Water Quality Monitoring and Response Plan

Cummeennabuddoge Wind Farm

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MAPPING

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1 INTRODUCTION

1.1 Terms of Reference

FuturEnergy Ireland via its lead consultant has appointed McCloy Consulting Ltd to prepare a Water Quality Monitoring and Response Plan (WQMRP) to support a planning application for the proposed Cummeennabuddoge Wind Farm development (hereafter referred to as the 'Proposed Development').

1.2 Purpose

The purpose of the WQMRP is to expand on mitigation proposed in the associated Environmental Impact Assessment Report (EIAR) submitted in support of the planning application, and to provide sufficient additional detail such that the planning authority and stakeholders can satisfy themselves that the mitigation proposed is robust and implementable and will be successful in its intended outcome.

The plan sets out the proposed methods to monitor water quality prior to any development in order to expand on the existing baseline dataset, and monitoring during subsequent phases of the Proposed Development (i.e. construction (including forestry felling), operation, and decommissioning).

A water quality monitoring program will be implemented to monitor effects to the hydrological regime and water quality during the aforementioned phases of the wind farm in order to:

- Provide early indication of potential deterioration of water quality that may be attributable to on- site works as to initiate any necessary response measures prior to the deterioration causing an adverse environmental effect;
- Demonstrate that the mitigation measures and construction-phase surface water management plan is performing as designed;
- Provide validation that the in-place mitigation measures are not having an adverse effect upon the environment; and
- Indicate the need for additional mitigation measures to prevent, reduce or remove any adverse effects on the water environment.

Water monitoring will consist of physicochemical monitoring. The extent, duration and frequency of the monitoring will be proportionate to the type and level of activity, and perceived risks.

1.3 Roles and Responsibilities

1.3.1 Applicant / Developer

The Applicant / Developer is responsible for pollution prevention during pre-construction felling, and construction phases of the Proposed Development. Therefore, the Applicant / Developer will appoint an appropriately competent person or persons (e.g., Environmental Site Manager, Environmental Consultant(s), or Environmental Clerk of Works (ECoW)) with specific hydrology and water quality experience to undertake relevant environmental tasks for the Proposed Development (including this WQMRP) during these phases.

1.3.2 Environmental Consultant

Water quality monitoring shall be supervised by a suitably qualified Environmental Consultant / ECoW with specific hydrology and water quality experience, appointed by the Applicant / Developer, during all phases of the Proposed Development.

Monitoring during the construction phase (which includes pre-construction felling) will include continuous monitoring using deployed autonomous sondes (equipped with telemetry and cloud-upload capabilities). The Environmental Consultant / ECoW shall monitor trends in specified water quality parameters (refer to **section 4**) and be responsible for initiating the response plan (i.e., cessation of works) in the event that water quality threshold levels are exceeded ('trigger thresholds' – refer to **Section 4.1**).

This shall be supplemented by discrete monitoring comprising grab / spot sample collection for laboratory analysis in a UKAS / INAB accredited laboratory and use of hand-held meters to provide supplementary in-situ readings, and visual observations. The Environmental Consultant / ECoW shall review data from in-situ readings and lab analysis, and report immediately any anomalous results to the Applicant / Developer.

Monitoring is proposed to continue for a 12-month period of the operational phase after commissioning of the Proposed Development. During that part of the operational phase, the Environmental Consultant / ECoW shall review data from in-situ readings and laboratory analysis, and report immediately any anomalous results to the Applicant / Developer.

During the decommissioning phase, monitoring would be as a minimum as per the construction phase (to include pre-decommissioning, decommissioning and post-decommissioning monitoring), or updated to reflect local authority and stakeholder requirements given potential for variation in those requirements across the 35-year operational lifespan.

All water quality analysis undertaken by the Environmental Consultant / ECoW must be recorded and reported such that findings can be reviewed and audited as necessary by the stakeholders and regulators if requested.

1.4 Aims and Objectives

In order to quantify any impact of the Proposed Development on the water environment and / or other identified sensitive receptors, it is necessary to establish baseline (pre-construction) trends in water quality and to continue monitoring trends throughout the pre-construction felling and construction phases of the Proposed Development.

Site-specific baseline water quality sampling has been undertaken as part of the pre-application process for the Proposed Development to provide a point of comparison and highlight any potential pre-existing pressures (refer to **section 2.2** of this report and **EIA Chapter 11: Hydrology, Water Quality and Flood Risk** for further detail) and shall recommence a minimum of one year prior to the commencement of pre-construction felling.

The subsequent phases of monitoring will help identify changes that may occur in the water environment as a result of the Proposed Development which will include:

- Pre-construction felling: increased mobilisation and transportation via surface water runoff of dissolved and / or sediment-bound nutrients / fertilisers (phosphate and nitrogen) from the disturbed soils into the wider water environment identified as a key pressure to downstream receptors (i.e., Lough Leane);
- Construction: increased mobilisation and transportation via surface water runoff of dissolved and / or sediment-bound nutrients / fertilisers (phosphate and nitrogen), mobilisation and transportation of sediments and silts, or accidental pollution;
- Operation: a 12-month period of monitoring in order to maintain pre- and post-development water quality records, and to validate that the constructed drainage systems / mitigation measures are operating as intended; and
- Decommissioning: mobilisation and transportation of sediments and silts, or accidental pollution.

Monitoring shall facilitate rapid response to offset any potential adverse impacts to sensitive receptors.

2 BACKGROUND INFORMATION

2.1 Application Site

The site is located approximately 20 km east / south-east of Killarney in County Kerry (ITM coordinates 520500, 583500). Parts of the north, east, and south of the Proposed Development site extents (hereafter referred to as the 'Site Boundary') are along the Kerry / Cork County border.

Context and location are shown Figure 2.1 and Figure 2.2, respectively, and on the drawings submitted in support of the application (see EIA **Figure: 1-1a: Site Location Plan**).

