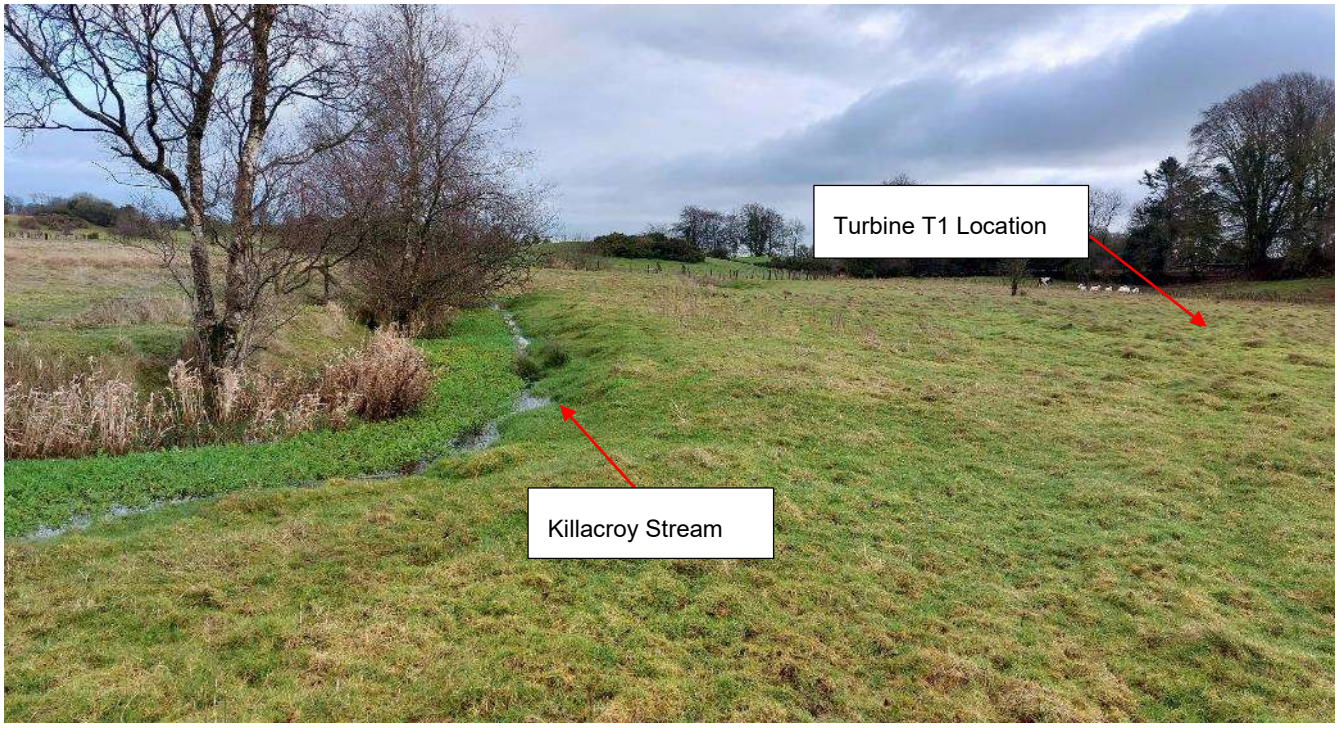
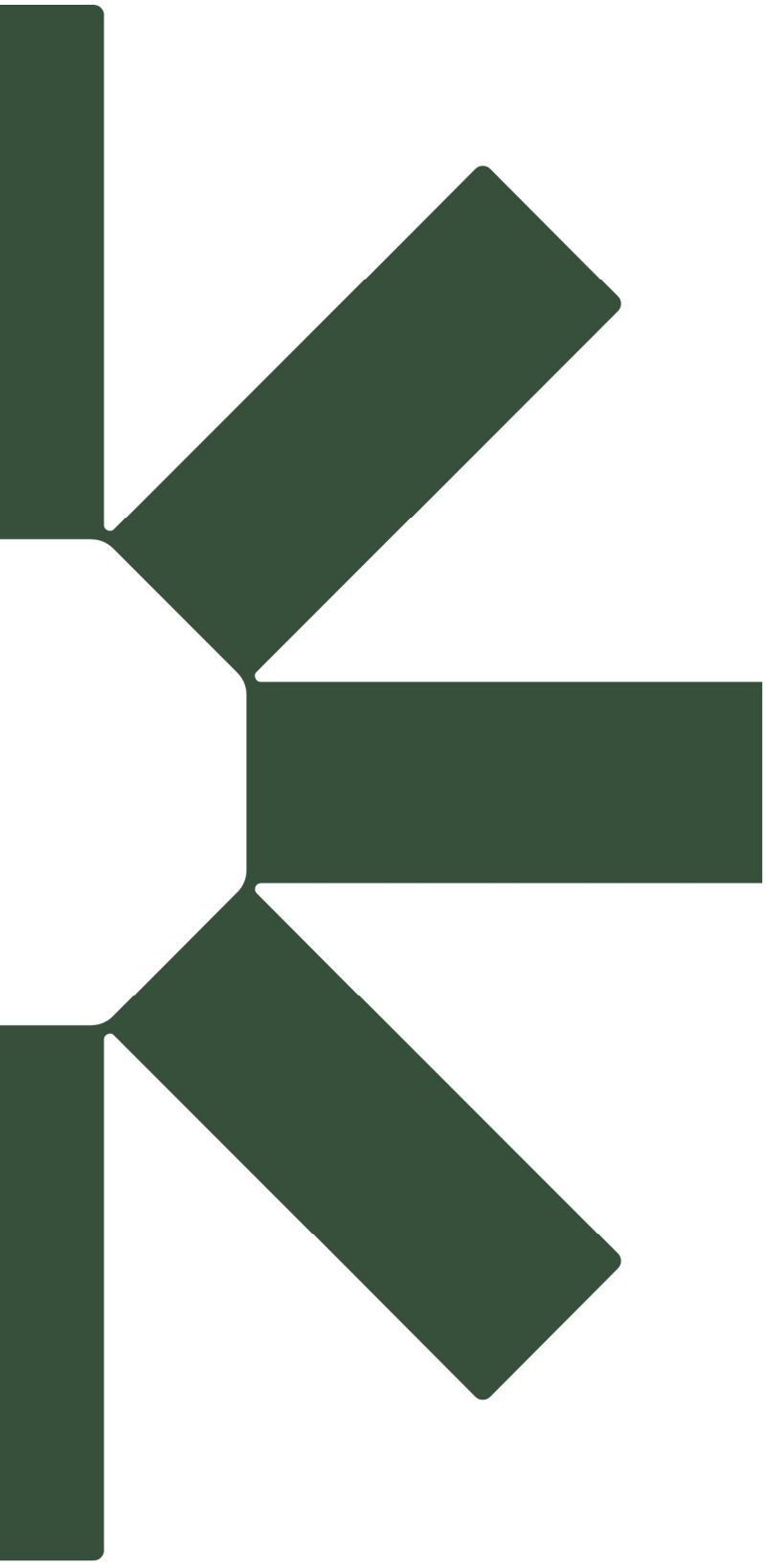


Plate 3 Field at Turbine T1

Plate 4 Killacroy Stream





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