SUBSTITUTE CONSENT APPLICATION

FLOOD RISK ASSESSMENTS

For

An Bord Pleanala

Bord na Mona
Boora
Leabeg
Co. Offaly

May 2020

DOCUMENT CONTROL SHEET

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FLOOD RISK ASSESSMENT – CHAPTER 1
Introduction

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1 INTRODUCTION

1.1 Background

This Flood Risk Assessment report has been prepared for Substitute Consent and planning applications by Bord na Móna for peat extraction and ancillary works at forty-one individual bog units. This report has been prepared by the Engineering Department of Bord na Móna in conjunction with Hydro Environmental Limited.

The 41 bogs included in this report have been used for peat extraction for many years and it is the intention of Bord na Móna to continue peat extraction on these bogs for a number of years. The 41 bog units which are listed in the Table below all currently operate under seven Integrated Pollution Control licences issued by the Environmental Protection Agency in 2000.

Bog	IPC Licence Ref	Planning authority
Bellair Nth	P0500-01 Boora	Offaly and Westmeath
Lemonaghan	P0500-01 Boora	Offaly
Kilaranny	P0500-01 Boora	Offaly
Noggusboy	P0500-01 Boora	Offaly
Boora	P0500-01 Boora	Offaly
Galros	P0500-01 Boora	Offaly
Killaun	P0500-01 Boora	Offaly
Derrinboy	P0500-01 Boora	Offaly
Derryclure	P0500-01 Boora	Offaly
Monettia	P0500-01 Boora	Offaly and Laois
Bracklin	P0501-01 Derrygreenagh	Westmeath
Carranstown	P0501-01 Derrygreenagh	Meath and Westmeath
Ballivor	P0501-01 Derrygreenagh	Meath and Westmeath
Kinnegad	P0501-01 Derrygreenagh	Meath
Ballybeg	P0501-01 Derrygreenagh	Offaly
Ballaghurt 1 &2	P0502-01 Blackwater	Offaly
Daingean (Derries)	P0503-01 Allen	Offaly and Westmeath
Daingean Rathdrum	P0503-01 Allen	Offaly
Clonad	P0503-01 Allen	Offaly
Ballykean	P0503-01 Allen	Offaly
Esker	P0503-01 Allen	Offaly
Garrymore	P0503-01 Allen	Laois
Derrylea	P0503-01 Allen	Offaly and Kildare
Ticknevin	P0503-01 Allen	Offaly and Kildare
Glashabaun Sth	P0503-01 Allen	Offaly and Kildare
Glashabaun Nth	P0503-01 Allen	Offaly and Kildare
Codd Nth	P0503-01 Allen	Offaly
Codd Sth	P0503-01 Allen	Offaly
Ballydermot North	P0503-01 Allen	Offaly and Kildare
Ballydermot South	P0503-01 Allen	Offaly and Kildare
Blackriver	P0503-01 Allen	Kildare
Barnaran	P0503-01 Allen	Kildare
Lodge	P0503-01 Allen	Kildare

Cuil na Gun	P0504-01 Mountdillon	Westmeath
Milkernagh	P0504-01 Mountdillon	Westmeath and Longford
Coolcraff	P0504-01 Mountdillon	Longford
Gilltown	P0506-01 Kilberry	Kildare
Allen	P0506-01 Kilberry	Kildare
Prosperous	P0506-01 Kilberry	Kildare
Kilberry	P0506-01 Kilberry	Kildare
Cuil na Carton	P0507-01 Cuil na Mona	Laois

Table 1.1.1 List of Bog Units

1.2 Site Location

The bog units assessed in this report are situated across counties Offaly, Westmeath, Laois, Meath, Kildare and Longford. Each bog unit operates under one of the following Integrated Pollution Control (IPC) licences issued by the Environmental Protection Agency.