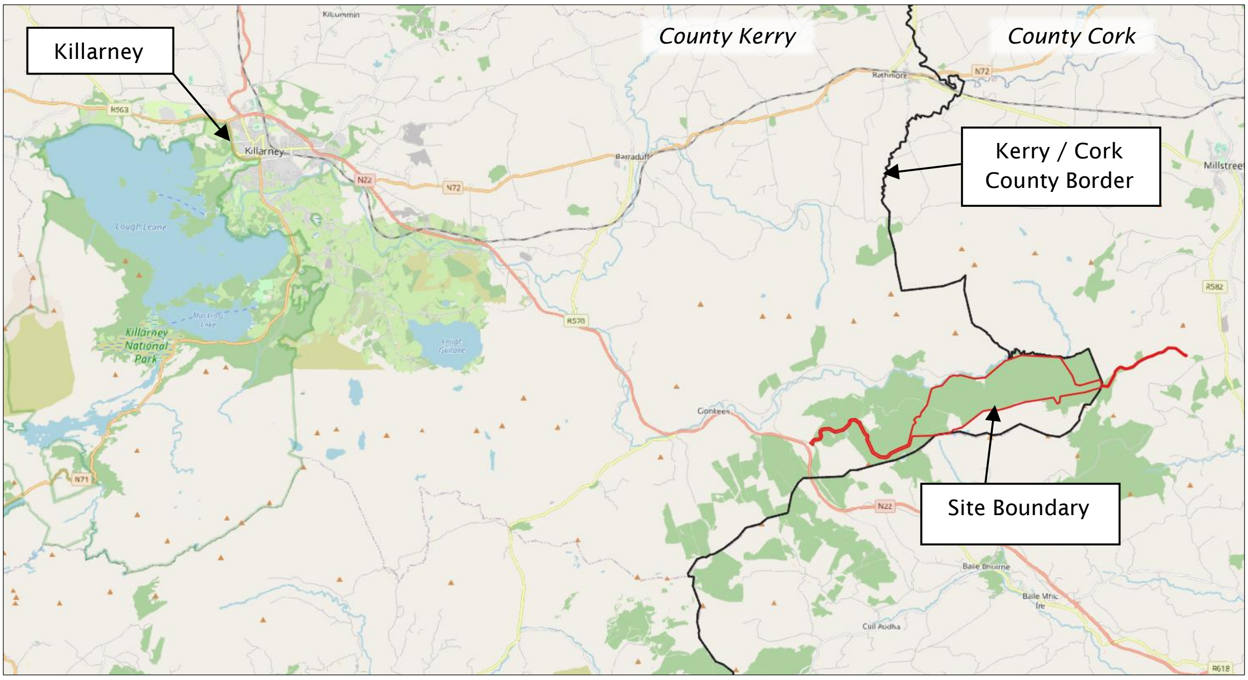


Figure 2.1 Location Context

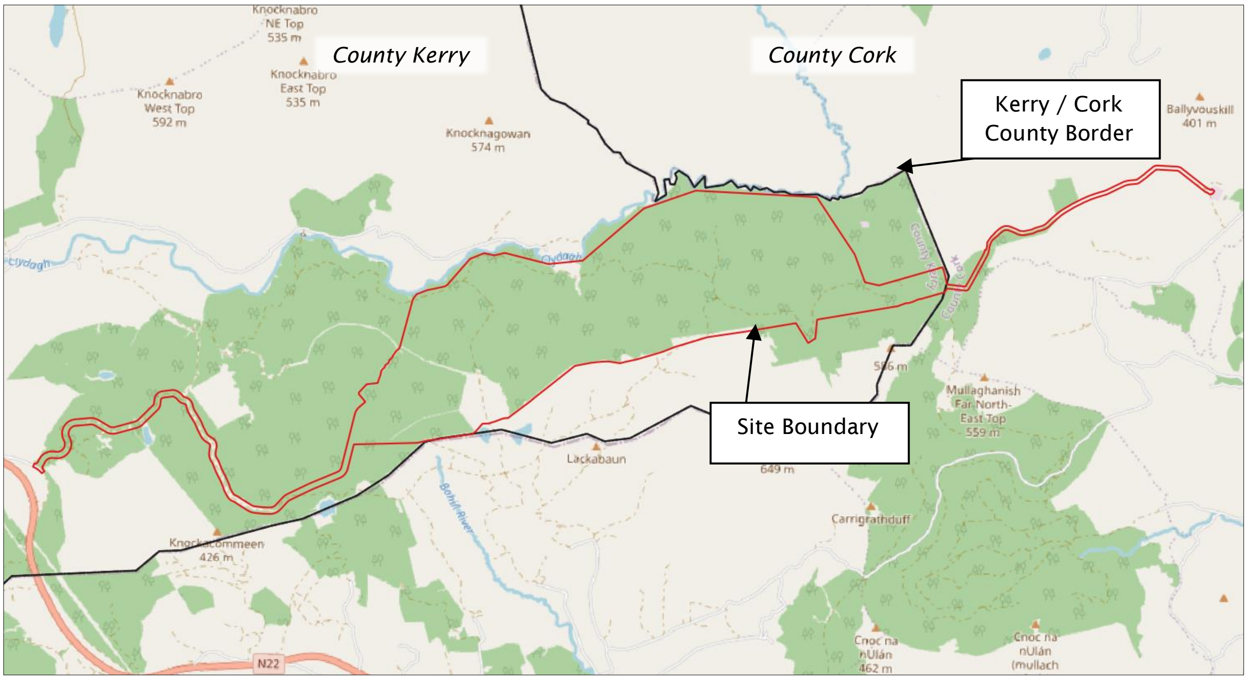


Figure 2.2: Site Location

2.1.1 Existing Land Use

The site lies within an existing forestry plantation owned and operated by Coillte. Site access is via an existing entrance in the west of the site, off a local road that is accessed from the N22 National Road. The existing entrance is currently used for the forestry operations.

2.1.2 Proposed Development

The Proposed Development is detailed in the accompanying Environmental Impact Assessment Report (EIAR) **Chapter 4: Description of Development**, but in summary comprises; the construction of 17 no. wind turbines and associated hardstand areas, an electrical substation, control building, electrical connections, met mast, upgraded tracks, permanent drainage features, peat repositories and borrow pits. Felling of existing woodland and additional temporary works will be required for construction.

2.1.3 Hydrological Setting

A review of Environmental Protection Agency (EPA) Rivers and Lakes has indicated that the WFD classified River Clydagh flows in a westerly direction along the northern site boundary. The River Clydagh is a tributary of the River Flesk which ultimately discharges into Lough Leane approximately 28 km downstream.

Several of the River Clydagh tributaries, including the Clydaghroe and Mullaghanish streams, flow through the Site Boundary. Given the steeply sloped nature of the site, these watercourses would tend to have steep gradients characteristic of upland streams.

The named watercourses within the Site Boundary vicinity of are shown in **Figure 2-3**. Further details on unnamed watercourses at, and downstream of, the Proposed Development site are described in EIAR **Chapter 11: Hydrology, Water Quality and Flood Risk**.

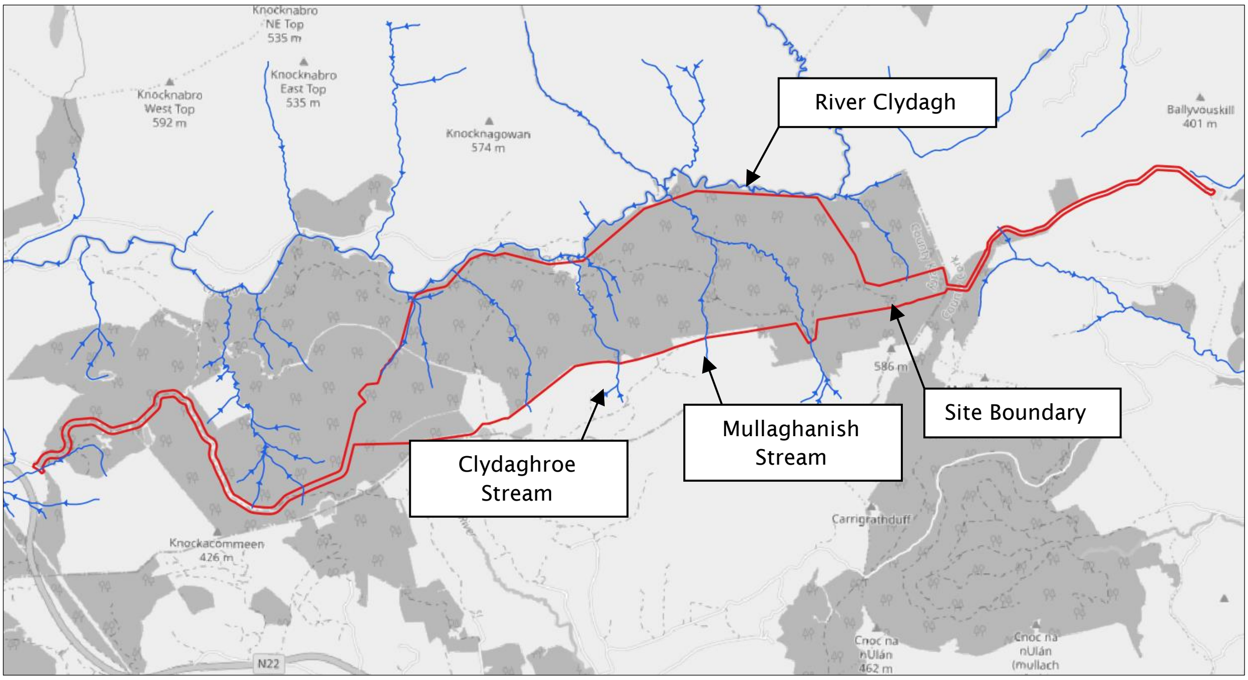


Figure 2-3 – Watercourses and Hydrological Setting

2.2 Baseline Water Quality Data

Site-specific independent water quality monitoring has been undertaken as part of EIA for the Proposed Development to provide baseline water quality standards of water features within, and downstream from, the Site Boundary prior to any development.

Results indicate that water quality for watercourses draining the Proposed Development site and in the wider River Flesk catchment is consistent with the WFD status assigned by the EPA for the downstream catchments (refer to **EIA Chapter 11** for further detail on WFD status of watercourses). Therefore, preservation of the baseline water quality results would be important at a local level to preserve the downstream WFD classifications.

Existing baseline monitoring locations are shown in **Figure 2-4** and **Figure 2-5** below and **Drawing WQMRP_02** and **WQMRP_03** in **Appendix A** of this report.

