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APPENDIX 8

Hydrology, Hydrogeology and Water Quality

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APPENDIX 8.1

Site Specific Flood Risk Assessment

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LONGFORDPASS, LITTLETON, LANESPARK AND DERRYVELLA BOGS – APPLICATION FOR SUBSTITUTE CONSENT

SITE SPECIFIC FLOOD RISK ASSESSMENT

FINAL REPORT

Prepared for:

BORD NA MÓNA ENERGY LTD

Prepared by:
Hydro-Environmental Services

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Signed:	 _____ **Michael Gill B.A., B.A.I., M.Sc., MIEI** **Managing Director – Hydro-Environmental Services**

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1. INTRODUCTION

1.1 BACKGROUND

Hydro-Environmental Services (HES) were requested by Fehily Timoney (FT), on behalf of Bord Na Móna Energy Ltd, to undertake a Flood Risk Assessment (FRA) for Longfordpass, Littleton, Lanespark and Derryvella Bogs (the 'Application Site') with respect to the following conditions:

- The current baseline hydrology of the Application Site; and,
- The implementation of the Cutaway Bog Decommissioning and Rehabilitation Plans for the Application Site.

The Application Site comprises of 4 no. bogs located in east Co. Tipperary. The bogs include Lanespark and Derryvella bogs in the south, Littleton Bog towards the centre and Longfordpass Bog in the north. The Application Site comprises an area of 1,616 hectares (ha). Bog drainage works began at the Application Site in 1941 followed by the commencement of peat extraction from 1952 which ceased in 2017.

The FRA is intended to support the remedial Environmental Impact Assessment (rEIAR) submitted as part of the substitute consent application. For the purposes of this FRA and for consistency with the rEIAR, the various components are described and assessed using the following references:

- the 'Peat Extraction Phase' (1988 – 2017);
- the 'Current Phase' (2017 – Present Day); and,
- the 'Remedial Phase' (the activities intended to be carried out at the Application Site into the future).

Collectively, these phases are hereafter referred to as 'the Project'." The Project is described in full in Chapter 4 of the rEIAR.

This FRA is carried out in accordance with 'The Planning System and Flood Risk Management Guidelines for Planning Authorities' (DoEHLG, 2009). This FRA is also completed in accordance with the Flood Risk Management policies (11-9, 11-10, 11-11) and the policies in relation to Sustainable Surface Water Management (15-1 to 15-7) detailed in the Tipperary County Council Development Plan (2022-2028).

1.2 STATEMENT OF EXPERIENCE

Hydro-Environmental Services (HES) are a specialist geological, hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford.

Our core area of expertise and experience in hydrology and hydrogeology, including flooding assessment and surface water modelling. We routinely work on surface water monitoring and modelling and prepare flood risk assessment reports.

This FRA report was prepared by Michael Gill, Conor McGettigan and Nitesh Dalal.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 24 years' environmental consultancy experience in Ireland. He has also managed EIAR assessments for infrastructure projects and private residential and commercial developments. In addition, he has substantial experience in wastewater engineering and site

suitability assessments, contaminated land investigation and assessment, wetland hydrology/hydrogeology, water resource assessments, surface water drainage design and SUDs design, and surface water/groundwater interactions. For example, Michael has worked on the EIS/EIARs for Slievecallan Wind Farm, Cahermurphy (Phase I & II) Wind Farm, Carrownagowan Wind Farm, Garrane Green Energy Project and over 100 other wind farm related projects across the country. Michael has also worked on rEIARs for Cleanrath WF, 41 no. Bord na Móna bogs, the Ballivor Bog Group, and also for a number of quarry sites.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with 5 years' experience in the environmental sector in Ireland. Conor holds an M.Sc. in Applied Environmental Science (2020) and a B.Sc. in Geology (2016) from University College Dublin. Conor routinely prepares the hydrology and hydrogeology chapters of environmental impact assessment reports for wind farm developments. Conor has worked on the EIARs for over 20 no. wind farms projects across the country, including Ballivor Wind Farm, Seskin Wind Farm, Lackareagh Wind Farm, Knockshanvo Wind Farm, Garrane Green Energy Project and Gannow Renewable Energy Development. Conor prepared the hydrological and hydrogeological assessment of the rEIAR completed for the substitute consent application for the peat extraction activities at the Ballivor Bog Group.

Nitesh Dalal (B.Tech, PG Dip., MSc) is an Environmental Scientist with over 7 years' experience in environmental consultancy and environmental management in India and over 1 year environmental consultancy experience in Ireland. Nitesh holds a M.Sc. in Environmental Science from University College Dublin (2024), a PG Diploma in Health, Safety and Environment from Annamalai University, India (2021) and B.Tech. in Environmental Engineering (2016) from Guru Gobind Singh Indraprastha University, India (2016). Nitesh has been involved in the preparation of the land, soils and geology and water chapters of environmental impact assessment reports for several renewable energy developments. Nitesh has worked on the EIARs for several wind farms projects across the country, including Gannow Renewable Energy Development, Lemanaghan Wind Farm and Littleton Wind Farm.

1.3 REPORT LAYOUT

This FRA report has the following format:

- Section 2 describes the location and background details of the Application Site;
- Section 3 outlines the hydrological and geological characteristics of the Application Site and downstream surface water catchments and the existing and proposed site drainage;
- Section 4 presents the current site-specific flood risk conditions across the Application Site;
- Section 5 assesses the potential change in flood risk conditions (from the baseline) at the Application Site, and downstream of the bogs, as a result of the proposed Phase 2 Rehabilitation Works (Remedial Phase), and also cumulatively with the proposed Littleton Wind Farm development; and,
- Section 6 presents the FRA report conclusions.

2. BACKGROUND INFORMATION

This section provides details on the topographical setting of the Application Site along with a description of the previous peat extraction activities.

2.1 SITE LOCATION AND TOPOGRAPHY

The Application Site comprises of 4 no. bogs located in east Co. Tipperary. The bogs include Lanespark and Derryvella bogs in the south, Littleton Bog towards the centre and Longfordpass Bog in the north. The Application Site comprises an area of 1,616 hectares (ha). Bog drainage works began at the Application Site in 1941 followed by the commencement of peat extraction from 1952 which ceased in 2017.

The closest settlements to the Application Site are Urlingford (approximately 5 km to the north-east), Gortnahoe (approximately 2.5 km to the east), Twomileborris (approximately 2 km to the west), Littleton (approximately 2.5 km to the west) and New Birmingham (approximately 2 km to the east). The town of Thurles is located approximately 9km to the west of the Application Site. A site location map is shown as **Figure A.**

The current topography of the Application Site is relatively flat with an elevation range of between approximately 120 and 130mOD (metres above Ordnance Datum). Topography at the Application Site has been modified through peat extraction and ancillary works including associated drainage works. Today the highest elevations are found at headlands and remnant peat banks which create a boundary berm, forming a basin effect within the former extraction areas of the bog. These remnant peat banks and headlands provide an approximation (albeit drained and subsided) of the original ground elevations which existed across the Application Site prior to the commencement of peat extraction and ancillary works.

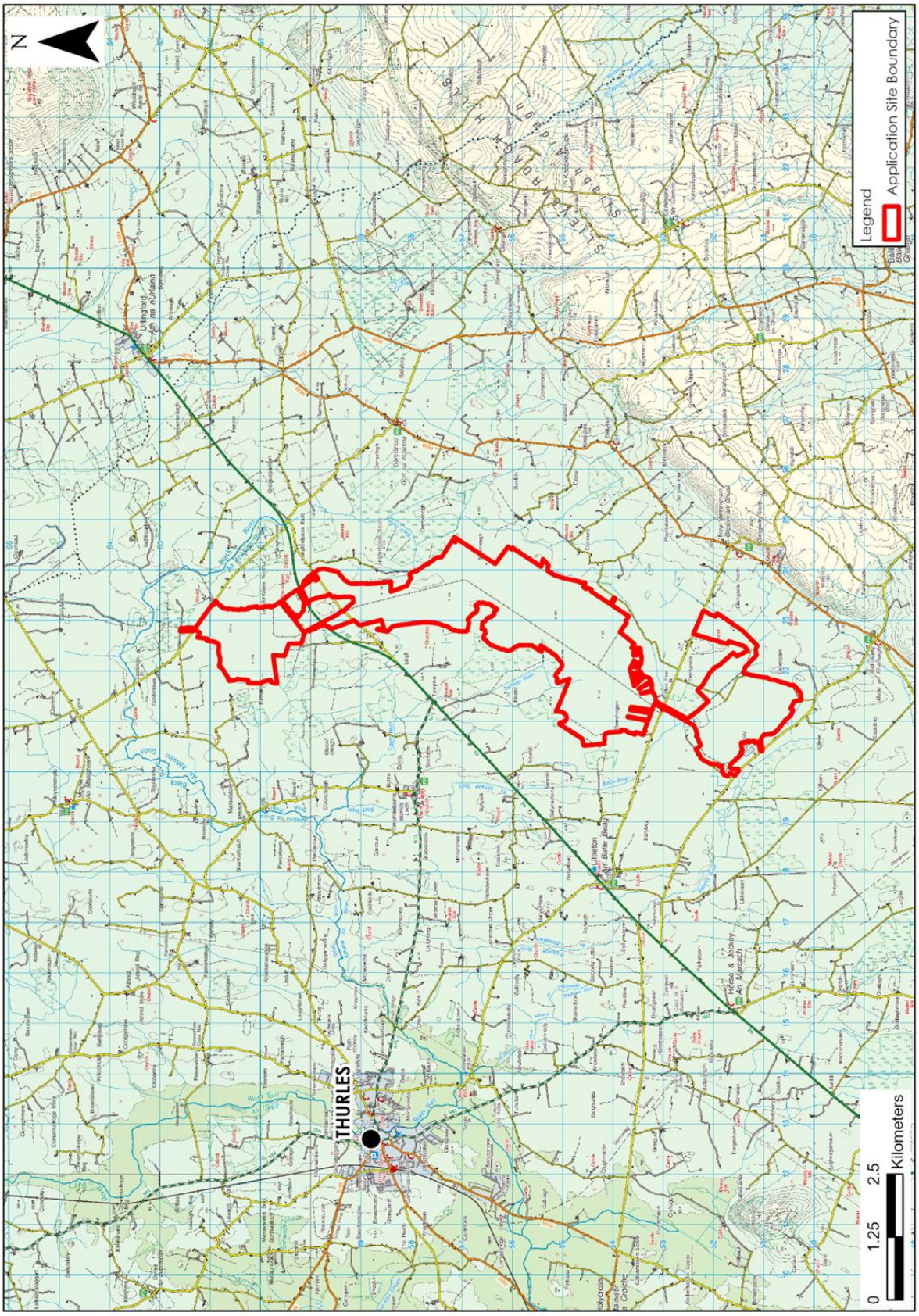

Figure A: Site Location Map

2.2 SITE HISTORY

The Application Site has been subject to drainage and peat extraction activities since 1941 and 1952 respectively, with peat extraction ceasing in 2017.

The primary change to land at the Application Site associated with peat extraction and ancillary activities occurred during the initial drainage of the bogs (which commenced in 1941) and the removal of vegetation in advance of peat extraction. Drainage ditches were inserted into the surface of the bogs and drained the upper surface of the bogs by lowering the local peat water table (full details on the drainage implemented at the Application Site are provided in Chapter 4 of the rEIAR). Ancillary infrastructure were also constructed including railway lines. After the site was drained, vegetation was removed from the bog surface, leaving only bare peat fields between the drains. During the Peat Extraction Phase, only minimal soils/land change occurred. During peat extraction, minor topographic changes have occurred annually due to the removal of peat from active peat extraction areas.

By 1988, the baseline year for the rEIAR, manmade drainage channels were established across the Application Site. In essence, the major changes from a hydrological perspective occurred within the bog during the initial drainage, significantly prior to July 1988. Consequently, no major hydrological changes would have occurred following the initial drainage of the bog apart from minor alteration of drainage ditches as peat extraction progressed.

Inspection of satellite imagery and Bord na Móna Annual Reports reveal that the Application Site was subject to milled peat extraction by July 1988. The associated drainage to facilitate milled peat extraction was already in situ, with field drains of variable orientation across the Application Site. In 1988 the Application Site included 8 no. silt ponds (3 no. on Longfordpass Bog, 4 no. on Lanespark Bog and 1 no. on Derryvella Bog) at the Application Site and 12 no. pumping stations installed at Littleton Bog. There was 1 no. pump in Lanespark Bog and 1no. pump in Longfordpass, with Derryvella bog drained by gravity.

Peat extraction within the Application Site has been regulated by the EPA under IPC Licence Registration No. P0499-01 since 2001. Prior to this date, Bord na Móna had been completing environmental monitoring and control measures at the Application Site. Initially these measures included the incorporation of silt ponds into the bog drainage system to minimise the concentrations of suspended solids entering local watercourses from the bog drainage network. These control measures were upgraded and enhanced in accordance with IPC Licence conditions from 2001.

Peat extraction ceased at the Application Site in 2017. Following cessation of peat extraction, the site drainage has continued to operate under the same drainage systems as during the Peat Extraction Phase i.e. a hierarchy of field drains, main drains, silt ponds etc. During the Current Phase (2017 to Present Day) all activities continue to be monitored in accordance with IPC licence conditions. During the Current Phase there was some limited activity at the Application Site, associated with the removal of stockpiles and railway infrastructure (site decommissioning) and the Phase 1 Rehabilitation works (which included drain blocking and hydrological management).

Drainage from the Application Site is regulated by the shallow (low gradient) nature of the drainage, and by routing all bog drainage via field drains, main drains, headland drains, then from silt ponds to outfalls, with final discharge to natural watercourses. Therefore, existing discharge volumes from the site to nearby surface watercourses will be comparable to surface water discharges during the Peat Extraction Phase.

3. EXISTING ENVIRONMENT AND CATCHMENT CHARACTERISTICS

This section gives an overview of the hydrological and geological characteristics in the area of the Application Site.

3.1 HYDROLOGY

3.1.1 Regional and Local Hydrology

Regionally the Application Site is located in River Suir surface water catchment within Hydrometric Area 16 of the South Eastern River Basin District. The Suir Catchment includes the area drained by the River Suir and all streams entering the tidal water between Drumdowney and Cheekpoint, Co. Waterford. The catchment has a total area of 3,542km^2. In the vicinity of the Application Site, the main tributary of the River Suir is the Drish River. This river discharges into the River Suir to the south of Thurles and ~7.7km west of the Application Site. The River Suir then continues to flow to the south, past Cahir, before it veers to the east, flowing through Clonmel, before it becomes tidal in the vicinity of Carrick-on-Suir.

More locally the Application Site is located in the Suir_040 WFD sub-catchment (Suir_SC_040) and is drained by the Drish River and its tributaries. This Site is mapped within a total of 9 no. WFD river sub-basins as detailed in the succeeding paragraphs.

- The southwest of Lanespark Bog is mapped in the Breagagh (Tipperary)_010 WFD river sub-basin. The closest mapped watercourses to this area of the Application Site is the Ballyley River, referred to on the EPA online mapping as the Breagagh River (EPA Code: 16B03) (note that for consistency this watercourse will be referred to as the Breagagh River within this chapter). This watercourse flows to the northwest ~140m from the Application Site. Further downstream, the Breagagh River discharges into the Drish River (EPA Code: 16D02) near Archerstown Bridge to the south of Thurles, just upstream of its confluence with the River Suir.
- The north of Lanespark Bog and the east of Derryvella Bog are mapped in the North Glengoole_010 WFD river sub-basin. The closest mapped watercourse to this area of the Application Site is the EPA named North Glengoole Stream (EPA Code: 16N28) which is a tributary of the Black River, referred to by the EPA as the Black (Two Mile Borris) River (EPA Code: 16B01). The North Glengoole Stream flows to the southwest along the eastern boundary of Derryvella Bog before veering to the northeast and passing along the northern boundary of Lanespark Bog.
- A large area in the south of Littleton Bog is mapped in the Black (TwoMileBorris)_010 WFD river sub-basin. This area is drained by the Black (Two Mile Borris) River. The EPA map the Black (Two Mile Borris) River to flow to the south/southeast along the eastern boundary of Littleton Bog. The Black (Two Mile Borris) River continues to flow to the northwest and discharges into the Drish River to the north of Twomileborris.
- Much of the centre of Littleton Bog is mapped in the Clover_010 WFD river sub-basin. The EPA map 2 no. watercourses to flow to the northwest from this area of Littleton Bog. One of these streams is referred to as the Derheen River on local basemaps and is not assigned a name by the EPA. The other stream is referred to as the Clover Stream (EPA Code: 16C04) on the EPA blueline database. These streams merge downstream of the Application Site to form the Clover River. The Clover River discharges into the Black (Two Mile Borris) River to the north of the village of Twomileborris.
- The northeast of Littleton Bog is mapped in the Drish_010 WFD river sub-basin. This area of the Application Site is drained by the Drish River (EPA Name: 16D02) which flows to the north. It is noted that this watercourse is referred to as the Black River on local base maps and is only referred to as the Drish River downstream of Ballyduff Bridge near Shanballyduff (For the purposes of this chapter the Drish River will be used to

refer to this watercourse in order to be consistent with the EPA nomenclature and to avoid confusion with the Black (Two Mile Borris) River).

- A small area in the north of Littleton Bog is mapped in the Drish_020 WFD river sub-basin. The Drish River flows to the northwest ~1.3km from this area of the Application Site.
- The northern section of Longfordpass Bog is mapped in the Drish_030 WFD river sub-basin. The Drish River flows to the west ~550m from the Application Site.
- The majority of the Longfordpass Bog and a small areas in the northwest of Littleton Bog are mapped in the Drish_050 WFD river sub-basin. An unnamed stream is mapped by the EPA to flow along the western boundary of this area before it discharges into the Drish River.

A regional hydrology map is included as **Figure B** below.

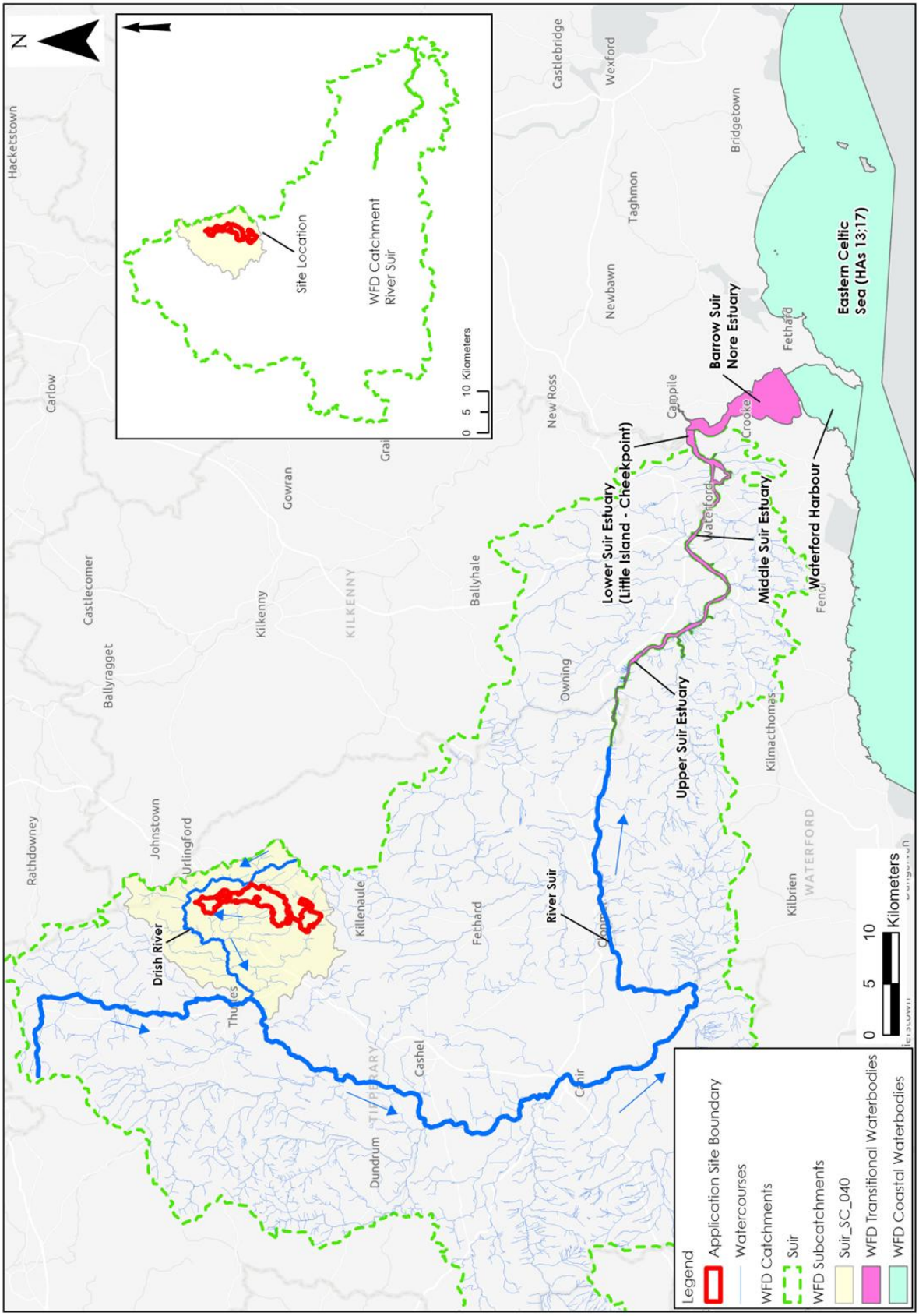

Figure B: Regional Hydrology Map

3.1.2 Rainfall and Evaporation

3.1.3 Water Balance

Long term Annual Average Rainfall (AAR) and evaporation data were sourced from Met Éireann (www.met.ie).

The 30-year AAR (1981-2010) recorded at Littleton rainfall station, located approximately 1km southwest of Application Site are presented in **Table A**. The long-term AAR at this station is 958mm/year.

Met Éireann also provide a grid of AAR for the entire country for the period of 1991 to 2020. Based on these more site-specific modelled rainfall values, the AAR at the Application Site ranges from 934 to 1,004mm/year, with the greatest values in Lanespark and Derryvella bogs in the south. The conservative AAR for the Application Site is taken to be 1,004mm/year (this is considered to be the most accurate estimate of AAR from the available sources).

Table A: Average long-term Rainfall Data (mm)

Station			x-Coord		Y-Coord		Ht (mOD)		Opened		Closed	
Littleton Rainfall Station			219700		153400		122		1950		1982	
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
98.3	72.1	74.2	63.5	67.0	68.7	65.1	78.9	76.4	108.9	91.3	93.8	958.1
Site (X-Coord: 217000, Y-Cord:150000)												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
100	77	74	66	66	74	71	83	78	106	105	105	1,004

The closest synoptic station where the average Potential Evapotranspiration (PE) is recorded is at Kilkenny, ~26km east of the Application Site. The long-term average PE for this station is ~459mm/year. This value is used as a best estimate of the PE at the Application Site. Actual Evaporation (AE) is estimated as ~436mm/year (which is 0.95 × PE).

The Effective Rainfall (ER) represents the water available for runoff and groundwater recharge. The ER for the Application Site is calculated as follows:

Effective Rainfall (ER) = Average Annual Rainfall (AAR) – Actual Evaporation (AE)
ER = 1,004mm/year – 436mm/year
ER = 568mm/year

The GSI estimate that the groundwater recharge coefficient for the Application Site is 4% (www.gsi.ie), with this estimate being provided based on the occurrence and extent of basin peat. Based on this recharge coefficient (4%) the average annual groundwater recharge for the Application Site is estimated to be ~23mm/year (i.e. 4% of the effective rainfall (568mm) for the Application Site). This means that the hydrology of the Application Site is characterised by very high surface water runoff rates and very low groundwater recharge rates. Therefore, conservative annual recharge and runoff rates for the Application Site are estimated to be 23mm/yr and 545mm/yr respectively.

The water balance presented above is unlikely to have changed significantly from 1988 to the period covered by the 1991-2020 Met Éireann data. Raised peat bogs are an excellent store of water. Pre-development, when the storage capacity of the peat was reached, surface water runoff would have occurred whereby rainwater would have moved slowly across the bog before discharging to fens and other wetland habitats at the bog margin. In the July 1988 baseline and in the present day, however, drainage channels act as preferential flowpaths which allow surface water to leave the Application Site. These channels generally have a low gradient and the on-site drainage systems have some

inherent storage and attenuation, and likely release runoff water at slightly higher rates than that of pre-development times. Meanwhile, the runoff rates between the July 1988 baseline and the present day are unlikely to have changed significantly as drainage had been inserted at the Application Site by July 1998. There may have been a very slight decrease in runoff rates due to the upgrade in silt ponds at the Application Site in the 1990s.

Met Éireann's Translate Project (https://www.met.ie/science/translate) provides projections for a range of future climate change scenarios, as Ireland's future climate will depend on global greenhouse gas emissions reductions. The severity of any future climate change will depend on the degree of future warming. In relation to precipitation chances, the models show that summer rainfall may decrease by approximately 9% and winter rainfall could increase by up to 24%. In a 1.5°C world, average winter and summer precipitation rates are projected to be 3.92mm/day and 2.34mm/day respectively in Co. Tipperary. In a 4°C world, the average winter and summer precipitation rates in Co. Tipperary are projected to be 4.31mm/day and 2.08mm/day respectively.

3.1.4 Geology

The published Teagasc soils map (www.gsi.ie) shows that the vast majority of the Application Site is underlain by cut peat. A small area in the south of Lanespark Bog is overlain by made ground which corresponds to the existing Bord na Móna works depot.

The published GSI subsoils map (www.gsi.ie) shows that the vast majority of the Application Site is underlain by cutover raised peat. A very small area in the southwest of the Lanespark Bog underlain by till derived from limestones (TLs).

The soils and subsoils present at the Application Site have been verified during site walkover surveys and intrusive site investigations. The results of these site investigations are detailed in Chapter 8 of the rEIAR.

A local subsoils map is attached below as **Figure C**.

The Application Site is underlain by a total of 5 no. bedrock geological formations. Much of the northern section of Littleton Bog is underlain by the Ballysteen Formation which consists of dark muddy limestones and shales. The south of Littleton Bog, the west of Lanespark Bog and the majority of Longfordpass Bog are underlain by the Waulsortian Limestones, comprising of massive, unbedded lime-mudstones. A small area in the northwest of Longfordpass Bog and a small area of Lanespark Bog are underlain by the Crosspatrick Formation which consists of pale-grey cherty crinoidal limestones. The southeast of Lanespark Bog and Derryvella Bog are underlain by the Aghmacart Formations, comprising of dark shaly micrite, peloidal limestone. A small area in the northeast of Littleton Bog is underlain by the Lisduff Oolite Member consisting of oolitic limestone.

A bedrock geology map of the local area is included as **Figure D**.

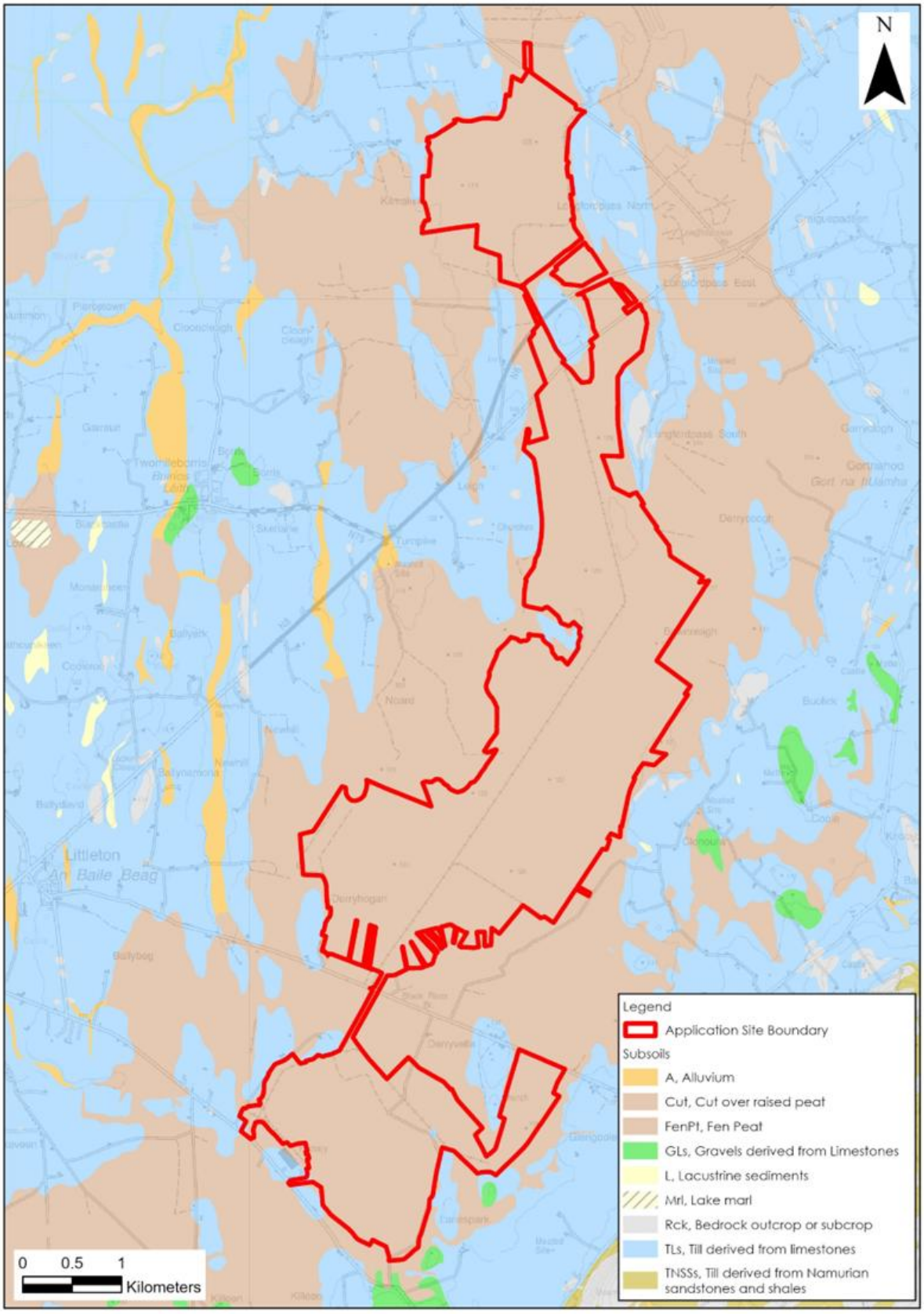

Figure C: Local Subsoils Map

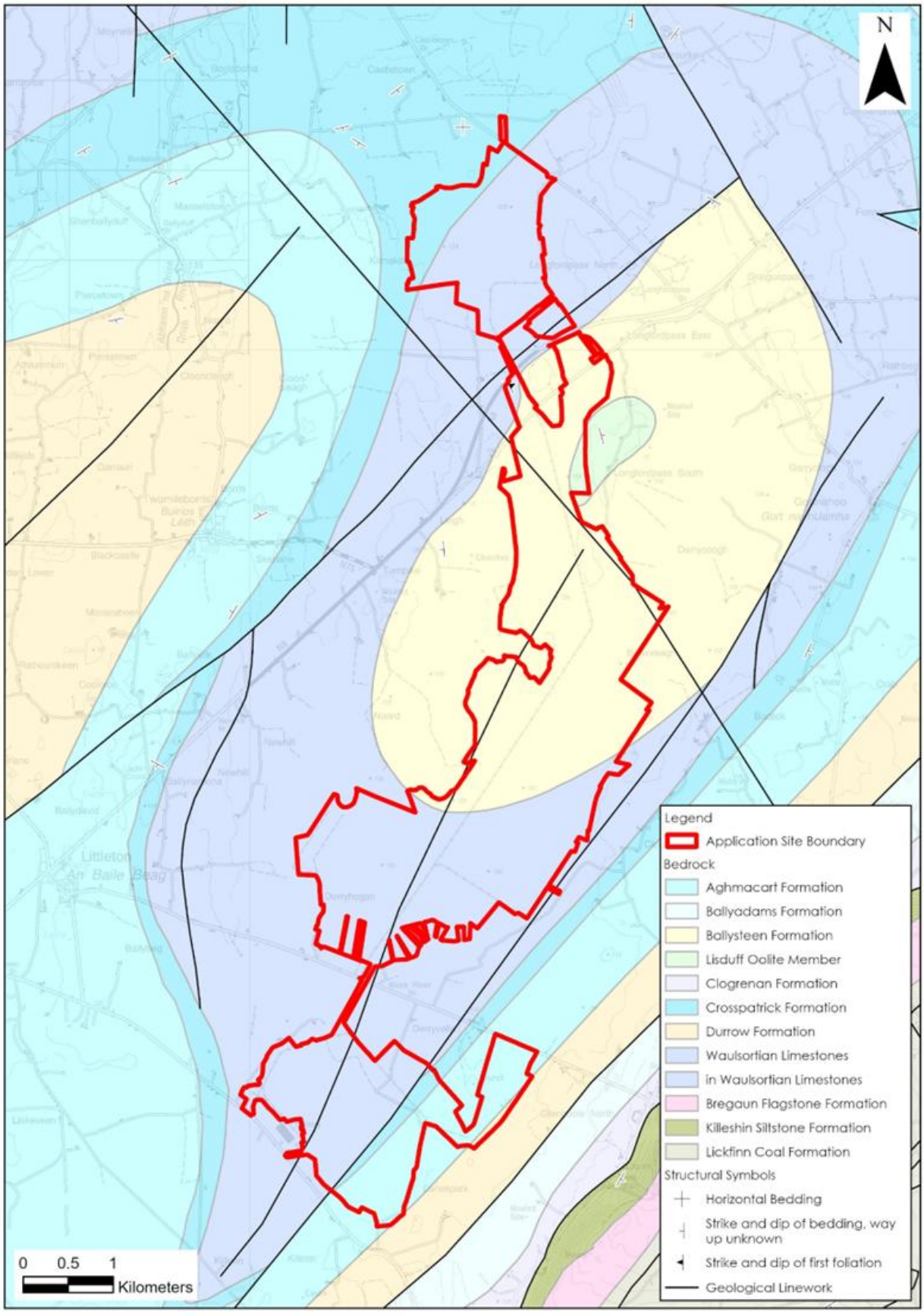

Figure D: Bedrock Geology Map

3.1.5 Site Drainage

Topography within the Application Site is relatively flat with an elevation range of between approximately 120 and 130mOD with gentle slopes in some locations. Along many of the bog boundaries, a 1-2m high peat headland exists which is a remnant of the original bog. These headlands and in some areas remnant peat banks create a boundary berm, forming a basin effect within former peat extraction areas.

Surface water was drained from the Application Site via a network of field drains typically spaced at 15 to 20m intervals, main drains, and settlement/silt ponds. Drainage is then discharged to off-site drainage channels which flow into the local river network. Drainage of Littleton Bog was formerly assisted through the use of pumps. It is noted that 12 no. pumps were active in Littleton Bog in 1988. These pumping stations are no longer active. By 1988 there was 1 no. pump in Longfordpass Bog. Lanespark and Derryvella bogs were drained by gravity.

A flow diagram for the existing drainage system is shown as **Figure E** below.

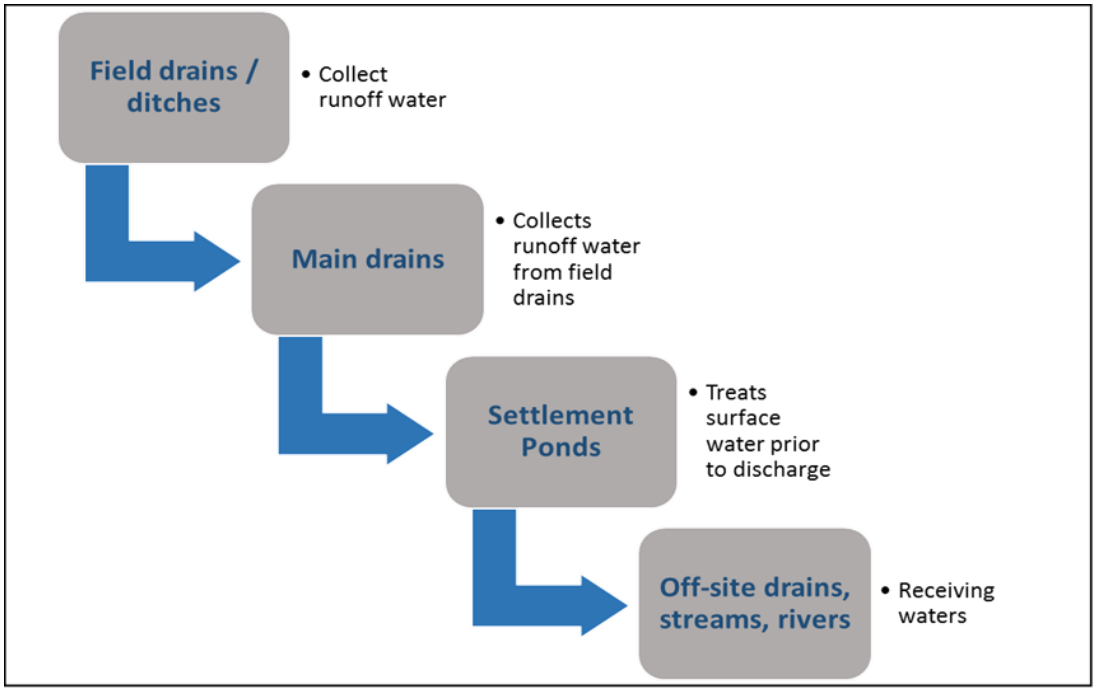

Figure E: Process Flow Diagram for the Existing Site Drainage System

A detailed hydrological audit of flowpaths for the Application Site to its eventual discharge point at the regional catchment scale was completed for the Application Site (refer to **Figure F**).

Drainage from the Application Site currently discharges through several gravity surface water outfalls and the locations of these outfalls and the receiving surface waterbodies are detailed below and in **Figure G**.

There are currently 2 no. outfalls from Longfordpass Bog. A silt pond located in the north of the bog, discharges to a small stream which is not included on the EPA database but is shown on the local 6" and 25" base mapping. This stream flows to the north for ~600m before it discharges into the Drish River. A second silt pond is located in the southwest of Longfordpass Bog and discharges to a small stream which is mapped along the western boundary of the bog. This stream is not assigned a name by the EPA, flows to the west and discharges into the Drish River ~4.8km downstream of the Application Site.

The drainage network in Littleton Bog is of variable orientation, with northeast to southwest orientated drains in the main bog area and northwest to southeast orientated drains in the northern section of the bog. Drainage of this bog was historically facilitated by several pumping stations as the previous peat extraction activities resulted in the bog being unable to drain by gravity due to the lowered ground elevations. The pumping stations were located in the west of Littleton Bog and discharged to small streams which merge downstream to form the Clover River. However, these pumping stations are no longer active. There remains 1 no. outfall to the Clover River which is drained by gravity. Water in much of the bog area is directed towards this outfall and also pools in some of the lower lying peat fields and deeper drains which act as large settlement ponds. This water may slowly recharge to ground in localised areas where the underlying glacial deposits are more porous. However, any groundwater recharge is likely very limited, as the ponded areas remain extensive in summer and during dry periods indicating little recharge to ground. It is also noted that some small areas in the northeast of Littleton Bog drain by gravity and discharge to local drains and small watercourses to the east of the bog. These features are hydrologically connected with the Drish River.

Lanespark Bog is drained by field drains of northwest to southeast orientation. Drainage within the bog is directed to several settlement ponds located around the perimeter of the bog. In the north a settlement pond discharges to a local drain which in turn discharges to the North Glengoole Stream. To the south, 2 no. settlement ponds discharge to local drains which are hydrologically connected to the Breagagh River which flows to the south of the bog.

Derryvella Bog contains field drains of variable orientation. Drainage rom this bog discharges via settlement ponds to the North Glengoole Stream which flows to the northwest between Derryvella and Lanespark bogs. This stream discharges into the Black (Two Mile Borris) River.

All watercourses draining the Application Site eventually discharge into the Drish River and the River Suir further downstream.