- P0500-01 - Boora Bog Group - issued May 2000
- P0501- 01- Derrygreenagh Bog Group – April 2000
- P0501- 01 – Blackwater Bog Group – April 2000
- P0503-01 – Allen Bog Group – April 2000
- P0504-01- Mountdillon Bog Group – May 2000
- P0506-01 – Kilberry Bog Group – April 2000
- P0507-01 - Cuil na Móna – Februrary 2000

Bord na Móna have two further IPC Licences for peat extraction, the Littleton Bog Group and the Oweninny Bog Group, however there are no bogs in these bog groups included in the Substitute Consent application and in this Flood Risk Report.

The bogs included in this report are located in the following Water Framework Directive (WFD) River catchments:

- Boora Bog Group – Lower Shannon 25A and 25B, Upper Shannon 26G and River Barrow 14
- Derrygreenagh Bog Group - River Boyne 07
- Blackwater Bog Group – Lower Shannon 25B
- Allen Bog Group – Lower Shannon 25A, River Barrow 14
- Mountdillon Bog Group – Upper Shannon 26F
- Kilberry Bog Group – River Barrow 14, River Boyne 07 and Liffey and Dublin Bay 09.

The location of the bog units included in this application is illustrated in the figure below:

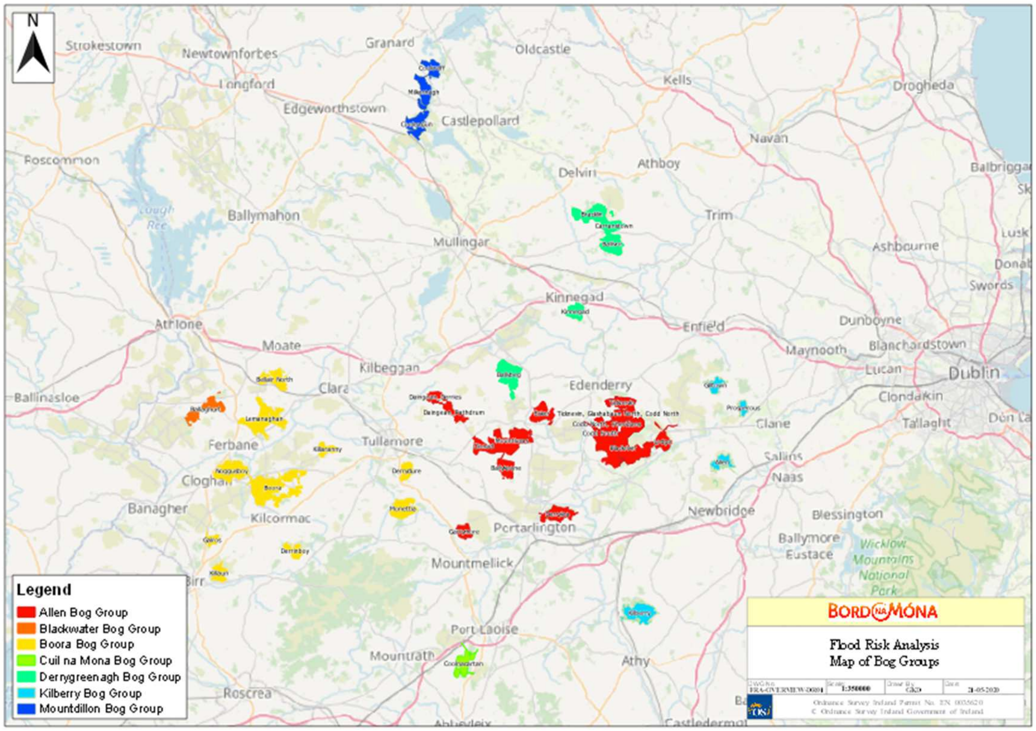

Figure 1.1 Locations of Bogs Included in this Report

1.3 Description of Project

Bord na Móna was established in 1946 and has provided peat for electricity and peat for horticulture since its establishment. The bogs included in this application have been used historically for the production of milled peat or sod moss to supply power stations and briquette factories and to supply horticultural peat. It is proposed that future peat produced in these bogs will be used to supply the Edenderry Power Station, the Derrinlough Briquette factory, Bord na Móna Horticultural Processing Plants in Ballivor, Cuil na Móna and Kilberry as well as other external Horticultural customers. The following is a high-level description of peat extraction and its ancillary works.