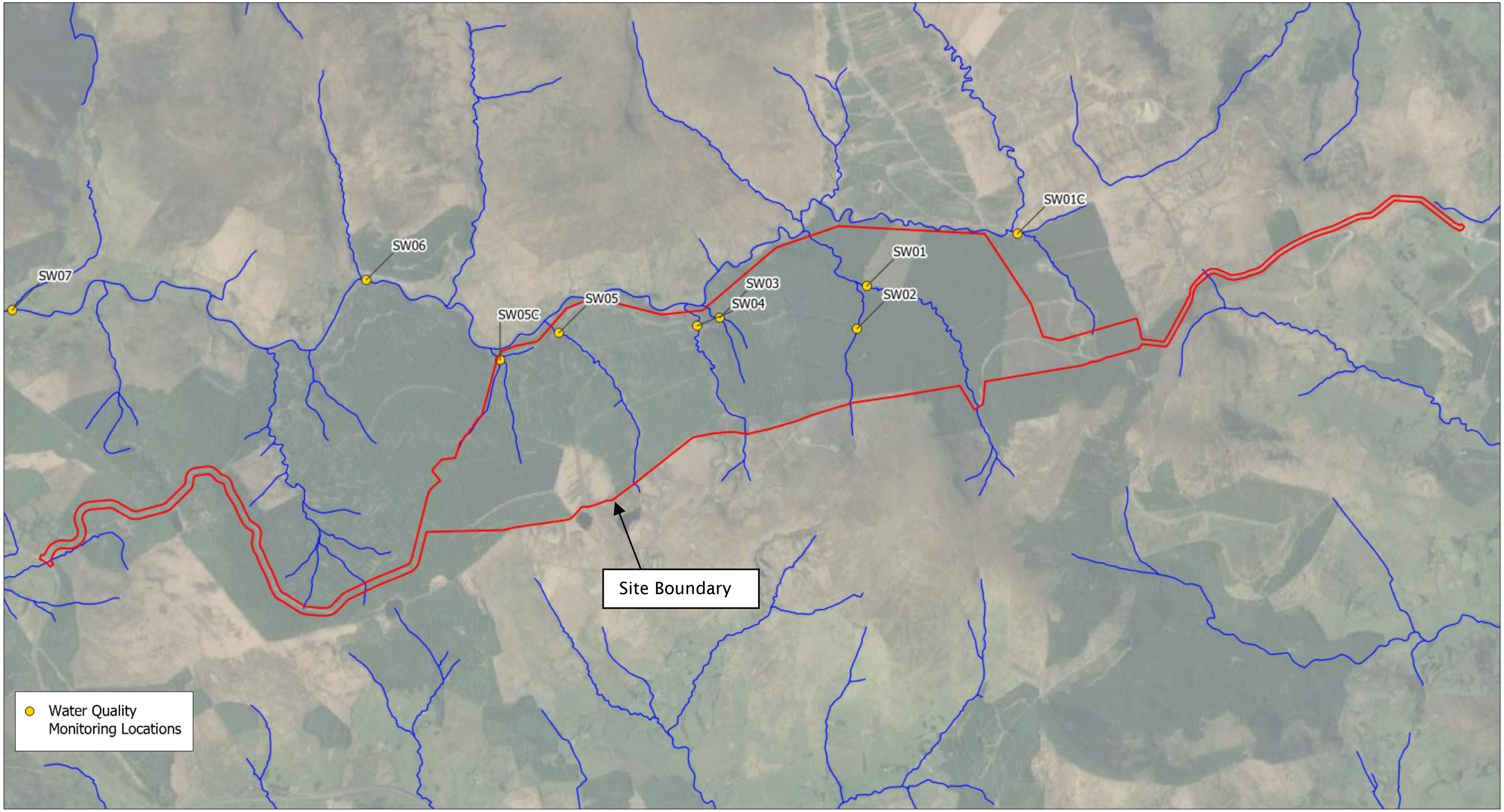


Figure 2-4 – Baseline Water Quality Monitoring Locations at the Proposed Development Site

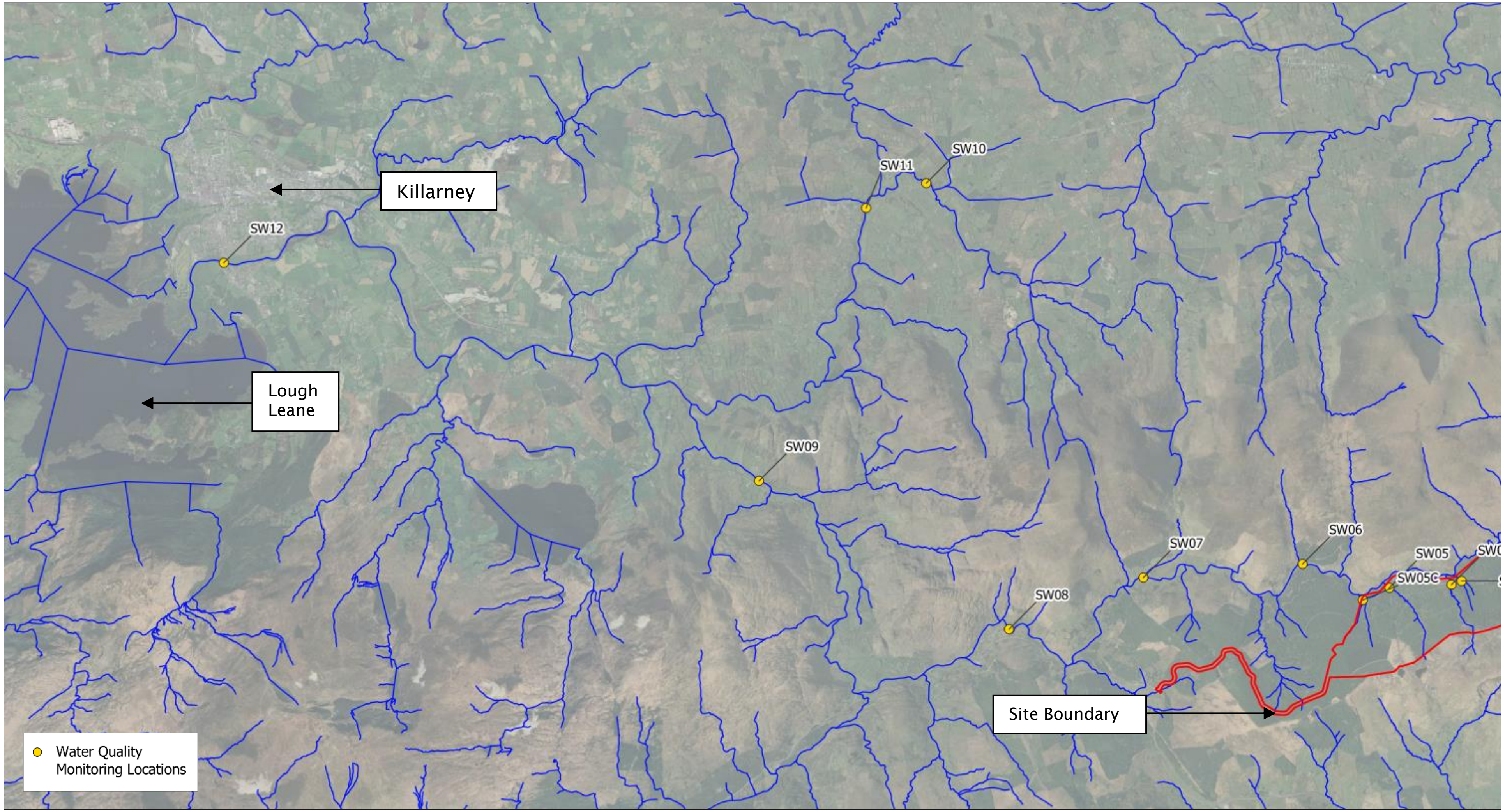


Figure 2-5 – Baseline Water Quality Monitoring Locations in Wider Lough Leane Catchment

3 APPROACH AND METHODS

The water quality sampling and analysis regime will consist of physico-chemical sampling techniques.

Water quality monitoring will be carried out at the following stages of the project:

- Baseline sampling (12 months prior to commencement of the construction phase (including felling)):
  - continuous monitoring via automated sonde with telemetry and cloud-upload capabilities (or similar capability to allow automated data capture in real time); and
  - nominally monthly via in-situ measurements and grab samples for lab analysis for approximately one year prior to pre-construction felling;
- Construction phase (including forestry felling) monitoring:
  - continuous monitoring via automated sonde with telemetry and cloud-upload capabilities; and
  - fortnightly in-situ measurements and grab samples for lab analysis;
- Operational phase monitoring (12 months post-completion of commissioning of the proposed development):
  - nominally monthly via in-situ measurements and grab samples for lab analysis for the monitoring period;
- Decommissioning phase:
  - the decommissioning phase poses similar risks to water quality in receiving watercourses (within and downstream of the Proposed Development) as during the construction phase. Notwithstanding changes in requirements by the planning authority, environmental regulators or stakeholders, decommissioning phase monitoring would comprise 6 months pre-decommissioning baseline monitoring, continuous and grab sample monitoring for the duration of decommissioning, and in-situ / grab sample monitoring for a 6-month period on completion of decommissioning.