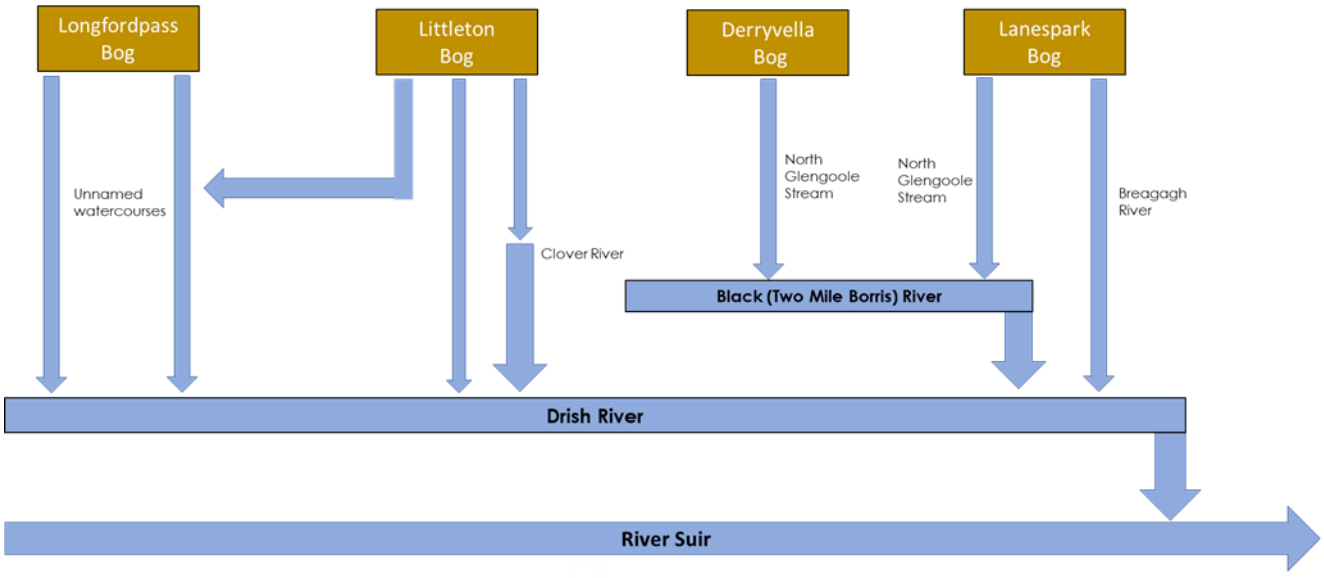

Figure F: Hydrological Flowpaths for the Application Site

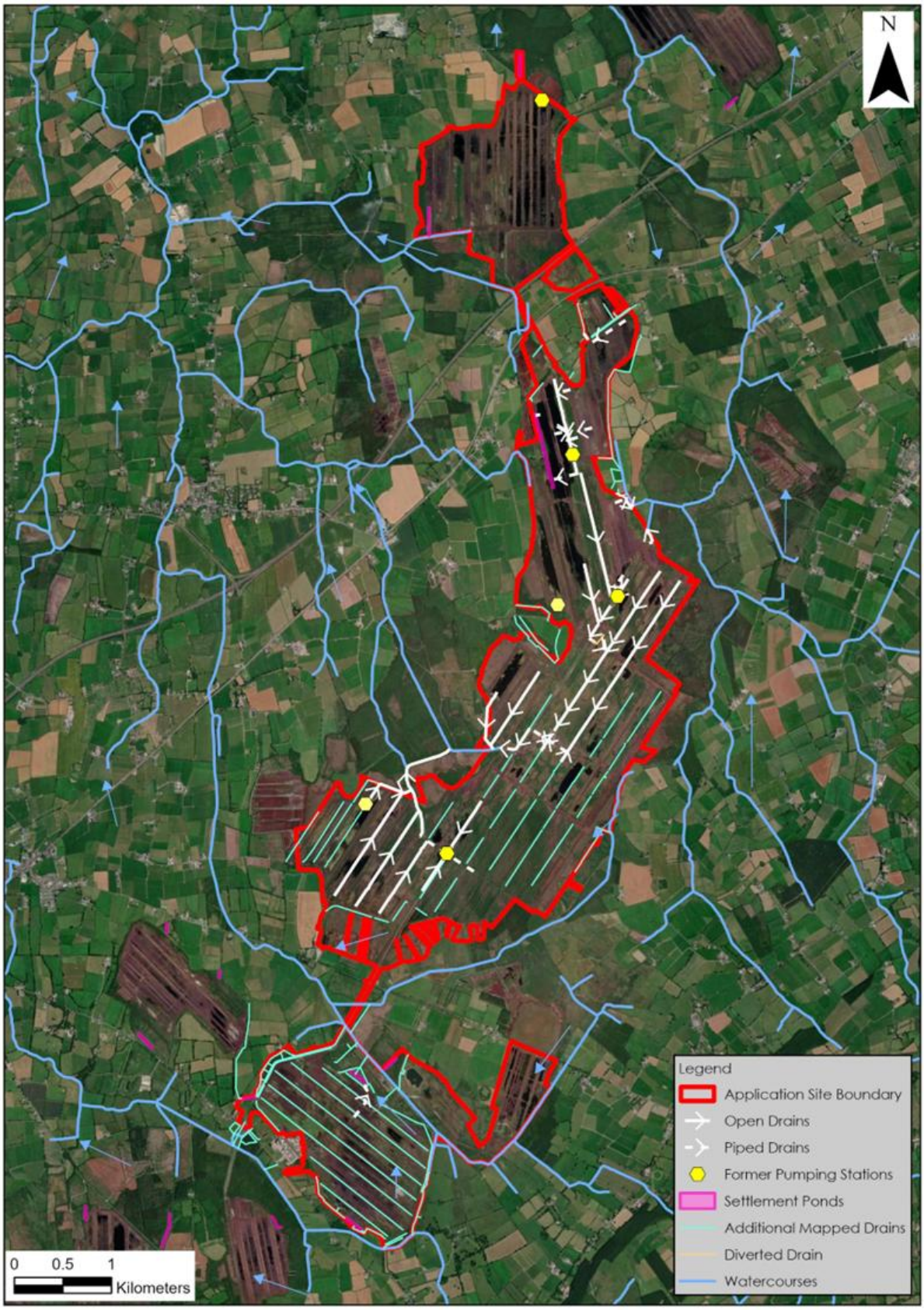

Figure G: Existing Application Site Drainage Map

4. BASELINE FLOOD RISK DEFINITION

4.1 INTRODUCTION

The following assessment is carried out in accordance with '*The Planning System and Flood Risk Management Guidelines for Planning Authorities*' (DoEHLG, 2009). The basic objectives of these guidelines are to:

- Avoid inappropriate development in areas at risk of flooding;
- Avoid new developments increasing flood risk elsewhere, including that which may arise from surface water runoff;
- Ensure effective management of residual risks for development permitted in floodplains;
- Avoid unnecessary restriction of national, regional or local economic and social growth;
- Improve the understanding of flood risk among relevant stakeholders; and,
- Ensure that the requirements of EU and national law in relation to the natural environment and nature conservation are complied with at all stages of flood risk management.

4.2 FLOOD RISK ASSESSMENT PROCEDURE

This section of the report details the site-specific flood risk assessment carried out for the Application Site and surrounding area. The primary aim of the assessment is to consider all types of flood risks and the potential impact on the Project. As per the relevant guidance (DOEHLG, 2009), the stages of a flood risk assessment are:

- *Flood risk identification* – identify whether there are surface water flooding issues at a site;
- *Initial flood risk assessment* - confirm sources of flooding that may affect a proposed development; and,
- *Detailed flood risk assessment* – quantitative appraisal of the potential risk to a proposed development.

As per the Guidelines, there are essentially two major causes of flooding:

Coastal flooding, which is caused by higher sea levels than normal, largely as a result of storm surges, resulting in the sea overflowing onto the land. Coastal flooding is influenced by the following three factors, which often work in combination:

- High tide level;
- Storm surges caused by low barometric pressure exacerbated by high winds (the highest surges can develop from hurricanes); and,
- Wave action, which is dependent on wind speed and direction, local topography and exposure.

Coastal Flooding is not applicable to the Application Site.

Inland flooding which is caused by prolonged and/or intense rainfall. Inland flooding can include a number of different types:

- Overland flow occurs when the amount of rainfall exceeds the infiltration capacity of the ground to absorb it. This excess water flows overland, ponding in natural hollows and low-lying areas or behind obstructions. This occurs as a rapid response to intense rainfall and eventually enters a piped or natural drainage system.

- River flooding occurs when the capacity of a watercourse is exceeded or the channel is blocked or restricted, and excess water spills out from the channel onto adjacent low-lying areas (the floodplain). This can occur rapidly in short steep rivers or after some time and some distance from where the rain fell in rivers with a gentler gradient.

- Flooding from artificial drainage systems results when flow entering a system, such as an urban stormwater drainage system, exceeds its discharge capacity and the system becomes blocked, and/or cannot discharge due to a high-water level in the receiving watercourse. This mostly occurs as a rapid response to intense rainfall. Together with overland flow, it is often known as pluvial flooding. Flooding arising from a lack of capacity in the urban drainage network has become an important source of flood risk, as evidenced during recent summers.

- Groundwater flooding occurs when the level of water stored in the ground rises as a result of prolonged rainfall to meet the ground surface and flows out over it, i.e. when the capacity of this underground reservoir is exceeded. Groundwater flooding tends to be very local and results from interactions of site-specific factors such as tidal variations. While water levels may rise slowly, they may be in place for extended periods. Hence, such flooding may often result in significant damage to property rather than be a potential risk to life.

- Estuarial flooding may occur due to a combination of tidal and fluvial flows, i.e., the interaction between rivers and the sea, with tidal levels being dominant in most cases. A combination of high flow in rivers and a high tide will prevent water flowing out to sea, tending to increase water levels inland, which may flood over riverbanks.

The Flood Risk Management Guidelines (DoEHLG, 2009) provide direction on flood risk and development. The guidelines recommend a precautionary approach when considering flood risk management and the core principle of the guidelines is to adopt a risk-based sequential approach to managing flood risk and to avoid development in areas that are at risk. The sequential approach is based on the identification of flood zones for inland and coastal flooding.

Flood zones are geographical areas within which the likelihood of flooding is in a particular range, and they are a key tool in flood risk management within the planning process as well as in flood warning and emergency planning.

There are three types or levels of flood zones defined within the guidelines:

Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% (AEP)[1] or 1 in 100 for river flooding or 0.5% (AEP) or 1 in 200 for coastal flooding);

Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% (AEP) or 1 in 1000 and 1% (AEP) or 1 in 100 for river flooding and between 0.1% (AEP) or 1 in 1000 year and 0.5% (AEP) or 1 in 200 for coastal flooding); and,

1 AEP – Annual Exceedance Probability

Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% (AEP) or 1 in 1000 for both river and coastal flooding). Flood Zone C covers all areas of the plan which are not in zones A or B.

Once a flood zone has been identified for a site, the guidelines set out the different types of development appropriate to each identified zone (pg. 25, Table 3.1 of the Guidelines). Exceptions to the restriction of development due to potential flood risks are provided for through the application of a Justification Test (JT), where the planning need and the sustainable management of flood risk to an acceptable level must be demonstrated by the applicant.

The Justification Test (JT) has been designed to rigorously assess the appropriateness, or otherwise, of particular developments that, for the reasons outlined above, are being considered in areas of moderate or high flood risk. The test is comprised of two processes.

- The first is the **Plan-making Justification Test** described in chapter 4 of the Guidelines and used at the plan preparation and adoption stage where it is intended to zone or otherwise designate land which is at moderate or high risk of flooding. Plan making Justification Tests are made at Plan/Policy development stage such as County Development Plans, or Local Area Plans.

- The second is the **Development Management Justification Test** described in chapter 5 of the Guidelines and used at the planning application stage where it is intended to develop land at moderate or high risk of flooding for uses or development vulnerable to flooding that would generally be inappropriate for that land. For example, application of Development Management Justification Test would be required at a site-specific level, such as for this FRA assessment, if a Justification Test is required.

4.3 BASELINE FLOOD RISK ASSESSMENT/IDENTIFICATION

4.3.1 Historical Mapping

To identify those areas as being at risk of flooding, historical mapping was consulted and reviewed. There is no text on local available historical 6" or 25" mapping that identifies areas that are "*prone to flooding*" within the Application Site. Furthermore, there is no text which indicates that the watercourses in the lands surrounding the Application Site are liable to floods. Downstream, text indicates lands which are "*liable to flood*" along the Drish River ~500km north of the Application Site and along the Drish River ~6km to the west.

4.3.2 Soils Maps – Fluvial Maps

A review of the soil types in the vicinity of the Application Site was undertaken as soils can be a good indicator of past flooding in an area. Due to past flooding of rivers deposits of transported silts/clays referred to as alluvium build up within the floodplain and hence the presence of these soils is a good indicator of potentially flood-prone areas.

Based on the EPA/GSI soil map for the area no regions of alluvium are mapped within the Application Site boundaries. However, some alluvium (fluvial deposits) is recorded along many of the local streams and rivers downstream of the Application Site.

4.3.3 OPW Past Flood Events Mapping

To identify those areas as being at risk of flooding, OPW's Past Flood Events Map was consulted (www.floodinfo.ie).

The OPW Past Flood Events Map has no records of historic or recurring flood events within the Application Site. The closest mapped recurring flood event to the Application Site is located

~1.9km west of Littleton Bog (Flood ID: 4373) at Garryclogh. Here a local road is reported to flood approximately every 2 years, with surface water runoff listed as the source of the flooding. A recurring flood event is also mapped ~2.5km west of Lanespark Bog (Flood ID: 3759) at Ballymurreen Bridge, associated with flooding of the Breagagh River. Further downstream recurring flood events are also recorded on the Drish River (Flood ID: 3752) and the River Suir (Flood ID: 3748) in the vicinity of Thurles. The OPW also record several historic flood events, several of which date from 2012 and are mapped to the east of Littleton Bog along the Drish River.

The OPW Past Flood Events Map is presented as **Figure H** below.

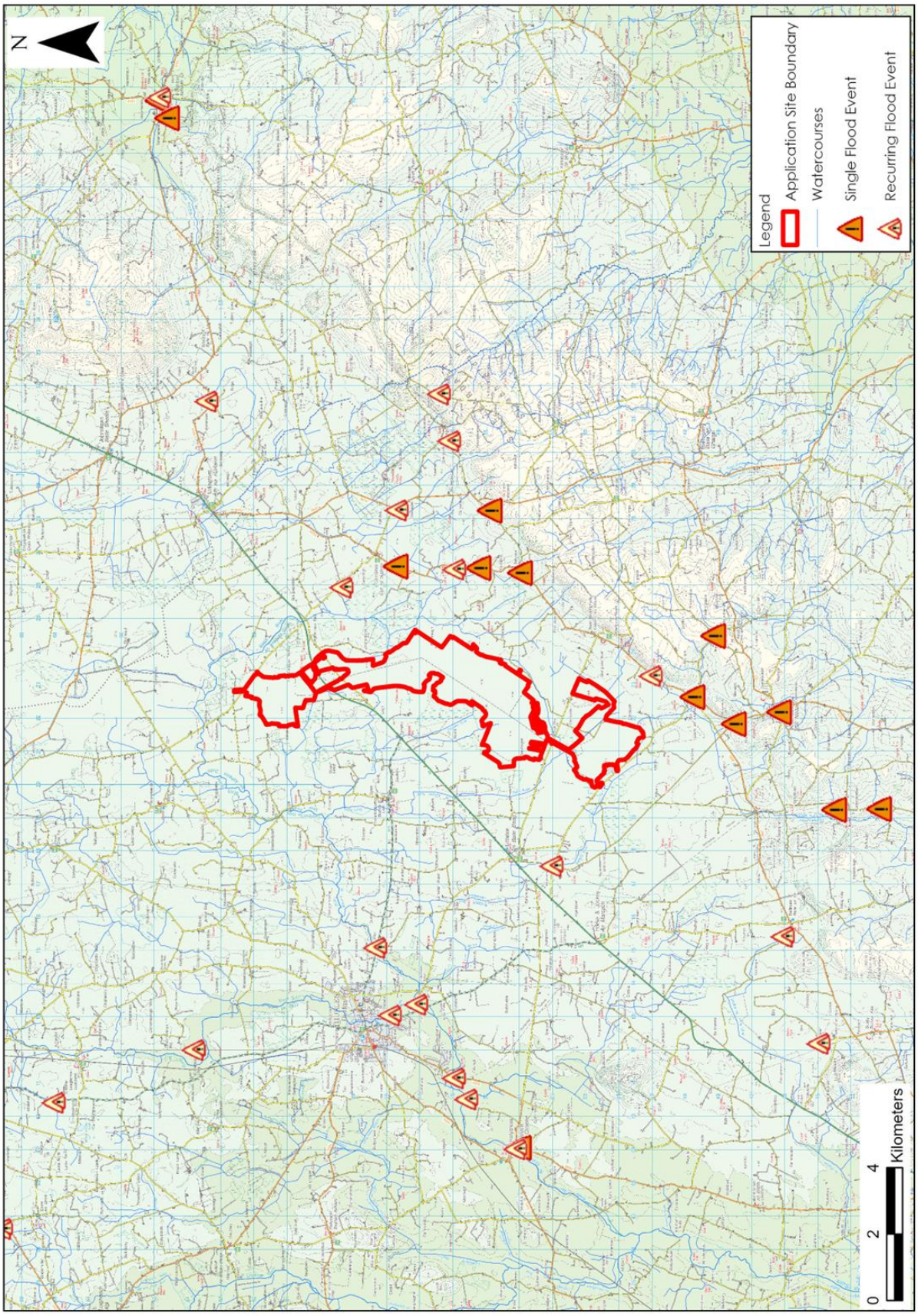

Figure H: OPW Past Flood Events Map

4.3.4 GSI Historical Surface Water Flood Mapping

The GSI Winter (2015/2016) Surface Water Flooding map shows areas of fluvial and pluvial flood extents during the Winter 2015/2016 flood event, which was the largest recorded flood event in many areas. This surface water flood map is available to view at www.floodinfo.ie.

This flood map shows several areas of surface water ponding within the Application Site. These flood zones correspond with large areas of surface water ponding which were recorded during the site walkover surveys.

The GSI Winter (2015/2016) Surface Water Flood Mapping is shown as **Figure I**.

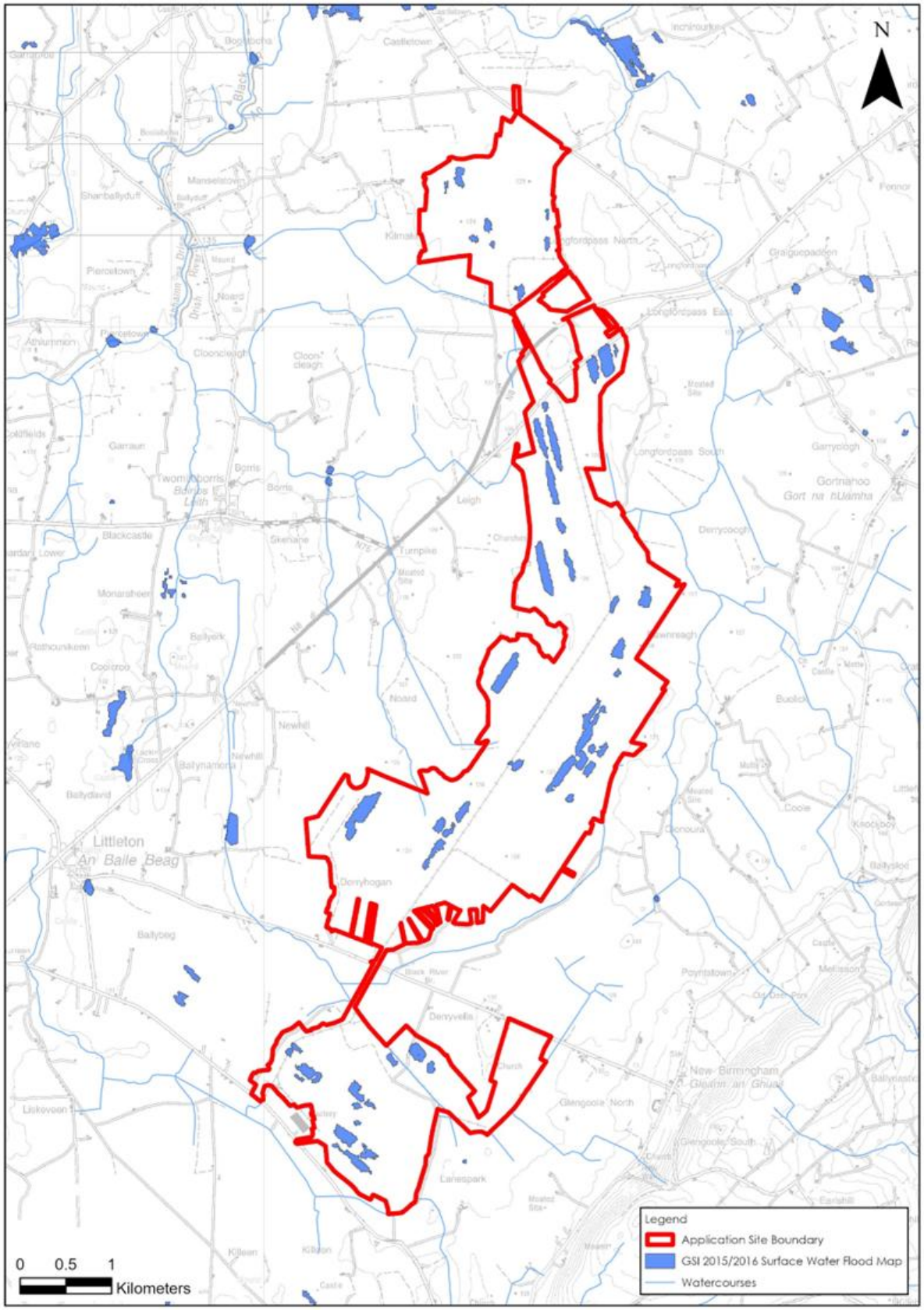

Figure I: GSI Historical Surface Water Flood Map

4.3.5 CFRAM Fluvial Flood Mapping

Catchment Flood Risk Assessment and Management (CFRAM)[2] OPW Flood Risk Assessment Maps are now the primary reference for flood risk planning in Ireland and supersede the previous PFRA[3] maps.

Where complete, the CFRAM OPW Flood Risk Assessment Maps are now the primary reference for flood risk planning in Ireland and supersede the PFRA maps. No CFRAM mapping has been completed for the area of the Application Site. The closest mapped CFRAM fluvial flood zones are located along the River Suir near Thurles, ~8.7km west of the Application Site.

4.3.6 OPW National Indicative Fluvial Flood Mapping

The National Indicative Fluvial Flood Mapping (NIFM) (www.floodinfo.ie) shows probabilistic fluvial flood zones for catchments greater than 5km^2 for which flood maps were not produced under the CFRAM Programme.

The Present-Day Scenario has been generated using methodologies based on historic flood data and does not consider the potential changes due to climate change. The potential effects of climate change on flooding have been separately modelled (see **Section 4.3.9** below.)

The National Indicative Fluvial Flood Map for the Present-Day Scenario records some flood zones within the northern section of Lanespark Bog. These modelled flood zones are associated with Black (Two Mile Borris) River and a small tributary which runs along the northern boundary of the bog (North Glengoole Stream). However, these flood zones do not encroach significantly upon the Application Site. Existing watercourse crossings (large diameter culverts) exist at these locations where the Bord na Móna railway line, and an adjacent machine pass, cross these watercourses. NIFM fluvial flood zones are also mapped along the Drish River to the northeast of Littleton Bog. However, these flood zones do not encroach upon the Application Site.

The NIFM flood zones in the local area are shown on **Figure J** below.

2 CFRAM is Catchment Flood Risk Assessment and Management. The national CFRAM programme commenced in Ireland in 2011 and is managed by the OPW. The CFRAM Programme is central to the medium to long-term strategy for the reduction and management of flood risk in Ireland.
3 Preliminary Flood Risk Assessment mapping.

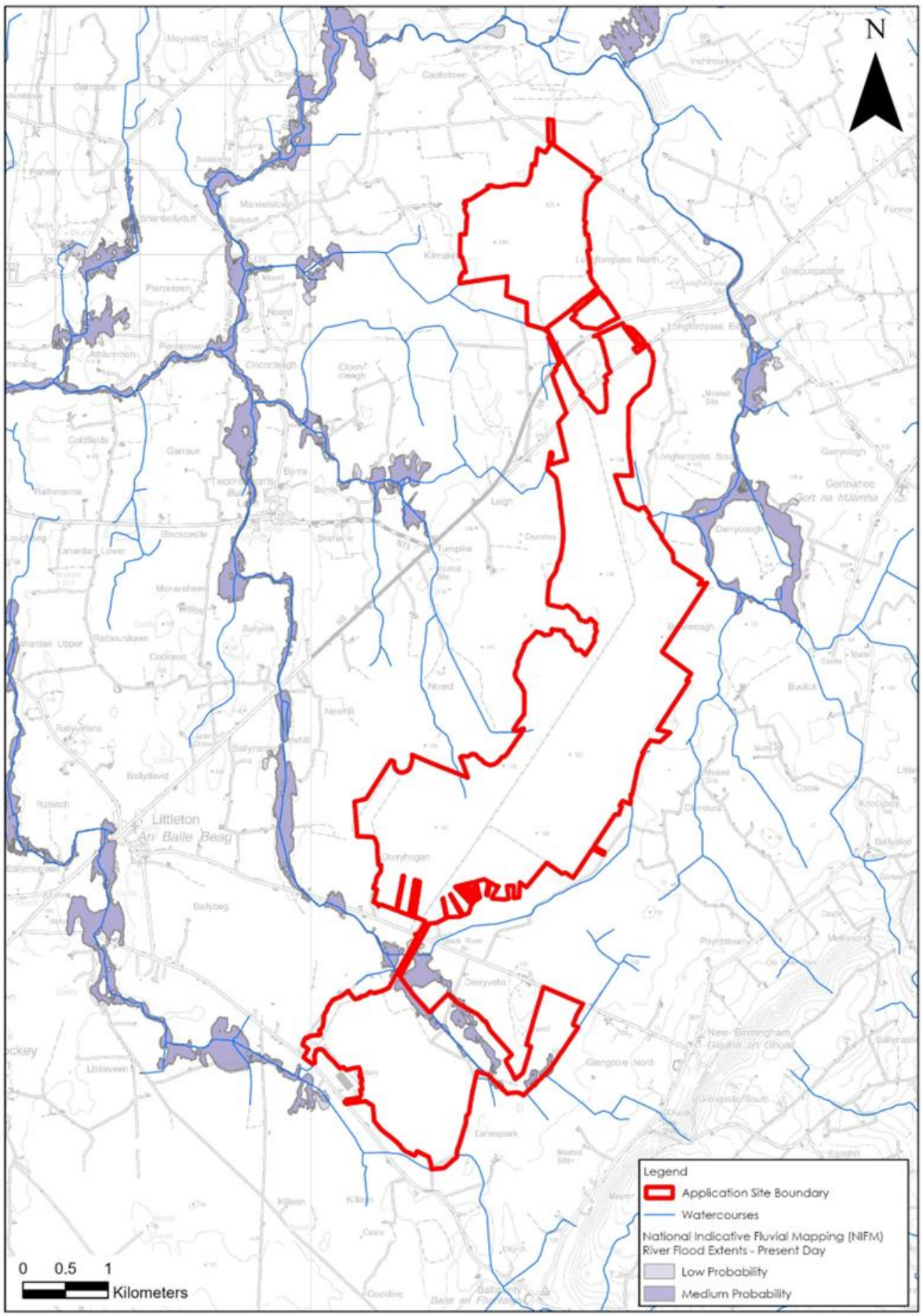

Figure J: National Indicative Fluvial Flood Mapping

4.3.7 Groundwater Flooding

The GSI Historical Groundwater flood map and the modelled groundwater flood extents map (www.floodinfo.ie) do not show the occurrence of any groundwater flooding within the Application Site.

The GSI's Historic Groundwater Flood Map records several small areas of groundwater flooding to the west of the Site. The closest historic groundwater flood zone is located ~1km to the west of Littleton Bog in the townland of Leigh. Meanwhile, a large area of groundwater flooding mapped ~1.2km to the northeast of the Longfordpass Bog in the townlands of Inchorourke and Derryfadda.

In addition, the GSI predictive groundwater flood maps do not record any zones of groundwater flooding within the Application Site.

4.3.8 Coastal Flooding

The Application Site is located in the Irish midlands and a significant distance (approximately 57km) from the coast. There is no risk of coastal flooding.

4.3.9 Climate Change

It is likely that climate change will have significant impacts on flooding and flood risk in Ireland due to rising sea levels, increased winter rainfall and more intense rainfall.

The National Indicative Fluvial Flood Mapping Mid-Range Future Scenario models flood extents based on a 20% increase in rainfall. Similarly, the National Indicative Fluvial Flood Mapping High-End Future Scenario models flood extends based on a 30% increase in rainfall. Both of these modelled flood extents show similar flood zones to the Present-Day Scenario discussed above in **Section 4.3.6.** Therefore, flood zones at the Application Site is unlikely to be significantly impacted by future climate change.

The CFRAM Programme has modelled flooding associated with potential 2 no. future climate change scenarios. The Mid-Range and High-End Future Scenario flood extents were generated using an increase in rainfall of 20% and 30% respectively. The extent of the CFRAM flood zones along the Suir River increase slightly for each future scenario. However, the low probability flood zone associated with the High-End Future Scenario does not encroach upon the Application Site.

Similarly, NIFM mapping has been modelled for the 2 no. potential future climate change scenarios. Both of these modelled flood extents show similar flood zones to the Present-Day Scenario discussed above in Section 4.3.6.

Therefore, flood zones at the Site are unlikely to be significantly impacted by future climate change.

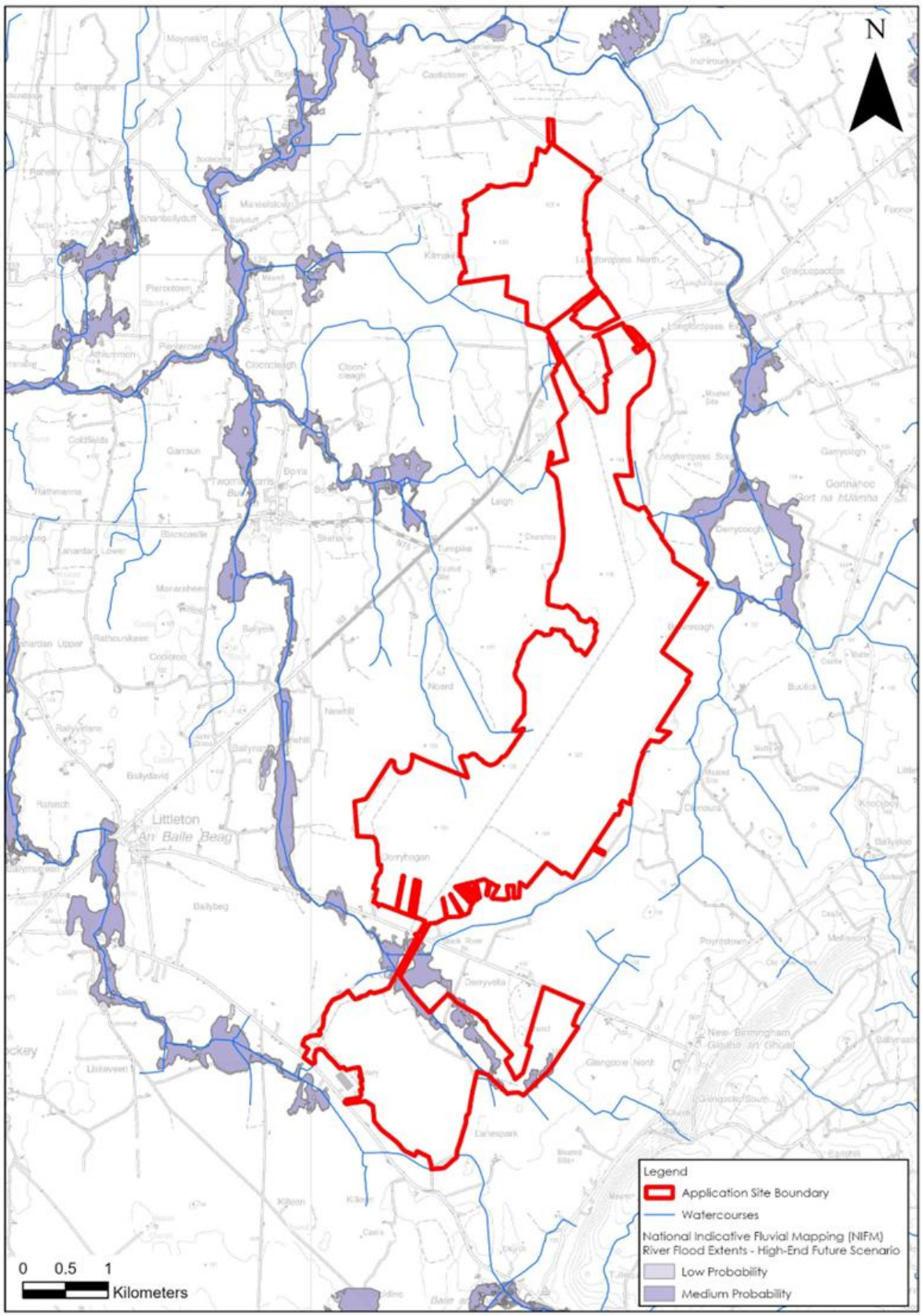

Figure K: High-End Future Scenario Fluvial Flood Zones

4.3.10 Drainage Schemes

'Benefited land' refers to land which has been drained as part of a drainage district. Drainage districts were carried out by the Commissioners of Public Works under a number of drainage and navigation acts from 1842 to the 1930s with the aim of improving the land for agriculture and to mitigate flooding. The works typically involved the deepening and widening of channels, the removal of weirs, the construction of embankments and the replacement or modification of bridges. These lands are mapped by the OPW and are available to view on www.floodinfo.ie.

The Application Site is not mapped as a drainage district. However, drainage districts are mapped in the surrounding lands along the Drish River and along the Black (Two Mile Borris) River. These watercourses are identified as drainage district channels. Local authorities are charges with the responsibility of maintaining these channels.

Benefited land is mapped immediately to the northeast of the northern section of Longfordpass Bog.

4.3.11 Site Walkover Surveys

HES completed site inspections, walkover surveys, drainage mapping at the Application Site as part of this remedial Environmental Impact Assessment (rEIAR) and to inform the proposed Littleton Wind Farm planning application. These site investigations comprised of peat probing and drainage mapping completed by HES on several dates between 2023 and 2025.

During the site walkover landuse across the Application Site was noted as comprising of cutover bog where peat extraction has previously occurred. Note that industrial peat extraction formally ceased at the Application Site in 2017. The bog was noted to be drained by regularly spaced field drains which drain towards larger arterial drains. Meanwhile certain areas of the Site have become overgrown, with peat extraction ceasing in these areas some time ago allowing vegetation to recover and recolonise the bare peat fields. At the boundaries of the bog surface water draining from the Application Site (Littleton, Lanespark, Longfordpass and Derryvella bogs) is routed via large settlement ponds prior to discharge to off-site drainage channels which flow into the local rivers and streams.

During the site walkover, flooded areas were noted on the lower peat fields towards the centre of Littleton Bog. Drainage is directed to these areas, which act as large settlement ponds. There is no discharge to surface waters across much of Littleton Bog. Water gathers in these large pools. Any recharge to ground is likely to be limited and localised due to the low permeability of the subsoil peat and underlying glacial mineral soils. If there were significant groundwater recharge rates, then the water levels in these ponded areas would drop in summer time. Such a fall in water levels was not recorded, indicating very low rates of groundwater recharge.

4.3.12 Hydrological Flood Conceptual Model

Based on the information gained through the flood identification process it is apparent that the vast majority of the Application Site is located within Flood Zone C. However, flood zones do exist at the Application Site. Some historic surface water flood zones are mapped by the GSI within the Application Site. NIFM fluvial flood zones are also mapped in the north of Lanespark Bog where existing watercourse crossings exist. Due to the low permeability of the soils and subsoils present at the Application Site, pluvial flooding and surface water ponding may also be an issue.

4.3.13 Summary – Baseline Flood Risk Definition

Based on the information gained through the flood identification process and Initial Flood Risk Assessment process it is apparent that the vast majority of the Application Site is located

in Flood Zone C. However, flood zones do exist at the Application Site with some historic surface water flood zones mapped by the GSI. NIFM fluvial flood zones are also mapped at an existing watercourse crossing in the north of Lanespark Bog. Due to the low permeability of the soils and subsoils present at the Application Site, pluvial and surface water flooding may occur following periods of intense or prolonged rainfall. The potential sources of flood risk for the Application Site are outlined and assessed in **Table B.**

Table B: S-P-R Assessment of Flood Sources for the Application Site

Source	Pathway	Receptor	Comment
Tidal	Not applicable	Land and infrastructure.	The Application Site is 57km from the coast and there is no risk of coastal flooding.
Fluvial	Overbank flooding of the surface waterbodies	Land and infrastructure.	The majority of the Application Site is located in Flood Zone C (Low Risk). However, some areas are mapped in fluvial flood zones along the Black (Two Mile Borris) River and the North Glengoole Stream.
Pluvial	Ponding of rainwater on site	Land and infrastructure.	The Application Site is generally flat and given the nature of the soils/subsoils, localised shallow pluvial flood is very likely after heavy or prolonged rainfall. Larger areas of flooding are present in the centre of Littleton Bog.
Surface water	Surface ponding/ Overflow	Land and infrastructure	Same as above (pluvial).
Groundwater	Rising groundwater levels	Land and infrastructure.	Based on the local hydrogeological regime and GSI groundwater flood mapping, no apparent risk from groundwater flooding.

5. FLOOD RISK ASSESSMENT – REMEDIAL PHASE

5.1 PHASE 2 REHABILITATION WORKS

The Remedial Phase includes the Phase 2 Rehabilitation works which are proposed to be completed in Derryvella Bog.

No additional rehabilitation works are proposed in Littleton, Lanespark or Longfordpass bogs, however some measures are ongoing at these bogs under Phase 1 rehabilitation, including revegetation and monitoring. As part of the ongoing Phase 1 rehabilitation, targeted active management, including the use of fertiliser to help promote re-colonisation will be completed, if natural re-colonisation has not progressed satisfactorily. Decommissioning works were completed during the Current Phase in these bogs.

The Phase 2 Rehabilitation works proposed in Derryvella include a series of short-term practical actions (0-2 years) and long-term actions (>3 years) and are detailed in Table 4-9 of Chapter 4 of the rEIAR. The measures include targeted drain blocking, along with fertiliser application targeting bare peat areas of headlands, high fields and other areas (where required) and hydrological management. A long-term goal also includes the decommissioning of silt ponds.

The Phase 2 Rehabilitation works plan uses bespoke interventions designed to first stabilise the environment and secondly to rehabilitate the site as much as possible by placing the existing peatland environments on a path towards naturally functioning peatlands. Rehabilitation allows a site to naturally colonise with vegetation to stabilise the bare peat production fields and minimise potential downstream water pollution and increased surface water runoff. Much of the physical work will occur during the initial stages. Once drain blocking and other measures have been implemented the operational activities will comprise non-intrusive ecological and hydrological monitoring and may also include minimal maintenance and repair works if/as those works are deemed necessary.

The Phase 2 Rehabilitation works, and the ongoing Phase 1 rehabilitation works, cannot be implemented without mitigation measures. All activities are required to operate in accordance with IPC Licence (P0499-01) until the licence is surrendered.

5.2 BASELINE HYDROLOGY & FLOOD RISK FOR PROPOSED REMEDIAL PHASE

The Phase 2 Rehabilitation Works will be implemented within Derryvella Bog, whilst the Phase 1 rehabilitation works will continue at Littleton, Lanespark and Longfordpass bogs. The baseline hydrology is therefore identical to the existing environment and catchment characteristics outlined in **Section 3** above. Similarly, the flood risk identification and assessment are identical to the flood risk identification and assessment as described above in **Section 4.3**.

5.3 DISCUSSION ON PROPOSED REMEDIAL PHASE FLOOD RISK & FLOOD RISK ASSESSMENT

Improvements in flow and water quality can be achieved through bog rehabilitation and rewetting at Derryvella Bog. The Phase 2 Rehabilitation works will generally involve the rewetting and revegetation of the drained cutover bog. The greatest hydrological/hydrogeological effects would be experienced in those areas selected for rewetting following ecological surveying. Rewetting will be achieved through measures such as drain blocking. These plans will likely have a positive effect on hydrogeology within the site where groundwater tables in the peat bogs are stabilised and closer to the bog surface. Water storage capacity within the site will therefore improve and reducing the risk of flooding

within the vicinity and downstream of the site. Elsewhere, where rewetting is not suitable the drainage regimes will remain relatively unchanged.