Bog Development

Prior to its development, the moisture content at the surface of the bog is in the region of 96 to 97%. When Bord na Móna bogs are developed for milled peat production, parallel drains at 15m intervals are excavated to a depth of 0.75m. Typically three subsequent deepenings are made every two years thereafter and after about five years the drains will stabilise at 1.2m to 1.4m depth. As such, the development of the bogs generally takes place a number of years in advance of the commencement of production. Drainage works commenced on all of the bogs in this report prior to 1996 with many of the bogs drained as early as the 1940's and the 1950's.

Drainage

As described above the parallel surface water drains are at intervals of 15m and the strip of bog between these drains forms the peat production fields. The fields are cambered to facilitate run-off and prevent standing water. The drains generally fall towards the headland which is located at both ends of each production field. This headland allows for the plant such as harrowers, millers or ridgers to turn from one field into the next field. The open drains are generally piped across the end of each production field to facilitate production plant and machinery to travel from field to field. The drainage network continues by either open channel or pipe to a silt pond or ponds prior to discharging to a local watercourse. Drainage is by gravity flow where possible, however in some bogs it is necessary to use pumped systems to drain areas of the bogs.

Production bogs are by their nature very flat and subsequently it is necessary to excavate drains and pipes at a flatter gradient than would be normally permitted. The minimum gradient used for a pipeline within Bord na Mona operational bogs is 1 in 1000 and the minimum gradient used for an open channel ranges from 1 in 1 in 1500 to 1 in 2000 depending on the size of the drain. These gradients provide less than the recommended self-cleansing velocities however these reduced velocities facilitate the settling out of silt. These gradients have been developed following years of drainage development and have been found to provide adequate drainage to facilitate peat production operations while avoiding very deep channels and pipes. These gradients also permit settlement of peat in advance of the silt ponds but not at a level that causes blockages of pipes or channels. As part of the design criteria for drainage design the minimum pipe size to be used for drainage of a production bog is 450mm diameter.

Silt Ponds

In accordance with the existing Integrated Pollution Control licences, all drainage water from boglands in the licensed area is discharged via an appropriately designed silt pond treatment arrangement as required in Condition 6.6.

The silt ponds serving operation bogs have been sized in accordance with a condition in the existing Integrated Pollution Control Licences which states:

Within three years of date of grant of this licence all existing silt ponds serving operational bogs shall achieve the following minimum performance criteria (flood periods excepted):

Maximum flow velocity < 10 cms-1

Silt design capacity of lagoons, minimum 50m3 per nett ha of bog serviced

All new ponds installed shall be designed to achieve these stated minimum design criteria.

Silt ponds are generally designed and constructed with a width of 8 metres, however in some cases silt ponds are up to 12 metres in width. Silt ponds of 12m width are only provided in areas where access is available to both sides of the silt ponds for cleaning. The length of the silt pond will vary depending on the capacity required. In some locations baffles have been provided within the ponds to reduce the energy in the flow and elongate the pond thereby increasing residence time and aiding settlement. Silt ponds are generally excavated to a depth of 1.5 metres below the pipe invert level, however in some locations, due to restricted space the silt pond depth is greater than this. Some typical examples of silt ponds are shown in the Figures below.

Photo 1.3.1 - Typical Example of Silt Pond

Photo 1.3.2 - Typical Example of Silt Pond

All silt ponds serving operational bogs are cleaned as a minimum twice a year and more frequently as inspections may dictate in accordance with the existing IPC licences. Cleaning of the silt ponds is overseen and arranged by the Compliance Officer for the area and Bord na Móna inspect and maintain the silt ponds in accordance with the Silt Pond Cleaning Procedure (FS-BM-07). A visual inspection of each silt pond is carried out on a fortnightly basis in accordance with Condition 6.7 of the existing licence and based on this visual assessment the silt ponds may be cleaned more frequently than twice a year. A log of all silt pond cleaning is maintained by the Compliance officer