Results from water quality sampling will be independently recorded and reported by the appointed Environmental Consultant. Reports will be made available to the local authority or related stakeholders if requested. Further testing and visual assessment may be carried out by the Developer to further augment the independent test regime proposed.

3.1 Pre-Development Baseline

Proposed continuous and discrete surface water monitoring locations for the pre-development baseline phase (12 months prior to commencement of felling) are detailed in **Table 3-1** and mapped at **Figure 3-1** and in high resolution on **Drawing WQMRP_01** in **Appendix A**.

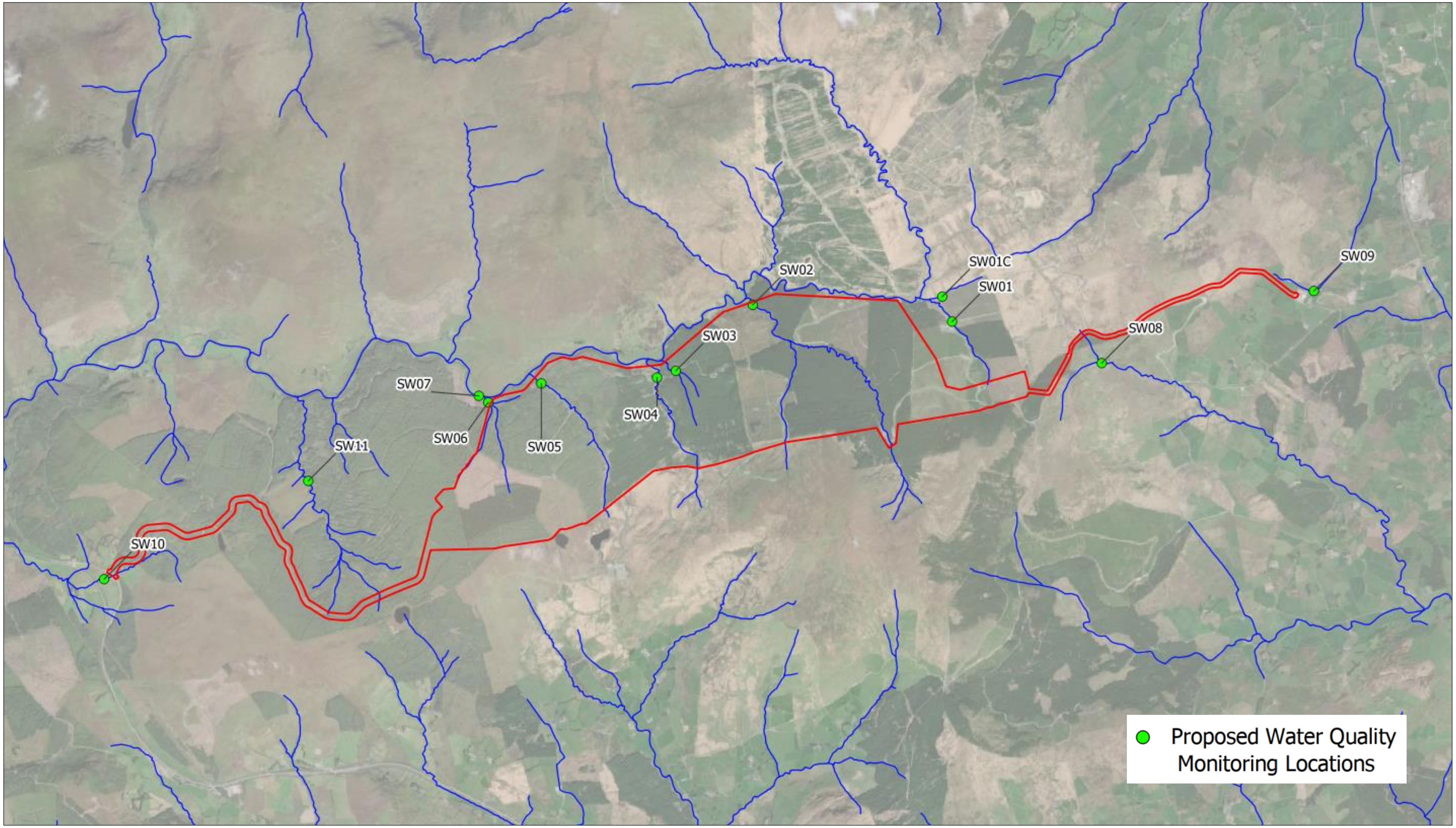


Figure 3-1 – Proposed Monitoring Locations

Surface water monitoring locations are positioned at strategic points on the River Clydagh. This watercourse ultimately receives runoff from the majority of the Proposed Development site and forms part of the Killarney National Park, Macgillycuddy's Reeks and Caragh River Catchment Special Area of Conservation (SAC).

Surface water monitoring locations are also positioned at strategic points in sub-catchments within the Site on watercourses crossed by, or running immediately adjacent to and downslope of, the Proposed Development. These watercourses receive run-off from the Proposed Development site and have the potential to be impacted during the construction phase. Monitoring points consider the locations of the substantial body of existing baseline monitoring data gathered to inform the design and assessment of the Proposed Development. The baseline data to be gathered shall be read and interpreted with the existing data as a single dataset when characterising baseline conditions.

Continuous monitoring probes measuring pH, Dissolved Oxygen (DO), Temperature (°C), Electrical Conductivity (EC) (µS/cm), Turbidity (NTU), Ammonium (NH_4) (mg/l), Nitrate (N) (mg/l N), and Dissolved (ortho-)phosphate (PO4-P) (mg/l) shall be installed on the River Clydagh at the upstream and downstream extent of the Proposed Development site.

During this phase of monitoring, in-situ measurements and grab samples for laboratory analysis shall also be gathered at all planned monitoring locations.

3.2 Construction Phase (Including Felling)

Continuous monitoring probes measuring pH, DO, Temperature, EC, and Turbidity, NH_4, N, and Phosphate shall be maintained on the River Clydagh at the upstream and downstream extent of the Proposed Development site, established during the pre-development baseline phase.

The downstream monitor shall measure water quality downstream of the catchment draining the felled areas / construction site to ensure specific water quality thresholds (trigger thresholds) are not exceeded (refer to **Section 4.1**) and will be used to monitor compliance with environmental quality standard thresholds. The upstream monitor shall be used as a Control to determine whether trends identified at the downstream monitoring location are potentially attributable to pre-existing pressures not attributable to the Proposed Development.

The monitoring locations proposed are a minimum scope and further locations may be proposed post-planning to allow for greater spatial control. Monitoring within the sub-catchments on watercourses crossed by, or running immediately adjacent to and downslope of, the Proposed Development, can be used to isolate observations to a smaller sub-catchment basis and allow refinement of any necessary adaptive response (i.e., work stoppages - refer to **Section 4.2**) to be initiated on a sub-catchment rather than a site-wide basis.

Grab samples for laboratory analysis and in-situ measurements with hand-held probes of parameters with potential to be affected by construction activities shall also be undertaken either at all monitoring locations or a rationalised number of locations sited downstream of the area where works are ongoing, where work is sufficiently localised to allow. Parameters to be monitored are set out in subsequent **Sections 3.5.2** and **3.5.3**.

As the Proposed Development will be constructed in a phased manner, unaffected sub-catchments (i.e., no on-going construction activities) may also be used as control points for adjacent catchments.

3.3 Operational Phase

Grab samples for laboratory analysis and in-situ measurements with hand-held probes shall be gathered for parameters tested during pre-construction phase to ensure water quality is consistent with baseline conditions and no adverse effects potentially attributable to the development are observed.

Monitoring shall be undertaken at locations consistent with pre-development baseline sampling. Parameters to be monitored are set out in subsequent **Sections 3.5.2** and **3.5.3**.

3.4 Decommissioning Phase

The decommissioning phase poses similar risks to water quality in receiving watercourses (within and downstream of the Proposed Development) as during the construction phase. Notwithstanding changes in requirements by the planning authority, environmental regulators or stakeholders, decommissioning phase monitoring would comprise 6 months pre-decommissioning baseline monitoring, continuous and grab sample monitoring for the duration of decommissioning, and in-situ / grab sample monitoring for a 6-month period on completion of decommissioning.