In order to be conservative, we have completed a Justification test below in **Section 5.4** for the Remedial Phase.

5.4 REQUIREMENT FOR A JUSTIFICATION TEST – REMEDIAL PHASE

A matrix of vulnerability versus flood zone is shown in **Table C**. This table is used to illustrate appropriate development types or indicate when a Justification Test is required.

It may be considered that the proposed Phase 2 Rehabilitation works can be categorised as a "Water Compatible development". The key rehabilitation plans to be implemented include regular drain blocking, blocking outfalls and managing water levels with overflow pipes which will improve water storage capacity within Derryvella Bog and will therefore improve and reduce the risk of flooding within the vicinity and downstream of the Application Site. Consequently, the proposed Remedial Phase is potentially not at risk of flooding and would not require further justification from a planning perspective.

Table C: Matrix of Vulnerability versus Flood Zone

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification test	Justification test	Appropriate
Less vulnerable development	Justification test	Appropriate	Appropriate
Water Compatible development	**Appropriate**	**Appropriate**	**Appropriate**

Note: Taken from Table 3.2 (DoEHLG, 2009)
***Bold:** Applies to this project site*

5.5 FLOOD RISK IMPLICATIONS ASSOCIATED WITH THE PROPOSED LITTLETON WIND FARM

Bord na Mona Powergen Ltd propose to develop a wind farm at Littleton and Lanespark bogs. The Proposed Development (i.e. the proposed Littleton Wind Farm) consists of an 11 no. turbine wind farm and associated infrastructure including internal access tracks, hard standings, additional amenity trails, an onsite borrow pit, peat deposition areas, a permanent meteorological mast, an onsite 110kV substation and associated grid connection infrastructure, internal electrical and communications cabling, temporary construction compounds, drainage infrastructure, biodiversity management and enhancement measures, temporary accommodation works along the Proposed Turbine Delivery Route and all associated works related to the construction of the Proposed Development. The Littleton Wind Farm development is subject to a separate Flood Risk Assessment (HES, 2026) which will accompany the planning application for the wind farm development.

The FRA for the wind farm development (HES, 2026) includes a flood risk identification study which identifies existing potential flood risks associated with the proposed Littleton wind farm (similar to Section 4 above). The FRA for the wind farm also includes an assessment of the risk of the wind farm development contributing to onsite and downstream flooding. The wind farm FRA found that the overall risk of flooding at the wind farm site (i.e. within the

Application Site) is low and all proposed infrastructure, including the proposed substation location, will be located at or above Flood Zone C elevations. The FRA also concludes that the risk of the wind farm contributing to downstream flooding is very low.

Furthermore, the proposed Littleton Wind Farm development and the Remedial Phase cumulatively will not result in an increase in flood risk due to the following:

- The majority of the proposed wind farm development infrastructures, including the proposed onsite substation are located in Flood Zone C;
- No wind farm infrastructure is proposed within Derryvella Bog;
- The footprint of the proposed wind farm infrastructure is minor in comparison to the scale of the bogs and the Application Site;
- The proposed wind farm drainage system will not significantly alter the existing drainage regime at the Application Site;
- The proposed wind farm drainage will be fully integrated into the existing bog drainage system and rehabilitation plans;
- All surface water from the wind farm drainage system will be treated via silt traps and settlement ponds, to ensure there is no deterioration in downstream surface water quality;
- The proposed wind farm drainage system will be designed to provide surface water attenuation with the drainage system limiting discharge from the wind farm site to greenfield runoff rates; and,
- As a result, there will be no increase in surface water discharge from the site as a result of the wind farm development.

Furthermore, the overall aim of the Phase 2 Rehabilitation works is to retain and slow down drainage within Derryvella Bog which will result in areas of the site being wetter for longer. Therefore, the proposed Phase 2 Rehabilitation works at the Application Site, the ongoing Phase 1 rehabilitation works, and the wind farm development will not result in any increased downstream flood risk.

6. REPORT CONCLUSIONS

- A flood risk identification study was undertaken to identify existing potential flood risks associated with the Application Site and the potential flood risks associated with the Remedial Phase. From this study:
    - No instances of historical flooding were identified in historic OS maps;
    - No instances of recurring flooding were identified on OPW maps within the Application Site;
    - The GSI Historical 2015/2016 flood mapping indicates that some area of the Application Site can be affected by surface water flooding;
    - The GSI Groundwater Flood Maps do not record any groundwater flood zones within the Application Site;
    - CFRAM maps for the local area do not show any fluvial flood zones within the Application Site;
    - The National Indicative Fluvial Flood Maps do record some fluvial flood zones within the Application Site, and in the vicinity of the Black (Two Mile Borris) River and North Glengoole Stream.
- The main risk of flooding across the Application Site is via pluvial flooding due to flat topography, and the low permeability of the residual peat soils and underlying subsoils;
- The Phase 2 Rehabilitation works proposed to be completed at Derryvella Bog whilst the Phase 1 rehabilitation works are ongoing at Littleton, Lanespark and Longfordpass bogs. The rehabilitation works can be categorised as a "Water Compatible Development" and a justification test is not therefore required. The Cutaway Bog Decommissioning and Rehabilitation Plans are designed to improve the hydrological regime within the Application Site and these measures will reduce flood risk in the vicinity and downstream of the Application Site; and,
- Cumulatively, the risk of the Remedial Phase (Phase 2 Rehabilitation works at Derryvella Bog and the ongoing Phase 1 rehabilitation works) and the proposed Littleton Wind Farm development contributing to downstream flooding is also very low, as the long-term plan is to retain and slow down drainage from the bog, and this will result in sections of the site being wetter for longer and therefore promoting more fen like conditions.

* *

7. REFERENCES

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HES	2026	Littleton Wind Farm, Co. Tipperary: Stage II - Site Specific Flood Risk Assessment

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APPENDIX 8.2

Water Framework Directive Assessment

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WATER FRAMEWORK DIRECTIVE ASSESSMENT
EXTRACTION AT LONGFORDPASS, LITTLETON, LANESPARK AND DERRYVELLA BOGS, CO. TIPPERARY

FINAL REPORT

Prepared for:

BORD NA MONA ENERGY LTD

Prepared by:

HYDRO-ENVIRONMENTAL SERVICES

DOCUMENT INFORMATION

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1. INTRODUCTION

1.1 BACKGROUND

Hydro-Environmental Services (HES) were requested by Fehily Timoney (FT), on behalf of Bord na Móna Energy Ltd, to complete a Water Framework Directive (WFD) Compliance Assessment for the effects of peat extraction and ancillary activities at Longfordpass, Littleton, Lanespark and Derryvella bogs, Co. Tipperary ("the Application Site").

The Application Site comprises of 4 no. bogs located in east Co. Tipperary. The bogs include Lanespark and Derryvella bogs in the south, Littleton Bog towards the center and Longfordpass Bog in the north. The Application Site comprises an areas of 1,616 hectares (ha). Bog drainage works began at the Application Site in 1941 followed by the commencement of peat extraction from 1952 which ceased in 2017.

The purpose of this WFD Compliance Assessment is to determine whether any specific components or activities associated with the peat extraction and ancillary activities at the Application Site have compromised WFD objectives or have resulted in a deterioration of the status of any waterbodies in the vicinity or downstream of the Application Site. The assessment will also determine if any of the decommissioning works or Phase 1 Rehabilitation works completed in accordance with the Decommissioning and Rehabilitation Plans for the bogs comprising the Application Site have compromised WFD objectives or have resulted in a deterioration of the status of any waterbodies in the vicinity or downstream of the Application Site. In addition, this assessment will determine whether any components or activities associated with the Phase 2 Rehabilitation works and associated activities will compromise WFD objectives or result in a deterioration of the status of any waterbodies in the vicinity or downstream of the Application Site. This assessment will determine the water bodies with the potential to be impacted, describe the control measures and determine if the peat extraction and ancillary activities have been in compliance with the objectives of the WFD since its required transposition into Irish Law in 2003.

This WFD Compliance Assessment is intended to supplement the remedial EIAR (rEIAR) submitted as part of the substitute consent application. For the purposes of this WFD Compliance Assessment, the various components are described and assessed using the following references:

- the 'Peat Extraction Phase' (2003 – 2017);
- the 'Current Phase' (2017 – Present Day); and,
- the 'Remedial Phase' (the activities intended to be carried out at the Application Site into the future).

Collectively, these phases are hereafter referred to as 'the Project'. The Project is described in full in Chapter 4 of the rEIAR.

1.2 STATEMENT OF AUTHORITY

Hydro-Environmental Services (HES) are a specialist geological, hydrological, hydrogeological and environmental practice that delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford. We routinely complete impact assessments for hydrology and hydrogeology for a large variety of project types including wind farms.

This WFD assessment was prepared by Michael Gill, Conor McGettigan and Nitesh Dalal.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 24 years' environmental consultancy experience in Ireland. He has also managed

EIAR assessments for infrastructure projects and private residential and commercial developments. In addition, he has substantial experience in wastewater engineering and site suitability assessments, contaminated land investigation and assessment, wetland hydrology/hydrogeology, water resource assessments, surface water drainage design and SUDs design, and surface water/groundwater interactions. For example, Michael has worked on the EIS/EIARs for Slievecallan Wind Farm, Cahermurphy (Phase I & II) Wind Farm, Carrownagowan Wind Farm, Garrane Green Energy Project and over 100 other wind farm related projects across the country. Michael has also worked on rEIARs for Cleanrath WF, 41 no. Bord na Móna bogs, the Ballivor Bog Group, and also for a number of quarry sites.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with 5 years' experience in the environmental sector in Ireland. Conor holds an M.Sc. in Applied Environmental Science (2020) and a B.Sc. in Geology (2016) from University College Dublin. Conor routinely prepares the hydrology and hydrogeology chapters of environmental impact assessment reports for wind farm developments. Conor has worked on the EIARs for over 20 no. wind farms projects across the country, including Ballivor Wind Farm, Seskin Wind Farm, Lackareagh Wind Farm, Knockshanvo Wind Farm and Garrane Green Energy Project. Conor prepared the hydrological and hydrogeological assessment of the rEIAR completed for the substitute consent application for the peat extraction activities at the Ballivor Bog Group.

Nitesh Dalal (B.Tech, PG Dip., MSc) is an Environmental Scientist with over 7 years' experience in environmental consultancy and environmental management in India and over 1 year environmental consultancy experience in Ireland. Nitesh holds a M.Sc. in Environmental Science from University College Dublin (2024), a PG Diploma in Health, Safety and Environment from Annamalai University, India (2021) and B.Tech. in Environmental Engineering (2016) from Guru Gobind Singh Indraprastha University, India (2016). Nitesh has been involved in the preparation of the land, soils and geology and water chapters of environmental impact assessment reports for several renewable energy developments. Nitesh has worked on the EIARs for several wind farms projects across the country, including Lemanaghan Wind Farm and Littleton Wind Farm.

1.3 WATER FRAMEWORK DIRECTIVE

The EU Water Framework Directive (2000/60/EC), as amended by Directives 2008/105/EC, 2013/39/EU and 2014/101/EU ("**WFD**"), was established to ensure the protection of the water environment. The Directive was transposed in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003).

The WFD requires that all member states protect and improve water quality in all waters, with the aim of achieving good status by 2027 at the latest. Any new development must ensure that this fundamental requirement of the WFD is not compromised.

The WFD is implemented through the River Basin Management Plans (RBMP) which comprises a six-yearly cycle of planning, action and review. RBMPs include identifying river basin districts, water bodies, protected areas and any pressures or risks, monitoring and setting environmental objectives. In Ireland the first RBMP covered the period from 2010 to 2015 with the second cycle plan covering the period from 2018 to 2021, and the third cycle covers the period from 2022 to 2027[1]. The RBMPs are forward looking.

[1] *The WFD RBMP cycles are forward looking plans, so 2009-2015 (1st Cycle), 2016-2021 (2nd Cycle), and 2022-2027 (3rd Cycle) are the plans and they use status from the previous 6 years.*
The EPA updates status every three years, but they also complete an additional assessment mid-RBMP cycle. The mid-cycle status does not get reported to the Commission.
The linkage between the two is that the 2nd Cycle plan uses the 2009-2015 status, the 3rd Cycle plan uses the 2016-2021 status. The 2013-2018 status was not used in the RBMP and the 2019-2024 status will not be used in the next RBMP.

The Water Action Plan 2024 is Ireland's 3rd River Basin Management Plan (2022 - 2027). The objectives of the Water Action Plan 2024 have been integrated into the design of the Proposed Development and include:

- Ensure full compliance with relevant EU legislation;
- Prevent deterioration;
- Meet the water standards and objectives for designated protected areas;
- Protect high-status waters; and,
- Implement targeted action and pilot schemes in focus sub-catchments aimed at (i) targeting water bodies close to meeting their objective and (ii) addressing more complex issues that will build knowledge for future cycles.

Our understanding of these objectives is that water bodies, regardless of whether they have 'Poor' or 'High' status, should be treated the same in terms of the level of protection and mitigation measures employed.

2. WATERBODY IDENTIFICATION AND CLASSIFICATION

2.1 INTRODUCTION

This section identifies those surface waterbodies (SWBs), groundwater bodies (GWBs) and protected areas with potential to be affected by peat extraction and ancillary activities completed during the Peat Extraction Phase, the decommissioning and Phase 1 Rehabilitation works completed during the Current Phase, and the proposed Phase 2 Rehabilitation works to be completed during the Remedial Phase. This section also reviews all available WFD information.

2.2 SURFACE WATERBODY IDENTIFICATION

Regionally the Application Site is located in River Suir surface water catchment within Hydrometric Area 16 of the South Eastern River Basin District. The Suir Catchment includes the area drained by the River Suir and all streams entering the tidal water between Drumdowney and Cheekpoint, Co. Waterford. The catchment has a total area of 3,542km^2. In the vicinity of the Application Site, the main tributary of the River Suir is the Drish River. This river discharges into the River Suir to the south of Thurles and ~7.7km west of the Application Site. The River Suir then continues to flow to the south, past Cahir, before it veers to the east, flowing through Clonmel, before it becomes tidal in the vicinity of Carrick-on-Suir.

More locally the Application Site is located in the Suir_040 WFD sub-catchment (Suir_SC_040) and is drained by the Drish River and its tributaries. This Application Site is mapped within a total of 9 no. WFD river sub-basins as detailed in the succeeding paragraphs.

- The southwest of Lanespark Bog is mapped in the Breagagh (Tipperary)_010 WFD river sub-basin. The closest mapped SWB to this area of the Application Site is the Breagagh (Tipperary)_010 River. This SWB flows to the southwest ~140m from the Application Site. Further downstream, the Breagagh (Tipperary)_010 SWB discharges into the Breagagh (Tipperary)_020 SWB which in turn discharges into the Drish_060 SWB near Archerstown Bridge to the south of Thurles, just upstream of its confluence with the River Suir.
- The north of Lanespark Bog and the east of Derryvella Bog are mapped in the North Glengoole_010 WFD river sub-basin. The North Glengoole_010 SWB flows to the southwest along the eastern boundary of Derryvella Bog before veering to the northeast and passing along the northern boundary of Lanespark Bog.
- A large area in the south of Littleton Bog is mapped in the Black (TwoMileBorris)_010 WFD river sub-basin. The Black (Two Mile Borris)_010 SWB is mapped to flow to the south/southeast along the eastern boundary of Littleton Bog. The Black (Two Mile Borris) River continues to flow to the northwest and discharges into the Drish_050 SWB to the north of Twomileborris.
- Much of the centre of Littleton Bog is mapped in the Clover_010 WFD river sub-basin. The Clover_010 SWB is mapped to flow to the northwest from this area of Littleton Bog. The Clover_010 SWB discharges into the Clover_020 SWB which in turn discharges into the Drish_050 SWB.
- A small area in the northwest of Littleton Bog is mapped in the Clover_020 WFD river sub-basin.
- The northeast of Littleton Bog is mapped in the Drish_010 WFD river sub-basin. The Drish_010 which flows to the north in this area.
- A small area in the north of Littleton Bog is mapped in the Drish_020 WFD river sub-basin. The Drish_020 SWB flows to the northwest ~1.3km from this area of the Application Site.
- The northern section of Longfordpass Bog is mapped in the Drish_030 WFD river sub-basin. The Drish_030 SWB flows to the west ~550m north from the Application Site.
- The majority of the Longfordpass Bog and a small area in the northwest of Littleton Bog are mapped in the Drish_050 WFD river sub-basin. The Drish_050 SWB is mapped by the EPA to flow along the western boundary of this area.

Figure A below is a local hydrology map of the area.

Table A presents the catchment area of each waterbody downstream of the Application Site as far as Upper Suir Estuary. The Breagagh (Tipperary)_010, North Glengoole_010 and Clover_010 SWBs in the vicinity of the Application Site have the smallest catchment areas (12.84, 12.32 and 8.83km^2 respectively). The catchment area increases progressively downstream with the Drish River having a catchment area of 205.62km^2 upstream of its confluence with the River Suir. In addition, **Table A** presents the area of the Application Site mapped within, and upstream of each SWB, as a percentage of the total catchment area for that SWB. Therefore, those SWBs which are located in close proximity to the Application Site are more susceptible to water quality impacts as a result of activities within the Application Site.

Table A: Downstream Catchment Size

WFD River Sub-Basin	Total Catchment Area (km^2)	Area of Application Site Mapped in Catchment to Waterbody (km^2)	Application Site as % Area of Catchment
Breagagh (Tipperary)_010	12.84	1.11	8.61%
Breagagh (Tipperary)_020	42.67	1.11	2.59%
North Glengoole_010	12.32	2.13	17.21%
Black (Two Mile Borris)_010	31.57	6.77	21.43%
Clover_010	8.83	3.91	44.31%
Clover_020	17.92	4.07	22.70%
Drish_010	24.37	1.08	4.41%
Drish_020	35.1	1.64	4.67%
Drish_030	48.11	2.18	4.53%
Drish_040	69.14	2.18	3.15%
Drish_050	130.63	15.05	11.52%
Drish_060	205.62	16.16	7.86%
Suir_070	442.89	16.16	3.65%
Suir_080	501.89	16.16	3.22%
Suir_090	806.35	16.16	2.00%
Suir_100	849.79	16.16	1.90%
Suir_110	1066.19	16.16	1.52%
Suir_120	1090.55	16.16	1.48%
Suir_130	1500.48	16.16	1.08%
Suir_140	1589.07	16.16	1.02%
Suir_150	1679.17	16.16	0.96%
Suir_160	1930.85	16.16	0.84%
Suir_170	2102.41	16.16	0.77%
Suir_180	2112.83	16.16	0.76%
Suir_190	2180.48	16.16	0.74%
Suir_200	2639.51	16.16	0.61%
Suir_210	2705.11	16.16	0.60%
Suir_220	2727.78	16.16	0.59%

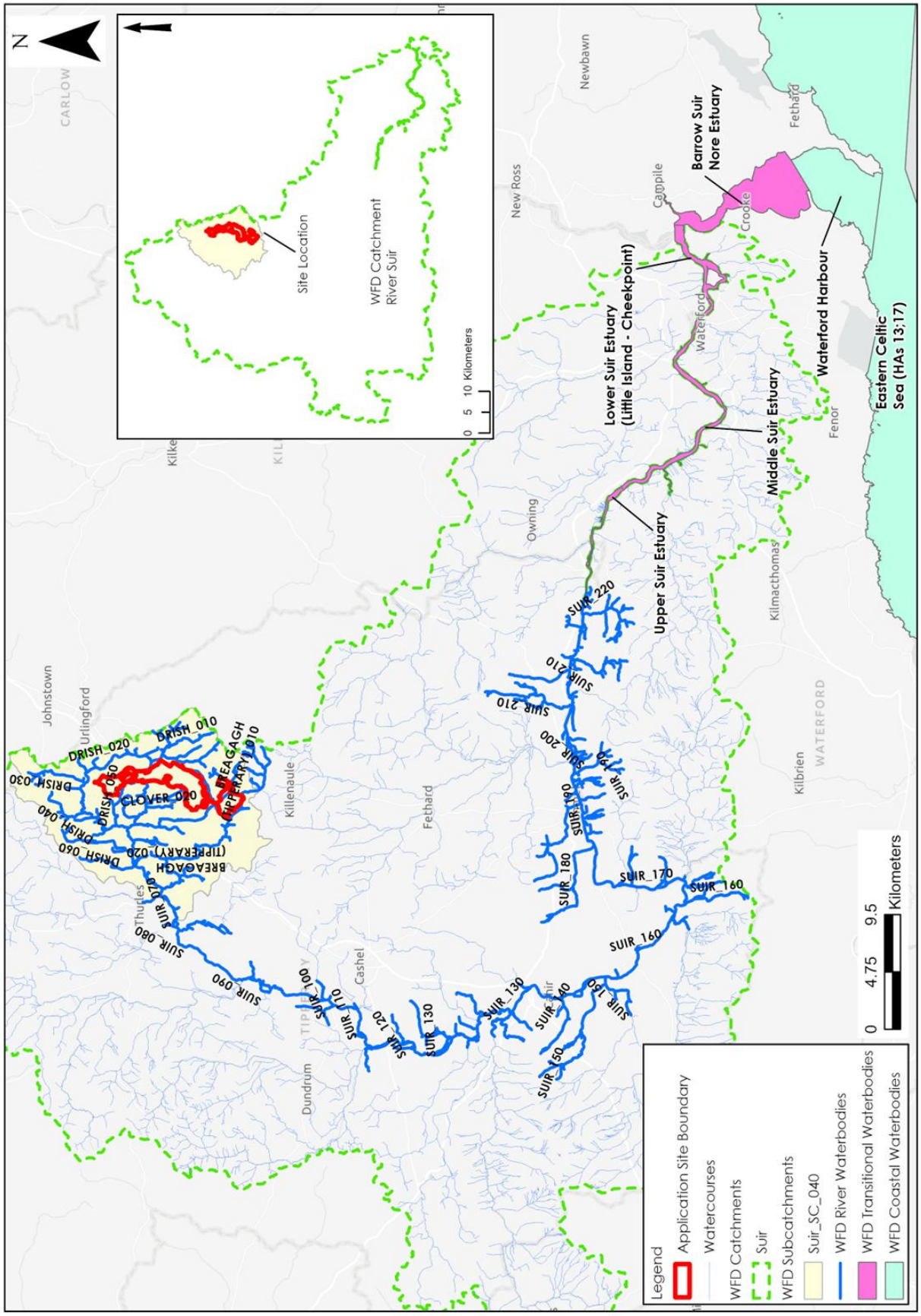

Figure A: Hydrological Setting and Downstream Surface Water Bodies

2.3 SURFACE WATER BODY CLASSIFICATION

A summary of the WFD status and risk result for Surface Water Bodies (SWBs) downstream of the Application Site are shown in **Table B**. The overall status is based on the ecological, chemical and quantitative status of each SWB. Local Groundwater Body (GWB) and Surface water Body (SWB) status information is available from (www.catchments.ie).

The Drish_010, Drish_020 and Drish_030 SWBs to the east and north of the Application Site achieved "Poor" status in the 3 no. most recent WFD cycles (2013-2018, 2016-2021 and 2019-2024). Further downstream the Drish_040 achieved "Moderate" status in the latest WFD cycle (2019-2024) which was an improvement from the "Poor" status which this SWB has achieved previously. Similarly, the Drish_050 SWB improved from "Poor" status to "Good" status in the latest WFD cycle. Meanwhile, the Drish_060 SWB achieved "Moderate" status.

The Clover_010 and Clover_020 SWBs to the west of Littleton Bog achieved "Poor" and "Moderate" status respectively. The North Glengoole_010, Breagagh (Tipperary)_010 and Black (Twomileborris)_010 SWBs also achieved "Poor" status in the latest WFD cycle. This represented a deterioration in status for the Black (Twomileborris)_010 SWB which had previously been of "Moderate" status. The Breagagh (Tipperary)_020 SWB achieved "Moderate" status and its status remained unchanged from the previous WFD cycle.

Downstream of its confluence with the Drish River, the River Suir (Suir_070 SWB) is of "Moderate" status. The WFD status of the River Suir (Suir_080 to Suir_220) further downstream and the transitional and coastal SWBs downstream of the Application Site are presented in **Table B**.

In terms of risk status, the majority of SWBs downstream of the Application Site have been deemed to be "at risk" of failing to meet their respective WFD objectives. Meanwhile, the risk status of the North Glengoole_010 and Breagagh_020 SWBs is currently "under review".

The 3rd Cycle Suir Catchment Report (EPA, 2024) states that excess nutrients remain the most prevalent issue in the Suir catchment, with agriculture being the significant pressure effecting the greatest number of waterbodies. Downstream of the Application Site agriculture is listed as being a significant pressure on the Drish_020, Drish_050, Clover_020 and Suir_070 SWBs. Agricultural issues in the Suir catchment relate to phosphorus loss to surface waters from, for example; direct discharges or runoff from yards, roadways or other compacted surfaces, or runoff from poorly draining soils. High nitrate concentrations have been identified in many waterbodies across the catchment and sediment is also a problem from land drainage works, bank erosion from animal access or stream crossings.

Forestry is listed as being a significant pressure on the Drish_020 and Clover_010 SWBs. Forestry activities including clear felling and drainage have resulted in heavy siltation and excess nutrients. Meanwhile, peat is listed as a significant pressure on several waterbodies in the vicinity and downstream of the Application Site. The 3rd Cycle Catchment Report states that the main issues relating to peat drainage are elevated ammonia concentrations, increased sedimentation and morphological impacts. Meanwhile, Lisheen mine has been identified as a significant pressure on the Drish_040 SWB resulting in elevated ammonia, increased sedimentation and morphological effects. The Suir_070 SWB is listed as being under significant pressure from urban wastewater. This pressure is associated with the Thurles wastewater treatment plant.

The risk status and pressures of all other SWBs downstream of the Application Site are detailed in **Table B**.

The SWB status for the 2019-2024 WFD cycle are shown on **Figure B**.

Table B: Summary WFD Information for Downstream Surface Water Bodies

River Waterbody	Status 2010-2015	Status 2013-2018	Status 2016-2021	Status 2019-2024	WFD 3rd Cycle Risk Status	WFD Pressures
Breagagh (Tipperary)_010	Unassigned	Moderate	Poor	Poor	At risk	Peat Drainage & extraction
Breagagh (Tipperary)_020	Unassigned	Good	Moderate	Moderate	Under review	None
North Glengoole_010	Unassigned	Poor	Poor	Poor	Under review	None
Black (Two Mile Borris)_010	Moderate	Moderate	Moderate	Poor	At risk	Peat Drainage & extraction
Clover_010	Poor	Poor	Poor	Poor	At risk	Industry and Forestry
Clover_020	Good	Moderate	Moderate	Moderate	At risk	Agriculture
Drish_010	Poor	Poor	Poor	Poor	At risk	Forestry
Drish_020	Unassigned	Poor	Poor	Poor	At risk	Agriculture, Peat Drainage & extraction and Forestry
Drish_030	Poor	Poor	Poor	Poor	At risk	Peat Drainage & extraction
Drish_040	Poor	Poor	Poor	Moderate	At risk	Peat Drainage & extraction and Mines & Quarries
Drish_050	Moderate	Poor	Poor	Good	At risk	Agriculture and Peat Drainage & extraction
Drish_060	Moderate	Moderate	Moderate	Moderate	At risk	Unknown
Suir_070	Good	Moderate	Moderate	Moderate	At risk	Agriculture, Urban Run-off and Urban wastewater
Suir_080	Good	Moderate	Moderate	Poor	At risk	Agriculture
Suir_090	Good	Moderate	Moderate	Poor	At risk	Agriculture and Hydromorphology
Suir_100	Good	Moderate	Moderate	Moderate	At risk	Agriculture
Suir_110	Good	Good	Good	Good	Not at risk	None
Suir_120	Good	Good	Moderate	Good	At risk	Agriculture
Suir_130	Good	Moderate	Moderate	Moderate	At risk	Forestry and Agriculture
Suir_140	Good	Moderate	Good	Good	Under review	None
Suir_150	Good	Moderate	Good	Moderate	Under review	None
Suir_160	Good	Good	Good	Good	Not at risk	None
Suir_170	Good	Good	High	Good	Not at risk	None
Suir_180	Good	Good	Good	Good	Not at risk	None

Suir_190	Good	Moderate	Good	Good	Not at risk	None
Suir_200	Good	Moderate	Moderate	Moderate	At risk	Forestry and Agriculture
Suir_210	Good	Moderate	Moderate	Moderate	At risk	Agriculture
Suir_220	Good	Poor	Moderate	Moderate	At risk	Agriculture
Upper Suir Estuary	Moderate	Poor	Bad	Poor	At risk	Agriculture
Middle Suir Estuary	Poor	Poor	Moderate	Moderate	At risk	Agriculture
Lower Suir Estuary (Little Island - Cheekpoint)	Moderate	Good	Moderate	Moderate	At risk	Agriculture
Barrow Suir Nore Estuary	Good	Moderate	Moderate	Moderate	At risk	Agriculture
Waterford Harbour	Good	Moderate	Moderate	Good	At risk	Agriculture and Urban Run-off
Eastern Celtic Sea (HAs 13;17)	Unassigned	Good	High	High	Not at risk	None

2.4 GROUNDWATER BODY IDENTIFICATION

The Application Site is underlain by a total of 5 no. bedrock geological formations. Much of the northern section of Littleton Bog is underlain by the Ballysteen Formation which consists of dark muddy limestones and shales. The south of Littleton Bog, the west of Lanespark Bog and the majority of Longfordpass Bog are underlain by the Waulsortian Limestones, comprising of massive, unbedded lime-mudstones. A small area in the northwest of Longfordpass Bog and a small area of Lanespark Bog are underlain by the Crosspatrick Formation which consists of pale-grey cherty crinoidal limestones. The southeast of Lanespark Bog and Derryvella Bog are underlain by the Aghmacart Formations, comprising of dark shaly micrite, peloidal limestone. A small area in the northeast of Littleton Bog is underlain by the Lisduff Oolite Member consisting of oolitic limestone.

The GSI classify the Waulsortian Limestones as a Regionally Important Aquifer - Karstified. The Ballysteen and Aghmacart Formations are classified as Locally Important Aquifers - Bedrock which is Moderately Productive only in Local Zones. The Crosspatrick Formation and the Lisduff Oolite Member are classified as Locally Important Aquifers - Bedrock which is Generally Moderately Productive.

In terms of Groundwater Bodies (GWBs) the Application Site is underlain by the Templemore and Thurles GWBs.

The GWB status for the 2019 – 2024 WFD cycle are shown on **Figure B**.

2.5 GROUNDWATER BODY CLASSIFICATION

Both GWBs underlying the Application Site achieved "Good" status in all WFD cycles (**Table C**). This status is defined based on the quantitative status and chemical status of each GWB.

Furthermore, the Thurles GWB underlying the Application Site has been deemed to be "not at risk" of failing to meet its respective WFD objectives. No significant pressures have been identified to be impacting this GWB. The Templemore GWB is 'at risk' of failing to achieve its WFD objectives with agriculture identified as a significant pressure on this GWB.

Table C: Summary WFD Information for Groundwater Bodies

GWB	Status 2010-2015	Status 2013-2018	Status 2016-2021	Status 2019-2024	WFD 3rd Cycle Risk Status	WFD Pressures
Templemore	Good	Good	Good	Good	At risk	Agriculture
Thurles	Good	Good	Good	Good	Not at risk	None

2.6 ZONE OF INFLUENCE

The Zone of Influence (ZoI) of the Application Site extends to the following SWBs and GWBS:

- River SWBs – Bregagh (Tipperary)_010, Bregagh (Tipperary)_020, North Glengoole_010, Black (Twomileborris)_010, Clover_010, Clover_020, Drish_010 to Drish_060, Suir_070 to Suir_140; and,
- GWBs – Templemore and Thurles GWBs.

Note that the conservative ZoI extends as far downstream as the Suir_140 SWB. It is considered that the Project had/has no potential to affect any SWBs located further downstream due to the large volumes of water within the River Suir and the increasing distance from the Application Site. This is considered to be a very conservative ZoI with the potential for any

effects on the River Suir considered to be very unlikely due to its large catchment area (refer to **Table A**).

2.7 PROTECTED AREA IDENTIFICATION

The WFD requires that activities are also in compliance with other relevant legislation, as considered below.

The potential effect of the Project on nature conservation designated sites, bathing waters, nutrient sensitive areas (NSAs), shellfish areas and drinking water protected area's (DWPAs) are also included as part of the WFD Compliance Assessment.

2.7.1 Nature Conservation Designations

Within the Republic of Ireland designated sites include Natural Heritage Areas (NHAs), Proposed Natural Heritage Areas (pNHAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs).

Ramsar sites are wetlands of international importance designated under the Ramsar Convention (adopted in 1971 and came into force in 1975), providing a framework for the conservation and wise use of wetlands and their resources.

There are no designated sites located within or in close proximity to the Application Site.

The Lower River Suir SAC (Site Code: 002137) is located ~9.3km west of the Application Site and is hydrologically connected to the Application Site via the Drish River (and its associated tributaries). The upper reaches of this SAC are associated with the Suir_080 SWB. This SAC consists of the freshwater stretches of the River Suir immediately south of Thurles and the tidal stretches as far as the confluence with the Barrow and Nore near Cheekpoint, Co. Waterford. The length of the shortest hydrological flowpath between the Application Site and the SAC is greater than 17km. With respect to timelines the Lower River Suir SAC was designated under the EU Habitats Directive, being formally designated in Irish law under S.I. 650/2004. However, the site has long been a Natura 2000 site, since 1992. Therefore, importantly, the baseline environment at the time of designation occurred during the Peat Extraction Phase.

The Cabragh Wetlands pNHA (Site Code: 001934) is located ~9.3km west of the Application Site and is hydrologically connected to the Application Site via the Drish River and the River Suir. The length of the hydrological flowpath between the Application Site and the pNHa is greater than 18km. This pNHA is associated with the Suir_080 SWB.

Other designated sites within 10km of the Application Site include:

- Kilcooly Abbey Lake pNHA (Site Code: 00958) located ~5.0km to the east. This pNHA is located in the River Nore surface water catchment. Therefore, there is no hydrological connection between the Application Site and this pNHA.
- The Loughans SAC and pNHA (Site Code: 00407) is located ~7.8km to the east. This SAC is located River Nore surface water catchment. Therefore, there is no hydrological connection between the Application Site and this SAC.
- Spahill and Clomantagh Hill SAC and pNHA (Site Code: 000849) is located ~9.8km northeast of the Application Site. This designated site is located in the River Nore surface water catchment. Therefore, there is no hydrological connection between the Application Site and this SAC.
- Cabragh Wetlands pNHA (Site Code: 001934) is located ~9.3km west of the Application Site. The Drish River acts as a hydrological barrier between the Application Site and this pNHA.
- Killough Hill pNHA (Site Code: 000959) is located ~8.3km west of the Application Site. The Breagagh and Black Rivers act as hydrological barriers between the Application Site and this designated site.

- Laffansbridge pNHA (Site Code: 000965) is located ~3.5km south of the Application Site. The Breagagh River acts as a hydrological barrier between the Application Site and this pNHA.

2.7.2 Bathing Waters

Bathing waters are those designated under the Bathing Water Directive (76/160/EEC) or the later revised Bathing Water Directive (2006/7/EC).

There are no bathing water sites located in the vicinity of the Application Site.

2.7.3 Nutrient Sensitive Areas

Nutrient Sensitive Areas (NSA) comprise Nitrate Vulnerable Zones and polluted waters designated under the Nitrates Directive (91/676/EEC) and areas designated as sensitive areas under the Urban Wastewater Treatment Directive (UWWTD)(91/271/EEC). Sensitive areas under the UWWTD are water bodies affected by eutrophication associated with elevated nitrate concentrations and act as an indication that action is required to prevent further pollution caused by nutrients.

The Suir River (Suir_070 to 090 SWBs) located downstream of the Application Site and within the ZoI are identified as an NSA. The Upper Suir Estuary, Middle Suir Estuary and Lower Suir Estuary (Little Island - Cheekpoint) transitional waterbodies located downstream of the Application Site and hydrologically connected via Suir River are also identified as NSA. However, these are outside of the ZoI and had no potential to be impacted by the Project.

2.7.4 Shellfish Waters

The Shellfish Waters Directive (2006/113/EC) aims to protect or improve shellfish waters in order to support shellfish life and growth.

The Lower Suir Estuary (Little Island – Checkpoint) and Barrow Suir Nore Estuary transitional waterbodies located downstream of the Application Site are mapped as Shellfish Waters.

2.7.5 Salmonid Waters

Within the ZoI the Suir_130 is identified as important Salmonid Waters.

2.7.6 Drinking Water

There are no SWB DWPA (Drinking Water Protected areas) located in the area or immediately downstream of the Application Site. The closest DWPA to the Application Site is the Suir_140 SWB located near Cahir. The length of the hydrological flowpath between the Application Site and this DWPA is in excess of 50km.

All GWBs underlying the Application Site are listed as DWPAs.

No source protection areas associated with any Public Water Supplies (PWS) or Group Water Schemes (GWS) are mapped within the Application Site. There are several public and group water schemes located within the ZoI including the Leigh GWS, the Newhill GWS, the Two-Mile-Borris PWS, the Moyne GWS, the Fethard Coalbrook PWS, the Fenor Inch GWS, and Longford Pass GWS. Note that these groundwater supplies will be assessed under the overall assessment on the underlying GWBs.

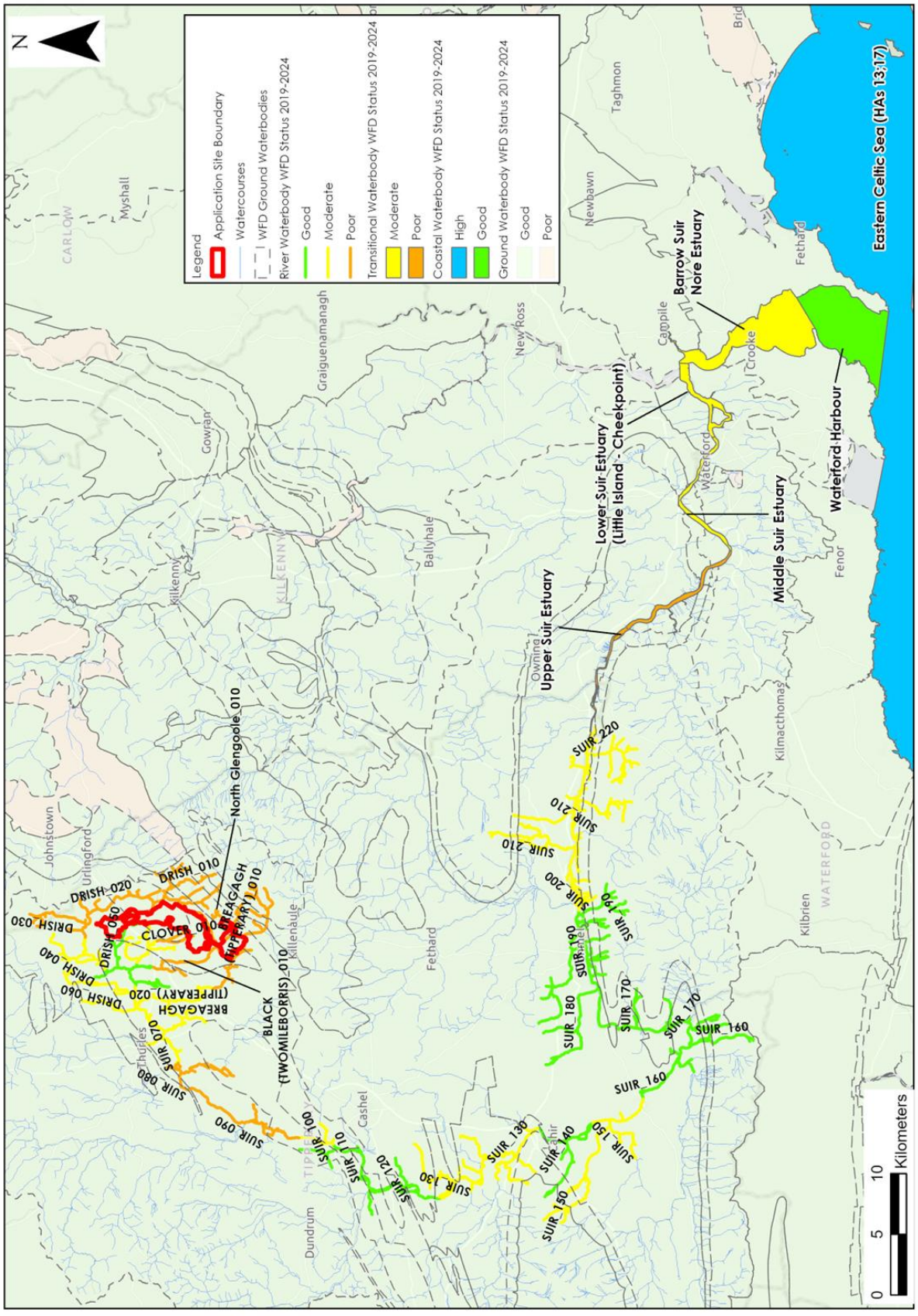

Figure B: WFD Groundwater and Surface Waterbody Status (2019 – 2024)

3. WFD SCREENING

3.1 SURFACE WATER BODIES

With respect to the Project, it is considered that the Breagagh (Tipperary)_010 and Breagagh (Tipperary)__020 SWB, the North Glengoole_010 SWB, the Black (TwoMileBorris)_010 SWB, the Clover_010 and Clover_020 SWBs and the Drish_010 to Drish_060 SWBs are included in the WFD Compliance Assessment. The Application Site discharges (discharged) to these SWBs via existing (former in the case of the outfalls to the Clover_010 to the west of Littleton Bog) surface water outfalls.