Milled Peat Production Process

Milled peat production is a seasonal activity that requires good drying conditions. Depending on weather conditions the production can commence in mid-April and continue until mid – September during periods when suitable drying conditions exist. There are four stages to the production of milled peat / milled moss;

> Milling - During the milling process the top 10-15 mm of the surface of each field is broken into peat crumbs by powered milling drums towed behind agricultural tractors. This layer of crumbed or milled peat / moss is called a crop and has a moisture content of about 80% when milled;
>
> Harrowing - After milling, the peat crop is dried. To assist in this drying, the loose peat is harrowed, or turned over. The harrow consists of a series of spoons which are towed behind an agricultural tractor;
> Ridging - When the milled material has dried to 45-55% moisture content it is gathered into ridges in the centre of each field. The ridger consists of a pair of blades towed in an open V behind an agricultural tractor. The open V blades rest on the bog and channel the loose crop into a triangular ridge in the centre of each field. This ridge is now ready to be harvested; and
> Harvesting - Harvesting is the final stage of the production process. Each individual ridge is lifted mechanically, by a machine called a harvester, transferred and dropped on top of the adjoining field's ridge, until five ridges have been accumulated into a single large ridge. This ridge forms the final lift into the peat storage stockpile.

Every 11th field is typically used to stockpile the peat from the output of five fields either side and the peat in these stockpiles are removed by rail. In some areas, a system known as "Haku" is utilised where the harvested peat is deposited directly into trailers and transported to a central stockpile on the headland. Weather permitting, the miller follows the harvester and the production cycle recommences in the emptied fields. Each production cycle is known as a harvest. In a year of average weather conditions, approximately 12 harvests are completed. When the production season is over, the stockpiles are covered to keep the peat dry, unless the peat is scheduled for immediate use. Peat is stored in these stockpiles until they are required for use.

Sod Moss Production Process

Most of the peat extracted by Bord na Móna is milled peat, however peat is also extracted in sod moss form, which is the term used to describe peat produced in block form for horticultural use. The sod moss is extracted mechanically with specially equipped excavators. The sods are cut from mini face-banks or the margins of trenches that are gradually widened and left on the bog to dry for approximately 12 months, reducing moisture content from 90% to 50% - 60%. Once the required moisture content is reached the sod moss is stockpiled at the edge of bog prior to transportation for processing.

Peat haulage
Much of the peat production areas are served by a permanent rail network linking bogs to the Edenderry Power Station, the Derrinlough Briquette factory and the horticultural peat processing plants allowing for direct delivery of peat from the stockpiles on the bog to these locations. When a peat stockpile is ready for outloading, temporary tracks are laid adjacent to the stockpile and the peat is loaded into the wagons by excavators. The peat is hauled by locomotives pulling sixteen peat wagons and this is termed a "rake".

In bogs where there is no permanent rail link to the end user, peat is removed from the bog by road. Peat is loaded into lorries by use of a lorry tippler which transfers peat automatically from the internal bog rail wagons to a waiting lorry. Alternatively, where there is no internal rail network, peat is harvested into "Haku" trailers which deposit peat into a large stockpile from which lorries are loaded using an excavator.

Pumps
As bogs have been developed and the draining of areas of bog by gravity is no longer feasible, pumps have been installed to drain part or all of the catchment. Bord na Mona have used Archimedean screw pumps for many years throughout their bogs and in recent years, submersible pumps have become more common. The following table lists the bogs included in this Flood Risk Assessment that have pumps. Pumps are usually installed on a duty/ standby basis with level sensors.