Table 3-1: Proposed Monitoring Locations

Location Ref	ITM	EPA River Sub-Basin	Watercourse (as per EIA Chapter 11)	Monitoring Type[1]	Rationale
SW01	522392, 584080	Flesk (Kerry) 010	River Clydagh Tributary – 1	CM, GS, IS	Downstream monitoring point within the Site Boundary. Drains easternmost section of the Proposed Development site where significant works are proposed. Located downstream from proposed substation, temporary compound and associated access track.
SW01C	522289, 584333	Flesk (Kerry) 010	River Clydagh	CM, GS, IS	Upstream control point adjacent to the Site Boundary, hydrologically discrete from the Proposed Development site.
SW02	520403, 584250	Flesk (Kerry) 010	Mullaghanish Stream	CM, GS, IS	Downstream monitoring point within the Site Boundary. Drains eastern section of the Proposed Development site. Can act as a control point for adjacent catchments during phased construction activities. Located in the downstream catchment / in the vicinity of turbines T3, T4, T6, T7 and T8, borrow pit, peat repository, and associated access tracks.
SW03	519634, 583590	Flesk (Kerry) 010	River Clydagh Tributary – 2	CM, GS, IS	Downstream monitoring point within the Site Boundary. Drains central section of the Proposed Development site. Can act as a control point for adjacent catchments during phased construction activities. Located in the downstream catchment / in the vicinity of turbines T6, T9, T10, temporary compound, borrow pit, and associated access tracks.
SW04	519447, 583517	Flesk (Kerry) 010	Clydaghroe Stream	CM, GS, IS	Downstream monitoring point within the Site Boundary. Drains central section of the Proposed Development site. Can act as a control point for adjacent catchments during phased construction activities. Located in the downstream catchment / in the vicinity of turbines T9, T11, and T12 and associated access tracks.

[1] CM = continuous monitoring using deployed autonomous sondes (equipped with telemetry and cloud-upload capabilities) GS = Grab sample (for chemical lab analysis); IS = In-situ (hand-held sonde to provide supplementary in-situ readings)

Location Ref	ITM	EPA River Sub-Basin	Watercourse (as per EIA Chapter 11)	Monitoring Type[1]	Rationale
SW05	518294, 583468	Flesk (Kerry) 020	River Clydagh Tributary – 3	CM, GS, IS	Downstream monitoring point within the Site Boundary. Drains western section of the Proposed Development site. Can act as a control point for adjacent catchments during phased construction activities. Located in the downstream catchment / in the vicinity of turbines T11, T13, T15, borrow pit, peat repository, and associated access tracks.
SW06	517763, 583277	Flesk (Kerry) 020	River Clydagh Tributary – 4 / Glashacormick	CM, GS, IS	Downstream monitoring point within the Site Boundary. Drains western section of the Proposed Development site. Can act as a control point for adjacent catchments during phased construction activities. Located in the downstream catchment / in the vicinity of turbines T14, T15, T16, T17, temporary compound, borrow pit, peat repository, and associated access tracks.
SW07	517669, 583343	Flesk (Kerry) 020	River Clydagh	CM, GS, IS	Downstream monitoring point located approx. 150 m downstream from the Site Boundary. Samples will determine cumulative trends in water quality downstream from the Proposed Development site.
SW08	515969, 582493	Flesk (Kerry) 020	River Clydagh Tributary – 6	CM, GS, IS	Downstream monitoring point located approx. 500 m east of the proposed access route. Located in the downstream catchment from the proposed site entrance access track.
SW09	513931, 581512	Flesk (Kerry) 030	River Clydagh Tributary – 8	CM, GS, IS	Downstream monitoring point located equidistant (approx. 80 m) between the site entrance and the N22 road. Located in the downstream catchment from approx. 2.6 km of access track.
SW10	523886, 583672	Garrane (Lee)_010	Foherish River Tributary – 1	CM, GS, IS	Downstream monitoring point located approx. 300 m downstream from the Site Boundary immediately downstream of the confluence of the two headwater channels that form Foherish River Tributary – 1. Located in the downstream catchment from the proposed 110kV grid connection route.
SW11	526001, 584386	Finnow (Blackwater)_010	Finnow River Tributary	CM, GS, IS	Downstream monitoring point located approx. 150 m downstream from the Site Boundary to the east of the Ballyvouskill Substation. Located in the downstream catchment from the proposed 110kV grid connection route.

3.5 Monitoring Specifications

Surface water monitoring will be carried out using continuous and discrete monitoring (in-situ readings and laboratory analysis) as set out in the following sections.

3.5.1 Continuous Monitoring

Continuous monitoring shall comprise the deployment of autonomous sondes at strategic monitoring points at the Proposed Development site. It is expected that sondes will be deployed and maintained from baseline through to completion of the construction phase monitoring.

Sondes shall be set to record water quality data at specified intervals (e.g., every 15 minutes). Data shall be uploaded via telemetry to the cloud or a similar system that allows real-time access and monitoring at specified agreed intervals (e.g., hourly).

Typical monitoring equipment shall comprise:

- Insitu Aquatroll with Rugged Dissolved Oxygen (RDO®) / Temperature / Conductivity Turbidity probes or equivalent.
- DropletSens™ Ammonium Probe or equivalent
- DropletSens™ Phosphate Probe or equivalent

Equipment shall be calibrated prior to installation, installed and maintained in accordance with manufacturers recommendations, with periodic recalibration and replacement of filters etc to suit those recommendations.

A warning system shall be implemented whereby exceedance of an agreed trigger threshold (refer to **Section 4.1)** shall notify the Site Environmental Manager / Environmental Consultant / ECoW to initiate a response plan i.e., cessation of felling or construction works.

3.5.2 Discrete Monitoring – In-Situ Analysis

Discrete monitoring during all phases shall comprise the use of hand-held probes to provide immediate in-situ readings for comparison against established trigger thresholds (refer to **Section 4.1**) and compare against the continuous monitoring data. The range of parameters suitable for in-situ field analysis is dictated primarily by the availability of suitable monitoring equipment.

The following details the requirements of sampling methodology used and site practice:

- The probes are to be immersed in the water until a steady reading is achieved;
- Visual assessments for deposited silt, discoloured water and oily sheens will also be carried out at each sample location; and
- Visual assessments shall be recorded, and results retained.

3.5.3 Discrete Monitoring – Laboratory Analysis

Discrete monitoring during all phases shall comprise sample collection for laboratory analysis in an INAB / UKAS (or similar) accredited laboratory and use of a hand-held meters to provide supplementary in-situ readings.

The monitoring will comprise samples obtained at periodic site visits for the collection of laboratory samples. The following details the requirements of sampling methodology used and site practice:

- Method statements and risk assessments are to be prepared and submitted by the appointed sampler for inspection by the Developer prior to collection of samples;
- All samples will be taken by a suitably trained scientist, engineer, or site staff member, who is familiar with standard sampling techniques, i.e., standard method “ISO 5667-7 Water Quality – Sampling – Guidance in Sampling Rivers and Streams”. Care should be taken to avoid disruption to the riverbed during sampling and samples must be taken facing upstream in order to avoid increased turbidity and suspended solids from disturbance caused by the sampler;
- Samples should be kept chilled at or below 4°C prior to delivery to the laboratory. All samples must reach the laboratory no later than 48 hours after the sample date;
- Visual assessments for deposited silt, discoloured water and oily sheens will also be carried out at each sample location. Visual assessments shall be recorded, and results retained;
- All bottle-ware etc. should be provided by the laboratory;
- Samples are to be accompanied with laboratory specific Chain of Custody documentation, which will provide details on the sample location. Chain of Custody

sheets will be retained for the duration of the Contract; and

- Analysis is to be carried out by a suitably accredited laboratory (INAB / UKAS or similar) only.

3.5.4 Sample Parameters

It is essential to monitor indicator parameters which have the greatest potential to be impacted during all phases of the Proposed Development. This must encompass parameters which have the potential to cause the greatest impact on any particularly sensitive receptors. The most prominent concerns are potential increases in siltation and release of P and N during the construction phase including felling.

Table 3-2 shows the suite of parameters that samples are to be tested / analysed during each phase of monitoring.