Downstream of the Drish River, the Suir River has been screened out of the WFD Compliance Assessment due to its distant location from the Application Site and the significant volumes of water within these SWBs. The significant flows are associated with the large upstream catchment area of the River Suir (refer to **Table A**). The Project had/has no potential to cause a deterioration in the status of these screened out SWBs and/or jeopardise their attainment of good surface water status.

Similarly, all the transitional and coastal SWBs have been screened out due to their distant location from the Application Site. The Project had/has no potential to cause a deterioration in the status of these screened out SWBs and/or jeopardise their attainment of good surface water status.

Regarding the SWBs which have been screened in, the potential of these SWBs to be impacted varies. This is dependent on the total area of the Application Site which drains to each SWB, the number of bog outfalls and the flow volumes within the receiving SWBs. As shown in **Table A**, the SWBs with the greatest potential to be impacted were the Breagagh (Tipperary)_010, North Glengoole_010 and Clover_010 SWBs.

3.2 GROUNDWATER BODIES

With respect to GWBs, the Templemore and the Thurles GWBs will be carried through to the WFD Compliance Assessment due to their proximal location directly underlying the Application Site.

3.3 PROTECTED AREAS

3.3.1 Nature Conservation Designations

The Lower Rover Suir SAC and the Cabragh Wetlands pNHA are included in the WFD Compliance Assessment for the purposes of an ultra-conservative assessment. Note that these designated sites are associated with the Suir_080 SWB and there is very limited potential for activities at the Application Site to effect the status of the SWB.

All other designated sites have been screened out of the assessment due to their distant location from the Application Site or the lack of hydrological/hydrogeological connectivity.

3.3.2 Bathing Waters

There are no bathing waters in close proximity to the Application Site.

3.3.3 Nutrient Sensitive Areas

The Suir_070 to Suir_140 NSA has been screened in for the purposes of an ultra-conservative assessment.

3.3.4 Shellfish Waters

There are no designated shellfish areas in close proximity to the Application Site.

3.3.5 Salmonid Waters

The Suir_130 SWB has been screened out of the WFD Compliance Assessment due to its distance location from the Application Site.

3.3.6 Drinking Water Protected Areas

The Suir_140 DWPA has been screened out due to the long hydrological flowpath between the Application Site and this DWPA.

All PWS and GWS will be included in the assessment under the overall qualitative and quantitative assessment completed for the underlying GWBs.

3.4 WFD SCREENING SUMMARY

A summary of WFD Screening discussed above is shown in **Table D**.

Table D: Screening of WFD Waterbodies and Protected Areas

Type	WFD Classification	Waterbody Name/ID	Inclusion in Assessment	Justification
Surface Water Body	River	Breagagh (Tipperary)_010	**Yes**	The southwest of Lanespark Bog is mapped in the Breagagh (Tipperary)_010 WFD river sub-basin. An assessment is required to consider the potential impacts that the Project had/may have on this SWB.
	River	Breagagh (Tipperary)_020	**Yes**	The Breagagh (Tipperary)_020 is mapped directly downstream of the Breagagh (Tipperary)_010. An assessment is required to consider the potential impacts that the Project had/may have on this SWB.
	River	North Glengoole_010	**Yes**	The north of Lanespark Bog and the east of Derryvella Bog are mapped in the North Glengoole_010 WFD river sub-basin. An assessment is required to consider the potential impacts that the Project had/may have on this SWB.
	River	Black (Two Mile Borris)_010	**Yes**	A large area in the south of Littleton Bog is mapped in the Black (TwoMileBorris)_010 WFD river sub-basin. An assessment is required to consider the potential impacts that the Project had/may have on this SWB.
	River	Clover_010	**Yes**	Much of the centre of Littleton Bog is mapped in the Clover_010 WFD river sub-basin. An assessment is required to consider the potential impacts that the Project had/may have on this SWB.
	River	Clover_020	**Yes**	The Clover_020 is mapped directly downstream of the Clover_010 and a small area of the Littleton Bog is mapped in the Clover_020 river sub-basin. An assessment is required to consider the potential impacts that the Project had/may have on this SWB.
	River	Drish_010	**Yes**	The northeast of Littleton Bog is mapped in the Drish_010 WFD river sub-basin. An assessment is required to consider the potential impacts that the Project had/may have on this SWB.
	River	Drish_020	**Yes**	A small area in the north of Littleton Bog is mapped in the Drish_020 WFD river sub-basin. An assessment is required to consider the potential impacts that the Project had/may have on this SWB.
	River	Drish_030	**Yes**	The northern section of Longfordpass Bog is mapped in the Drish_030 WFD river sub-basin. An assessment is required to consider the potential impacts that the Project had/may have on this SWB.
	River	Drish_040	**Yes**	The Drish_040 is mapped directly downstream of the Drish_030. An assessment is required to consider the potential impacts that the Project had/may have on this SWB.
	River	Drish_050	**Yes**	The majority of the Longfordpass Bog and a small areas in the northwest of Littleton Bog are mapped in the Drish_050 WFD river sub-basin. An assessment is required to consider the potential impacts that the Project had/may have on this SWB.
	River	Drish_060	**Yes**	The Drish_060 is mapped directly downstream of the Drish_050. An assessment is required to consider the potential impacts that the Project had/may have on this SWB.
	River	Suir_070	No	The Suir_070 SWB has been screened out due to its distant location from the Application Site and the large volumes of water within the River Suir associated with its large upstream

				catchment area (442km^2).
	River	Suir_080	No	The Suir_080 SWB has been screened out due to its distant location from the Application Site and the large volumes of water within the River Suir associated with its large upstream catchment area (501km^2).
	River	Suir_090	No	The Suir_090 SWB has been screened out due to its distant location from the Application Site and the large volumes of water within the River Suir associated with its large upstream catchment area (806km^2).
	River	Suir_100	No	The Suir_100 SWB has been screened out due to its distant location from the Application Site and the large volumes of water within the River Suir associated with its large upstream catchment area (849km^2).
	River	Suir_110	No	The Suir_110 SWB has been screened out due to its distant location from the Application Site and the large volumes of water within the River Suir associated with its large upstream catchment area (1,066km^2).
	River	Suir_120	No	The Suir_120 SWB has been screened out due to its distant location from the Application Site and the large volumes of water within the River Suir associated with its large upstream catchment area (1,090km^2).
	River	Suir_130	No	The Suir_130 SWB has been screened out due to its distant location from the Application Site and the large volumes of water within the River Suir associated with its large upstream catchment area (1,500km^2).
	River	Suir_140	No	The Suir_140 SWB has been screened out due to its distant location from the Application Site and the large volumes of water within the River Suir associated with its large upstream catchment area (1,589km^2).
Groundwater Body	Groundwater	Templemore	**Yes**	The Application Site overlies the Templemore GWB. An assessment is required to consider the potential impacts that the Project had/may have on this SWB.
	Groundwater	Thurles	**Yes**	The Application Site overlies the Thurles GWB. An assessment is required to consider the potential impacts that the Project had/may have on this SWB.
Protected Areas	Nature Conservation Designations	Lower River Suir SAC	**Yes**	The Lower River Suir SAC has been included for the purposes of an ultra-conservative assessment.
		Cabragh Wetlands pNHA	**Yes**	The Cabragh Wetlands pNHA has been included for the purposes of an ultra-conservative assessment.
		Kilcooly Abbey Lake pNHA	No	The Kilcooly Abbey Lake pNHA has been screened out due to lack of hydrological connection between this pNHA and the Application Site. Therefore, the historic or proposed activities have no potential to impact this pNHA.
		The Loughans SAC and pNHA	No	The Loughans SAC and pNHA has been screened out due to lack of hydrological connection between this SAC and pNHA and the Application Site. Therefore, the historic or proposed activities have no potential to impact this SAC and pNHA.
		Spahill and Clomantagh Hill SAC and pNHA	No	The Spahill and Clomantagh Hill SAC and pNHA has been screened out due to lack of hydrological connection between this SAC and pNHA and the Application Site. Therefore, the historic or proposed activities have no potential to impact this SAC and pNHA.
		Cabragh Wetlands	No	The Cabragh Wetlands pNHA has been screened out due to lack of hydrological

		pNHA		connection between this pNHA and the Application Site. Therefore, the historic or proposed activities have no potential to impact this pNHA.
		Killough Hill pNHA	No	The Killough Hill pNHA has been screened out due to lack of hydrological connection between this pNHA and the Application Site. Therefore, the historic or proposed activities have no potential to impact this pNHA.
		Laffansbridge pNHA	No	The Laffansbridge pNHA has been screened out due to lack of hydrological connection between this pNHA and the Application Site. Therefore, the historic or proposed activities have no potential to impact this pNHA.
	Nutrient Sensitive Area	Suir_070 to 090	**Yes**	The Suir_070 to 090 has been included for the purposes of an ultra-conservative assessment.
	Drinking Water Protected Area	Suir_140	No	The Suir_140 has been screened out due to its distant location from the Application Site and the large volumes of water within the River Suir associated with its large upstream catchment area.

4. WFD COMPLIANCE ASSESSMENT (ASSESSING THE EFFECT OF PREVIOUS ACTIVITIES)

4.1 PEAT EXTRACTION ACTIVITIES (PRE-2003)

The Application Site has been subject to peat extraction and ancillary activities since 1941, i.e. for more than 60 years before the WFD existed.

The primary hydrological and hydrogeological changes associated with the peat extraction process occurs during the initial drainage of the bog in advance of peat extraction. Constructed drainage ditches drained the upper surface of the bog by lowering the local peat water table. At this time, ancillary features were also constructed including railway lines. After the Application Site was drained, vegetation was removed from the bog surface, leaving only bare peat fields between the drains. During the Peat Extraction Phase, only minimal landuse change occurs which predominantly relate to minor annual topographic changes (i.e., lower ground levels) caused by ongoing peat extraction.

The timing of drainage and initiation of peat extraction varies across the Application Site. The first drainage occurred in 1941 in Littleton Bog, with peat extraction commencing in this bog in 1952. Drainage and site clearance commenced at Longfordpass Bog in 1948, with extraction also commencing in 1952. Drainage was installed across Lanespark and Derryvella bogs in 1968 and peat extraction commenced in these bogs in 1973. Therefore, peat extraction was ongoing for a significant period of time by 2003 and the transposition of the WFD into law.

Prior to 2001, peat extraction and ancillary activities were not subject to IPC Licence controls. However, management of silt in discharges was always implemented, and this became formalised in the 1970s with the setting up of the silt committees within Bord na Móna. Also, since 1988, environmental monitoring and control measures in the form of silt ponds have been utilised at the Application Site with the aim of minimising the concentrations of suspended solids entering local watercourses.

Due to the nature of peat extraction and ancillary activities being near-surface activities, impacts on groundwater are generally negligible. Any groundwater impacts will be contained within the bog basin which is typically isolated from the underlying bedrock groundwater body due to a substantial thickness impermeable lacustrine deposits which underlies the basin peat. Therefore, surface water is the main sensitive receptor. The primary risks to groundwater at the Application Site was from cementitious materials and hydrocarbon spillage and leakages. The primary risk to surface waters will be entrained suspended sediments (peat and soil particles) in site runoff during peat extraction and ancillary activities along with potential hydrocarbons spillage and leakages.

There is no requirement to assess the peat extraction and ancillary activities at the Application Site with respect to the WFD which pre-date 2003 (i.e. the required transposition of the WFD Directive into Irish Law).

However, for completeness and in order to describe the baseline environment we provide a brief discussion on the potential impacts of peat extraction and ancillary activities on water quality and water quantity and present the available water quality data for this period.

4.1.1 Effects

4.1.1.1 Surface Water Quantity/Quality

Peat in its natural state can act as a sponge providing storage of water after rainfall. However, with the implementation of bog drainage, the water levels in the peat bog were lowered and the capacity of the bog to store water was reduced. The available water storage within the bog would have provided a small buffer for downstream flooding.

However, following drainage, surface runoff rates from the Application Site would have increased slightly causing downstream rivers and streams to become flashier (faster and higher flood peaks). However, drainage from the Application Site is regulated by the shallow (low gradient) nature of the drainage, and by routing all bog drainage via field drains, main drains, headland drains, pumps (where required) then from silt ponds to outfalls, with final discharge to natural watercourses. The bog drainage network likely alters flow volumes entering downstream surface waterbodies due to the increased connectivity of drains to the river network.

In terms of surface water quality, the primary potential negative impact on surface water quality would be the increase in suspended solid entrainment in surface waterbodies. The greatest risk of suspended sediment entrainment occurs during times of major earthworks, such as during the removal of vegetation and the construction of the bog drainage network. During the Peat Extraction Phase, there was an ongoing risk of elevated concentrations of suspended solids making their way into downstream surface watercourses from the erosion and transport of peat sediment via the bog drainage network. This potential pathway would have posed a significant risk to local surface water quality. The largest potential negative water quality effect would have occurred in those surface waterbodies directly downstream of the outfalls from the Application Site.

4.1.1.2 Effects from Hydrocarbon Leakages and Spills

Accidental spillage during refuelling of peat extraction plant and machinery with petroleum hydrocarbons is a major pollution risk to groundwater and surface water quality. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. It is also a nutrient supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in waters, resulting in the death of aquatic organisms.

Potential accidental wastewater discharges from on-site welfare facilities (local holding area sand workshop/office facilities) have the potential to impact on groundwater and surface water quality. Runoff from concrete works can also impact on surface water and groundwater quality.

Furthermore, discharges from wastewater systems (septic tanks) at office buildings, and at welfare facilities and workshops could potentially have caused surface water contamination.

4.1.2 Baseline Water Quality

4.1.2.1 Pre-2003

As the 1st WFD cycle was completed in 2010-2015, no WFD status reports exist for this period (pre-2003). However, the EPA have been completing ecological monitoring on these watercourses since the 1970s. The Biological Q-Value is a water quality rating system based on both the habitat and the invertebrate community assessment and is divided into status categories[2] (Q-values) ranging from 0-1 (Poor) to 4-5 (Good/High) (refer to **Table E**). These historic Q-values guide our estimates of the health of the waterbodies during this period.

Historic Q-values for SWBs directly downstream of the Application Site are summarized in in **Figure C**. In the late 1980s and 1990s many of the watercourses in the vicinity and downstream of the Application Site achieved moderate to good Q-status. However, bad Q-status was recorded at stations on the Clover River and the Drish River.

[2] *Referred to hereinafter as 'Q-status' in order to differentiate between the EPA Q-Rating status, which is based solely on ecological parameters, and the WFD status which is a combination of ecological and chemical parameters.*

Table E: EPA Q-Rating System

EPA Q-Rating	EPA Q-Status	Pollution Status	Waterbody Condition
Q5/Q4-5	High Q-Status	Unpolluted	Satisfactory
Q4	Good Q-Status	Unpolluted	Satisfactory
Q3-4	Moderate Q-Status	Slightly Polluted	Unsatisfactory
Q3/Q2-3	Poor Q-Status	Moderately Polluted	Unsatisfactory
Q2/Q1-2/Q1	Bad Q-Status	Seriously Polluted	Unsatisfactory

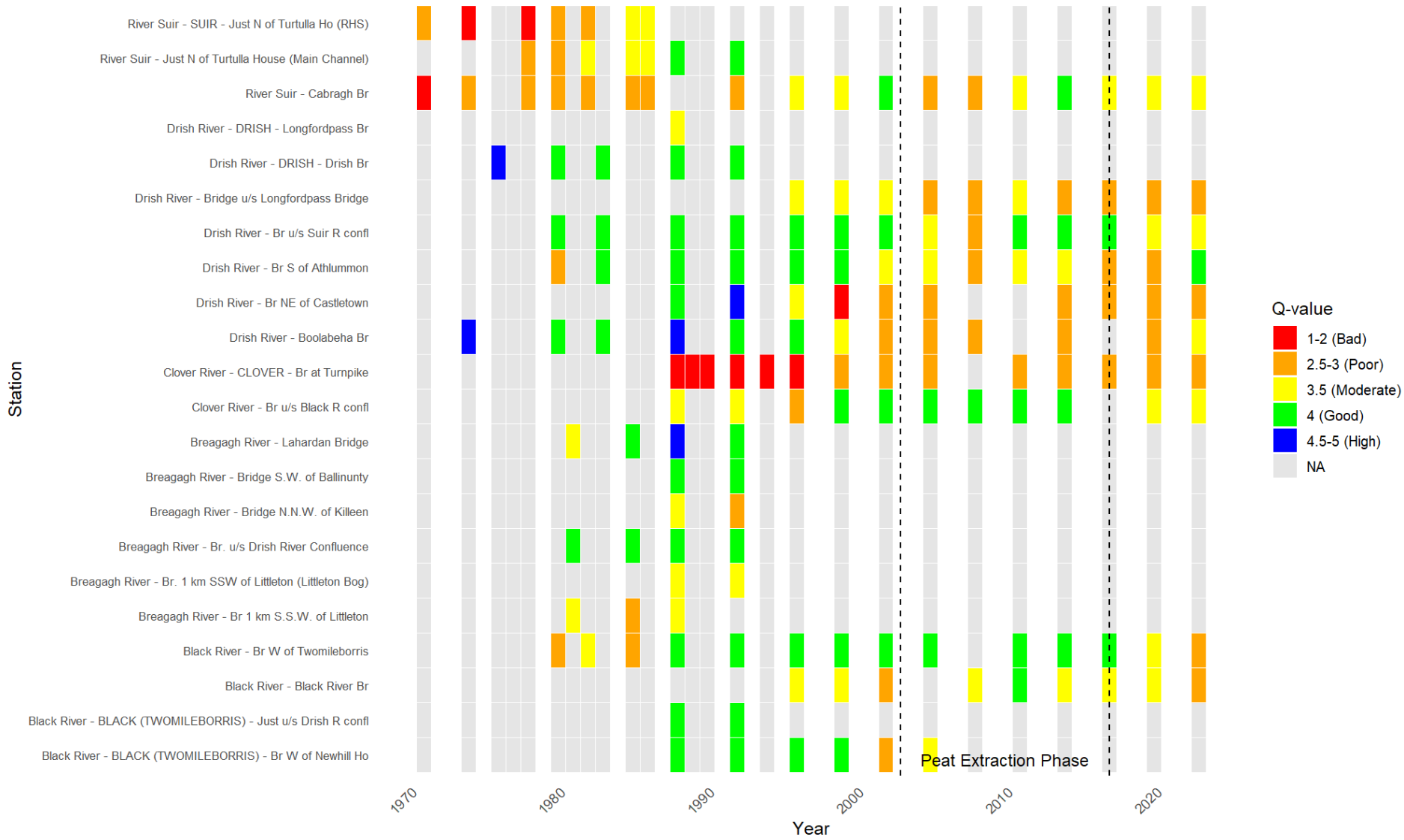

Figure C: Q-Ratings on the Breagagh, Clover, Black, Drish and Suir Rivers

4.2 PEAT EXTRACTION PHASE (2003-2017)

This phase includes all peat extraction and ancillary activities from the required transposition of the WFD into Irish Law in 2003 to the formal cessation of industrial peat extraction in 2017. During this time period, peat extraction and ancillary activities at the Application Site were completed under the conditions set out in IPC Licence No. P0499-01. This IPC Licence came into effect in 2001 and upgraded and enhanced several pre-existing environmental monitoring and control measures which had been implemented at the Application Site since and pre-1988 (refer to Section 4.3.5 of rEIAR Chapter 4 for a complete description of the measures). These pre-IPC measures largely included the incorporation of silt ponds into the bog drainage system to minimise the concentrations of suspended solids entering local watercourses. Further amendments were made to the IPC Licence conditions in 2003 following the required transposition of the WFD into Irish Law. The Application Site also has a Surface Water Management Plan which defines how compliance with the Licences is achieved. Therefore, throughout this phase peat extraction and ancillary activities have been operating under strict conditions designed to protect downstream water quality and quantity.

4.2.1.1 2002/2003 to 2017

As the 1st WFD cycle was completed in 2010-2015, no WFD status exists for the first half of this period. However, EPA Q-values are available from 2002 to 2017 for all watercourses downstream of the Application Site and are summarized in **Table F** and presented graphically presented in **Figure C**. The data shows fluctuating Q-ratings during this period with the majority of watercourses fluctuating between Q3 ("Poor" Q-rating) and Q4 ("Good" Q-rating).

We consider that with the implementation of the control measures in accordance with IPC Licence Requirements the potential WFD status of the SWBs during the early years postdating the WFD phase were comparable to those recorded in the 1st WFD cycle (2010-2015).

Table F: Summary Historic Q-values (2002/2003 to 2017)

River	Station ID	Location	No. of Rounds (Years)	Q-Status Range
Black River	RS16B010100	Br W of Twomileborris	5 (2002 – 2017)	Q4
	RS16B010030	Black River Br	5 (2002 – 2017)	Q3 – Q4
	RS16B010090	BLACK (TWOMILEBORRIS) - Br W of Newhill Ho	2 (2002 – 2005)	Q3 – Q3.5
Clover River	RS16C040100	CLOVER - Br at Turnpike	5 (2002 – 2017)	Q3
	RS16C040300	Br u/s Black R confl	5 (2002 – 2014)	Q4
Drish River	RS16D020070	Br NE of Castletown	4 (2002 – 2017)	Q2.5 – Q3
	RS16D020100	Boolabeha Br	4 (2002 – 2014)	Q3
	RS16D020040	Bridge u/s Longfordpass Bridge	6 (2002 – 2017)	Q3 – Q3.5
	RS16D020200	Br S of Athlummon	6 (2002 – 2017)	Q3 – Q3.5
	RS16D020400	Br u/s Suir R confl	6 (2002 – 2017)	Q3 – Q4
Suir River	RS16S020500	Rossestown Br	6 (2002 – 2017)	Q3.5 – Q4
	RS16S020900	Cabragh Br	6 (2002 – 2017)	Q3 – Q4
	RS16S020600	Thurles Br	6 (2002 – 2017)	Q3 – Q3.5

4.2.2 Effects

4.2.2.1 Surface Water Quality Effects from Bog Drainage

During this period the Application Site operated in accordance with IPC Licence conditions which put in place a series of control measures designed for the protection of surface water quality in the vicinity and downstream of the Application Site. These measures included:

- All surface water runoff from the peat extraction areas was treated via an appropriately designed silt pond treatment system which has been inspected and maintained in accordance with Condition 6 of the IPC Licence. Treated surface water was discharged into nearby surface watercourses, with quarterly grab sampling completed on a select number of discharge outlets;
- Stormwater derived on-site is released into a local waterbody following basic treatment.

Bord na Móna have been conducting monitoring of emissions to water from the Application Site with the results summarised in **Table G** below.

We consider that the status of the SWBs at this time was comparable to those recorded during the 1st WFD round. The monitoring and requirements of the IPC licence would have ensured that peat extraction and ancillary activities were not adversely impacting water quality in downstream receptors.

A summary of potential status change to SWBs arising from potential surface water quality impacts from peat extraction and ancillary activities, during the mitigated Peat Extraction Phase are outlined in **Table H.**

Table G: Bord na Móna Water Quality Monitoring (2002-2024)

Parameter	ELV	No. samples (n)	No. Exceedances	% Compliant
Suspended Solids (mg/l)	35	253	6	98%
Total Solids (mg/l)		229	NA	NA
Ammonia (mg/l)	4	253	0	100%
Total Phosphorus (mg/l)	-	253	NA	NA
pH	6.5 – 9.5	253	0	100
Colour		237	NA	NA
COD (mg/l)	100	253	19	92%

Table H: Surface Water Quality Effects During Mitigated Peat Extraction Phase

SWB	WFD Code	Assessed Post-IPC Licence Status (2002-2010)	WFD Cycle 1 Status (2010-2015) (WFD Cycle 2 where no Cycle 1 status is available)
Breagagh (Tipperary)_010	IE_SE_16B030200	Moderate	Unassigned (Moderate)
Breagagh (Tipperary)_020	IE_SE_16B030400	Good	Unassigned (Good)
North Glengoole_010	IE_SE_16N280780	Poor	Unassigned (Poor)
Black (Twomileborris)_010	IE_SE_16B010100	Moderate	Moderate
Clover_010	IE_SE_16C040100	Poor	Poor
Clover_020	IE_SE_16C040300	Good	Good
Drish_010	IE_SE_16D020040	Poor	Poor
Drish_020	IE_SE_16D020068	Poor	Unassigned (Poor)
Drish_030	IE_SE_16D020070	Poor	Poor
Drish_040	IE_SE_16D020100	Poor	Poor
Drish_050	IE_SE_16D020200	Moderate	Moderate
Drish_060	IE_SE_16D020400	Moderate	Moderate

4.2.2.2 Groundwater Quality Effects from Leakages and Spills

The Application Site has been regulated by the EPA under IPC Licence Registration No. P0499-01 since 17th August 2001. Compliance with the IPC Licence requires a series of water quality protection controls. The list below outlines control measures conditioned under the IPC licencing regime, as regulated by the EPA:

- *Effective spill/leak management of mobile fueling units;*
- *Replacement (and remediation where necessary) of all underground fuel tanks;*
- *There shall be no other emissions to water of environmental significance;*
- *All tank and drum storage areas shall be rendered impervious to the materials stored therein. In addition, tank and drum storage areas shall, as a minimum be bunded;*
- *Drainage from bunded areas shall be diverted for collection and safe disposal;*
- *The integrity and water tightness of all the bunding structures and their resistance to penetration by water or other materials stored therein shall be tested and demonstrated by the licensee to the satisfaction of the Agency and shall be reported to the Agency within eighteen months from the date of grant of this licence and every two years thereafter;*
- *The loading and unloading of fuel oils shall be carried out in designated areas protected against spillage and leachate run-off;*
- *While awaiting disposal, all materials shall be collected and stored in designated areas protected against spillage and leachate run-off;*
- *Except for roof water, all surface water discharges from workshop areas shall be fitted with oil interceptors;*

- *An inspection for leaks on all flanges and valves on over-ground pipes used to transport materials other than water shall be carried out weekly;*
- *The licensee (BnM) shall undertake a programme of testing and inspection of underground fuel pipelines to ensure that all underground fuel lines are tested at least every three years; and,*
- *The licensee shall have in storage an adequate supply of containment booms and/or suitable absorbent material to contain and absorb any spillage.*

Due to the local hydrogeological regime, and the isolated perched water table in the peat bog of the Application Site which is separated from the underlying regional groundwater table, we consider that no change occurred in the status of the underlying GWBs during the Peat Extraction Phase (refer to **Table I**).

Table I: Groundwater Quality Effects during Unmitigated Operational Phase

GWB	WFD Code	Assessed Post IPC Licence Status (2002-2010)	WFD Cycle 1 Status (2010-2015)
Templemore	IE_SE_G_131	Good	Good
Thurles	IE_SE_G_158	Good	Good

4.2.2.3 Surface Water Quality Effects from Leakages and Spills

The Application Site has been regulated by the EPA under IPC Licence Registration No. P0499-01 since 17th August 2001. The Application Site also has a Surface Water Management Plan which defines how compliance with the Licence is achieved via various control measures.

Therefore, with the implementation of the control measures set out in the IPC licence, peat extraction and ancillary activities during the Peat Extraction Phase did not result in a significant deterioration in surface water quality due to leakages and spills.

A summary of potential status change to SWBs arising from leakages and spills during the mitigated Peat Extraction Phase are outlined in **Table J**.

Table J: Surface Water Quality Effects from Leakages and Spills during Mitigated Peat Extraction Phase

SWB	WFD Code	Assessed Post IPC Licence Status (2002-2010)	WFD Cycle 1 Status (2010-2015) (WFD Cycle 2 where no Cycle 1 status is available)
Breagagh (Tipperary)_010	IE_SE_16B030200	Moderate	Unassigned (Moderate)
Breagagh (Tipperary)_020	IE_SE_16B030400	Good	Unassigned (Good)
North Glengoole_010	IE_SE_16N280780	Poor	Unassigned (Poor)
Black (Twomileborris)_010	IE_SE_16B010100	Moderate	Moderate
Clover_010	IE_SE_16C040100	Poor	Poor
Clover_020	IE_SE_16C040300	Good	Good
Drish_010	IE_SE_16D020040	Poor	Poor

SWB	WFD Code	Assessed Post IPC Licence Status (2002-2010)	WFD Cycle 1 Status (2010-2015) (WFD Cycle 2 where no Cycle 1 status is available)
Drish_020	IE_SE_16D020068	Poor	Unassigned (Poor)
Drish_030	IE_SE_16D020070	Poor	Poor
Drish_040	IE_SE_16D020100	Poor	Poor
Drish_050	IE_SE_16D020200	Moderate	Moderate
Drish_060	IE_SE_16D020400	Moderate	Moderate

4.2.2.4 Effects on Protected Areas

Due to the significant distance of the relevant designated sites from the Application Site and the large volumes of water within the River Suir, it is considered impacts to surface water which may have arisen during the Peat Extraction Phase could not have affected the conservation objectives of the relevant downstream designated sites.

Furthermore, during this period peat extraction and ancillary activities at the Application Site operated in accordance with IPC licence conditions which put in place a series of control measures designed for the protection of surface water quality in the vicinity and downstream of the Application Site. Therefore, it can be concluded that the potential to affect the qualifying interests of the downstream Lower River Suir SAC and Cabragh Wetlands pNHA, throughout the Peat Extraction Phase was negligible.

The potential effects on local PWSs and GWSs was also negligible due to the local hydrogeological regime which is characterised by high rates of surface water runoff and very low rates of groundwater recharge.

4.3 CURRENT PHASE (2017 – PRESENT DAY)

The Current Phase of the Project includes all activities carried out at the Application Site from the cessation of peat extraction in 2017 to the present day.

During this period activities at the Application Site have been included the undertaking of decommissioning activities. To date the decommissioning activities completed at the Application Site include the removal of remaining peat stockpiles from the bogs, which was completed by mid-2019, and the removal of railway infrastructure from Lanespark and Derryvella bogs in 2024.

In addition to the Decommissioning activities, and Phase 1 Rehabilitation works have been completed during the Current Phase in accordance with the Cutaway Bog Decommissioning and Rehabilitation Plans (Appendix 4-2). The Phase 1 Rehabilitation works commenced at the Application Site between 2018 and 2021 and comprised of extensive drain-blocking and hydrological management.

During this phase environmental monitoring and drainage and silt maintenance continued in accordance with IPC licence conditions.

4.3.1 Surface Water Quality Effects from Bog Drainage

During the Current Phase, Phase 1 Rehabilitation Works were completed across the Application Site as part of the Decommissioning and Rehabilitation Plans. The overall aim of

the rehabilitation plan is to put the Application Site on a trajectory towards becoming a naturally functioning peatland. The drainage system for peat extraction was designed to lower the local water table in the bog. This lowered peat water table does not support typical bog communities. Therefore, in order to achieve the aims of the rehabilitation plans, it was necessary to alter the drainage regime at the Application Site through extensive drain blocking and hydrological management. These works were completed between 2018 and 2021 and will encourage natural re-vegetation of the cutaway areas with typical bog communities in the future. The drain blocking has established a more suitable hydrological/hydrogeological regime where the peat water table is much closer to the surface than it was during the Peat Extraction Phase. It is noted that post rehabilitation monitoring in other sites has shown that groundwater levels in rewetted bogs can recover relatively quickly i.e. within 2-5 years.

The status of SWBs during the Current Phase has largely remained unchanged from the earlier status recorded during the Peat Extraction Phase. Some SWBs (Drish_040 and Drish_050) have experienced improving WFD status during this phase, whilst the Black (Twomileborris)_010 experienced a deterioration in status. A summary of the status during the Current Phase are detailed in **Table K**.

Table K: Surface Water Quality Effects from Bog Drainage during the Current Phase

SWB	WFD Code	Status (2016-2021)	Status (2019-2024)
Breagagh (Tipperary)_010	IE_SE_16B030200	Poor	Poor
Breagagh (Tipperary)_020	IE_SE_16B030400	Moderate	Moderate
North Glengoole_010	IE_SE_16N280780	Poor	Poor
Black (Twomileborris)_010	IE_SE_16B010100	Moderate	Poor
Clover_010	IE_SE_16C040100	Poor	Poor
Clover_020	IE_SE_16C040300	Moderate	Moderate
Drish_010	IE_SE_16D020040	Poor	Poor
Drish_020	IE_SE_16D020068	Poor	Poor
Drish_030	IE_SE_16D020070	Poor	Poor
Drish_040	IE_SE_16D020100	Poor	Moderate
Drish_050	IE_SE_16D020200	Poor	Good
Drish_060	IE_SE_16D020400	Moderate	Moderate

4.3.1.1 Contamination of Groundwater by Leakages and Spills

Following the cessation of peat extraction at the Application Site, there was still some limited activity at the Application Site involving machinery and plant, with which there is always a risk of accidental spillage of hydrocarbons. Similarly, the office buildings at the Bord na Móna Littleton Works (which is outside of the Application Site) remained occupied and discharges from wastewater systems (septic tanks) etc. have the potential to cause surface water and groundwater contamination. However, the risks are of a lesser extent due to the lower volumes of plant, machinery and workers operating at the Application Site during the Current Phase.

A summary of status change to GWBs arising from potential groundwater quality impacts during the Current Phase are outlined in **Table L.** There has been no change in WFD status.

Table L: Groundwater Quality Effects during Current Phase

GWB	WFD Code	Status (2016-2021)	Status (2019-2024)
Templemore	IE_SE_G_131	Good	Good
Thurles	IE_SE_G_158	Good	Good

4.3.1.2 Contamination of Surface Water by Leakages and Spills

Following the cessation of peat extraction at the Application Site, there is still some limited activity at the Application Site involving machinery and plant with which there is always a risk of accidental spillage of hydrocarbons. Similarly, the office buildings at the Bord na Móna Littleton Works (which is outside of the Application Site) remain occupied and discharges from wastewater systems (septic tanks) etc. have the potential to cause surface water and groundwater contamination. These risks of a lesser extent due to the lower volumes of plant, machinery and workers operating at the Application Site during the Current Phase.

A summary of status change to SWBs arising from bog drainage during the Current Phase are outlined in **Table M**. Some SWBs (Drish_040 and Drish_050) have experienced improving WFD status during this phase, whilst the Black (Twomileborris)_010 experienced a deterioration in status.

Table M: Surface Water Quality Effects from Leakages and Spills during the Current Phase

SWB	WFD Code	Status (2016-2021)	Status (2019-2024)
Breagagh (Tipperary)_010	IE_SE_16B030200	Poor	Poor
Breagagh (Tipperary)_020	IE_SE_16B030400	Moderate	Moderate
North Glengoole_010	IE_SE_16N280780	Poor	Poor
Black (Twomileborris)_010	IE_SE_16B010100	Moderate	Poor
Clover_010	IE_SE_16C040100	Poor	Poor
Clover_020	IE_SE_16C040300	Moderate	Moderate
Drish_010	IE_SE_16D020040	Poor	Poor
Drish_020	IE_SE_16D020068	Poor	Poor
Drish_030	IE_SE_16D020070	Poor	Poor
Drish_040	IE_SE_16D020100	Poor	Moderate
Drish_050	IE_SE_16D020200	Poor	Good
Drish_060	IE_SE_16D020400	Moderate	Moderate

4.3.1.3 Effects on Protected Areas

The Application Site remains hydrologically linked with the Lower River Shannon SAC and the Cabragh Wetlands pNHA. The risks to the receiving waters (in terms of water quantity and water quality) are the same as those outlined for the Peat Extraction Phase but to a much lesser extent due to the lower intensity of works being completed at the Application Site. Less activity on-site has decreased the likelihood of pollution incidents or exceedances of discharge limits occurring. The risk is much reduced in comparison to the Peat-Extraction Phase of the Project.

5. WFD COMPLIANCE ASSESSMENT (REMEDIAL PHASE)

5.1 REMEDIAL PHASE

The Remedial Phase includes the Phase 2 Rehabilitation works which are proposed to be completed in Derryvella Bog. No additional rehabilitation works are proposed in Littleton, Lanespark or Longfordpass bogs. However some measures are ongoing at these bogs under Phase 1 rehabilitation, including revegetation and monitoring. As part of the ongoing Phase 1 rehabilitation, targeted active management, including the use of fertiliser to help promote re-colonisation will be completed, if natural re-colonisation has not progressed satisfactorily.

The Phase 2 Rehabilitation works proposed in Derryvella include a series of short-term practical actions (0-2 years) and long-term actions (>3 years) and are detailed in Table 4-9 of Chapter 4 of the rEIAR. The measures include targeted drain blocking, along with fertiliser application targeting bare peat areas of headlands, high fields and other areas (where required) and hydrological management. A long-term goal also includes the decommissioning of silt ponds.

5.2 POTENTIAL EFFECTS (UNMITIGATED)

The Cutaway Bog Decommissioning and Rehabilitation Plans for the Application Site, including the Phase 2 Rehabilitation works proposed for Derryvella Bog, cannot be implemented without mitigation measures. All activities at the Application Site are required to operate in accordance with IPC Licence (P0499-01) until the licence is surrendered. Therefore, an unmitigated scenario is not applicable to the WFD Compliance Assessment of the Remedial Phase.

5.3 POTENTIAL EFFECTS (MITIGATED)

5.3.1 Surface Water Quality Effects and Mitigation Measures

Whereas draining the Application Site to facilitate peat extraction has likely had a negative impact on downstream surface watercourses, improvements in flow and water quality can be achieved through bog rehabilitation and rewetting.

International studies have shown a long-term reduction in pollutant concentrations, including nitrate and ammonia, following rewetting in comparison to drained peatlands (Pschenyckyj. C. et al. 2021). Several studies have shown that the magnitude of these positive effects depends on site-specific factors such as the degree of degradation and local peat characteristics. Some studies have shown a short-term increase in phosphorous and suspended solids following rehabilitation linked to initial drain-blocking activities before the hydrogeological regime of the site becomes stabilised (Pschenyckyj. C. et al. 2021). These will be short term impacts and will not impact the overall status of downstream waterbodies.

The greatest improvement in water quality will occur in the receiving waterbodies directly downstream of Derryvella Bog (North Glengoole_010 and Black (Twomileborris)_010 SWBs). In the long term, enhanced water quality associated with bog rehabilitation will aid these waterbodies in achieving an improved WFD status. These SWBs will have the greatest potential to experience an improvement in WFD status due to their small upstream catchments.

Any works undertaken as part of the Cutaway Bog Decommissioning and Rehabilitation Plans will be completed under licence from the EPA with BnM reporting to the EPA until the IPC Licence is surrendered. The existing drainage systems which have proven effective will continue to operate during this period, including the operation, maintenance and monitoring of silt ponds to prevent silt-run-off from the Application Site.

The Cutaway Bog Decommissioning and Rehabilitation Plans state that the effects of any management activities will be monitored and assessed.