Bog Name	**Pump Reference**
Bellair North	P15/001
Lemanaghan	P15/003
Lemanaghan	P15/004
Monettia	P15/005
Noggusboy (no longer in use)	P15/002
Coolnagun	P05/048
Coolnagun	P05/049
Milkernagh	P05/050
Ballybeg	P37/001
Ballydermot South & North	P37/011
Ballydermot South & North	P37/012
Codd South	P37/014
Blackriver	P37/007
Lodge	P37/013
Glashabaun North	P37/008
Ticknevin	P37/010
Derrinboy	P15/008

Table 1.3.1 Location of Pumps

A photograph of a typical Bord na Mona pump arrangement is shown below:

Photo 1.3.3 - Typical Submersible Pump Sump

Works Areas / Production Centres

The bogs included in this report generally have a Works area also known as a Production Centre. The infrastructure in these Works Areas vary depending on the bog. They generally consist of buildings containing welfare facilities and an office and car parking facilities for employees. A fenced compound area is usually provided to store plant and machinery. In some bogs an external bunded fuel tank is provided and/ or a bunded container for storage of oil drums. Where bogs are not connected to the end user by rail, lorry loading facilities are provided and where there is an internal rail line on the bog, a tippler is provided to transfer peat from rail wagons to lorries. Where no tippler is provided, peat is loaded from stockpiles into lorries by an excavator.

1.4 Planning Guidelines

In November 2009, the OPW and DoEHLG jointly published for public consultation Flood risk management planning guidelines entitled "The Planning System and Flood Risk Management" which is aimed at ensuring a more consistent, rigorous and systematic approach to fully incorporate flood risk assessment and management into the planning system, both at the strategic level of county/city and local area plans and at the specific level of planning application assessments. The aim of these planning guidelines is a tiered system of avoidance of flood risk where possible, substitution with less vulnerable development where avoidance is not possible, justification of development where avoidance and substitution are not possible and mitigate and manage to reduce flood risk and damage to acceptable levels where justification test permits the development. The flood risk management planning guidelines sets out how to assess and manage flood risk potential and includes guidance on the preparation of flood risk assessments by developers.

Site Specific Flood Risk assessment

A site-specific flood risk assessment should in general include the following assessments

- All potential sources of flooding that may affect the site;

- Flood alleviation measures already in place;
- The potential impact of flooding on the site and consideration of flood zones in which the site falls within and the demonstration that development meets the vulnerability criteria set out in the guidance;
- The potential impact of the proposed development on the flooding and flood risk to other lands and properties;
- How the layout and form of the development can reduce those impacts, including arrangements for safe access and egress, which may include an evacuation plan for the development;
- Proposals for surface water management according to sustainable drainage principles;
- The effectiveness and impacts of any necessary mitigation measure;
- The residual risks to the site after the construction of any necessary measures and the means of managing these risks;

Decision Making Process

Management of flood hazard and potential risks in the planning system is based on

1. Sequential Approach
2. Justification test

Sequential Approach

The aim of the sequential approach is to guide development away from areas at risk of flooding. The approach makes use of flood risk zones, ignoring presence of flood protection structures and classifications of vulnerability of property to flooding. Flood zones are defined as follows in the Guidelines:

- Zone A is at highest risk. In any one year, Zone A has a 1 in 100 year (1%) chance of flooding from rivers and a 1 in 200 year (0.5%) chance of flooding from the sea. Development should be avoided and/or only considered through the application of Justification test.

- Zone B is at moderate risk. The outer limit of Zone B is defined by the 1 in 1,000 year (or 0.1%) flood from rivers and the sea. Development should only be considered in this zone if adequate land or sites are not available in Zone C or if development in this zone would pass the Justification test.

- Zone C is at low risk. In any one year, Zone C has less than 1 in 1,000 year (<0.1%) chance of flooding from rivers, estuaries or the sea. Development in this zone is appropriate from a flood risk point of view.

Further sequentially-based decision making should be applied when undertaking the Justification Test for development that needs to be in flood risk areas for reasons of proper planning and sustainable development:

- within Zone or site, development should be directed to areas of lower flood probability;
- where impact of the development on adjacent lands is considered unacceptable the justification of the proposal or Zone should be reviewed;
- where the impacts are acceptable or manageable, appropriate mitigation measures within the site and if necessary elsewhere should be considered.

Application of the Justification Test in Development Management

Where a planning Authority is considering proposals for new development in areas at a high or moderate risk of flooding that include types of development that are vulnerable to flooding and that would generally be inappropriate, the planning authority must be satisfied that the development satisfies all of the criteria of the Justification Test as it applies to development management as set out below:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

   The acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.