Table 3-2: Surface Water Quality Parameters

Continuous Monitoring (B,C)	
pH	Turbidity (NTU)
Dissolved Oxygen (DO)	Ammonium (NH_4) (mg/l)
Temperature (°C)	Nitrate (mg/l N)
Electrical Conductivity (µS/cm)	Dissolved (ortho-)phosphate (PO4-P) (mg/l)
Field Analysis (B,C,O,D)	
pH	Dissolved Oxygen (DO)
Temperature (°C)	Total Dissolved Solids
Turbidity (NTU)	Ammonium (NH_4)
Electrical Conductivity (µS/cm)	Nitrate
Laboratory Analysis (B,C,O,D)	
Alkalinity (mg/l $CaCO_3$)	Turbidity (NTU)
Molybdate Reactive Phosphorus (MRP) (mg/l P)	Nitrate (mg/l N)
Ammoniacal Nitrogen (mg/l NH_3) Ammonia	Nitrite (mg/l N)
Ammonium (NH_4)	Total Oxidized Nitrogen (TON) (mg/l N)
Biological Oxygen Demand (BOD) (mg/l)	Total Aluminium (mg/l Al)
Chemical Oxygen Demand (COD) (mg/l)	Total Iron (mg/l Fe)
Total Suspended Solids (TSS) (mg/l)	TPH (mg/l)
Phases: B = Baseline / Pre-Construction; C= Construction (including felling); O = Operational; and D = Decommissioning	

3.5.5 Visual Inspections

Quantitative monitoring will be aided by visual inspections during each sample collection. Visual observations shall be logged at each monitoring location. This will include:

- Weather observations;
- Flow rate / velocity;
- Relative water level / depth vs bank full conditions;
- Presence / absence of vegetation;
- Water clarity (turbidity); and
- Presence / absence of visible hydrocarbons (i.e., oily sheen on water surface).

4 TRIGGER THRESHOLDS & RESPONSE PLAN

4.1 Trigger Thresholds

Trigger thresholds requiring an adaptive response will be established based on the baseline monitoring undertaken for 12 months prior to the commencement of the construction phase, and by comparison (where applicable) with Environmental Quality Standard levels and classifications outlined in the following water quality legislation and

Table 4-1**Error! Reference source not found.**:

- S.I. No. 272/2009 - European Communities Environmental Objectives (Surface Waters) Regulations 2009 and amendment (S.I. 327 of 2012);
- S.I. No. 122/2014 - European Union (Drinking Water) Regulations 2014; and
- Freshwater Fish Directive for Salmonid Waters, 1978;
- Freshwater Fish Directive, 2006;
- Salmonid Water Regulations, 1988;
- Surface Water Regulations, 1989; and
- S.I. No. 258/1988 Water Quality Standards for Phosphorus Regulations 1998.

Table 4-1 - EQS Threshold Levels for Relevant Water Quality Parameters

Parameter		WQ Directive	Target Level
pH (individual values)		Environmental Objectives (Surface Waters) Regulations 2009	Soft Water[2] 4.5< pH <9.0
			Hard Water[3] 6.0< pH <9.0
Dissolved Oxygen	lower limit	Environmental Objectives (Surface Waters) Regulations 2009	95%ile >80% saturation
	upper limit		95%ile <120% saturation
Total Ammonia (mg N/l)		Environmental Objectives (Surface Waters) Regulations 2009	High status ≤0.040 (mean) or ≤0.090 (95%ile)
			Good status ≤0.065 (mean) or ≤0.140 (95%ile)
Biochemical Oxygen Demand (BOD) (mg O_2/l)		Environmental Objectives (Surface Waters) Regulations 2009	High status ≤ 1.3 (mean) or ≤ 2.2 (95%ile)
			Good status ≤ 1.5 (mean) or ≤ 2.6 (95%ile)
Molybdate Reactive Phosphorus (MRP) (mg P/l)		Environmental Objectives (Surface Waters) Regulations 2009	High status ≤ 0.025 (mean) and ≤ 0.045 (95%ile)
			Good status ≤ 0.035 (mean) and ≤ 0.075 (95%ile)
Total Phosphorous (TP) (mg/l P)		Freshwater Fish Directive (78/659 EEC) for salmonid waters	0.2
Total Ammonium (mg/l NH_4) / Ammonium nitrogen (mg/l NH_4-N)		Freshwater Fish Directive for salmonid waters, 1978	0.04
Total Suspended Solids (TSS) (mg/l)		Salmonid Water Regulations, 1988	25
Nitrogen (mg/l N)		Surface Water Regulations, 1989	3
Nitrate (mg/l NO_3) Nitrate (mg/l N)		Surface Water Regulations, 1989	50 11.3

[2] Water hardness 100 mg/l $CaCO_3$
[3] Water hardness > 100 mg/l $CaCO_3$

Parameter	WQ Directive	Target Level
Nitrate (mg/l NO_3) Nitrate (mg/l N)	Surrogate Nitrate EQS for 'high' WFD status as defined by EPA	4 0.9
Nitrite (mg/l NO_2) Nitrite (mg/l N)	Directive 2006/44/EC on the quality of fresh waters needing protection or improvement in order to support fish life, 2006	0.01 0.003
Total Oxidised Nitrogen TON (mg/l N)	-	0.9

<u>Trigger thresholds shall be the EQS target level or the measured antecedent concentration established by the pre-development baseline monitoring assessment, whichever is greater.</u>

With regards to specific concerns around the potential effect of nutrification at sensitive downstream receptors caused by forestry felling and potential release of nutrients in disturbed ground soils, a precautionary and conservative trigger threshold is to be set at a threshold 10% lower from the EQS target level or the measured antecedent concentration established by the pre-development baseline monitoring assessment, whichever is greater. This applies to concentrations of:

- NH_4-N (Ammonium),
- TON (Total Nitrogen),
- molybdate-reactive phosphorus (MRP),
- and total phosphorus (TP).

The use of continuous monitoring by sondes means that it shall be possible to respond to fluctuations in water quality approaching trigger thresholds.

4.2 Response Plan / Adaptive Mitigation

4.2.1 Construction Phase (including Forestry Felling)

All monitoring data uploaded to the cloud will be screened by the appointed Environmental Consultant / ECoW, and sensibility checked for anomalies. Trends in concentrations of specified parameters shall be determined to pre-empt any potential exceedance of established trigger thresholds.

An exceedance event requiring a response will be determined by the ECoW or Environmental Consultant where:

- in their judgement based on trends indicated on monitored data, a breach of the trigger threshold *is likely*; or
- where the automated sonde and telemetry triggers an alarm that a trigger threshold has been exceeded for the specified water quality parameters and where the Environmental Consultant determines that the exceedance is not spurious.

In that case, the Environmental Consultant / ECoW shall initiate a response which will <u>require work to cease</u> within the catchment draining to the location where the trigger threshold has been met. This may require a site-wide stoppage.

The Environmental Consultant / ECoW shall investigate the potential cause of the trend or exceedance, and implement effective adaptive mitigation measures where a potential source of reduced quality runoff is identified (such as implementing additional temporary SuDS).

Works shall only recommence when monitoring has determined that specific water quality parameters have returned to acceptable levels determined by the Environmental Consultant / ECoW.

4.2.2 Operation Phase

Continuation of monitoring for the specified phase of the operational life of the development (after commissioning) is for validatory purposes and no actions are expected to be required. Monitoring results shall be retained and reported monthly for inspection by the local authority or EPA if required.

4.2.3 Decommissioning Phase

It is recommended that a similar approach to the construction and operational phase procedures be employed during decommissioning phase, i.e., a review of measured chemical parameters in relation to relevant EQS at the time of decommissioning, pre-decommissioning baseline chemical data and expected natural chemical ranges is to be undertaken by a suitably qualified professional Environmental Consultant / ECoW.

Any significant adverse deviation in the opinion of the Environmental Consultant or ECoW trigger a reactive measure to seek to remedy the pollution identified.

Given the proposed operating life of the Proposed Development is 35 years, any alternate approaches required at the time of decommissioning shall be agreed with in advance with the environmental regulator.

5 REPORTING & ANALYSIS

5.1 Screening Data

Data will be recorded and maintained. All monitoring data uploaded to the cloud will be screened by the appointed Environmental Consultant / ECoW, and sensibility checked for anomalies. Trends in concentrations of specified parameters shall be determined to pre-empt any potential exceedance of established trigger levels.

All in-situ and laboratory monitoring data will be screened, and sensibility checked for anomalies. This will involve:

- Use of duplicate sampling to verify laboratory testing methods;
- Comparison of parameters recorded via different techniques to ensure consistency (e.g., in-situ versus laboratory testing);
- Graphing of data to identify unusual trends;
- Comparison of onsite rainfall with nearest available Met Éireann/ site-based rain gauges (if applicable) to ensure consistency; and
- Where anomalous data is recorded, this will be identified as such on graphed and / or tabulated results and excluded during generation of statistics in order to prevent inaccurate representation of existing conditions.

5.2 Reporting of Results

Following each round of monitoring and screening of data, results shall be appropriately tabulated, graphed and analysed in periodic 'Water Monitoring Reports'. Relationships shall be defined between water quality indicator parameters and records of existing natural and anthropogenic influencers (where available). These include:

- Temperature;
- Precipitation; and
- Flow volumes and / or water levels.