5.3.2 Groundwater Quality Effects from Leakages and Spills

During the Remedial Phase, there will be some activity at the Application Site involving machinery and plant with which there is always a risk of accidental spillage of hydrocarbons. This activity will be greatest during the initial stages of rehabilitation when works associated with rewetting and revegetation such as drain blocking will be completed. Once this work has been completed there will only be very limited activity at the Application Site which will mainly comprise of non-intrusive monitoring and minimal repairs to drain blocks if required and/or additional fertilisation to aid the development of successional vegetation communities.

Due to the presence of peat at the Application Site and the bulk low permeability of the underlying mineral soil deposits, groundwater recharge at the Application Site is limited. A shallow perched groundwater table exists in the peat stratum, and this is isolated from the underlying regional groundwater system. Therefore, even in an unmitigated scenario any groundwater contamination will occur within the perched water table which discharges to nearby surface watercourses. No deterioration in groundwater quality in the underlying bedrock aquifer or the Templemore or Thurles GWBs will occur.

Mitigation measures will be implemented and adhered to until the IPC Licence for the Application Site is surrendered. These measures significantly decrease the risk of groundwater contamination. No further mitigation measures, beyond those implemented to date, are deemed necessary.

5.3.3 Surface Water Quality Effects from Leakages and Spills

As stated in **Section 5.3.2** above, there is a risk of accidental spillage of hydrocarbons during initial rehabilitation works. Due to the local hydrogeological regime and low rates of groundwater recharge, contaminants will enter the bog drainage network and downstream river waterbodies, resulting in a deterioration in surface water quality. This will have a potential negative effect on the WFD status of river waterbodies directly downstream of the Application Site (North Glengoole_010 and Black (Twomileborris)_010 SWBs).

Mitigation measures will be implemented and adhered to until the IPC Licence for the Application Site is surrendered.

5.3.4 Effects on Protected Areas

No potential impacts are anticipated on as the designated sites are located at distant location from the Application site, have large volume of water associated with large upstream catchment area and the lack of hydrological and/or hydrogeological connectivity with the Application Site. No such impacts are anticipated on designated sites.

5.3.5 Summary Potential Effects of Remedial Phase

In all instances, the mitigation measures described above are sufficient to meet the WFD objectives. The assessment of WFD elements for the WFD waterbodies for the short-term and long-term is summarised in **Table N** below.

With the implementation of the conditions of the IPC Licence at the Application Site during this period, the rehabilitation works will have no potential to cause a deterioration in the status of downstream SWBs and/or jeopardise their attainment of good surface water status. The long-term impacts of the Application Site rehabilitation plans may lead to an improvement in the status of those waterbodies directly downstream of the Application Site, however this is dependent on several site-specific factors (the degree of rehabilitation – greatest positive

effect likely where drain blocking and revegetation have been successfully implemented) and other activities being carried out in the catchment of these SWBs.

Table N: Summary of WFD Status for Unmitigated and Mitigated Scenarios

SWB	WFD Code	Status (2019-2024)	Assessed Short-term Status	Assessed Long-term Status
Breagagh (Tipperary)_010	IE_SE_16B030200	Poor	Poor	Poor
Breagagh (Tipperary)_020	IE_SE_16B030400	Moderate	Moderate	Moderate
North Glengoole_010	IE_SE_16N280780	Poor	Poor	Poor / Moderate
Black (Twomileborris)_010	IE_SE_16B010100	Poor	Poor	Poor / Moderate
Clover_010	IE_SE_16C040100	Poor	Poor	Poor
Clover_020	IE_SE_16C040300	Moderate	Moderate	Moderate
Drish_010	IE_SE_16D020040	Poor	Poor	Poor
Drish_020	IE_SE_16D020068	Poor	Poor	Poor
Drish_030	IE_SE_16D020070	Poor	Poor	Poor
Drish_040	IE_SE_16D020100	Moderate	Moderate	Moderate
Drish_050	IE_SE_16D020200	Good	Good	Good
Drish_060	IE_SE_16D020400	Moderate	Moderate	Moderate

6. SUMMARY AND CONCLUSION

6.1.1 Summary

WFD status for SWBs (Surface Water Bodies) and GWBs (Groundwater Bodies) hydraulically linked to the Application Site are defined in **Section 2** above.

From a hydrological perspective, the main impacts associated with peat extraction activities at the Application Site occurred during the initial stages of peat extraction with the installation of the drainage infrastructure to facilitate peat extraction. Littleton Bog was the first bog to be drained, with drainage and vegetation clearance commencing in 1941 and would have experienced a relatively abrupt change in land cover from this date to the beginning of commercial peat extraction in 1952. Meanwhile, vegetation clearance and drainage insertion commenced at Longfordpass Bog in 1947 and at Lanespark and Derryvella bogs in 1968. Peat extraction commenced at Longfordpass Bog at the same time as Littleton Bog (1952), and later in Lanespark and Derryvella bogs (1973). By 2003, all bogs comprising the Application Site had been drained, and peat extraction was in progress. Therefore, these activities and their potential effect on the underlying GWBs and downstream SWBs pre-date the transposition of the WFD into Irish Law.

The WFD Directive came into effect in Ireland in 2003 and this report assesses the effects of the peat extraction activities at the Application Site from this date until the formal cessation of peat extraction in 2017. During this time period, all activities at the Application Site were operating under IPC Licence requirements. The IPC Licence (P0499-01) sets out several conditions and emission limits designed to ensure the protection of surface and groundwaters. These measures likely led to an improvement in the status of local surface waterbodies in the vicinity of the Application Site.

Peat extraction ceased at the Application Site in 2017 and no significant impacts to the hydrological and/or hydrogeological environments have occurred from the termination of peat extraction to the present day. Positive impacts have occurred in terms of the implementation of the Phase 1 Rehabilitation Works detailed in the Cutaway Bog Decommissioning and Rehabilitation Plans for the Application Site. These works involved drain blocking, the removal of stockpiles and railway infrastructure. The Cutaway Bog Decommissioning and Rehabilitation Plans for the Application Site involve the rewetting and revegetation of the drained bog. The works will likely have a long-term positive effect on the hydrogeology within the Application Site where the groundwater table in the peat bog is stabilised and closer to the bog surface than I was during the Peat Extraction Phase. However, the Application Site will never return to the original intact raised bog condition which was present before the commencement of the drainage/peat extraction activities. Studies (e.g., Pschenyckyj. C. et al. 2021) have shown that bog rewetting can also result in improvements in local and downstream surface water quality.

While no WFD status reports are available for the period pre-dating 2010, the EPA have been completing ecological monitoring on downstream waterbodies since the 1970s. The Q-values, and the results from the IPC licence monitoring, which show that discharge from the Application Site has been largely compliant with the ELVs, suggest that the peat extraction and ancillary activities from 2003 to 2010 did not have a significant negative impact before the first WFD cycle in 2010.

During the Remedial Phase, Phase 2 Rehabilitation works are proposed for Derryvella Bog and will include intensive drain blocking and hydrological management. The Application Site will be operated in accordance with IPC Licence requirements. These mitigation measures will ensure the protection of downstream surface waterbodies.

Several SWBs downstream of the Application Site are ‘at risk’ of failing to meet their respective WFD objectives. Therefore, catchment pressures (on water quality and water

quantity/volume) appear to be significant at present. Peat extraction is listed as a significant pressure on the Breagagh (Tipperary)_010, Black (Two Mile Borris)_010 and Drish (_020 to _050) waterbodies downstream of the Application Site.

The local hydrogeological regime at the Application Site with low permeability peat and glacial deposits ensure that the perched groundwater table within the bog is isolated from the underlying GWBs. Therefore, the historic peat extraction activities (Peat Extraction Phase) and the decommissioning and Phase 1 Rehabilitation works (Current Phase) are unlikely to have impacted the qualitative (chemical) or quantitative (volume) status of the Templemore and Thurles GWBs. Similarly, there will be no change in GWB status associated with the Remedial Phase.

As such, the Current Phase has not negatively impacted upon any SWB or GWB as it will not cause a deterioration in the status of the waterbody and/or it will not jeopardise the attainment of good status. Furthermore, the Current Phase has not negatively impacted upon any downstream protected areas.

As such, the Remedial Phase will not negatively impact upon any SWB or GWB as it will not cause a deterioration in the status of the waterbody and/or it will not jeopardise the attainment of good status. Furthermore, the Remedial Phase will not negatively impact upon any downstream protected areas

Table O presents a summary of the estimated WFD status of downstream SWBs and the underlying GWB as discussed in **Section 4.2**, **Section 4.3** and **Section 5.3** above.

Table O: Summary WFD Status

SWB	Assessed Post IPC Licence Status (2002-2010)	WFD Status (2010-2015)	WFD Status (2013-2018)	WFD Status (2016-2021)	WFD Status (2019-2024)	Short-term Rehabilitation Phase	Long-term Rehabilitation Phase
Breagagh (Tipperary)_010	-	Unassigned	Moderate	Poor	Poor	Poor	Poor / Moderate
Breagagh (Tipperary)_020	-	Unassigned	Good	Moderate	Moderate	Moderate	Moderate / Good
North Glengoole_010	-	Unassigned	Poor	Poor	Poor	Poor	Poor / Moderate
Black (Twomileborris)_010	Moderate / Poor	Moderate	Moderate	Moderate	Poor	Poor	Poor / Moderate
Clover_010	Poor	Poor	Poor	Poor	Poor	Poor	Poor / Moderate
Clover_020	Good	Good	Moderate	Moderate	Moderate	Moderate	Moderate / Good
Drish_010	Moderate / Poor	Poor	Poor	Poor	Poor	Poor	Poor / Moderate
Drish_020	-	Unassigned	Poor	Poor	Poor	Poor	Poor / Moderate
Drish_030	Poor	Poor	Poor	Poor	Poor	Poor	Poor / Moderate
Drish_040	Poor	Poor	Poor	Poor	Moderate	Moderate	Moderate / Good
Drish_050	Moderate / Poor	Moderate	Poor	Poor	Good	Good	Good / High
Drish_060	Good / Poor	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate /Good
Suir_070	Good / Poor	Good	Moderate	Moderate	Moderate	Moderate	Moderate

6.1.2 Conclusion

WFD status for SWBs (Surface Water Bodies) and GWBs (Groundwater Bodies) hydraulically linked to the Application Site are defined in **Section 2** above.

Activities during the Peat Extraction Phase at the Application Site would have had the potential to impact on the status of downstream SWBs and underlying GWBs. However, since the transposition of the WFD into Irish Law in 2003, all peat extraction and ancillary activities at the Application Site have been operating in under strict IPC Licence requirements designed for the protection of surface and groundwaters and the protection of the status of these waterbodies.

Therefore, there has been no change in GWB or SWB status in the underlying GWB or downstream SWBs resulting from the Peat Extraction or Current Phases. The mitigation measures have ensured that there was no change in quantitative (volume) or qualitative (chemical) status, and the underlying GWB, downstream SWBs and downstream protected areas have been protected from any potential deterioration.

As such, the Peat Extraction Phase (2003-2017) and the Current Phase (2017-Present):

- Have not caused a deterioration in the status of all surface and groundwater bodies assessed;
- Have not jeopardised the objectives to achieve 'Good' surface water/groundwater status;
- Have not jeopardised the attainment of 'Good' surface water/groundwater chemical status;
- Have not jeopardised the attainment of 'Good' surface water/groundwater quantity status;
- Have not permanently excluded or compromised the achievement of the objectives of the WFD in other waterbodies within the same river basin district;
- Have been compliant with the requirements of the Water Framework Directive (2000/60/EC); and,
- Have been consistent with other Community Environmental Legislation including the EIA Directive (2014/52/EU), the Habitats Directive (92/43/EEC) and the Birds Directive (2009/147/EC) (Note that a full list of legislation complied with in relation to hydrology and hydrogeology is included in Section 9.2.1 of rEIAR Chapter 8).

Furthermore, the Remedial Phase for the Application Site will be completed in accordance with IPC Licence conditions and will not impact the status of any waterbody. In addition, there will be no potential effects on any downstream protected areas as a result of the Remedial Phase or the long-term effects associated with the rehabilitation works completed during the Current Phase. Indeed, the Cutaway Bog Decommissioning and Rehabilitation Plans will likely have a positive long-term effect to the Water Framework Directive Classification of downstream waterbodies.

As such, the Remedial Phase:

- will not cause a deterioration in the status of all surface and groundwater bodies assessed;
- will not jeopardise the objectives to achieve 'Good' surface water/groundwater status;
- does not jeopardise the attainment of 'Good' surface water/groundwater chemical status;
- does not jeopardise the attainment of 'Good' surface water/groundwater quantity status;
- does not permanently exclude or compromise the achievement of the objectives of the WFD in other waterbodies within the same river basin district;

- is compliant with the requirements of the Water Framework Directive (2000/60/EC); and,
- is consistent with other Community Environmental Legislation including the EIA Directive (2014/52/EU), the Habitats Directive (92/43/EEC) and the Birds Directive (2009/147/EC) (Note that a full list of legislation complied with in relation to hydrology and hydrogeology is included in Section 9.2.1 of rEIAR Chapter 8).

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EPA (2024): 3rd Cycle Suir Catchment Report.

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Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption.

Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy.

Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds.

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S.I. No. 477/2011 - European Communities (Birds and Natural Habitats) Regulations 2011.

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APPENDIX 8.3

Peatland Hydrology Study Report

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PEATLAND HYDROLOGY STUDY AT 4 NO. BNM BOGS

PEATLAND HYDROLOGY STUDY REPORT

FINAL REPORT

Prepared for:

Bord na Mona Energy Ltd

Prepared by:

HYDRO-ENVIRONMENTAL SERVICES

DOCUMENT INFORMATION

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APPENDICES

1. INTRODUCTION

1.1 BACKGROUND

Hydro-Environmental Services (HES) were commissioned by BnM to complete a hydrological study at 4 no. peat bogs. HES installed piezometers transects at the bogs to allow collection of seasonal water level data. Investigations and monitoring were completed at Garryduff, Blackwater, and Mongan bogs (Blackwater Group), and Derrycolumb bog (Mountdillon Group). BnM collected water level data at these 4 no. sites between September/October 2018 and February 2020. The purpose of the study was to determine likely zones of influence of drainage on BnM bog unit sites, and also to determine the likely zones of influence of BnM pumping stations. A site location map, showing the relative location of the study sites is included below as **Figure A**.

The hydrological study at these bogs had the following objectives:

- Setup and installation of hydrological monitoring transects that include monitoring points in shallow peat, deep peat and underlying mineral subsoil;
- Collect and analyse seasonal water level data; and,
- Inform how far the likely Zone of Influence of BnM bog drainage and pumping station dewatering has on surrounding peatland and aquifers.

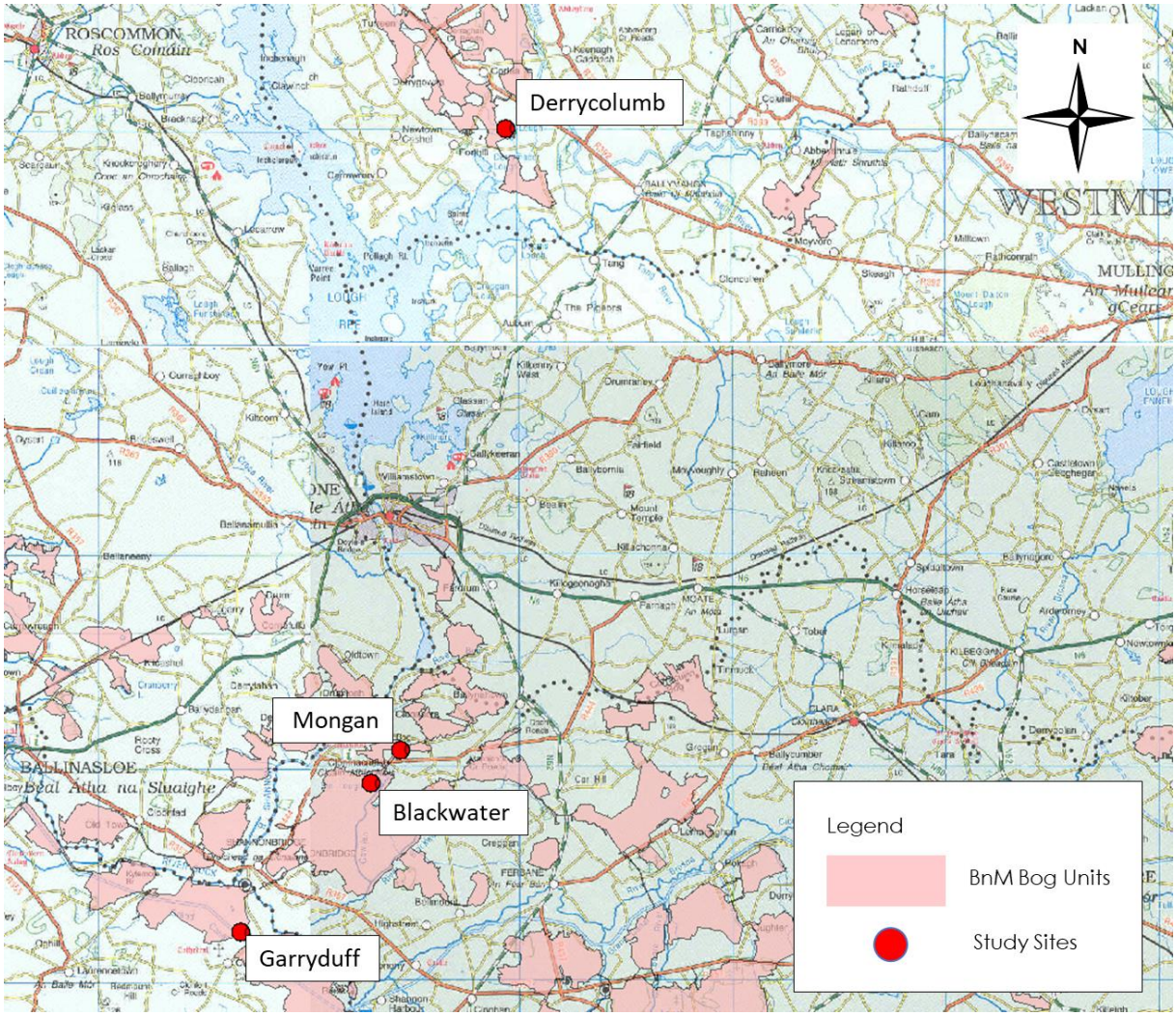

Figure A: Study Sites Location Map

2. SITE INVESTIGATION WORKS

2.1 BLACKWATER

Table A provides a is a summary of the site investigation and piezometer install works at the Blackwater Study site.

Table A: Summary of piezometer install works at Blackwater Study site

Information Type	Data
Install Dates	July 2018
No. of Transects	3 (T1, T2, and T3)
No. of Shallow Phreatic Tubes	43
No. of Deep Peat Piezometers	26
No. of Mineral Soil Piezometers	0
Interval of Peat Depths Recorded (m)	0.1-3.41 (n=42, σ=1.28)[1]
Dates of Water Level Monitoring (by BnM)	July 2018 to February 2020 (n=19)

Full details of the site investigation and piezometer install works are attached in **Appendix I**. A map of the Blackwater piezometer install locations is shown below as **Figure B**.

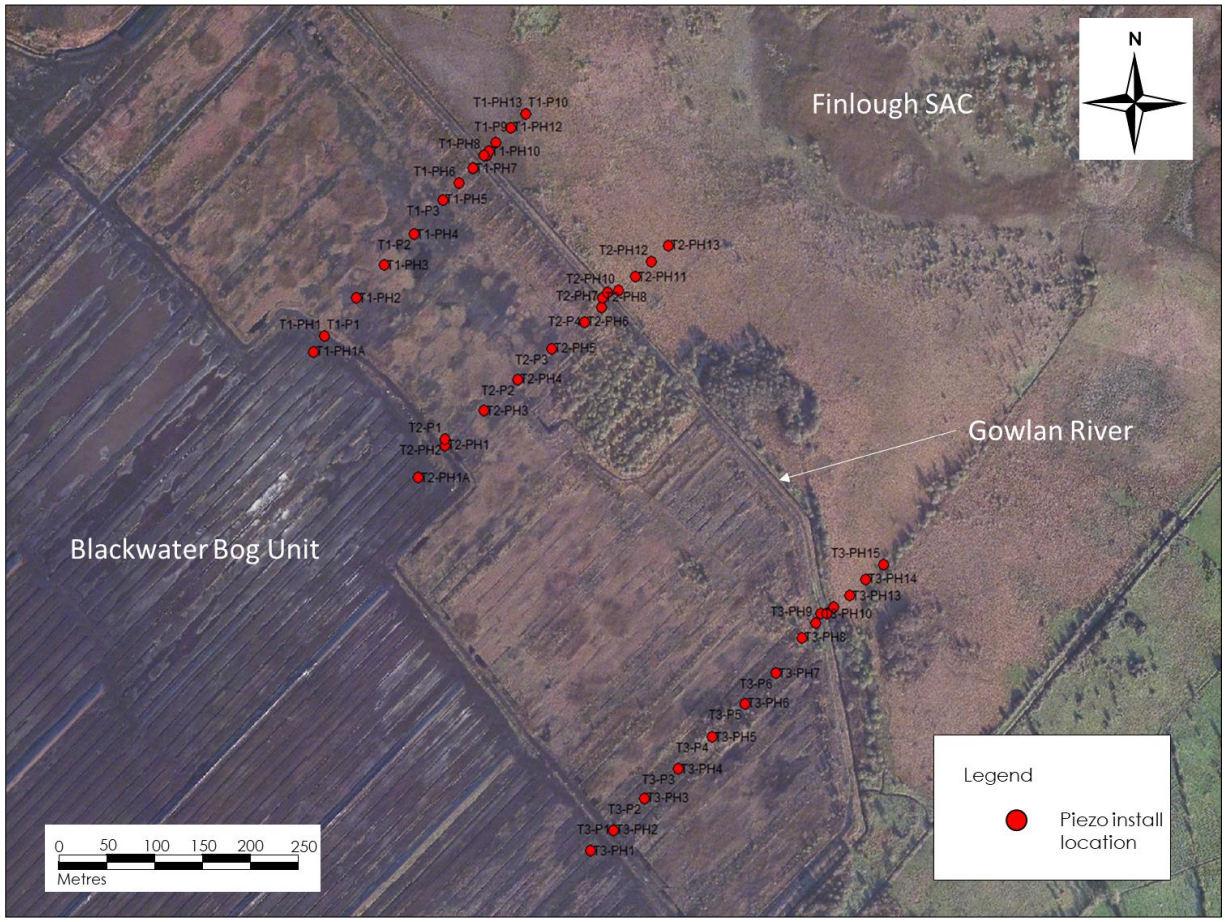

Figure B: Blackwater - piezometer install location map

[1] *n = no. of data points. σ = mean of data.*

2.2 DERRYCOLUMB

Table B provides a is a summary of the site investigation and piezometer install works at the Derrycolumb Study site.

Table B: Summary of piezometer install works at Derrycolumb Study site

Information Type	Data
Install Dates	August 2018
No. of Transects	3 (T1, T1A, and T3)
No. of Shallow Phreatic Tubes	18
No. of Deep Peat Piezometers	17
No. of Mineral Soil Piezometers	0
Interval of Peat Depths Recorded (m)	3.2->7.0 (n=18, σ=4.63)
Dates of Water Level Monitoring (by BnM)	Sept 2018 to November 2019 (n=14)

Full details of the site investigation and piezometer install works are attached in **Appendix I**. A map of the Derrycolumb piezometer install locations is shown below as **Figure C**.

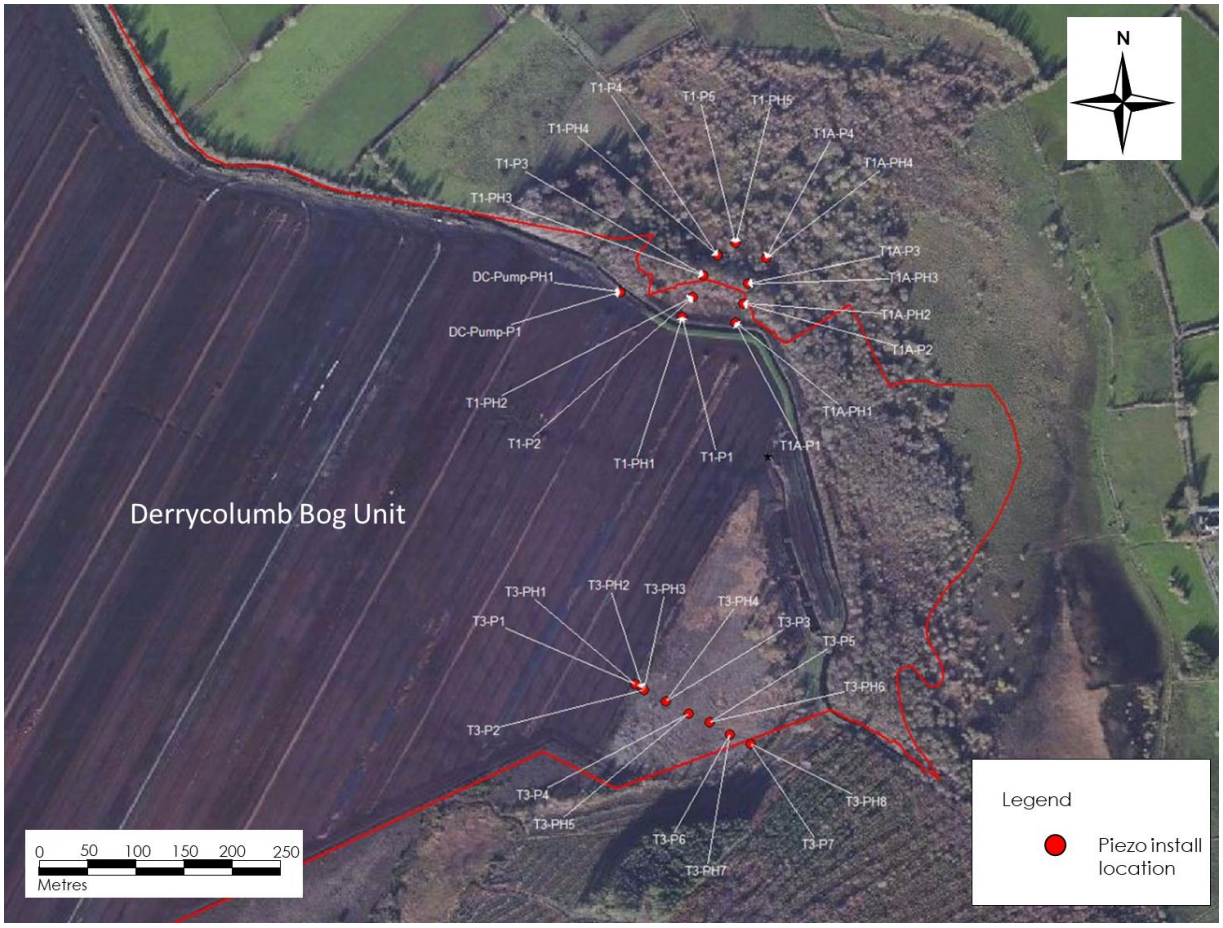

Figure C: Derrycolumb - piezometer install location map

2.3 MONGAN

Table C provides a is a summary of the site investigation and piezometer install works at the Mongan Study site.

Table C: Summary of piezometer install works at Mongan Study site

Information Type	Data
Install Dates	August 2018
No. of Transects	3 (T1, T2, and T3)
No. of Shallow Phreatic Tubes	26
No. of Deep Peat Piezometers	22
No. of Mineral Soil Piezometers	0
Interval of Peat Depths Recorded (m)	3.3-6.5 (n=26, σ=4.99)
Dates of Water Level Monitoring (by BnM)	Sept 2018 to February 2020 (n=19)

Full details of the site investigation and piezometer install works are attached in **Appendix I**. A map of the Mongan piezometer install locations is shown below as **Figure D**.

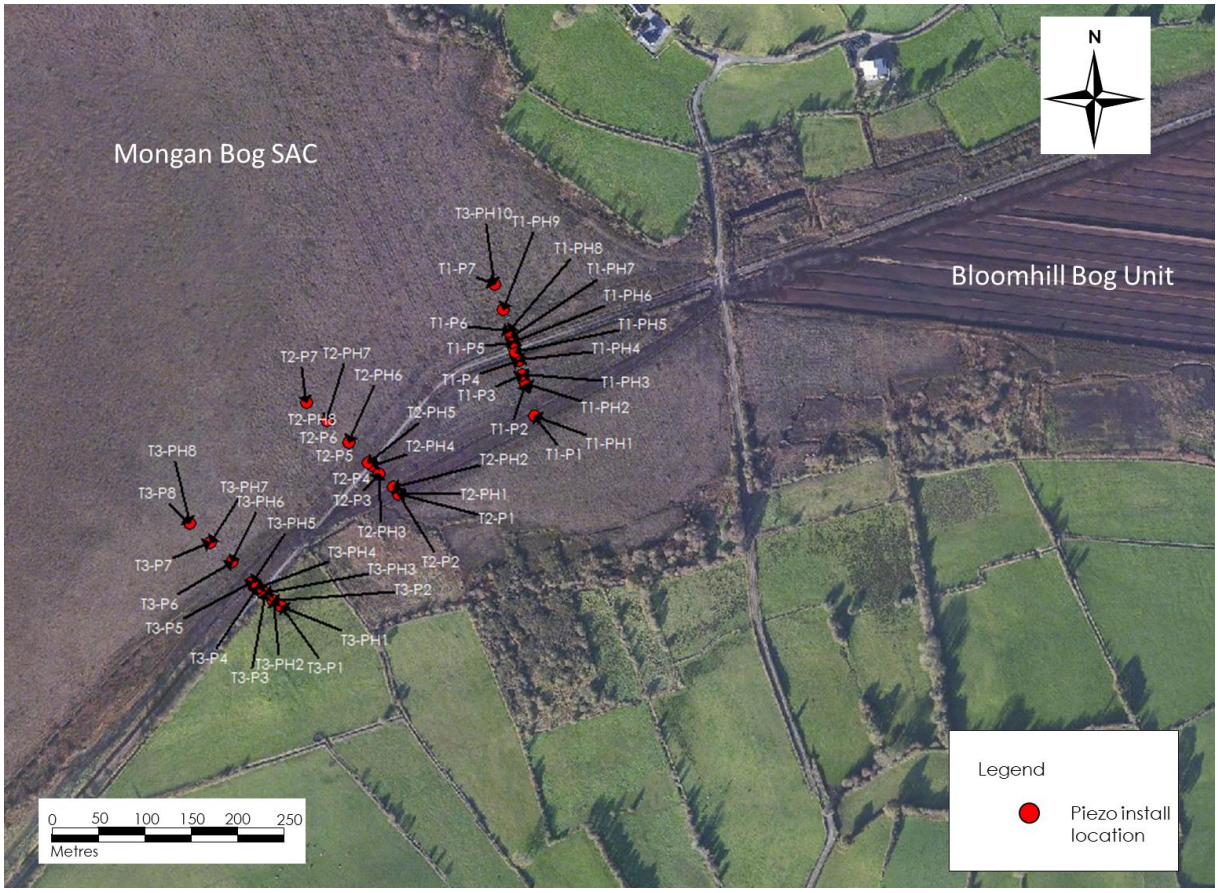

Figure D: Mongan - piezometer install location map

At Mongan bog, HES also completed a detailed survey of peat depths between Mongan bog and the adjacent Bloomhill bog unit. 34 no. peat depths were recorded. The minimum peat depth recorded was 1.55m, and the maximum peat depth recorded was 5.7m. The average peat depth recorded in the augering study area was 4.17m. Data from the Mongan augering study is attached in **Appendix II**.

2.4 GARRYDUFF

Table D provides a is a summary of the site investigation and piezometer install works at the Garryduff Study site.

Table D: Summary of piezometer install works at Garryduff Study site

Information Type	Data
Install Dates	August 2018
No. of Transects	1 (T1)
No. of Shallow Phreatic Tubes	4
No. of Deep Peat Piezometers	0
No. of Mineral Soil Piezometers	4
Interval of Peat Depths Recorded (m)	1.8-3.10 (n=4, σ=2.12)
Dates of Water Level Monitoring (by BnM)	Aug 2018 to December 2019 (n=18)

Full details of the site investigation and piezometer install works are attached in **Appendix III**. A map of the Garryduff piezometer install locations is shown below as **Figure E**. An existing shallow and deep set of monitoring wells existed to the south of the pump station as shown on **Figure E.**

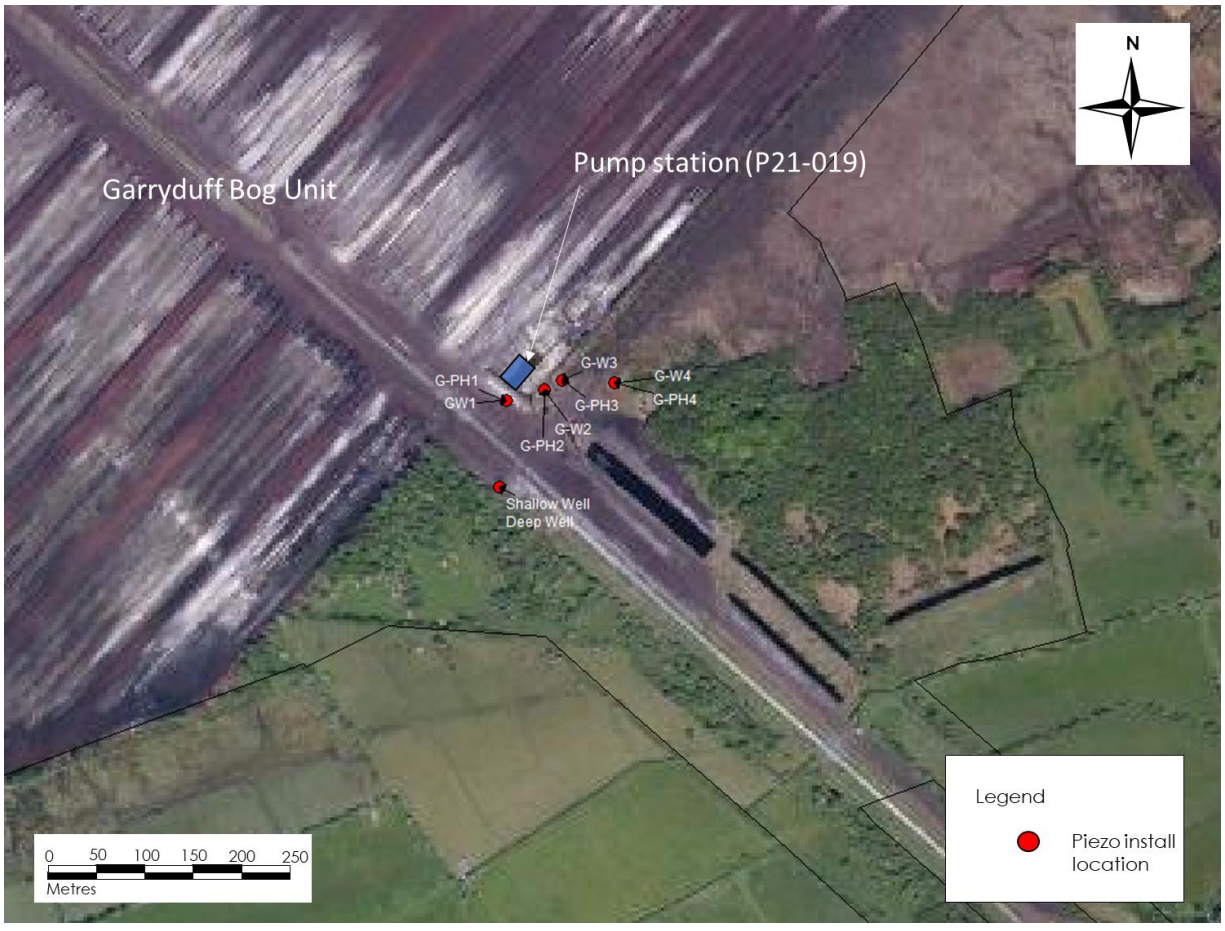

Figure E: Garryduff - piezometer install location map

3. HYDROLOGICAL ANALYSIS

3.1 BLACKWATER

Data and water level plots for the Blackwater study site are attached in **Appendix IV**.

The following is observed from analysis of the seasonal water level data:

- Water levels in cutover parts of Blackwater bog show less seasonal fluctuations than those to the north of the Gowlan River (within the designated Finlough SAC area);
- Beyond ~50m to the south of the Gowlan River, water levels in all phreatic tubes are consistently within 10cm or less of the residual peat surface level with only small temporal fluctuations. The field drains in this area are blocked and essentially those measures have stabilised the hydrology to the benefit of the local vegetation;
- Further to the south, where operational field drains occur along open production fields, water levels in the peat profile are deep, and well below ground level (up to 0.75m below ground level). This shows the influence of field drains, as within 20/30m where drains are locked water levels are consistently higher as outlined above; and,
- The influence of the Gowlan River on water levels is apparent, especially to the north of the river where seasonal fluctuations in water levels can be as deep as 1m below ground level.

3.2 DERRYCOLUMB

Data and water level plots for the Derrycolumb study site are attached in **Appendix V**.

The following is observed from analysis of the seasonal water level data:

- Water levels in piezometers [along T1 and T1A] close to the deep bog boundary drain [northeastern corner of the bog] and pumping station P05-031 show higher seasonal fluctuations than those to the north of the bog, remote from the deep bog boundary drain;
- Beyond ~50 to ~80m to the north of the deep bog boundary drain, along Transect 1 and Transect 1A, water levels in all phreatic tubes are consistently within 10cm or less of the natural peat surface level with only small temporal fluctuations. Beyond these distances the bog hydrology does not appear to be significantly altered by the drainage and pumping completed at Derrycolumb bog unit; and,
- Further to the south at T3, the facebank drain shows an influence on peat water levels to ~40m to the southeast of the facebank. Beyond ~40m water levels in all phreatic tubes are consistently within 10cm or less of the natural peat surface level with only small temporal fluctuations, and deeper piezometers also show normal temporal variations.

3.3 MONGAN

Data and water level plots for the Mongan study site are attached in **Appendix VI**.

The following is observed from analysis of the seasonal water level data:

- Water levels in piezometers along Transects T1, T2, and T3, close to rail line and associated drains show higher seasonal fluctuations than data from higher on the intact raised bog to the north;
- On the high bog there is a surface drain parallel to the facebank [on T1 and T2, not T3], and while this is blocked, it appears to have some continued influence on temporal (phreatic) water levels;

- Deep peat piezometers have water levels up to 1m below ground level, and this indicates a string downward gradient, and this is likely driven by deep perimeter drainage along the rail line, and the edge of the bog to the south;
- On the high bog within ~30 to ~40m of the rail line water levels in some phreatic tubes are occasionally (~50% of the time) within 10cm or less of the natural peat surface level, but with variable temporal fluctuations; and,
- From visual inspection there appears to be significant surface subsidence towards the rail line along the southern edge of Mongan bog.

3.4 GARRYDUFF

Data and water level plots for the Garryduff study site are attached in **Appendix VII**. Continuous water level monitoring was also completed in GW1 and GW2, and these data are plotted and also included in **Appendix VII**. On/off operational data (time series of when duty and standby pumps were on/off) for the pumping station was also provided by BnM.

The following is observed from analysis of the seasonal water level data:

- The pumping station is operated almost continuously, and it has a high low float switch, and a duty and standby pump set;
- Most of the water pumped is surface water, which feeds towards the sump via a network of field drains off the adjacent Garryduff bog unit;
- The pump sump is ~4.5m deep;
- Water level observations in the deep wells (GW1, GW2, GW3, and GW4) do not appear to respond (rise and fall) significantly to on/off pumping in the pump sump;
- Seasonal variations in deeper (mineral soil) water levels vary by ~1m. This is not significant;
- Shallow peat water levels do not appear to respond to pumping or changes of water level in the pump sump;
- Shallow peat water levels are influenced by deep drains at the edge of the bog; and,
- Water levels at GW4 and GPH4 do not appear to be influenced at all by drawdown at the pumping station. These wells are ~60m from the pumping station.

In order extrapolate our observations from Garryduff to all pumping sites, we have completed a sensitivity analysis on R_0 (radius of influence) calculations using the Sichardt equation (Section 6.2.1 of CIRIA, 2000)[2]. Using variations in permeability of the mineral soil profile, and varying the thickness of mineral soils, indicates that even in the most extreme of circumstances (i.e. using the most conservative values) the radius of influence of shallow pumping stations is <300m. this is without even trying to separate out groundwater flows from surface water flows (*i.e.* the analysis assumes all water is coming from groundwater, which is clearly not the case).