Relationships will also be determined between continuously monitored data for key discretely monitored parameters, including:

- Turbidity and TSS;
- Electrical Conductivity;
- Total Dissolved Solids;
- pH; and
- Dissolved Oxygen.

The 'Water Monitoring Reports' will clearly define existing conditions and can be utilised as a point of comparison during construction to determine whether the water environment is being adversely affected by the Proposed Development. Reporting shall include interpretation of results based on the EQS / trigger thresholds previously established and bearing in mind other sources of information setting out normally expected ranges of water quality in similar settings, such as those set out in the following table.

Table 5-1: WQ Parameter Guidance

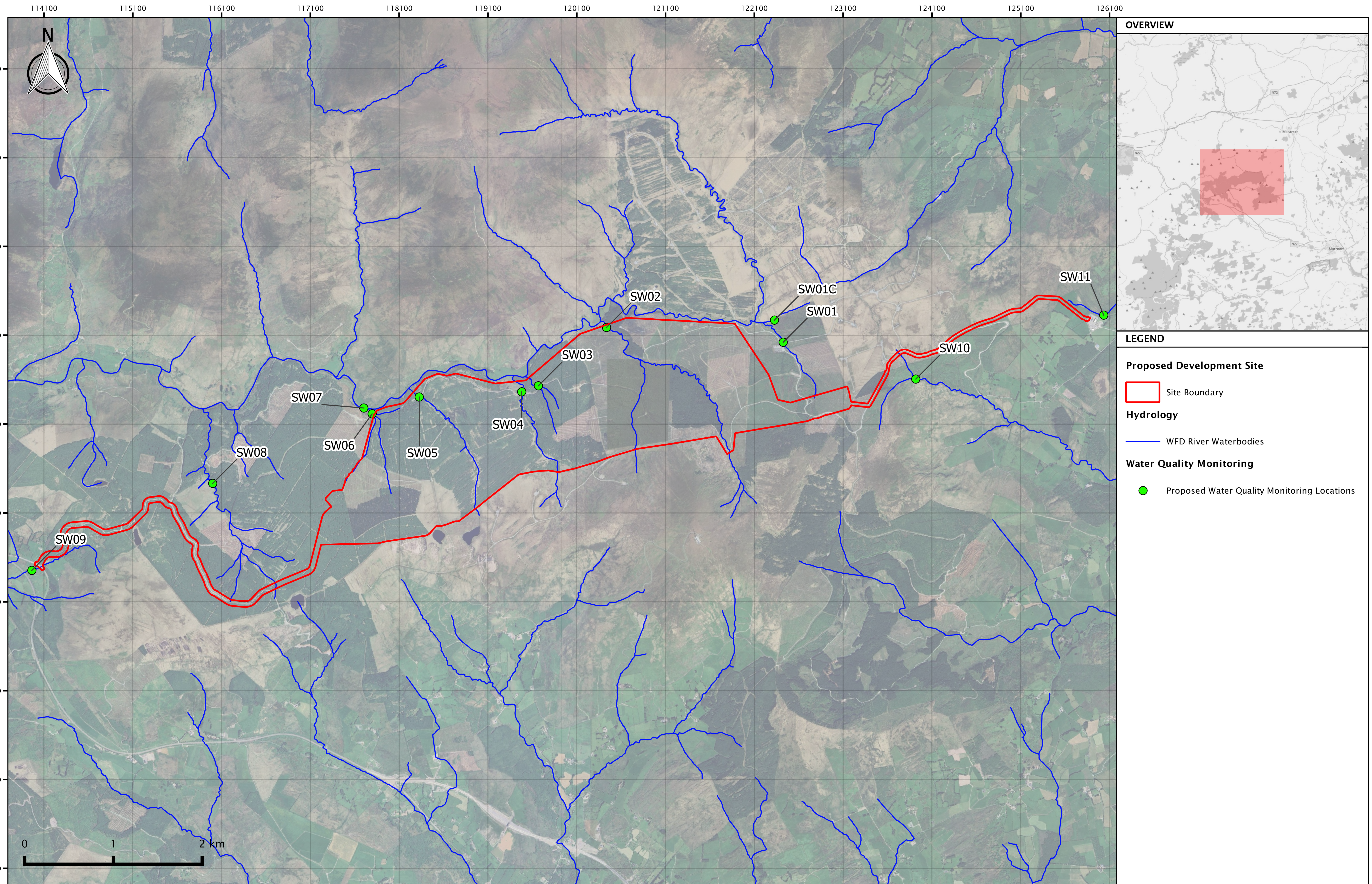
Parameter	Expected natural range	Notes
Total suspended solids (mg/l)	< 25 Typical Conditions <100 Flood Conditions	Elevated TSS may indicate increased levels of silt, fine aggregates, or cementitious material discharging to the watercourse.
Turbidity (NTU)	< 10 to protect fish life (may be higher during rainfall events)	Turbidity is a measure of water clarity; how much the material suspended in water decreases the passage of light through the water. Turbidity can be useful as an indicator of the effects of runoff from construction. Turbidity often increases sharply during a rainfall event and monitoring in combination with rainfall data may be appropriate.
Electrical conductivity (µS/cm)	< 800	Conductivity is a measure of the ability of a solution to conduct electricity and is proportional to the concentration of dissolved mineral salts. High conductivity could indicate cement/concrete discharges to water.
Dissolved Oxygen (% saturation)	> 70% 8 – 15 mg/l	DO is a key indicator of a waterbodies potential to support aquatic life. Reduced DO levels may be caused by: • siltation / suspended solids - Oxygen is more easily dissolved into water with low levels of dissolved or suspended solids. • improper disposal of foul waste from on-site facilities. Conditions of 7-9 mg/l are conducive to freshwater fisheries.
Oils	None	Laboratory measurements greater than trace levels, or visible presence of an oily sheen is an indication of leakage/spillage of oil from construction vehicles etc into watercourses.
Alkalinity (mg/l $CaCO_3$)	20 – 200 mg/l	Alkalinity refers to how much acid that can be neutralised within the watercourse. Alkalinity acts as a buffer protecting the river and habitats from fluctuations in pH. • UKTAG classifies alkalinity as low (<10), moderate (10-50), high (50-200) and very high (>200). • Levels < 10 mg/l indicate a low buffering potential with the watercourse likely to be susceptible to fluctuations in pH from natural or human sources. • Levels 100-200 mg/l will provide sufficient buffering to reduce significant changes pH levels. Typical levels in freshwater are 20-200 mg/l.
Chemical Oxygen Demand (COD) (mg/l)	< 20	COD is commonly used to indirectly measure the amount of organic compounds in water. Most applications of COD determine the amount of organic pollutants found in surface water. Causes of raised COD levels would be similar to those for BOD.

5.3 Submission of Reports

During all phase, internal reports will be maintained by the Applicant / Developer / Contractor and made available to the Planning Authority or nominated stakeholders on request.