[2] Groundwater Control – Design and Practice, CIRIA C515, 2000.

4. SUMMARY CONCLUSIONS

We have used the water level data to attempt to determine conservative Zone of Influences for peat works field drains, deep perimeter drains, facebank drains, and pumping stations.

The following was observed:

- Without blocking or management, field drains can influence peat water levels at a distance of up to 30m;
- Deep perimeter bog drains can have an influence on peat water levels at a distance of between ~50-80m. Applying a zone of influence distance of 100m would be a conservative buffer;
- The influence of facebank drains depends on the height of the facebank. But data from Derrycolumb indicates that water levels on the high bog adjacent to a 1.5m high facebank (with drain along production side) are not significantly influenced by the facebank and associated drainage beyond ~40m distance. Applying a zone of influence distance of 60m would be a conservative buffer; and,
- Data from Garryduff bog indicates that the pumping station there (P21-019) does not significantly influence water levels in monitoring wells at a distance of ~60m from the pump sump. Additional hydrogeological modelling and analysis indicates that even when using the most conservative aquifer parameters the zone of influence of BnMs pumping stations (which are generally <5m deep) on local groundwater levels is likely to be <300m.

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APPENDIX I: SITE INVESTIGATION DATA

Bog	Date	Transect	Piezo type	Location ID	Easting	Northing	Top of Pipe (mOD)	Ground Level (mOD)	peat depth (m)	peat interval(mbgl)	marl interval (mbgl)	lacustrine clay interval (mbgl)	standpipe screen (mbgl)	piezoemter screen (mbgl)	upstand (m)	Top of Pipe (mOD)	Ground Level (mOD)
Blackwater	Jul-18	T1	phreatic	T1-PH1A	202510.2	229238	37.544	36.459	0.4	0-0.4	0.4->1.2	-	0-1.0	1.10		37.544	36.459
Blackwater	Jul-18	T1	phreatic	T1-PH1	202528.1	229258.9	37.528	36.471	1.44	0-1.44	1.44->2.0	-	0-1.0	-	1.00	37.528	36.471
Blackwater	Jul-18	T1	Piezo	T1-P1	202528.4	229258.7	37.518	36.54						1.1-1.4	0.98	37.518	36.54
Blackwater	Jul-18	T1	phreatic	T1-PH2	202567.5	229297.7	37.963	36.64	0.57	0-0.57	0.57->2.0	-	0-1.0	-	1.35	37.963	36.64
Blackwater	Jul-18	T1	phreatic	T1-PH3	202601.4	229334.1	37.702	36.654	0.4	0-0.4	0.4->1.0	-	0-1.0	-	1.06	37.702	36.654
Blackwater	Jul-18	T1	phreatic	T1-PH4	202635.4	229370.7	37.705	36.691	2.4	0-2.4	2.4->3.0	-	0-1.0		1.03	37.705	36.691
Blackwater	Jul-18	T1	Piezo	T1-P2	202635.4	229370.5	37.817	36.692						2.0-2.3	1.13	37.817	36.692
Blackwater	Jul-18	T1	phreatic	T1-PH5	202670	229406.5	38.113	37.203	1.16	0-1.116	1.16-1.56	1.56-2.36 (brown silt)	0-1.0		0.91	38.113	37.203
Blackwater	Jul-18	T1	Piezo	T1-P3	202670.4	229406.3	38.169	37.17						0.8-1.10	1.00	38.169	37.17
Blackwater	Jul-18	T1	phreatic	T1-PH6	202687.7	229424.4	38.303	37.557	1.35	0-1.35	1.35->3.0	-	0-1.0		1.00	38.303	37.557
Blackwater	Jul-18	T1	Piezo	T1-P4	202687.8	229424.1	38.526	37.537						1.0-1.3	0.78	38.526	37.537
Blackwater	Jul-18	T1	phreatic	T1-PH7	202704.8	229441.9	39.049	38.137	2.4	0-2.4	2.4->3.0	-	0-1.0		0.90	39.049	38.137
Blackwater	Jul-18	T1	phreatic	T1-PH8	202714.1	229451.9	38.794	38.032	2.3	0-2.3	2.3-4.2	4.2->5.0	0-2.0		0.77	38.794	38.032
Blackwater	Jul-18	T1	Piezo	T1-P5	202714.3	229451.6	38.7	38.042						2.0-2.3	0.70	38.7	38.042
Blackwater	Jul-18	T1	phreatic	T1-PH9	202719.8	229457.1	38.845	37.729	2.4	0-2.4	2.4->3.0	-	0-1.0		1.10	38.845	37.729
Blackwater	Jul-18	T1	Piezo	T1-P6	202719.5	229457.2	38.675	37.714						2.15-2.45	0.96	38.675	37.714
Blackwater	Jul-18	T1	phreatic	T1-PH10	202723.8	229461.8	39.27.1	38.365	2.56	0-2.56	2.56->3.0	-	0-1.0		0.92	39.271	38.365
Blackwater	Jul-18	T1	Piezo	T1-P7	202724.1	229461.6	39.178	38.353						2.25-2.55	0.86	39.178	38.353
Blackwater	Jul-18	T1	phreatic	T1-PH11	202729.9	229468	39.572	38.893	2.8	0-2.8	2.8->3.0	-	0-1.0		0.75	39.572	38.893
Blackwater	Jul-18	T1	Piezo	T1-P8	202729.6	229468.4	39.57	38.894						2.40-2.70	0.70	39.57	38.894
Blackwater	Jul-18	T1	phreatic	T1-PH12	202747.6	229486.2	39.948	38.948	3.41	0-3.41	3.0->4.0	-	0-1.0		1.00	39.948	38.948
Blackwater	Jul-18	T1	Piezo	T1-P9	202747.5	229485.9	39.213	38.898						2.8-3.1	0.35	39.213	38.898
Blackwater	Jul-18	T1	phreatic	T1-PH13	202764.4	229503.4	39.534	38.546	2.05	0-2.05	2.05->3.0	-	0-1.0		1.43	39.534	38.546
Blackwater	Jul-18	T1	Piezo	T1-P10	202764.4	229503.5	39.952	38.569						1.7-2.0	1.00	39.952	38.569
Blackwater	Jul-18	T2	phreatic	T2-PH1A	202633.8	229111.5	38.242	36.71	1.95	0-1.95	1.95->2.5		0-1.0		1.55	38.242	36.71
Blackwater	Jul-18	T2	phreatic	T2-PH1	202671.9	229140.9	37.523	36.421		in pond			0-1.0		1.06	37.523	36.421
Blackwater	Jul-18	T2	phreatic	T2-PH2	202679.7	229147.4	37.878	36.888	0.75	0-0.75	0.75->2.0	-	0-1.0		1.01	37.878	36.888
Blackwater	Jul-18	T2	Piezo	T2-P1	202679.9	229147.2	37.832	36.849						0.45-0.75	1.00	37.832	36.849
Blackwater	Jul-18	T2	phreatic	T2-PH3	202717.9	229179.7	37.533	36.724	0.4	0-0.4	0.4->2.0	-	0-1.0		0.82	37.533	36.724
Blackwater	Jul-18	T2	phreatic	T2-PH4	202755.6	229212.2	37.773	36.77	1.67	0-1.67	1.67->2.5	-	0-1.0		1.02	37.773	36.77
Blackwater	Jul-18	T2	Piezo	T2-P2	202755.8	229212.1	37.758	36.776						1.25-1.55	1.00	37.758	36.776
Blackwater	Jul-18	T2	phreatic	T2-PH5	202794.3	229244.6	38.096	37.061	1.1	0-1.1	1.1->2.0	-	0-1.0		1.05	38.096	37.061
Blackwater	Jul-18	T2	Piezo	T2-P3	202794	229244.8	38.05	37.08						0.7-1.0	1.00	38.05	37.08
Blackwater	Jul-18	T2	phreatic	T2-PH6	202832.9	229278.1	38.216	37.287	1.44	0-1.44	1.44->2.0	-	0-1.0		0.93	38.216	37.287
Blackwater	Jul-18	T2	Piezo	T2-P4	202832.7	229278.3	38.279	37.25						1.1-1.4	1.02	38.279	37.25
Blackwater	Jul-18	T2	phreatic	T2-PH7	202851.7	229293.2	38.78	37.759	2.05	0-2.05	2.05->3.0	-	0-1.0		1.05	38.78	37.759
Blackwater	Jul-18	T2	Piezo	T2-P5	202851.6	229293.5	38.79	37.785						1.7-2.0	1.02	38.79	37.785
Blackwater	Jul-18	T2	phreatic	T2-PH8	202857.3	229302.1	38.337	37.484	1.8	0-1.8	1.8->2.2	-	0-1.5		0.865	38.337	37.484
Blackwater	Jul-18	T2	Piezo	T2-P6	202857	229302.1	38.041	37.48						1.5-1.8	0.55	38.041	37.48
Blackwater	Jul-18	T2	phreatic	T2-PH9	202861.8	229307.6	38.056	36.912	0.8	0-0.8	0.8->2.0	-	0-0.8		1.14	38.056	36.912
Blackwater	Jul-18	T2	Piezo	T2-P7	202861.6	229307.7	38.194	36.922						0.5-0.8	1.275	38.194	36.922
Blackwater	Jul-18	T2	phreatic	T2-PH10	202873.5	229312.1	38.076	37.532	0.7	0-0.7	0.7->1.6	-	0-0.8			38.076	37.532
Blackwater	Jul-18	T2	Piezo	T2-P8	202873.5	229312	38.194	37.533						0.4-0.7	0.7	38.194	37.533
Blackwater	Jul-18	T2	phreatic	T2-PH11	202892.3	229327.8	39.514	37.991	0.5	0-0.5	-	0.5->1.0	0-1.0		1.58	39.514	37.991
Blackwater	Jul-18	T2	phreatic	T2-PH12	202912	229344.5	39.473	38.055	0.25	0-0.25		0.25->1.0	0-1.0		1.62	39.473	38.055
Blackwater	Jul-18	T2	phreatic	T2-PH13	202931.8	229361.1	39.359	37.993	0.15	0-0.15	-	0.15->1.0	0-1.0		1.52	39.359	37.993
Blackwater	Aug-18	T3	phreatic	T3-PH1	202840.9	228696	37.848	36.81	0.85	0-0.85	0.85->1.0	-	0-1.0		1.04	37.848	36.81
Blackwater	Aug-18	T3	phreatic	T3-PH2	202870.9	228723.5	38.077	37.216	1.2	0-1.2	1.2-1.6	1.6->2.0	0-1.0		0.875	38.077	37.216
Blackwater	Aug-18	T3	Piezo	T3-P1	202870.7	228723.7	38.297	37.221						0.9-1.2	1.085	38.297	37.221
Blackwater	Aug-18	T3	phreatic	T3-PH3	202906.9	228757.5	38.605	37.535	2.25	0-2.25	2.25->3.0	-	0-1.0		1.07	38.605	37.535
Blackwater	Aug-18	T3	Piezo	T3-P2	202906.7	228757.7	37.844	37.353						1.8-2.1	0.32	37.844	37.353
Blackwater	Aug-18	T3	phreatic	T3-PH4	202944.5	228790.6	37.643	37.114	1.73	0-1.73	1.73->2.6		0-1.0		1.05	37.643	37.114
Blackwater	Aug-18	T3	Piezo	T3-P3	202944.7	228790.3	38.18	37.094						1.4-1.7	0.55	38.18	37.094
Blackwater	Aug-18	T3	phreatic	T3-PH5	202980.9	228827.2	38.651	37.244	1.8	0-1.8	1.8->2.6	-	0-1.0		1.37	38.651	37.244
Blackwater	Aug-18	T3	Piezo	T3-P4	202980.6	228827.5	37.764	37.275						1.4-1.7	0.48	37.764	37.275
Blackwater	Aug-18	T3	phreatic	T3-PH6	203016.9	228864.3	38.473	37.383	1.5	0-1.5	1.5->2.6	-	0-1.0		1.1	38.473	37.383
Blackwater	Aug-18	T3	Piezo	T3-P5	203016.7	228864.7	38.238	37.379						1.1-1.4	0.87	38.238	37.379
Blackwater	Aug-18	T3	phreatic	T3-PH7	203054.6	228897.5	38.338	37.334	1.3	0-1.3	1.3->2.0	-	0-1.0		1.02	38.338	37.334
Blackwater	Aug-18	T3	Piezo	T3-P6	203054.3	228897.7	37.822	37.327						0.9-1.2	0.5	37.822	37.327
Blackwater	Aug-18	T3	phreatic	T3-PH8	203089.9	228934.5	38.471	37.47	1.2	0-1.2	1.2->2.0	-	0-1.0		1.02	38.471	37.47
Blackwater	Aug-18	T3	phreatic	T3-PH9	203105.6	228951.4	38.436	37.306	0.8	0-0.8	0.8->2.0	-	0-1.0		1.18	38.436	37.306
Blackwater	Aug-18	T3	phreatic	T3-PH10	203111.8	228960.5	38.218	37.186	0.8	0-0.8	0.8->1.6	-	0-1.0		1.01	38.218	37.186
Blackwater	Aug-18	T3	Piezo	T3-P7	203111.8	228960.8	37.751	37.191						0.5-0.8	0.56	37.751	37.191
Blackwater	Aug-18	T3	phreatic	T3-PH11	203118.7	228962.2	37.809	36.838	0.75	0-0.75	0.75->1.2	-	0-0.7		0.8	37.809	36.838
Blackwater	Aug-18	T3	Piezo	T3-P8	203118.7	228962.4	37.372	36.816						0.3-0.7	0.72	37.372	36.816
Blackwater	Aug-18	T3	phreatic	T3-PH12	203127	228968	38.882	37.273	0.15	0-0.15	0.15->1.0	-	0-1.0		1.6	38.882	37.273
Blackwater	Aug-18	T3	phreatic	T3-PH13	203147.4	228982	39.219	37.824	0.15	0-0.15	0.15->1.0	-	0-1.0		1.52	39.219	37.824
Blackwater	Aug-18	T3	phreatic	T3-PH14	203165.7	229000.5	39.225	37.764	0.12	0-0.12	-	0.12->1.0	0-1.0		1.52	39.225	37.764
Blackwater	Aug-18	T3	phreatic	T3-PH15	203186.1	229016.3	39.225	37.693	0.1	0-0.1	-	0.1->1.0	0-1.0		1.575	39.225	37.693
Blackwater	Aug-18	T3	phreatic	T3-PH1 Replaced	602791.0	728724.2										37.59	

Bog	Date	Transect	Piezo type	Location ID	Easting	Northing	peat depth (m)	peat interval(mbgl)	marl interval (mbgl)	lacustrine clay interval (mbgl)	standpipe screen (mbgl)	piezoemter screen (mbgl)	upstand (m)
Derrycolumb	Aug-18	T1	phreatic	T1-PH1	209308	260082	6.54	0-6.54	6.54->7.0	-	0.26-1.26		0.74
Derrycolumb	Aug-18	T1	Piezo	T1-P1	209308	260082						5.7-6.0	0.33
Derrycolumb	Aug-18	T1	phreatic	T1-PH2	209319	260103	5.7	0-5.7	5.7->6.0	-	0-1.0		0.92
Derrycolumb	Aug-18	T1	Piezo	T1-P2	209319	260103						5.3-5.6	0.81
Derrycolumb	Sep-18	T1	phreatic	T1-PH3	209329	260125	3.2	0-3.2	3.2->4.0		0-1.0		0.98
Derrycolumb	Sep-18	T1	Piezo	T1-P3	209329	260125						2.8-3.1	0.3
Derrycolumb	Sep-18	T1	phreatic	T1-PH4	209344	260140	5.1	0-5.1		5.1-6.1	0-1.0		0.89
Derrycolumb	Sep-18	T1	Piezo	T1-P4	209344	260140						4.7-5.0	1.05
Derrycolumb	Sep-18	T1	phreatic	T1-PH5	209363	260159	4	>4.0			0-1.0		0.98
Derrycolumb	Sep-18	T1	Piezo	T1-P5	209363	260159						2.6-2.9	0.54
Derrycolumb	Aug-18	T1A	phreatic	T1A-PH1	209363	260076	7	>7	-	-	0.34-1.34		0.66
Derrycolumb	Aug-18	T1A	Piezo	T1A-P1	209363	260076						5.1-5.4	0.39
Derrycolumb	Aug-18	T1A	phreatic	T1A-PH2	209371	260096	5.5	0-5.5	5.5-5.8		0-1.0		0.84
Derrycolumb	Aug-18	T1A	Piezo	T1A-P2	209371	260096						4.0-4.3	0.72
Derrycolumb	Sep-18	T1A	phreatic	T1A-PH3	209376	260116	3.8	0-3.8	3.8->4.0		0-1.0		1
Derrycolumb	Sep-18	T1A	Piezo	T1A-P3	209376	260116						3.2-3.5	0.97
Derrycolumb	Sep-18	T1A	phreatic	T1A-PH4	209394	260143	4	>4.0			0-1.0		0.93
Derrycolumb	Sep-18	T1A	Piezo	T1A-P4	209394	260143						2.3-2.6	0.8
Derrycolumb	Aug-18	T3	phreatic	T3-PH1	209264	259702	3.5	0-3.5	3.5-4.1	4.1->5.0	0-2.0		1
Derrycolumb	Aug-18	T3	piezo	T3-P1	209264	259702						3.0-3.3	0.13
Derrycolumb	Aug-18	T3	phreatic	T3-PH2	209271	259698	3.5	0-3.5			0-1.0		0.66
Derrycolumb	Aug-18	T3	phreatic	T3-PH3	209273	259696	3.7	0-3.7	3.7-4.0	4.0->5	0-1.0		1.03
Derrycolumb	Aug-18	T3	Piezo	T3-P2	209273	259696						2.97-3.27	0.17
Derrycolumb	Aug-18	T3	phreatic	T3-PH4	209296	259685	4.56	0-4.56	4.56->5.0	-	0-1.0		1
Derrycolumb	Aug-18	T3	Piezo	T3-P3	209296	259685						4.17-4.47	0.93
Derrycolumb	Aug-18	T3	phreatic	T3-PH5	209319	259672	5.5	0-5.5	5.5->6.0	-	0-1.0		1.02
Derrycolumb	Aug-18	T3	Piezo	T3-P4	209319	259672						4.6-4.9	0.5
Derrycolumb	Aug-18	T3	phreatic	T3-PH6	209341	259663	5.2	0-5.2	5.2->6.0	-	0-1.0		1.04
Derrycolumb	Aug-18	T3	Piezo	T3-P5	209341	259663						4.88-5.18	0.67
Derrycolumb	Aug-18	T3	phreatic	T3-PH7	209362	259651	5.45	0-5.45	5.45->6.0	-	0-1.0		1.01
Derrycolumb	Aug-18	T3	Piezo	T3-P6	209362	259651						4.9-5.2	0.54
Derrycolumb	Aug-18	T3	phreatic	T3-PH8	209384	259641	3.7	0-3.7	3.7->5.2	-	0-1.0		1.05
Derrycolumb	Aug-18	T3	Piezo	T3-P7	209384	259641						3.10-3.40	0.14
Derrycolumb	Sep-18	T4	phreatic	DC-Pump-PH1	209244	260107	3.4	0-3.4	3.4->4.0		0.3-1.3		0.7
Derrycolumb	Sep-18	T4	Piezo	DC-Pump-P1	209244	260107						2.8-3.1	0.27

Bog	Date	Transect	Piezo type	Location ID	Easting	Northing	peat depth (m)	peat interval(mbgl)	marl interval (mbgl)	lacustrine clay interval (mbgl)	standpipe screen (mbgl)	piezoemter screen (mbgl)	upstand (m)
Mongan	Aug-18	T1	phreatic	T1-PH1	204306	230832	5.48	0-5.48	none	5.48->5.78	0-1.0		1.00
Mongan	Aug-18	T1	Piezo	T1-P1	204306	230832						4.8-5.1	1.29
Mongan	Aug-18	T1	phreatic	T1-PH2	204299	230859	5.09	0-5.09	none	5.09->5.34	0.5-1.5		0.50
Mongan	Aug-18	T1	Piezo	T1-P2	204299	230859						4.7-5.0	1.06
Mongan	Aug-18	T1	phreatic	T1-PH3	204295	230868	4.41	0-4.41	none		0.5-1.5		0.50
Mongan	Aug-18	T1	Piezo	T1-P3	204295	230868						3.9-4.2	0.98
Mongan	Aug-18	T1	phreatic	T1-PH4	204292	230880	5.1	0-5.10	none	5.1->5.35	0.5-1.5		0.50
Mongan	Aug-18	T1	Piezo	T1-P4	204292	230880						4.7-5.0	1.43
Mongan	Aug-18	T1	phreatic	T1-PH5	204289	230888	5	>5.0			0-1.0		1.00
Mongan	Aug-18	T1	phreatic	T1-PH6	204287	230896	5.28	0-5.28	none		0-1.0		1.02
Mongan	Aug-18	T1	Piezo	T1-P5	204287	230896						4.7-5.0	1.43
Mongan	Aug-18	T1	phreatic	T1-PH7	204286	230900	5	>5.0			0-1.0		0.98
Mongan	Aug-18	T1	phreatic	T1-PH8	204284	230905	5.4	0-5.4	none		0-1.0		0.60
Mongan	Aug-18	T1	Piezo	T1-P6	204284	230905						5.0-5.3	1.09
Mongan	Aug-18	T1	phreatic	T1-PH9	204278	230924	5.2	>5.2			0-1.0		1.00
Mongan	Aug-18	T1	phreatic	T3-PH10	204271	230946	6.5	0-6.5	none	6.5->6.8	0-1.0		1.02
Mongan	Aug-18	T1	Piezo	T1-P7	204271	230946						4.85-5.15	1.27
Mongan	Aug-18	T2	phreatic	T2-PH1	204187	230763	4.7	0-4.7	none	4.7->4.95	0.5-1.5		0.5
Mongan	Aug-18	T2	piezo	T2-P1	204187	230763						3.75-4.05	0.96
Mongan	Aug-18	T2	phreatic	T2-PH2	204183	230769	4.72	0-4.72	none	4.7->5.0	0.5-1.5		0.48
Mongan	Aug-18	T2	piezo	T2-P2	204183	230769						4.1-4.4	0.98
Mongan	Aug-18	T2	phreatic	T2-PH3	204170	230760	4.75	0-4.75	none		0.5-1.5		0.5
Mongan	Aug-18	T2	piezo	T2-P3	204170	230760						4.4-4.7	0.68
Mongan	Aug-18	T2	phreatic	T2-PH4	204163	230788	5.05	0-5.05	none	4.05->4.35	0-1.0		1
Mongan	Aug-18	T2	piezo	T2-P4	204163	230788						4.7-5.0	0.9
Mongan	Aug-18	T2	phreatic	T2-PH5	204160	230790	4	>4.0			0-1.0		0.95
Mongan	Aug-18	T2	phreatic	T2-PH6	204143	230807	5.3	0-5.3	none	4.3->4.65	0-1.0		1
Mongan	Aug-18	T2	piezo	T2-P5	204143	230807						4.6-4.9	0.52
Mongan	Aug-18	T2	phreatic	T2-PH7	204124	230826	5.45	0-5.45	none	5.45->5.68	0-1.0		0.98
Mongan	Aug-18	T2	piezo	T2-P6	204124	230826						5.05-5.35	1.05
Mongan	Aug-18	T2	phreatic	T2-PH8	204106	230842	5.7	0-5.7	none	5.7->5.95	0-1.0		1.05
Mongan	Aug-18	T2	piezo	T2-P7	204106	230842						5-5.3	0.8
Mongan	Aug-18	T3	phreatic	T3-PH1	204085	230664	3.3	0-3.3	none	3.3->3.65	0.5-1.5		1.18
Mongan	Aug-18	T3	Piezo	T3-P1	204085	230664						2.43-2.73	0.67
Mongan	Aug-18	T3	phreatic	T3-PH2	204077	230669	3.4	0-3.4	none	3.4->3.8	0.5-1.5		1
Mongan	Aug-18	T3	Piezo	T3-P2	204077	230669						2.5-2.8	0.6
Mongan	Aug-18	T3	phreatic	T3-PH3	204071	230675	4.62	0-4.62	none	4.62>4.9	0-1.0		1.2
Mongan	Aug-18	T3	Piezo	T3-P3	204071	230675						4.05-4.35	1
Mongan	Aug-18	T3	phreatic	T3-PH4	204063	230680	4.7	0-4.7	none	4.7->5.0	0-1.0		1.01
Mongan	Aug-18	T3	Piezo	T3-P4	204063	230680						4.25-4.55	0.6
Mongan	Aug-18	T3	phreatic	T3-PH5	204059	230685	4.85	0-4.85	none	4.85>5.25	0-1.0		1.06
Mongan	Aug-18	T3	Piezo	T3-P5	204059	230685						4.4-4.7	0.7
Mongan	Aug-18	T3	phreatic	T3-PH6	204041	230703	5.2	0-5.2	none	5.2>5.45	0-1.0		1
Mongan	Aug-18	T3	Piezo	T3-P6	204041	230703						4.4-4.7	0.7
Mongan	Aug-18	T3	phreatic	T3-PH7	204022	230719	5.7	0-5.7	none	5.7>5.99	0-1.0		1
Mongan	Aug-18	T3	Piezo	T3-P7	204022	230719						5.1-5.4	1
Mongan	Aug-18	T3	phreatic	T3-PH8	204004	230736	5.75	0-5.75	none	5.75>6.0	0-1.0		1.2
Mongan	Aug-18	T3	Piezo	T3-P8	204004	230736						4.95-5.25	1.16

APPENDIX II: MONGAN BOG – AUGERING DATA

Bog	Location	Easting	Northing	peat depth (mbgl)	Mineral Soil Depth (mbgl) and description	Base type
Mongan	GC2	204493	230953	3.70	no clay	hard base @ 3.7mbgl
Mongan	GC3	204543	230969	4.20	4.2-4.5 - lacustrine clay	hard base at 4.5mbgl
Mongan	GC4	204592	230989	4.60	4.6-4.8 - lacustrine clay	hard base at 4.8mbgl
Mongan	GC5	204386	230931	4.74	no clay	hard base @ 4.74mbgl
Mongan	GC6	204436	230938	4.90	4.9-5.2 - soft lacustrine clay	hard base @ 5.2mbgl
Mongan	GC7	204470	230923	3.80	grey fine soft clay	hard base @ 3.8mbgl
Mongan	GC8	204497	230928	4.05	4.05-4.15 - lacustrine clay	hard base @4.15mbgl
Mongan	GC9	204546	230943	3.80	no clay	hard gravel @3.8mbgl
Mongan	GC10	204594	230952	4.62	4.62-4.82 - lacustrine clay	hard base @ 4.82mbgl
Mongan	GC11	204644	230964	4.60	sandy/gravelly base	hard base @ 4.6mbgl
Mongan	GC12	204692	230971	2.75	2.75-2.95 - soft lacustrine clay	hard base @ 2.95mbgl
Mongan	GC13	204395	230885	5.25	5.25-5.35 - wet sand and gravel 5.35-5.55 - Lacustrine clay	hard base @ 5.55mbgl
Mongan	GC14	204439	230892	2.85	2.85-2.95 - light brown sand	hard base @ 2.95mbgl
Mongan	GC15	204479	230876	2.40	no clay	hard base @ 2.4mbgl
Mongan	GC16	204507	230884	5.02	5.02-5.22- lacustrine clay	hard base @5.22mbgl
Mongan	GC16a	204555	230883	4.60	no clay	hard base @ 4.6mbgl
Mongan	GC17	204550	230912	3.35	3.35-3.55 - black lacustrine clay	hard base @3.55mbgl
Mongan	GC18	204597	230907	2.90	2.9-3.1 - lacustrine clay	hard base @ 3.10mbgl
Mongan	GC19	204636	230904	3.75	3.75-3.85 - lacustrine lay	hard base @ 3.85mbgl
Mongan	GC20	204682	230919	3.00	no clay	hard base @ 3.0mbgl
Mongan	GC21	204404	230833	5.40	5.4-5.6 - grey lacustrine clay	hard base @ 5.6mbgl
Mongan	GC22	204454	230838	5.42	5.42-5.6 - grey lacustrine clay	hard base @ 5.6mbgl
Mongan	GC23	204485	230826	4.00	4.0-4.1 - grey sand 4.1-4.4 - grey lacustrine clay	hard base @ 4.4mbgl
Mongan	GC24	204516	230834	4.25	4.25-4.65 - light brown clay	hard base @ 4.65mbgl
Mongan	GC25	204565	230844	5.37	5.37-5.6 - lacustrine clay	hard base @ 5.6mbgl
Mongan	GC26	204613	230854	5.55	no clay	hard base @ 5.55mbgl
Mongan	GC27	204657	230863	5.40	5.4-5.6 - lacustrine clay	hard base @ 5.6mbgl
Mongan	GC28	204710	230870	3.50	3.5-3.7 - lacustrine clay	hard base @ 3.7mbgl
Mongan	GC29	204408	230791	5.70	no clay	hard base @ 5.7mbgl
Mongan	GC30	204458	230796	5.55	no clay	hard base @ 5.55mbgl
Mongan	GC31	204489	230778	4.67	4.67-5.0 - grey lacustrine clay	hard base @ 5.0mbgl
Mongan	GC32	204522	230798	4.40	4.4-4.6 - lacustrine clay	hard base @ 4.6mbgl
Mongan	GC33	204573	230798	1.55	1.55-1.77 - lacustrine clay	hard base @ 1.77mbgl
Mongan	GC34	204617	230810	2.15	no clay	hard base @ 2.15mbgl

APPENDIX III: GARRYDUFF WS LOGS

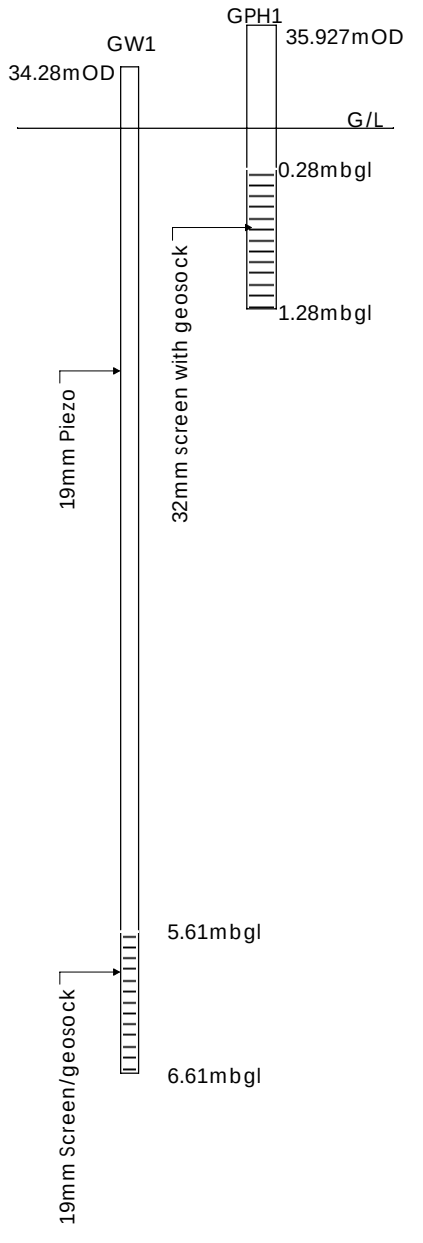
CAMERA SURVEY LOG

WELL NUMBER: GW1

PROJECT NUMBER: P1420-1
SITE: Garyduff, Clonfert, Co. Galway
CLIENT: Bord na Mona
DRILLING CONTRACTOR: HES

DATE STARTED: 02/08/2018
DATE FINISHED: 09/08/2018
LOGGED BY: M. Gill
DRILLING TYPE: Hand augering and window sampling

EASTING: 196606
NORTHING: 222257
ELEVATION: 33.884 mOD

Well Completion Description	Comments	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
	3" PVC casing installed from ground level to top of mineral soil. Deep piezometer is installed wihtin this casing, with screened section installed below the base of the 3" casing. The 3" casing was pushed into the ground using a 360 excavator, and the insdie of the casing was cleaned out using handheld auger and bailer. GW1: bentonite seal from 5.5mbgl to ground level GW1: coarse sand installed from 6.61 to 5.5mbgl		33.88 32.08 29.73 29.21 27.27	0 5		Ground Surface Peat Light brown, soft Shell Marl Grey, sticky Lacustine CLAY Hard, grey gravelly Silt/Clay - Limestone Till E.O.H 6.61mbgl Total Depth of Borehole

REMARKS

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SCALE

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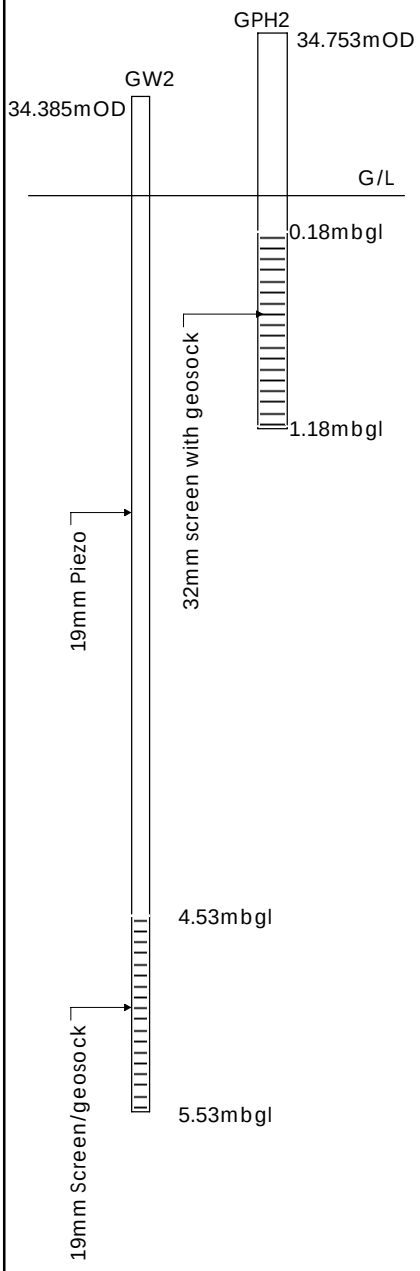
CAMERA SURVEY LOG

WELL NUMBER: GW2

PROJECT NUMBER: P1420-1
SITE: Garyduff, Clonfert, Co. Galway
CLIENT: Bord na Mona
DRILLING CONTRACTOR: HES

DATE STARTED: 02/08/2018
DATE FINISHED: 09/08/2018
LOGGED BY: M. Gill
DRILLING TYPE: Hand augering and window sampling

EASTING: 196640
NORTHING: 222266
ELEVATION: 33.901mOD

Well Completion Description	Comments	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
	3" PVC casing installed from ground level to top of mineral soil. Deep piezometer is installed within and below this casing. Screened section installed below base of 3" casing. The 3" casing was pushed into the ground using a 360 excavator, and the insdie of the casing was cleaned out using handheld auger and bailer. GW2: bentonite seal from 4.4mbgl to ground level GW2: Coarse sand from 4.4mbgl to 5.53mbgl		33.90 32.80 32.10 29.65 29.30 28.37	0 5		Ground Surface Dry, hard Peat Softer, damp brown Peat Light brown, soft Shell Marl Grey sticky Clay - Lacustine deposits Wet, Sandy Mineral Soil - Limestone Till E.O.H 5.53mbgl Total Depth of Borehole

REMARKS

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SCALE

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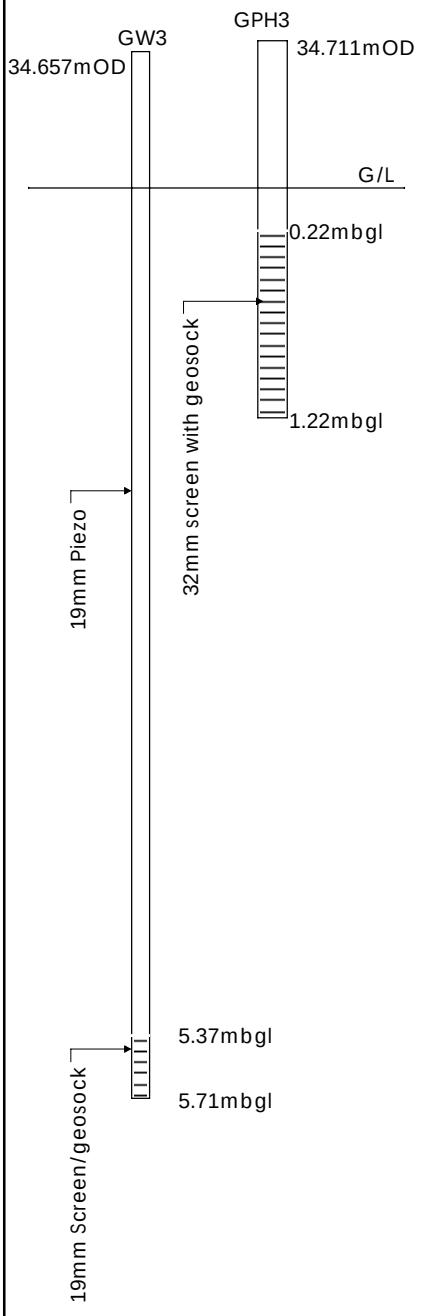
CAMERA SURVEY LOG

WELL NUMBER: GW3

PROJECT NUMBER: P1420-1
SITE: Garyduff, Clonfert, Co. Galway
CLIENT: Bord na Mona
DRILLING CONTRACTOR: HES

DATE STARTED: 02/08/2018
DATE FINISHED: 09/08/2018
LOGGED BY: M. Gill
DRILLING TYPE: Hand augering and window sampling

EASTING: 196655
NORTHING: 222275
ELEVATION: 33.914mOD

Well Completion Description	Comments	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
	3" PVC casing installed from ground level to top of mineral soil. Deep piezometer is installed within and below this casing. Screened section installed below base of 3" casing. The 3" casing was pushed into the ground using a 360 excavator, and the insdie of the casing was cleaned out using handheld auger and bailer. GW3: bentonite seal from 4.6mbgl to ground level GW3: Coarse sand from 4.6mbgl to 5.71mbgl		0.00 -1.20 -1.80 -4.00 -4.60 -5.71	0 5		Ground Surface Dry, hard Peat Softer, damp brown Peat Light brown, soft Shell Marl Grey, soft, sticky Silt/Clay - Lacustine deposits Wet, grey, sandy Mineral Soil - Limestone Till E.O.H 5.71mbgl Total Depth of Borehole

REMARKS

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SCALE

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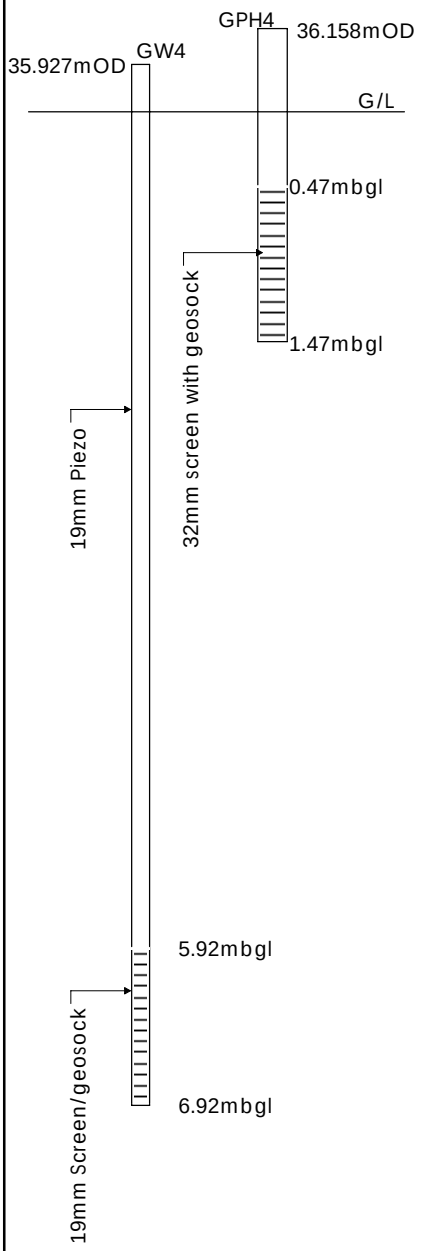
CAMERA SURVEY LOG

WELL NUMBER: GW4

PROJECT NUMBER: P1420-1
SITE: Garyduff, Clonfert, Co. Galway
CLIENT: Bord na Mona
DRILLING CONTRACTOR: HES