Appendix A

Water Quality Monitoring Locations



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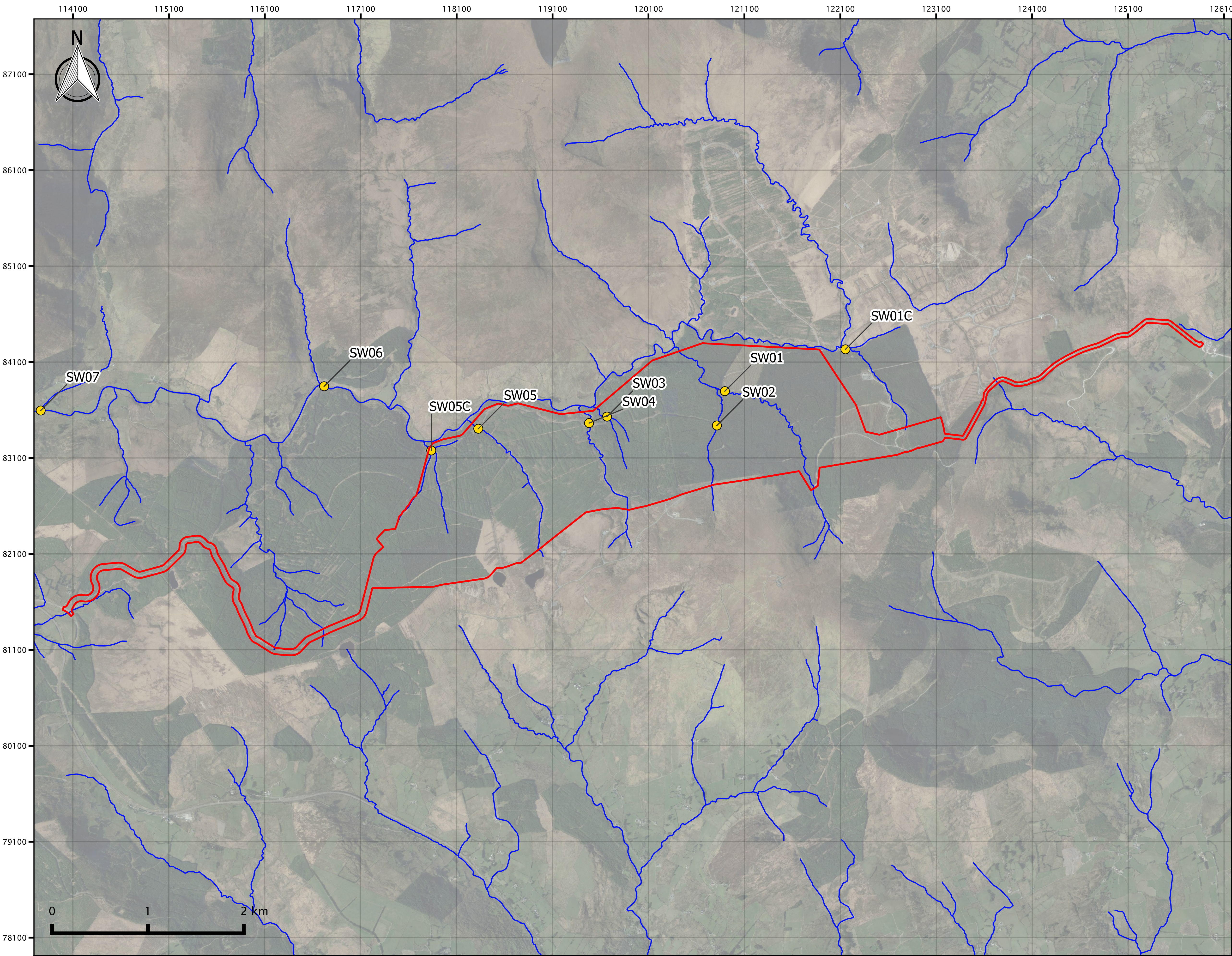
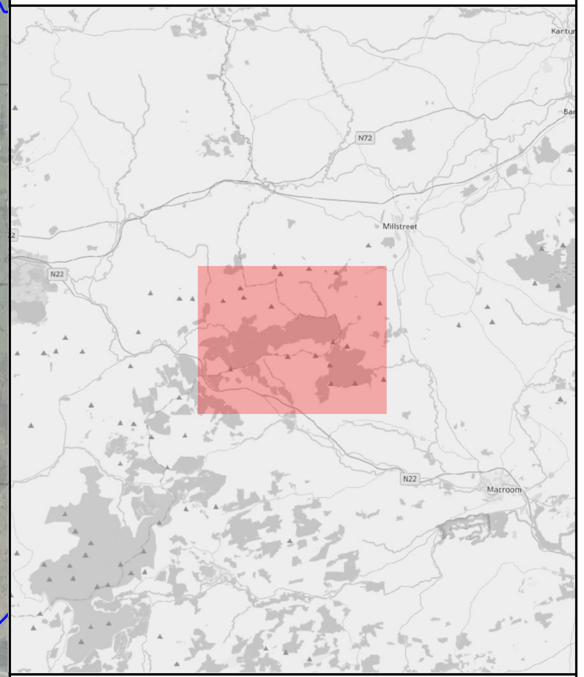
DESCRIPTION			
CUMMEENNABUDDOGE WIND FARM PROPOSED MONITORING LOCATIONS - WATER QUALITY MONITORING & RESPONSE PLAN			
PROJECT / FIGURE NO.			
M01944-02_WQMRP_01			
DRAWN BY	SCALE	REVISION	DATE
IM	AS SHOWN	00	29/05/2024





LEGEND

Proposed Development Site

Site Boundary

Hydrology

WFD River Waterbodies

Water Quality Monitoring

Baseline Water Quality Monitoring Locations

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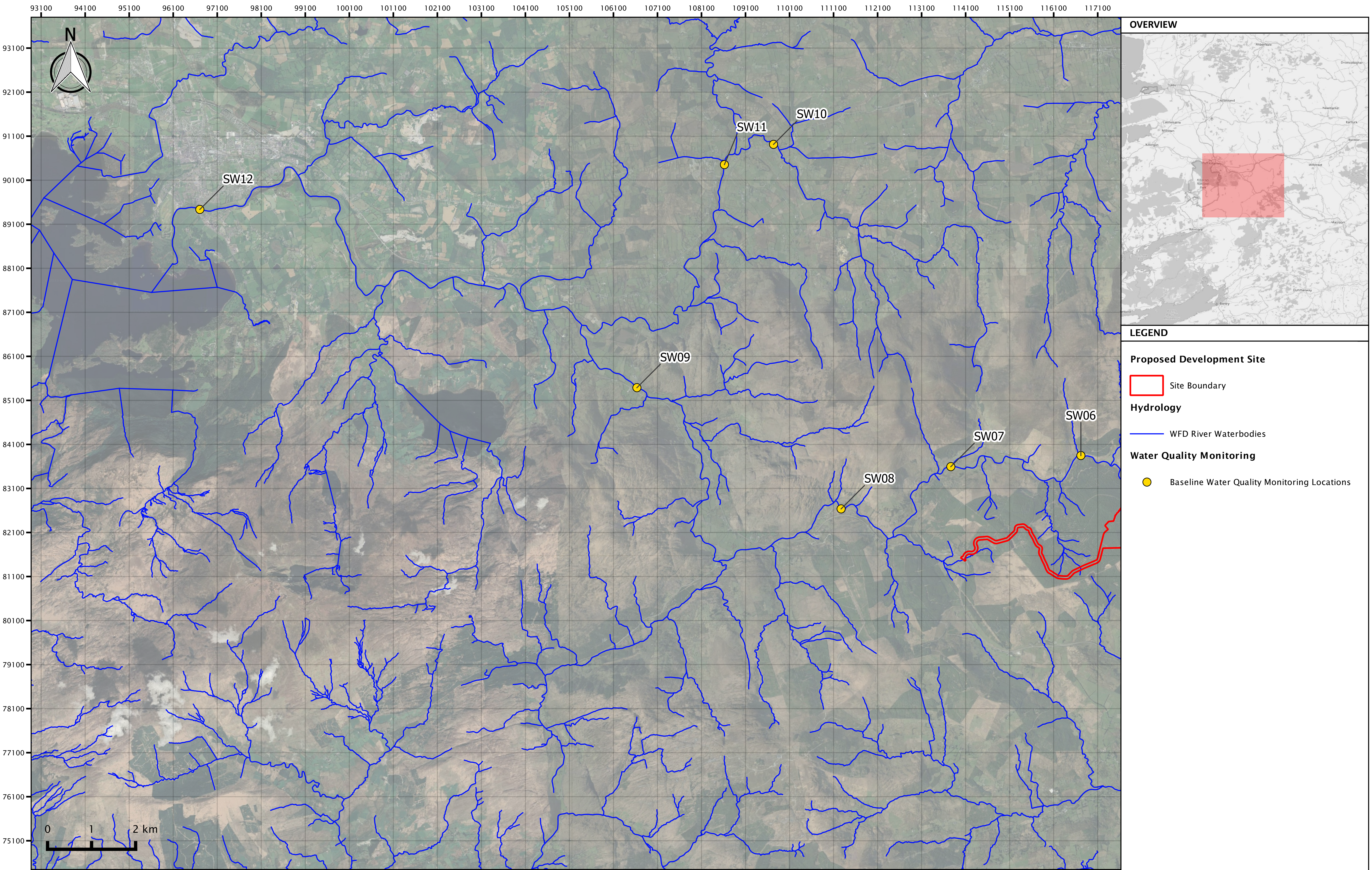
DESCRIPTION			
CUMMEENNABUDDOGE WIND FARM BASELINE WATER QUALITY MONITORING PLAN (PROPOSED DEVELOPMENT SITE)			
PROJECT / FIGURE NO.			
M01944-02_WQMP_02			
DRAWN BY	**SCALE**	**REVISION**	**DATE**
IM	AS SHOWN	00	21/11/2023



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DESCRIPTION			
CUMMEENNABUDDOGE WIND FARM BASELINE WATER QUALITY MONITORING PLAN (LOUGH LEANE CATCHMENT)			
PROJECT / FIGURE NO.	M01944-02_WQMP_03		
DRAWN BY	SCALE	REVISION	DATE
IM	AS SHOWN	00	21/11/2023