DATE STARTED: 02/08/2018
DATE FINISHED: 09/08/2018
LOGGED BY: M. Gill
DRILLING TYPE: Hand augering and window sampling

EASTING: 196702
NORTHING: 222272
ELEVATION: 35.645mOD

Well Completion Description	Comments	Water Strikes	Elevation	Meters Below Ground Surface	Lithology	Formation Description
	3" PVC casing installed from ground level to top of mineral soil. Deep piezometer is installed within and below this casing. Screened section installed below base of 3" casing. The 3" casing was pushed into the ground using a 360 excavator, and the insdie of the casing was cleaned out using handheld auger and bailer. GW4: bentonite seal from 4.8mbgl to ground level GW4: Coarse sand from 4.8mbgl to 6.92		35.65 34.55 32.55 30.75 28.73	0 5		Ground Surface Dry, hard dark brown Peat Damp, brown soft Peat Light brown, soft Shell Marl Stiff, grey, clayey, gravelly SILT - Limestone Till (Hammering in hard gravel) E.O.H 6.92mbgl Total Depth of Borehole

REMARKS

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SCALE

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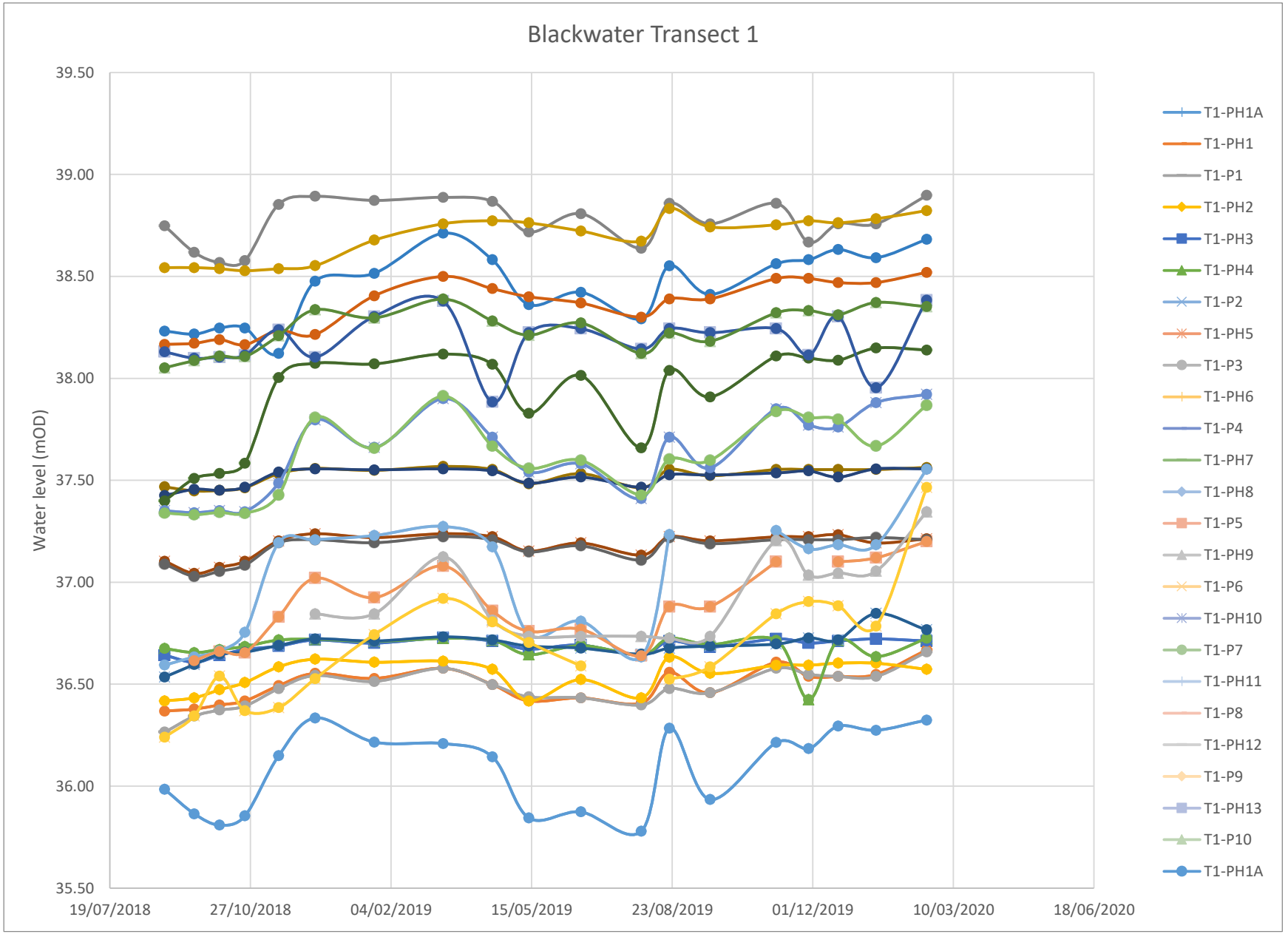
APPENDIX IV: SUMMARY OF BNM WATER LEVEL DATA – BLACKWATER

Location ID	27/08/2018	17/09/2018	05/10/2018	23/10/2018	16/11/2018	12/12/2018	23/01/2019	13/03/2019	17/04/2019	13/05/2019	19/06/2019	01/08/2019	21/08/2019	19/09/2019	05/11/2019	28/11/2019	19/12/2019	15/01/2020	20/02/2020
T1-PH1A	35.98	35.86	35.81	35.85	36.15	36.33	36.22	36.21	36.14	35.84	35.87	35.78	36.28	35.93	36.21	36.18	36.29	36.27	36.32
T1-PH1	36.37	36.38	36.40	36.42	36.49	36.55	36.53	36.58	36.50	36.42	36.43	36.41	36.56	36.46	36.61	36.54	36.54	36.55	36.67
T1-P1	36.27	36.34	36.37	36.39	36.48	36.54	36.51	36.58	36.50	36.44	36.43	36.40	36.48	36.46	36.58	36.55	36.54	36.54	36.66
T1-PH2	36.42	36.43	36.47	36.51	36.59	36.62	36.61	36.61	36.57	36.42	36.52	36.43	36.63	36.55	36.59	36.59	36.60	36.60	36.57
T1-PH3	36.64	36.61	36.64	36.67	36.69	36.72	36.70	36.73	36.71	36.67	36.69	36.64	36.71	36.68	36.72	36.70	36.71	36.72	36.71
T1-PH4	36.68	36.66	36.67	36.69	36.72	36.72	36.71	36.73	36.72	36.65	36.69	36.65	36.73	36.70	36.72	36.43	36.72	36.64	36.73
T1-P2	36.54	36.60	36.65	36.66	36.69	36.72	36.71	36.73	36.72	36.69	36.68	36.65	36.68	36.69	36.70	36.73	36.72	36.85	36.77
T1-PH5	37.10	37.04	37.07	37.10	37.20	37.24	37.22	37.24	37.22	37.15	37.19	37.13	37.22	37.20	37.22	37.22	37.23	37.19	37.21
T1-P3	37.09	37.03	37.05	37.08	37.19	37.21	37.19	37.22	37.21	37.15	37.18	37.11	37.22	37.19	37.21	37.21	37.21	37.22	37.21
T1-PH6	37.47	37.45	37.45	37.46	37.53	37.56	37.55	37.57	37.55	37.48	37.53	37.46	37.55	37.52	37.55	37.55	37.55	37.55	37.56
T1-P4	37.43	37.46	37.45	37.47	37.54	37.56	37.55	37.56	37.55	37.49	37.52	37.47	37.53	37.53	37.54	37.55	37.52	37.56	37.56
T1-PH7	37.40	37.51	37.53	37.58	38.00	38.07	38.07	38.12	38.07	37.83	38.01	37.66	38.04	37.91	38.11	38.10	38.09	38.15	38.14
T1-PH8	36.59	36.63	36.66	36.75	37.19	37.21	37.23	37.27	37.17	36.74	36.81	36.63	37.23		37.25	37.16	37.18	37.18	37.55
T1-P5		36.62	36.66	36.66	36.83	37.02	36.93	37.08	36.86	36.76	36.77	36.64	36.88	36.88	37.10		37.10	37.12	37.20
T1-PH9						36.85	36.85	37.13	36.82	36.74	36.74	36.74	36.73	36.74	37.21	37.04	37.05	37.06	37.35
T1-P6	36.24	36.35	36.54	36.37	36.39	36.53	36.74	36.92	36.81	36.71	36.59		36.53	36.59	36.85	36.91	36.89	36.79	37.47
T1-PH10	37.35	37.34	37.35	37.35	37.49	37.80	37.66	37.90	37.71	37.54	37.58	37.41	37.71	37.56	37.85	37.77	37.76	37.88	37.92
T1-P7	37.34	37.33	37.34	37.34	37.43	37.81	37.66	37.91	37.67	37.56	37.60	37.43	37.60	37.60	37.84	37.81	37.80	37.67	37.87
T1-PH11	38.23	38.22	38.25	38.25	38.12	38.48	38.52	38.71	38.58	38.36	38.42	38.29	38.55	38.41	38.56	38.58	38.63	38.59	38.68
T1-P8	38.17	38.17	38.19	38.17	38.24	38.22	38.41	38.50	38.44	38.40	38.37	38.30	38.39	38.39	38.49	38.49	38.47	38.47	38.52
T1-PH12	38.75	38.62	38.57	38.58	38.85	38.89	38.87	38.89	38.87	38.72	38.81	38.64	38.86	38.76	38.86	38.67	38.76	38.76	38.90
T1-P9	38.54	38.54	38.54	38.53	38.54	38.55	38.68	38.76	38.77	38.76	38.72	38.67	38.83	38.74	38.75	38.77	38.76	38.78	38.82
T1-PH13	38.13	38.10	38.10	38.11	38.24	38.10	38.30	38.38	37.88	38.22	38.24	38.14	38.24	38.22	38.24	38.11	38.30	37.95	38.38
T1-P10	38.05	38.09	38.11	38.11	38.21	38.34	38.30	38.39	38.28	38.21	38.27	38.12	38.22	38.18	38.32	38.33	38.31	38.37	38.35
T2-PH1A	36.15	36.10	36.12	36.10	36.39	36.61	36.45	36.49	36.36	36.08	36.11	36.01	36.45	36.15	36.43	36.43	36.53	36.53	36.57
T2-PH1	36.37	36.39	36.42	36.45	36.56	36.61	36.56	36.64	36.54	36.45	36.47	36.45	36.57	36.43	36.64	36.60	36.55	36.60	36.07
T2-PH2	36.55	36.50	36.49	36.51	36.65	36.44	36.67	36.68	36.63	36.48	36.53	36.44	36.67	36.56	36.67	36.55	36.62	36.72	36.43
T2-P1	36.55		36.50		36.64	36.69	36.65	36.67	36.63	36.48	36.53		36.66	36.55	36.66	36.65	36.66	36.69	36.72
T2-PH3	36.62	36.60	36.64	36.66	36.70	36.72	36.71	36.71	36.71	36.61	36.69	36.58	36.69	36.68	36.69	36.71	36.71	36.72	36.72
T2-PH4	36.71	36.66	36.70	36.74	36.77	36.79	36.77	36.79	36.77	36.69	36.73	36.67	36.77	36.74	36.76	36.76	36.76	36.78	36.67
T2-P2	36.53	36.63	36.68	36.71	36.76	36.80	36.79	36.81	36.78	36.75	36.76	36.69	36.75	36.75	36.87	36.77	36.79	36.81	36.80
T2-PH5	36.85	36.81	36.83	36.85	36.94	36.98	36.96	36.99	36.95	36.83	36.90	36.81	37.00	36.89	36.97	36.97	37.00	37.03	37.02
T2-P3	36.71	36.81	36.83	36.86	36.96	36.99	36.97	37.03	36.95	36.87	37.03	36.85	36.97	36.92	36.99	36.99	36.98	37.01	37.03
T2-PH6	37.02	36.96	36.98	37.01	37.18	37.20	37.19	37.23	37.20	37.06	37.14	37.02	37.23	37.12	37.21	37.13	37.10	37.13	37.32
T2-P4	36.82	36.89	36.94	36.98	37.11	37.17	37.15	37.21	37.18	37.09	37.23	37.03	37.16	37.12	37.18	37.18	37.18	37.17	37.18
T2-PH7	37.12	36.93	36.91	36.96	37.14	37.18	37.18	37.22	37.15	36.98	37.08	36.96	37.20	37.07	37.20	37.18	37.21	37.21	37.33
T2-P5	36.60	36.73	36.76	36.78	36.79	36.82	36.92	36.99	37.01	37.00	36.98	36.92	36.96	36.96	36.98	37.00	37.08	37.11	37.11
T2-PH8	36.21	36.18	36.19	36.22	36.53	36.68	36.67	36.72	36.66	36.36	36.49	36.33	36.69	36.59	36.95				
T2-P6	36.17	36.17	36.23	36.24	36.45	36.53	36.50	36.69	36.57	36.26	36.47	36.35	36.63	36.48	36.92			36.82	37.10
T2-PH9	36.27	36.27	36.25		36.33	36.41	36.38	36.60	36.41	36.27	36.27	36.26	36.52	36.31	36.88	36.41	36.41	36.33	36.99
T2-P7					36.27	36.39	36.34	36.63	36.38		36.28	36.08	36.24	36.15	36.65		36.30	36.57	36.95
T2-PH10	36.10	36.04	36.05	36.07	36.21	36.41	36.36	36.42	36.40	36.28	36.21	36.15	36.41	36.28	36.41	36.41	36.43	36.47	36.15
T2-P8					37.19	37.36	37.34	37.40	37.34	37.30	37.30	37.17	37.32	37.30	37.45	37.38	37.36	37.17	37.42
T2-PH11	37.53	37.49	37.48	37.50	37.65	37.78	37.77	37.79	37.76	37.69	37.71	37.60	37.76	37.70	37.76	37.76	37.77	37.78	37.64
T2-PH12	37.67	37.63	37.63	37.65	37.78	37.89	37.88	37.89	37.87	37.83	37.85	37.74	37.87	37.86	37.88	37.89	37.88	37.89	37.89
T2-PH13	37.66	37.62	37.62	37.64	37.76	37.89	37.89	37.90	37.89	37.83	37.86	37.75	37.90	37.83	37.88	37.90	37.68	37.92	37.90
T3-PH1	36.217	36.178	36.128	36.183	36.405	36.408									36.628	36.618	36.658	36.648	36.728
T3-PH2	36.735	36.692	36.682	36.722	37.032	37.062	37.047	37.077	37.017	36.807	36.837	36.737	37.057	36.877	37.047	37.037	37.047	37.067	37.127
T3-P1	36.647	36.677	36.712	36.727	36.897	37.027	36.989	37.072	36.987	36.817	36.827	36.757	36.907	36.887	37.037	37.047	37.027	37.027	37.097
T3-PH3		36.78	36.83	36.84	37.17	37.365	37.265	37.35	37.265	37.005	37.08	36.955	37.335	37.095	37.305	37.475	37.295	37.265	37.355
T3-P2	36.682	36.779	36.799	36.814	36.899	37.099	37.147	37.229	37.164	37.134	37.054	36.994	37.044	37.104	37.184	37.274	37.244	37.224	37.234
T3-PH4	36.488	36.508	36.533	36.543	36.708	36.838	36.888	36.928	36.873	36.843	36.818	36.723	36.833	36.823	36.883	36.893	36.903	36.913	36.923
T3-P3	36.515	36.5	36.51	36.56	36.778	36.88	36.867	36.895	36.88	36.8	36.82	36.7	36.85	36.82	36.88	36.86	36.87	36.87	36.93
T3-PH5	36.393				36.559	37.056	37.006	37.046	37.011	36.841	36.871	36.641	37.031	36.861	37.041	37.011	37.031	37.051	37.521
T3-P4	36.528	36.554	36.534	36.517	36.519	36.789	36.919	36.999	36.954	36.944	36.894	36.824	36.824	36.904	36.924	36.944	36.964	36.994	36.974
T3-PH6	36.943	36.938	36.935	36.968	37.19	37.288	37.233	37.268	37.213	37.043	37.093	37.003	37.283	37.113	37.253	37.243	37.273	37.313	37.313
T3-P5	36.798	36.888	36.958	36.973	37.17	37.223	37.198	37.273	37.198	37.058	37.113	37.028	37.198	37.128	37.228	37.198	37.228	37.198	37.218
T3-PH7	36.808	36.838	36.823	36.875	37.053	37.173	37.098	37.143	37.088	36.948	37.018	36.918	37.058	37.008	37.118	36.848	37.078	37.148	37.188
T3-P6	36.722	36.777	36.847	36.867	37.032	37.097	37.067	37.142	37.092	36.992	37.002	36.922	37.062	37.032	37.092	37.092	37.102	37.082	37.112
T3-PH8		36.676	36.699	36.761	37.006	37.181	37.086	37.161	37.111	36.871	36.941	36.751	37.131	36.921	37.151	37.121	37.151	37.161	37.281
T3-PH9	36.868	36.826	36.791	36.831	37.066	37.186	37.126	37.241	37.146	36.851	36.941	36.766	37.166	36.946	37.226	37.186	37.166	37.216	37.166
T3-PH10	36.31	36.268	36.278	36.298	36.473	36.603	36.523	37.008	36.888	36.698	36.738	36.578	36.918	36.758	37.218	36.898	36.948	37.018	37.328
T3-P7						36.566			36.511	36.701	36.711	37.751	36.541	37.751	36.831	36.501	36.551	36.481	36.731
T3-PH11	35.989	35.904	35.934	35.974	36.124	36.219	36.179	36.554	36.189	36.029	36.049	35.929	36.459	36.069	36.799	36.269	36.259	36.329	36.939
T3-P8						36.237		36.587	36.212	36.322	36.322	37.372	36.462	35.992	36.822	36.322	36.302	36.322	36.922
T3-PH12	36.972	36.897	36.887	36.904	37.057	37.206	37.152	37.247	37.192	36.992	37.052	36.932	37.202	37.022	37.212	37.212	37.232	37.242	37.272
T3-PH13	37.474	37.424	37.414	37.434	37.574	37.654	37.644	37.699	37.679	37.589	37.584	37.509	37.679	37.599	37.679	37.689	37.569	37.699	37.719
T3-PH14	37.487	37.44	37.43	37.44	37.61	37.71	37.7	37.73	37.705	37.635	37.65	37.535	37.695	37.615	37.675	37.665	37.705	37.715	37.725
T3-PH15	37.369	37.3	37.295	37.323	37.545	37.67	37.67	37.69	37.675	37.545	37.475	37.435	37.655	37.575	37.665	37.685	37.665	37.715	37.705
T3-PH1 Replaced													36.37	36.170					


Blackwater Transect 1
Water level (mOD)
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36.50
36.00
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27/10/2018
04/02/2019
15/05/2019
23/08/2019
01/12/2019
10/03/2020
18/06/2020
T1-PH1A
T1-PH1
T1-P1
T1-PH2
T1-PH3
T1-PH4
T1-P2
T1-PH5
T1-P3
T1-PH6
T1-P4
T1-PH7
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T1-P6
T1-PH10
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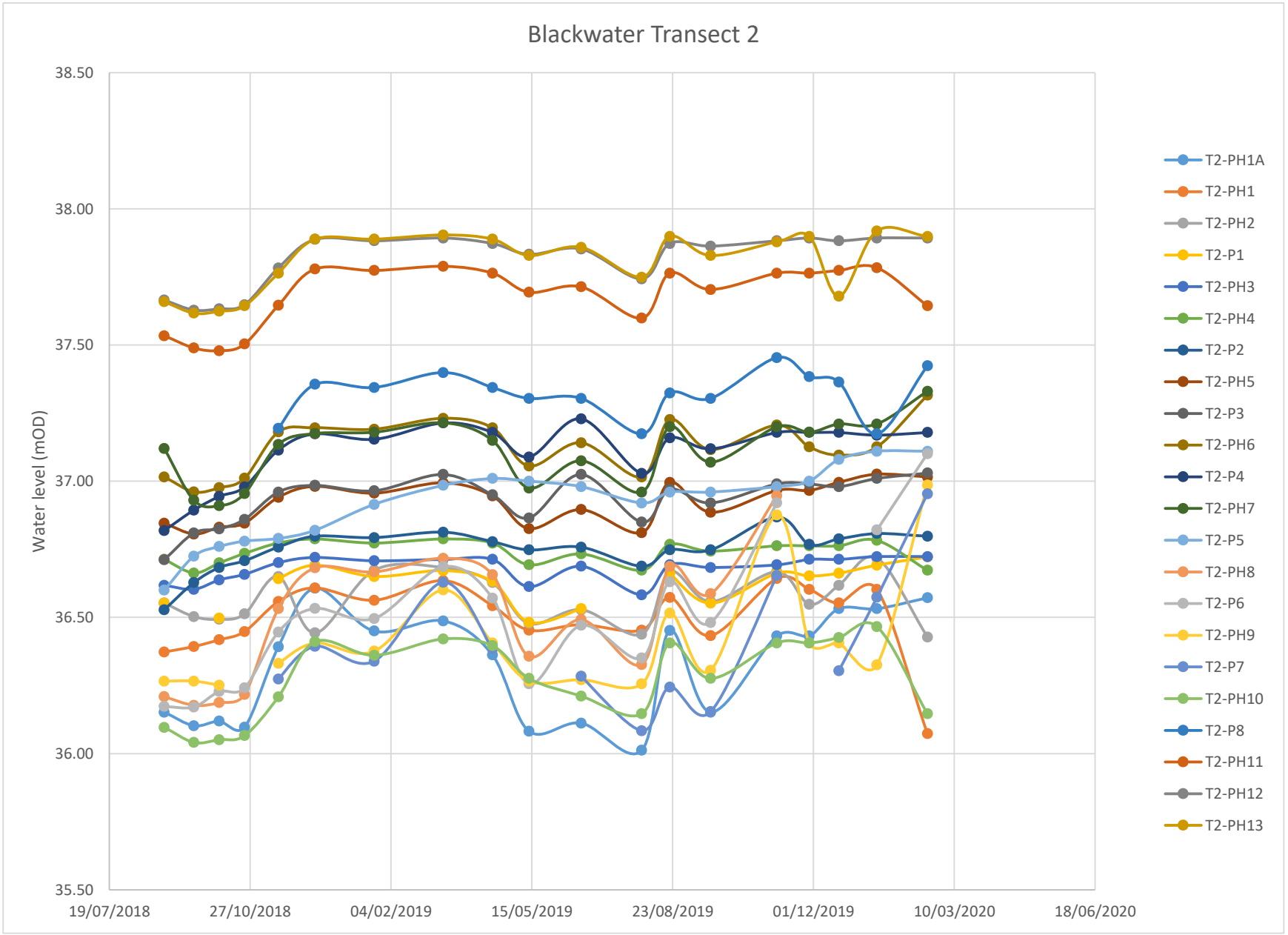
Blackwater Transect 2
Water level (mOD)
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36.50
36.00
35.50
19/07/2018
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04/02/2019
15/05/2019
23/08/2019
01/12/2019
10/03/2020
18/06/2020
T2-PH1A
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T2-PH2
T2-P1
T2-PH3
T2-PH4
T2-P2
T2-PH5
T2-P3
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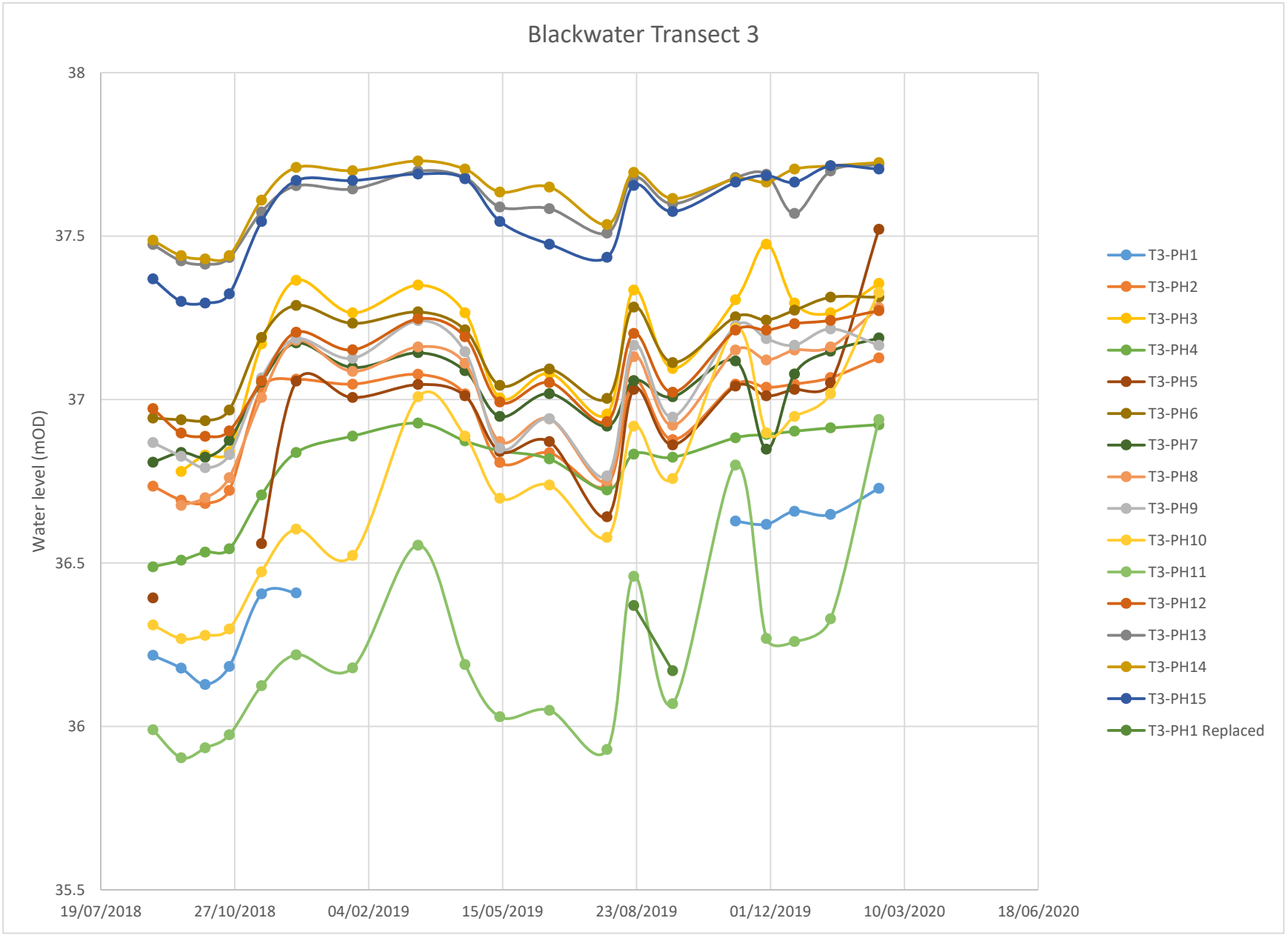
Blackwater Transect 3
Water level (mOD)
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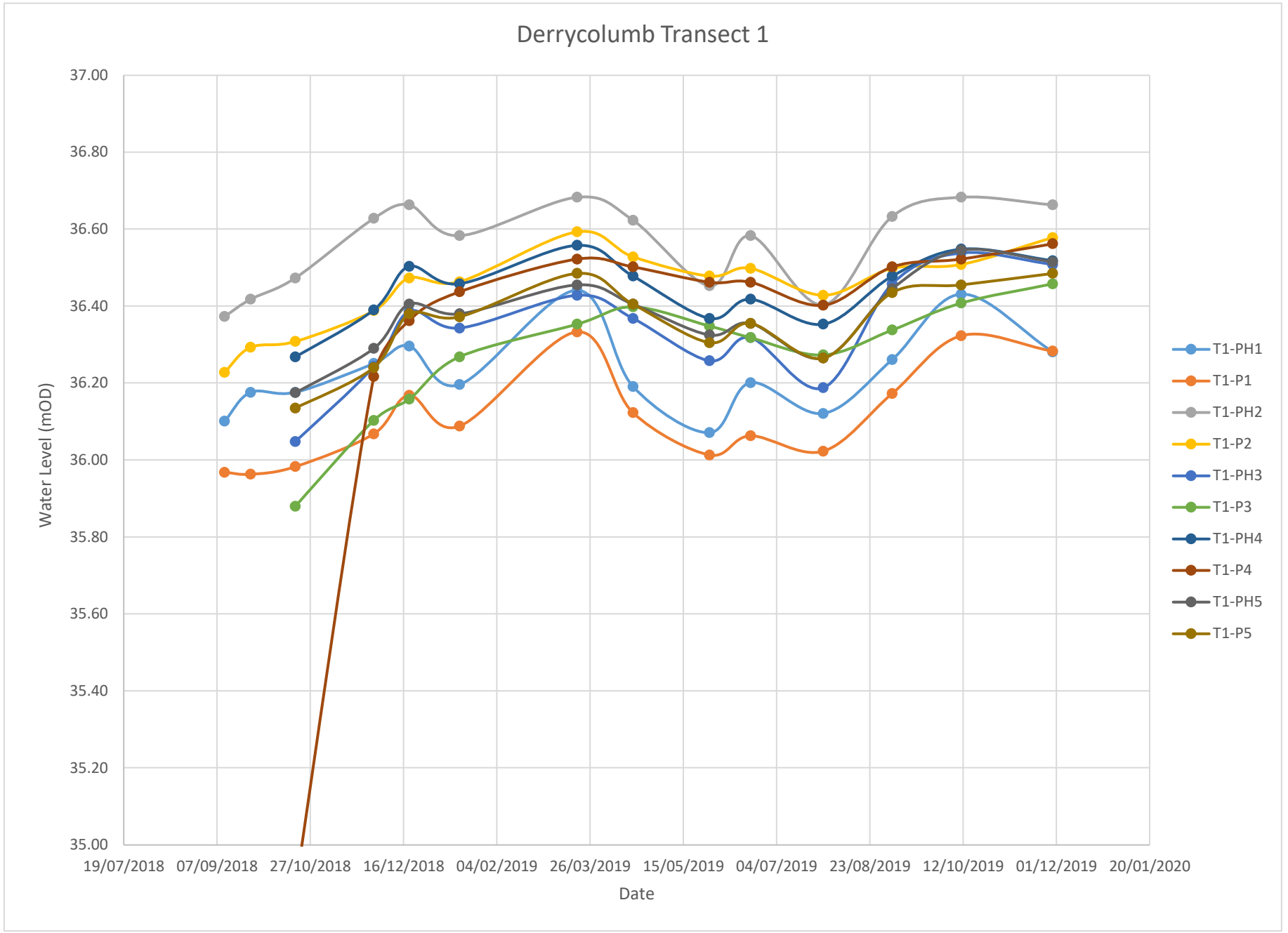
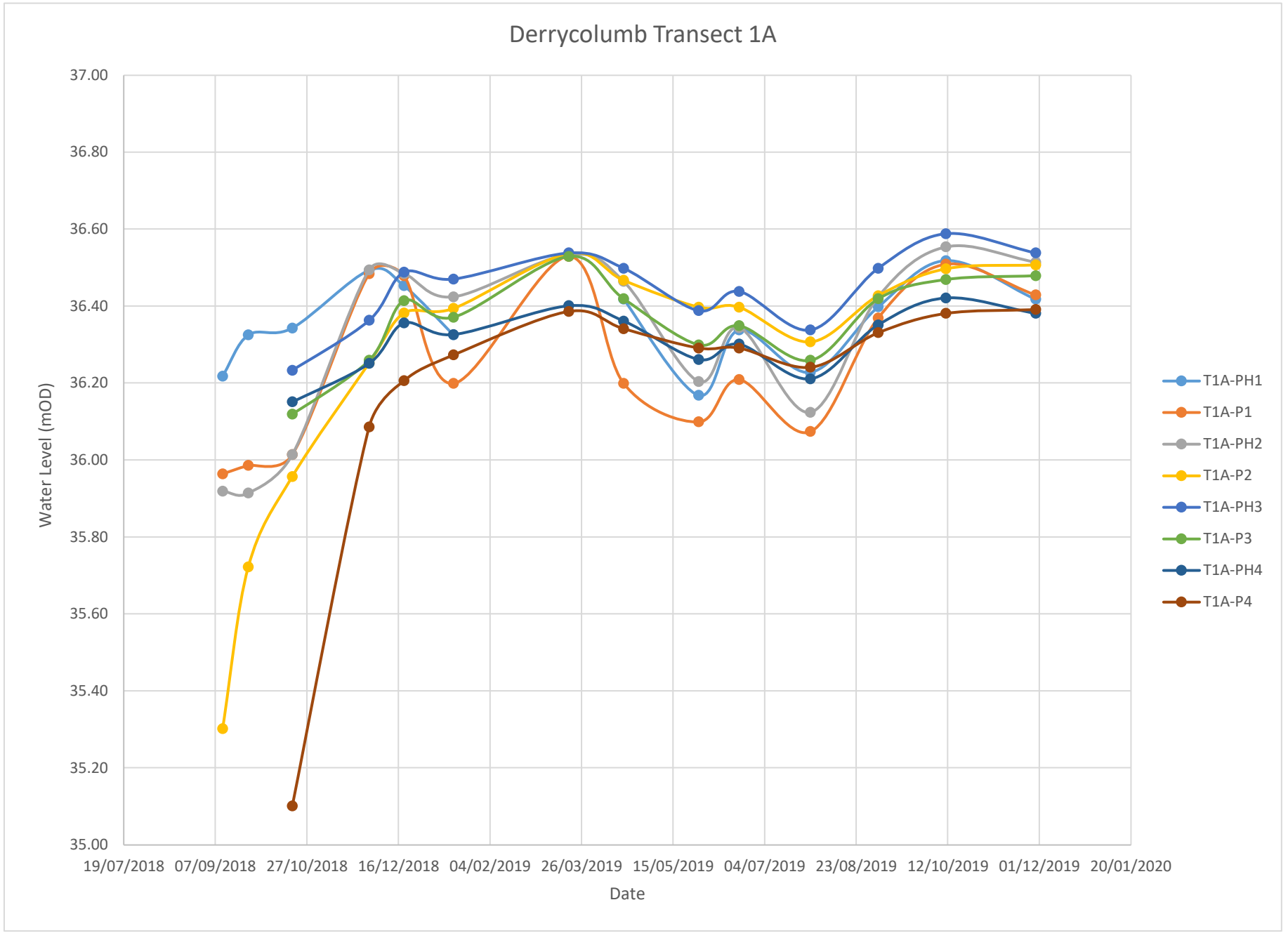
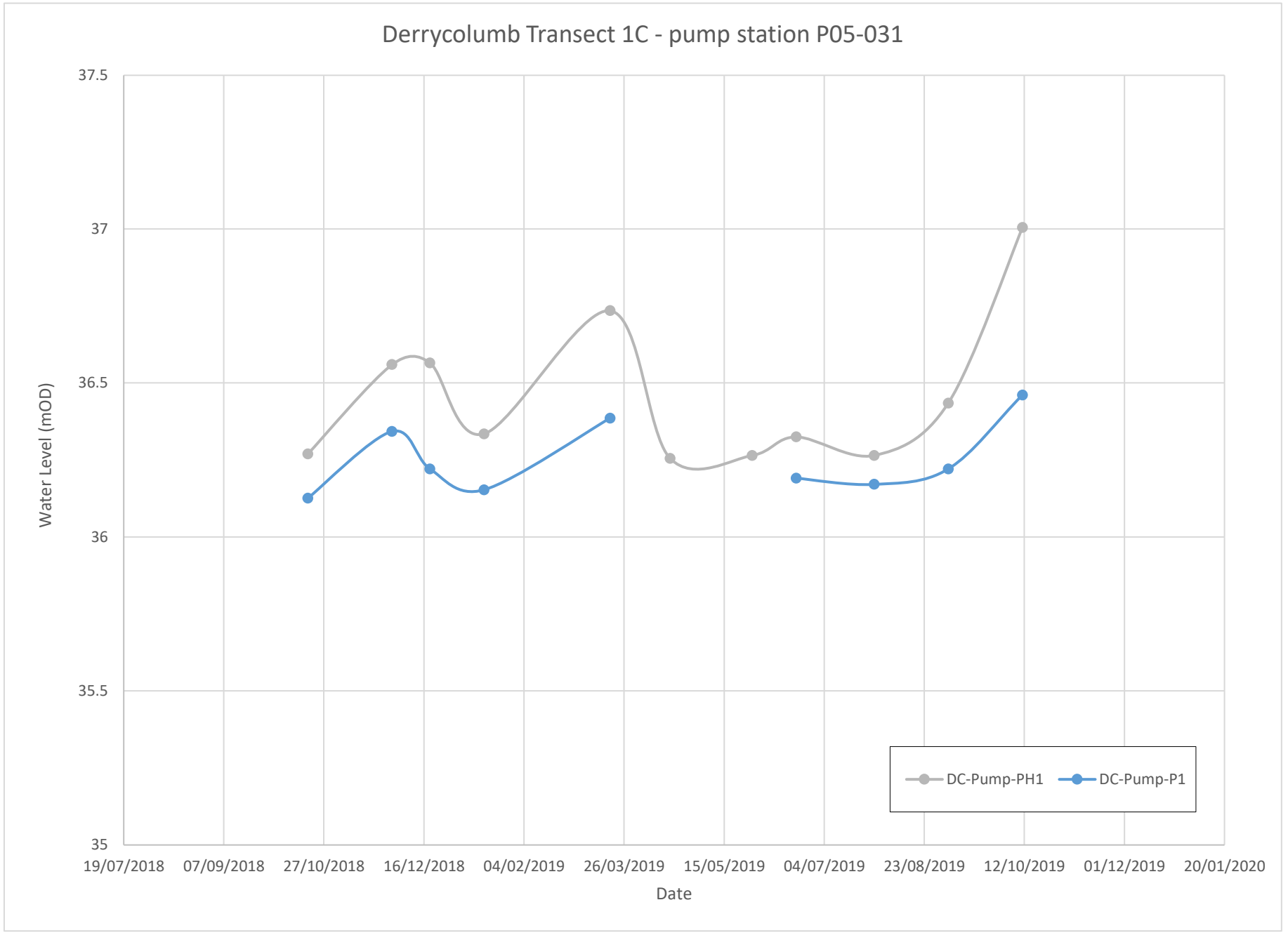
37.5
37
36.5
36
35.5
19/07/2018
27/10/2018
04/02/2019
15/05/2019
23/08/2019
01/12/2019
10/03/2020
18/06/2020
T3-PH1
T3-PH2
T3-PH3
T3-PH4
T3-PH5
T3-PH6
T3-PH7
T3-PH8
T3-PH9
T3-PH10
T3-PH11
T3-PH12
T3-PH13
T3-PH14
T3-PH15
T3-PH1 Replaced

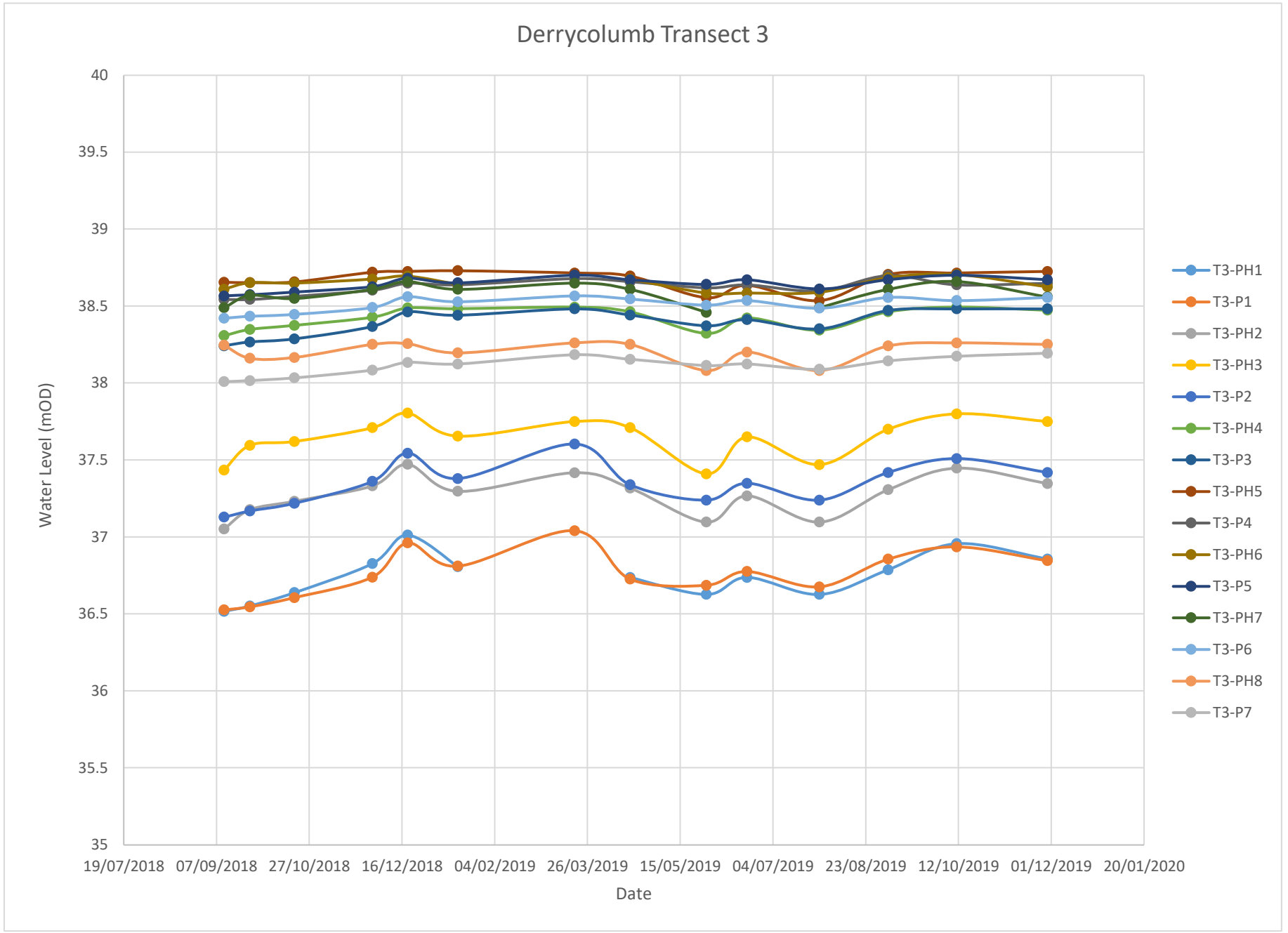
APPENDIX V: SUMMARY OF BNM WATER LEVEL DATA – DERRYCOLUMB

Location ID	11/09/2018	25/09/2018	19/10/2018	30/11/2018	19/12/2018	15/01/2019	19/03/2019	18/04/2019	29/05/2019	20/06/2019	29/07/2019	04/09/2019	11/10/2019	29/11/2019
T1-PH1	36.10	36.18	36.18	36.25	36.30	36.20	36.44	36.19	36.07	36.20	36.12	36.261	36.431	36.281
T1-P1	35.97	35.96	35.98	36.07	36.17	36.09	36.33	36.12	36.01	36.06	36.02	36.173	36.323	36.283
T1-PH2	36.37	36.42	36.47	36.63	36.66	36.58	36.68	36.62	36.45	36.58	36.40	36.633	36.683	36.663
T1-P2	36.23	36.29	36.31	36.39	36.47	36.46	36.59	36.53	36.48	36.50	36.43	36.498	36.508	36.578
T1-PH3			36.05	36.24	36.39	36.34	36.43	36.37	36.26	36.32	36.19	36.458	36.538	36.508
T1-P3			35.88	36.10	36.16	36.27	36.35	36.40	36.35	36.32	36.27	36.338	36.408	36.458
T1-PH4			36.27	36.39	36.50	36.46	36.56	36.48	36.37	36.42	36.35	36.478	36.548	36.518
T1-P4			34.89	36.22	36.36	36.44	36.52	36.50	36.46	36.46	36.40	36.502	36.522	36.562
T1-PH5			36.18	36.29	36.41	36.38	36.46	36.41	36.33	36.36	36.27	36.445	36.545	36.515
T1-P5			36.14	36.24	36.38	36.37	36.49	36.41	36.31	36.36	36.27	36.435	36.455	36.485
T1A-PH1	36.22	36.33	36.34	36.49	36.45	36.33		36.42	36.17	36.34	36.23	36.398	36.518	36.418
T1A-P1	35.96	35.99	36.01	36.48	36.48	36.20	36.53	36.20	36.10	36.21	36.07	36.369	36.509	36.429
T1A-PH2	35.92	35.91	36.01	36.49	36.48	36.42	36.53	36.46	36.20	36.34	36.12	36.424	36.554	36.514
T1A-P2	35.30	35.72	35.96	36.25	36.38	36.39	36.54	36.47	36.40	36.40	36.31	36.427	36.497	36.507
T1A-PH3			36.23	36.36	36.49	36.47	36.54	36.50	36.39	36.44	36.34	36.498	36.588	36.538
T1A-P3			36.12	36.26	36.41	36.37	36.53	36.42	36.30	36.35	36.26	36.419	36.469	36.479
T1A-PH4			36.15	36.25	36.36	36.33	36.40	36.36	36.26	36.30	36.21	36.351	36.421	36.381
T1A-P4			35.10	36.09	36.21	36.27	36.39	36.34	36.29	36.29	36.24	36.331	36.381	36.391
T3-PH1	36.517	36.552	36.639	36.827	37.012	36.807		36.737	36.627	36.737	36.627	36.787	36.957	36.857
T3-P1	36.526	36.546	36.606	36.739	36.961	36.811	37.041	36.726	36.686	36.776	36.676	36.856	36.936	36.846
T3-PH2	37.052	37.177	37.232	37.332	37.472	37.297	37.417	37.317	37.097	37.267	37.097	37.307	37.447	37.347
T3-PH3	37.435	37.595	37.62	37.71	37.805	37.655	37.75	37.71	37.41	37.65	37.470	37.700	37.800	37.750
T3-P2	37.129	37.169	37.219	37.361	37.544	37.379	37.604	37.339	37.239	37.349	37.239	37.419	37.509	37.419
T3-PH4	38.308	38.348	38.375	38.428	38.488	38.483	38.493	38.463	38.323	38.423	38.343	38.463	38.493	38.473
T3-P3	38.242	38.267	38.287	38.367	38.462	38.44	38.482	38.442	38.372	38.412	38.352	38.472	38.482	38.482
T3-PH5	38.655	38.653	38.657	38.72	38.725	38.73	38.715	38.695	38.555	38.635	38.535	38.705	38.715	38.725
T3-P4	38.543	38.543	38.563	38.603	38.648	38.638	38.678	38.658	38.618	38.638	38.598	38.698	38.638	38.648
T3-PH6	38.61	38.652	38.65	38.675	38.695	38.64		38.675	38.585	38.585	38.59	38.685	38.705	38.625
T3-P5	38.566	38.574	38.591	38.626	38.681	38.651	38.701	38.671	38.641	38.671	38.611	38.671	38.701	38.671
T3-PH7	38.489	38.569	38.549	38.609	38.659	38.609	38.649	38.609	38.459		38.489	38.609	38.659	38.559
T3-P6	38.421	38.434	38.446	38.491	38.561	38.528	38.566	38.546	38.506	38.536	38.486	38.556	38.536	38.556
T3-PH8	38.246	38.161	38.166	38.251	38.256	38.196	38.261	38.251	38.081	38.201	38.081	38.241	38.261	38.251
T3-P7	38.009	38.016	38.034	38.084	38.134	38.124	38.184	38.154	38.114	38.124	38.089	38.144	38.174	38.194
DC-Pump-PH1			36.27	36.56	36.565	36.335	36.735	36.255	36.265	36.325	36.265	36.435	37.005	
DC-Pump-P1			36.126	36.343	36.221	36.153	36.386			36.191	36.171	36.221	36.461	


Derrycolumb Transect 1
37.00
36.80
36.60
36.40
36.20
36.00
35.80
35.60
35.40
35.20
35.00
Water Level (mOD)
19/07/2018
07/09/2018
27/10/2018
16/12/2018
04/02/2019
26/03/2019
15/05/2019
04/07/2019
23/08/2019
12/10/2019
01/12/2019
20/01/2020
Date
T1-PH1
T1-P1
T1-PH2
T1-P2
T1-PH3
T1-P3
T1-PH4
T1-P4
T1-PH5
T1-P5

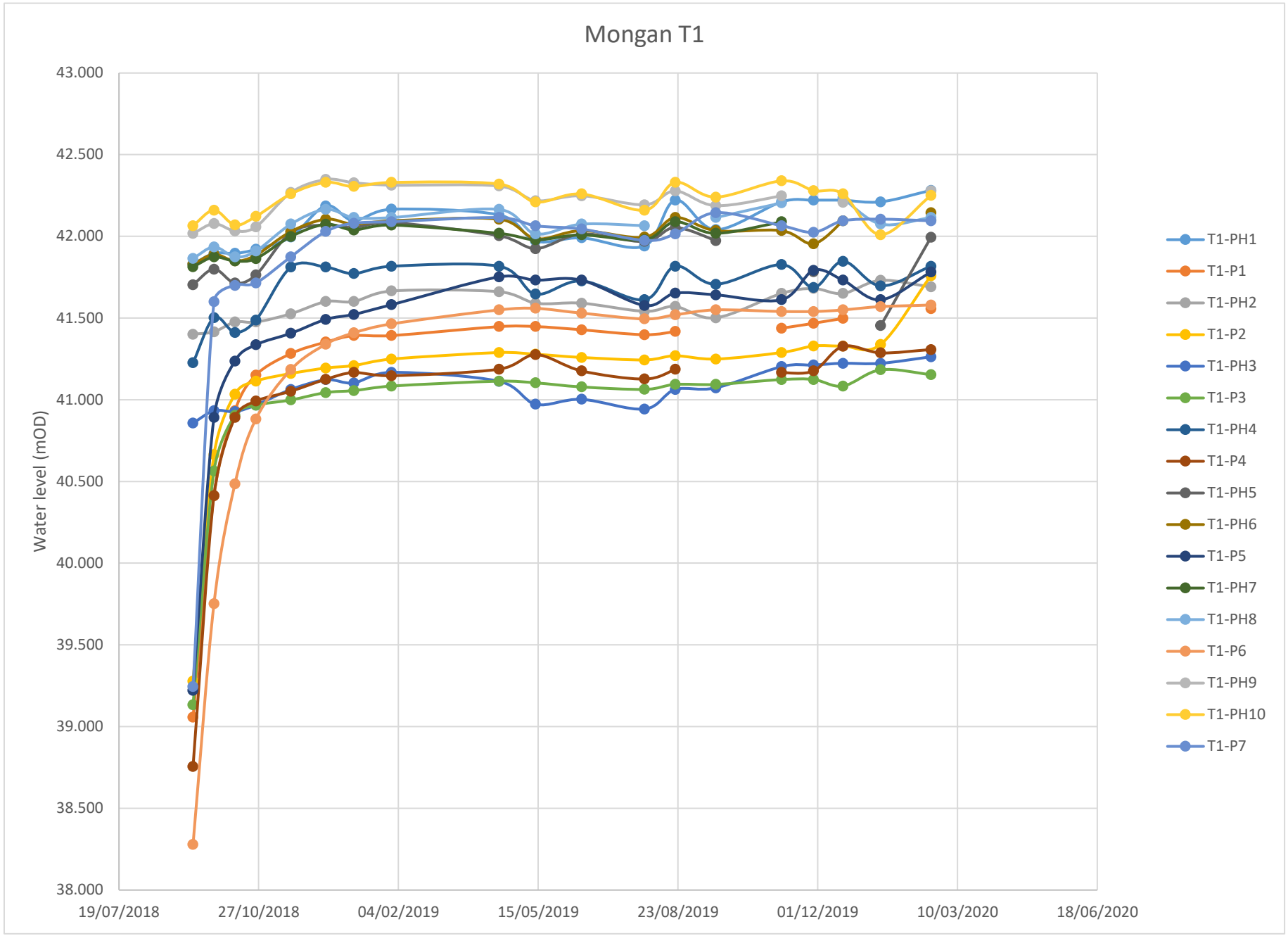

Derrycolumb Transect 1A
Water Level (mOD)
37.00
36.80
36.60
36.40
36.20
36.00
35.80
35.60
35.40
35.20
35.00
19/07/2018
07/09/2018
27/10/2018
16/12/2018
04/02/2019
26/03/2019
15/05/2019
04/07/2019
23/08/2019
12/10/2019
01/12/2019
20/01/2020
Date
T1A-PH1
T1A-P1
T1A-PH2
T1A-P2
T1A-PH3
T1A-P3
T1A-PH4
T1A-P4

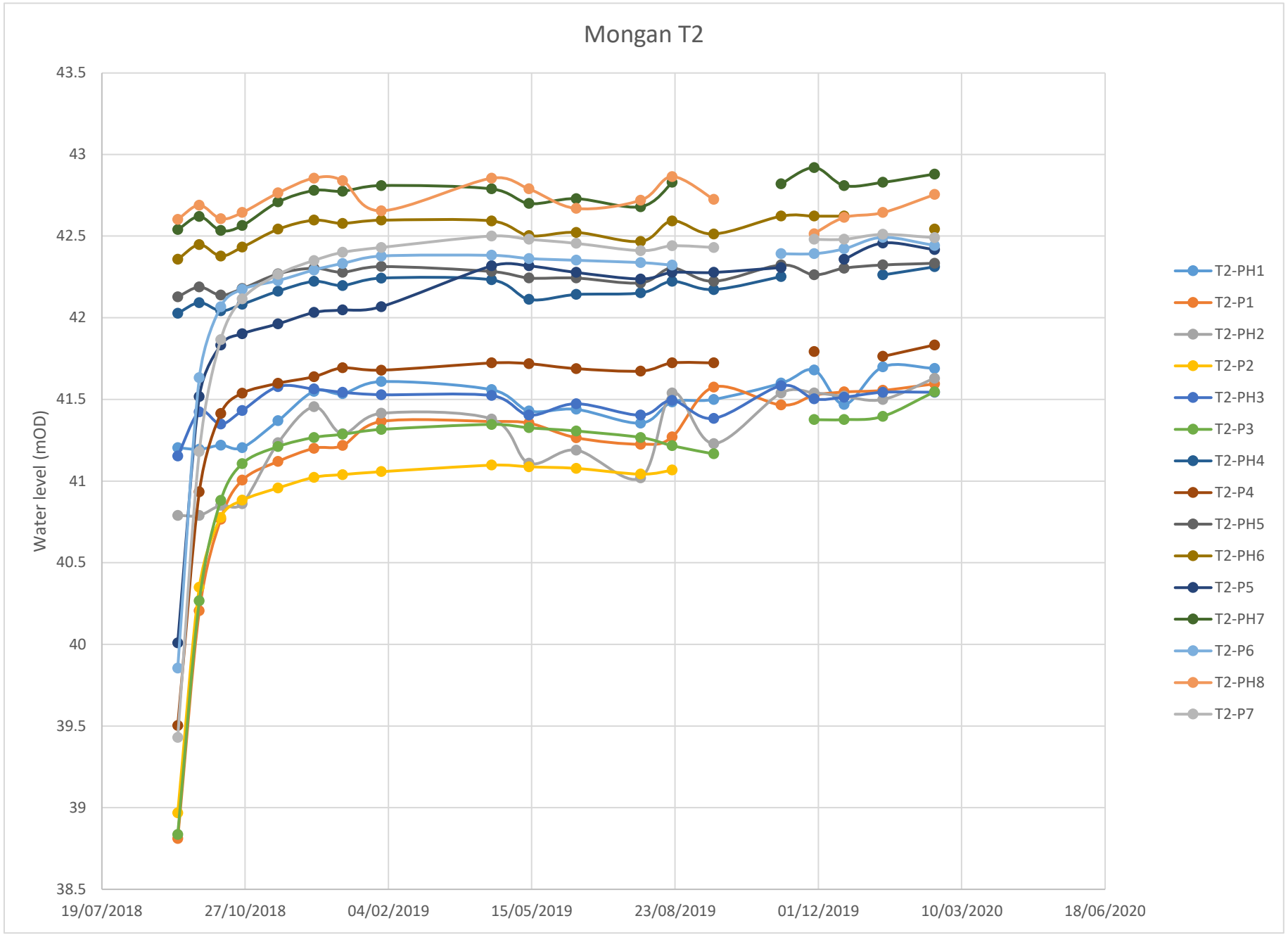

Derrycolumb Transect 1C - pump station P05-031
37.5
37
36.5
36
35.5
35
Water Level (mOD)
19/07/2018
07/09/2018
27/10/2018
16/12/2018
04/02/2019
26/03/2019
15/05/2019
04/07/2019
23/08/2019
12/10/2019
01/12/2019
20/01/2020
Date
DC-Pump-PH1
DC-Pump-P1

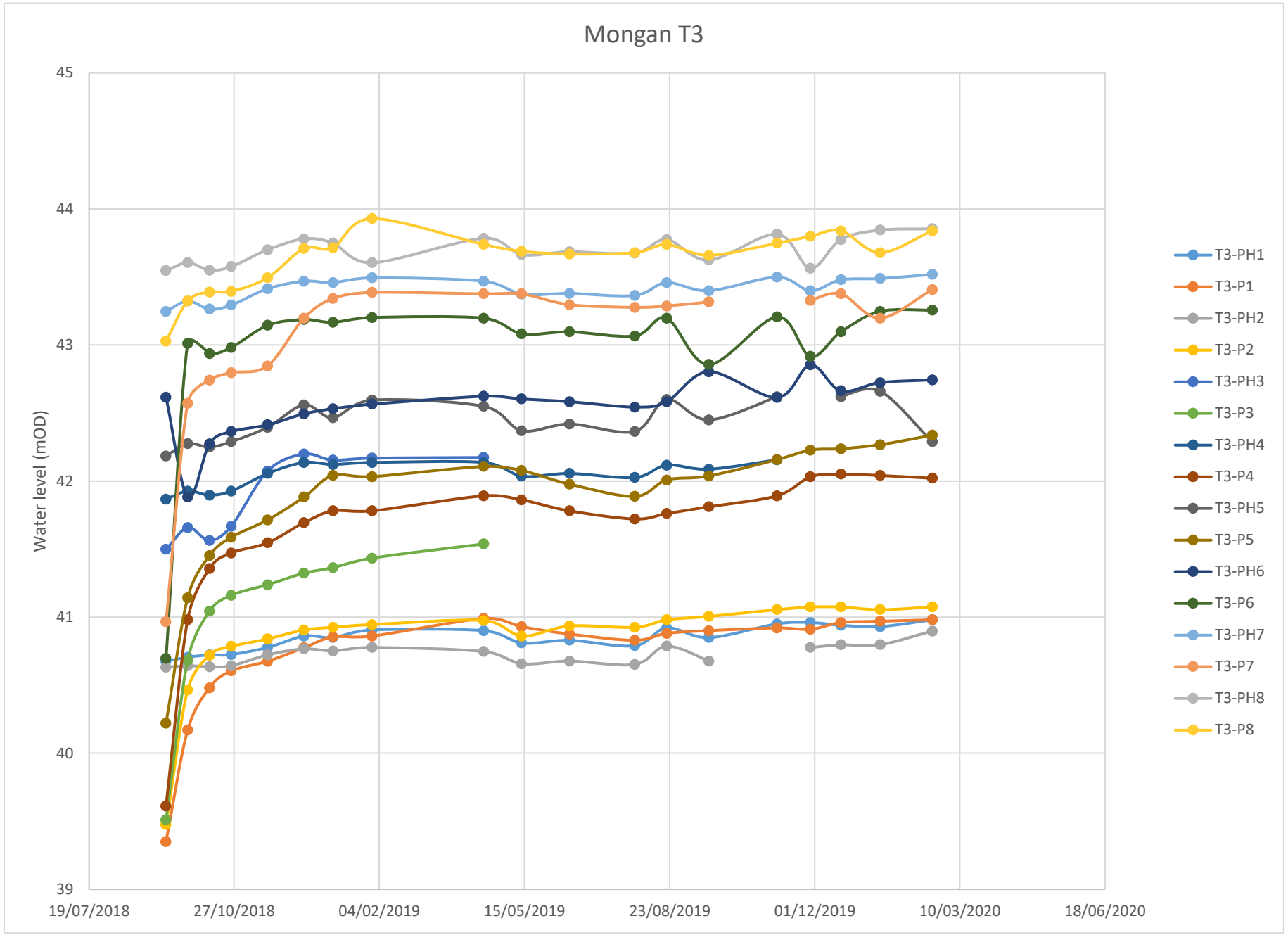

Derrycolumb Transect 3
Water Level (mOD)
40
39.5
39
38.5
38
37.5
37
36.5
36
35.5
35
19/07/2018
07/09/2018
27/10/2018
16/12/2018
04/02/2019
26/03/2019
15/05/2019
04/07/2019
23/08/2019
12/10/2019
01/12/2019
20/01/2020
Date
T3-PH1
T3-P1
T3-PH2
T3-PH3
T3-P2
T3-PH4
T3-P3
T3-PH5
T3-P4
T3-PH6
T3-P5
T3-PH7
T3-P6
T3-PH8
T3-P7

APPENDIX VI: SUMMARY OF BNM WATER LEVEL DATA – MONGAN

Bog	Transect	Piezo type	Location ID	Easting	Northing	Peat depth (m)	peat interval(mbgl)	marl interval (mbgl)	lacustrine clay interval (mbgl)	standpipe screen (mbgl)	piezoemter screen (mbgl)	Ground Level (mOD)	Top pf Pipe (mOD)	upstand (m)
Mongan	T1	phreatic	T1-PH1	204305.5	230829.3	5.5	0-5.48	none	5.48->5.78	0-1.0		42.33	43.30	1.00
Mongan	T1	Piezo	T1-P1	204305.8	230829.5						4.8-5.1	42.31	43.59	1.29
Mongan	T1	phreatic	T1-PH2	204295.7	230857.3	5.1	0-5.09	none	5.09->5.34	0.5-1.5		42.00	42.49	0.50
Mongan	T1	Piezo	T1-P2	204296.0	230857.5						4.7-5.0	41.96	43.01	1.06
Mongan	T1	phreatic	T1-PH3	204293.2	230865.6	4.4	0-4.41	none		0.5-1.5		41.32	41.81	0.50
Mongan	T1	Piezo	T1-P3	204293.6	230865.7						3.9-4.2	41.33	42.29	0.98
Mongan	T1	phreatic	T1-PH4	204290.0	230878.1	5.1	0-5.10	none	5.1->5.35	0.5-1.5		41.92	42.57	0.50
Mongan	T1	Piezo	T1-P4	204289.6	230877.9						4.7-5.0	41.91	43.34	1.43
Mongan	T1	phreatic	T1-PH5	204287.3	230885.8	>5.0	>5.0			0-1.0		42.08	43.13	1.00
Mongan	T1	phreatic	T1-PH6	204284.1	230895.1	5.3	0-5.28	none		0-1.0		42.24	43.25	1.02
Mongan	T1	Piezo	T1-P5	204284.4	230895.2						4.7-5.0	42.07	43.48	1.43
Mongan	T1	phreatic	T1-PH7	204282.8	230898.4	>5.0	>5.0			0-1.0		42.11	43.07	0.98
Mongan	T1	phreatic	T1-PH8	204281.3	230904.5	5.4	0-5.4	none		0-1.0		42.20	42.82	0.60
Mongan	T1	Piezo	T1-P6	204280.9	230904.5						5.0-5.3	42.30	43.42	1.09
Mongan	T1	phreatic	T1-PH9	204274.6	230923.3	>5.2	>5.2			0-1.0		42.40	43.38	1.00
Mongan	T1	phreatic	T1-PH10	204268.5	230943.2	6.5	0-6.5	none	6.5->6.8	0-1.0		42.39	43.40	1.02
Mongan	T1	Piezo	T1-P7	204268.8	230943.1						4.85-5.15	42.37	43.65	1.27
Mongan	T2	phreatic	T2-PH1	204186.7	230760.4	4.7	0-4.7	none	4.7->4.95	0.5-1.5		41.893	42.41	0.5
Mongan	T2	piezo	T2-P1	204187.0	230760.7						3.75-4.05	41.908	42.846	0.96
Mongan	T2	phreatic	T2-PH2	204180.7	230765.9	4.7	0-4.72	none	4.7->5.0	0.5-1.5		41.892	42.36	0.48
Mongan	T2	piezo	T2-P2	204180.9	230766.2						4.1-4.4	41.902	42.878	0.98
Mongan	T2	phreatic	T2-PH3	204168.1	230777.6	4.8	0-4.75	none		0.5-1.5		42.002	42.494	0.5
Mongan	T2	piezo	T2-P3	204168.2	230777.8						4.4-4.7	42.002	42.677	0.68
Mongan	T2	phreatic	T2-PH4	204160.8	230784.9	5.1	0-5.05	none	4.05->4.35	0-1.0		42.322	43.363	1
Mongan	T2	piezo	T2-P4	204160.6	230784.7						4.7-5.0	42.357	43.244	0.9
Mongan	T2	phreatic	T2-PH5	204157.6	230787.7	>4.0	>4.0			0-1.0		42.413	43.384	0.95
Mongan	T2	phreatic	T2-PH6	204139.9	230804.8	5.3	0-5.3	none	4.3->4.65	0-1.0		42.686	43.603	1
Mongan	T2	piezo	T2-P5	204140.2	230805.0						4.6-4.9	42.588	43.118	0.52
Mongan	T2	phreatic	T2-PH7	204121.9	230822.1	5.5	0-5.45	none	5.45->5.68	0-1.0		42.802	43.81	0.98
Mongan	T2	piezo	T2-P6	204122.3	230822.2						5.05-5.35	42.784	43.873	1.05
Mongan	T2	phreatic	T2-PH8	204103.7	230839.5	5.7	0-5.7	none	5.7->5.95	0-1.0		42.875	43.905	1.05
Mongan	T2	piezo	T2-P7	204104.2	230839.8						5-5.3	42.863	43.701	0.8
Mongan	T3	phreatic	T3-PH1	204082.1	230661.7	3.3	0-3.3	none	3.3->3.65	0.5-1.5		41.243	42.411	1.18
Mongan	T3	Piezo	T3-P1	204082.5	230662.0						2.43-2.73	41.256	41.921	0.67
Mongan	T3	phreatic	T3-PH2	204076.3	230666.5	3.4	0-3.4	none	3.4->3.8	0.5-1.5		41.118	42.138	1
Mongan	T3	Piezo	T3-P2	204076.5	230666.6						2.5-2.8	41.167	41.736	0.6
Mongan	T3	phreatic	T3-PH3	204067.3	230674.4	4.6	0-4.62	none	4.62>4.9	0-1.0		42.117	43.274	1.2
Mongan	T3	Piezo	T3-P3	204067.4	230674.1						4.05-4.35	42.105	43.089	1
Mongan	T3	phreatic	T3-PH4	204061.4	230678.2	4.7	0-4.7	none	4.7->5.0	0-1.0		42.381	43.367	1.01
Mongan	T3	Piezo	T3-P4	204061.5	230678.4						4.25-4.55	42.353	42.972	0.6
Mongan	T3	phreatic	T3-PH5	204056.6	230682.6	4.9	0-4.85	none	4.85>5.25	0-1.0		42.822	43.84	1.06
Mongan	T3	Piezo	T3-P5	204056.8	230682.7						4.4-4.7	42.813	43.428	0.7
Mongan	T3	phreatic	T3-PH6	204038.5	230699.2	5.2	0-5.2	none	5.2>5.45	0-1.0		43.317	44.004	1
Mongan	T3	Piezo	T3-P6	204038.2	230698.9						4.4-4.7	43.319	44.317	0.7
Mongan	T3	phreatic	T3-PH7	204020.0	230716.1	5.7	0-5.7	none	5.7>5.99	0-1.0		43.551	44.549	1
Mongan	T3	Piezo	T3-P7	204020.2	230716.4						5.1-5.4	43.595	44.577	1
Mongan	T3	phreatic	T3-PH8	204001.7	230732.7	5.8	0-5.75	none	5.75>6.0	0-1.0		43.886	44.905	1.2
Mongan	T3	Piezo	T3-P8	204001.9	230732.9						4.95-5.25	43.87	45.039	1.16
Mongan	T3	Piezo	T3-PH3 Replaced									41.947	42.962	1.16
Mongan	T3	Piezo	T3-P3 Replaced									41.939	42.464	1.16

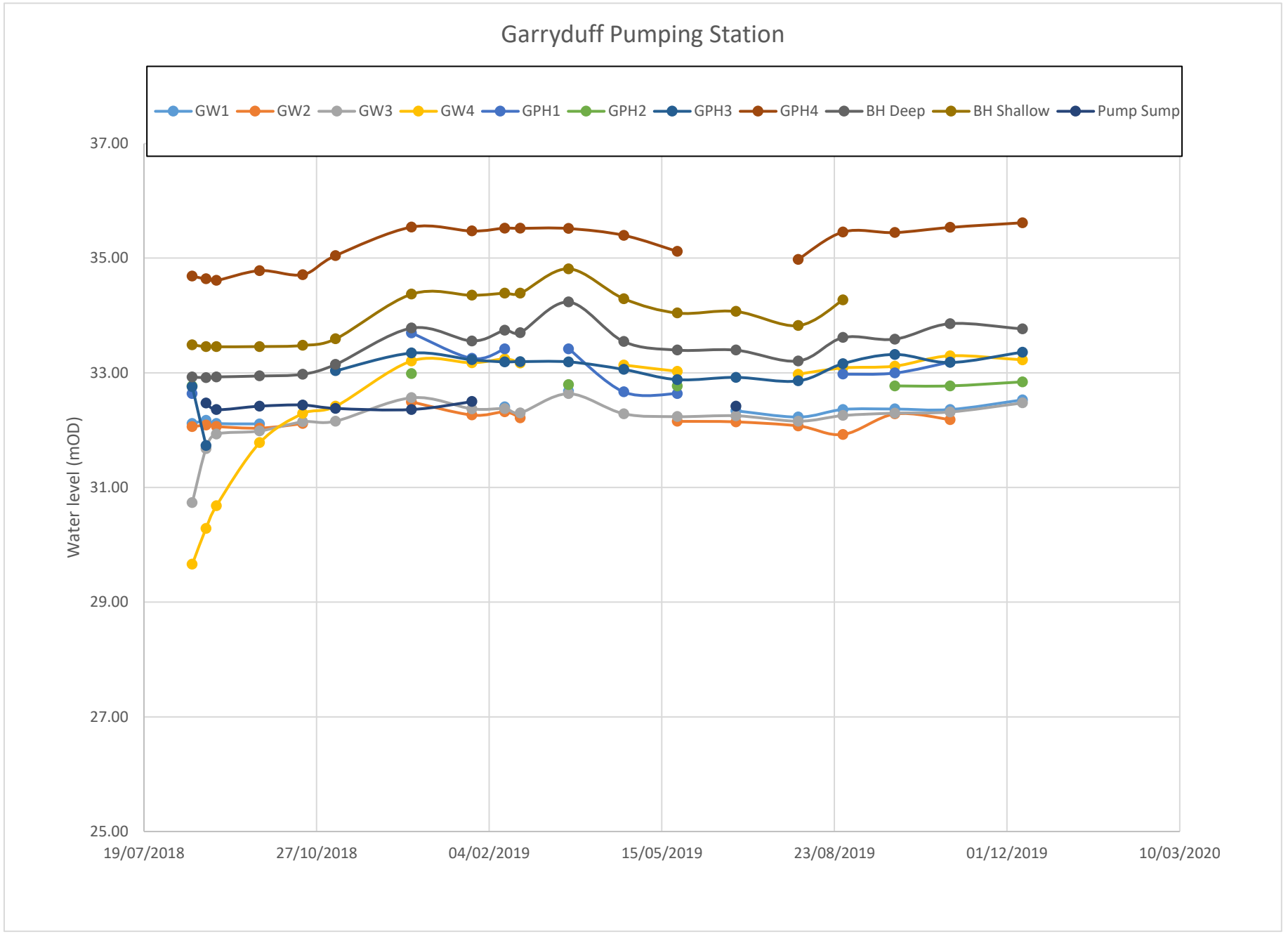

Mongan T1
Water level (mOD)
43.000
42.500
42.000
41.500
41.000
40.500
40.000
39.500
39.000
38.500
38.000
19/07/2018
27/10/2018
04/02/2019
15/05/2019
23/08/2019
01/12/2019
10/03/2020
18/06/2020
T1-PH1
T1-P1
T1-PH2
T1-P2
T1-PH3
T1-P3
T1-PH4
T1-P4
T1-PH5
T1-PH6
T1-P5
T1-PH7
T1-PH8
T1-P6
T1-PH9
T1-PH10
T1-P7

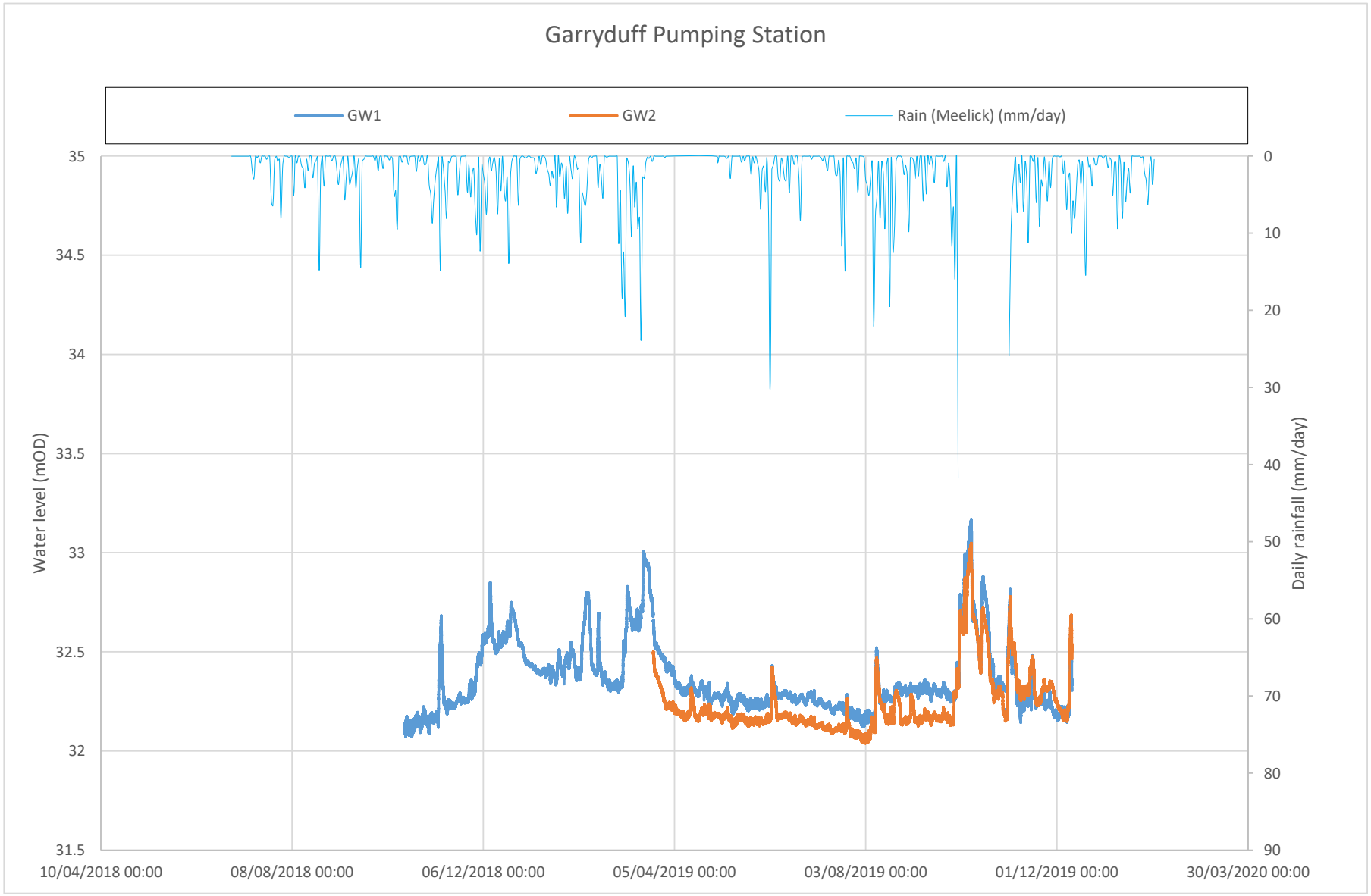

Mongan T2
Water level (mOD)
43.5
43
42.5
42
41.5
41
40.5
40
39.5
39
38.5
19/07/2018
27/10/2018
04/02/2019
15/05/2019
23/08/2019
01/12/2019
10/03/2020
18/06/2020
T2-PH1
T2-P1
T2-PH2
T2-P2
T2-PH3
T2-P3
T2-PH4
T2-P4
T2-PH5
T2-PH6
T2-P5
T2-PH7
T2-P6
T2-PH8
T2-P7


Mongan T3
Water level (mOD)
45
44
43
42
41
40
39
19/07/2018
27/10/2018
04/02/2019
15/05/2019
23/08/2019
01/12/2019
10/03/2020
18/06/2020
T3-PH1
T3-P1
T3-PH2
T3-P2
T3-PH3
T3-P3
T3-PH4
T3-P4
T3-PH5
T3-P5
T3-PH6
T3-P6
T3-PH7
T3-P7
T3-PH8
T3-P8

APPENDIX VII: SUMMARY OF BNM WATER LEVEL DATA – GARRYDUFF

Surveyed Levels Top of Pipes	Surveyed Levels - ground levels	Well ID	16/08/2018	24/08/2018	30/08/2018	24/09/2018	19/10/2018	07/11/2018	21/12/2018	25/01/2019	13/02/2019	22/02/2019	22/03/2019	23/04/2019	24/05/2019	27/06/2019	02/08/2019	28/08/2019	27/09/2019	29/10/2019	10/12/2019
34.28	33.884	GW1	32.12	32.17	32.12	32.11					32.41		32.68			32.34	32.23	32.36	32.37	32.36	32.53
34.385	33.901	GW2	32.06	32.09	32.07	32.04	32.12		32.50	32.27	32.32	32.22			32.16	32.15	32.08	31.93	32.29	32.19	
34.657	33.914	GW3	30.74	31.68	31.93	31.99	32.15	32.16	32.57	32.37	32.38	32.30	32.64	32.29	32.24	32.25	32.16	32.26	32.30	32.32	32.48
35.927	35.645	GW4	29.66	30.29	30.68	31.78	32.29	32.42	33.21	33.18	33.24	33.17		33.14	33.03		32.98	33.09	33.12	33.30	33.23
34.588	33.923	GPH1	32.64						33.70	33.25	33.42		33.42	32.67	32.64			32.98	33.00	33.19	
34.753	33.904	GPH2	32.77						32.99				32.79		32.77				32.77	32.77	32.84
34.711	33.942	GPH3	32.76	31.73				33.04	33.35	33.23	33.19	33.20	33.19	33.06	32.88	32.92	32.86	33.16	33.32	33.18	33.36
36.158	35.633	GPH4	34.69	34.64	34.61	34.78	34.71	35.05	35.54	35.48	35.52	35.52	35.52	35.40	35.12		34.98	35.46	35.45	35.54	35.62
35.137	35.037	BH Deep	32.93	32.92	32.93	32.95	32.98	33.15	33.78	33.56	33.74	33.70	34.24	33.55	33.40	33.40	33.21	33.62	33.59	33.86	33.77
35.074	35.024	BH Shallow	33.49	33.46	33.46	33.46	33.48	33.59	34.37	34.35	34.39	34.39	34.81	34.29	34.04	34.07	33.82	34.27			
35.56		Pump Sump		32.48	32.36	32.42	32.44	32.38	32.36	32.50						32.42					


Garryduff Pumping Station
GW1
GW2
GW3
GW4
GPH1
GPH2
GPH3
GPH4
BH Deep
BH Shallow
Pump Sump
Water level (mOD)
37.00
35.00
33.00
31.00
29.00
27.00
25.00
19/07/2018
27/10/2018
04/02/2019
15/05/2019
23/08/2019
01/12/2019
10/03/2020


Garryduff Pumping Station
GW1
GW2
Rain (Meelick) (mm/day)
Water level (mOD)
Daily rainfall (mm/day)
35
34.5
34
33.5
33
32.5
32
31.5
0
10
20
30
40
50
60
70
80
90
10/04/2018 00:00
08/08/2018 00:00
06/12/2018 00:00
05/04/2019 00:00
03/08/2019 00:00
01/12/2019 00:00
30/03/2020 00:00

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