While this report assesses the flood risk of each bog in accordance with these planning guidelines, it should be noted that the drainage development and peat extraction in all of these bogs commenced prior to the introduction of these Flood Risk Management Guidelines.

1.5 Methodology

The flood risk for each of the 41 bogs are assessed in Sections 2 to 8 of this report. The bogs are grouped by their IPC Licence Bog Group. Most of the bogs are considered separately however a number of the bogs in the Allen Bog group are grouped together due to their proximity to each other.

Each bog has been assessed under the following headings:

- Site Location
- Bog Description
- Regional Hydrology
- Historical Flooding
- Groundwater Flood Risk
- Fluvial Flood Risk
- Pluvial Flood Risk
- Climate Change

- Conclusions

Further details of some of these headings are set out below.

1.6 Historical Flooding

The sources of information for historical flooding in the area includes the OPW website Floodinfo.ie, flood maps including aerial flood mapping of 2009 and 2015 events, historical Ordnance Survey maps and other material relevant to the area. Key information was also obtained from anecdotal information from Bord na Móna employees and site managers.

1.7 Coastal Flood Risk

As all the bogs under consideration are in excess of 35 kilometres from the sea coastal flooding is not considered to be a risk and has not been assessed in this report.

1.8 Groundwater Flood Risk

Groundwater flooding occurs when the water table level rises above ground level as a result of prolonged rainfall. Local groundwater flooding may also be produced from springs and seepages under artesian conditions from the underlying aquifer. Groundwater flooding tends to be very local and results from the interaction of site-specific factors such as local geology.

In Ireland, groundwater flooding is most commonly related to turloughs in the karstic limestone areas prevalent in particular in the west of Ireland.

Groundwater flooding was assessed using available information from PFRA mapping, from the GSI website and also from local knowledge of past groundwater flood event and identified groundwater features sych as springs and seepages.

The groundwater table level is generally high close to the base of the peat and drainage channel inverts. The drainage of the bog via the network of bog drains controls groundwater levels that occur below the bog. Existing and historical drainage has a significant effect on groundwater levels drawing down the water table to the base of the peat as was designed for peat production on the Bog.

Groundwater flows in the form of springs and seepages within the bog are unlikely to be significant in terms of flood flows given limited upstream recharge area, (due to peat depths and existing drainage) and at the extreme return flow period events, these groundwater seepage rates would be minor in comparison to the direct pluvial and surface runoff rates and flood volume.

1.9 Fluvial Flood Risk

Fluvial flooding occurs when rivers and streams break their banks and water flows out onto the adjacent low-lying areas (the natural floodplains). This can arise where the runoff from heavy rain exceeds the natural capacity of the river channel, and can be exacerbated where a channel is blocked or constrained.

Different rivers will respond differently to rainfall events, depending on a range of factors such as the size and slope of the catchment, the permeability of the soil and underlying rock, the degree of urbanisation of the catchment and the degree to which flood waters can be stored and slowly released into lakes and along the river's floodplains. A storm of a given rainfall depth and duration may cause flooding in one river, but not in another, and some catchments may be more prone than others to prolonged rainfall or a series of rain events. River flooding can occur rapidly in short, steep rivers or after some time, and some distance from where the rain fell, in larger or more gently flowing rivers. Changes in rainfall patterns, such as might be caused by climate change, will have different impacts on flood magnitudes and frequency in different catchments.

To assess the fluvial flood risk in this report, the regional hydrology and river catchments and sub-basins for each bog are identified. As well as assessing historical information on fluvial flooding the following has been considered in the assessment of fluvial flood risk.

1.9.1 **Predictive Flood Mapping**

The OPW have prepared predictive flood mapping that have been referred to in the fluvial assessment of each of the bogs. These maps are indicitive showing areas predicted to be inundated during a theoretical 'design' flood event with an estimated probability of occurrence, rather than information for actual floods that have occurred in the past.
The maps refer to flood event probabilities in terms of a percentage Annual Exceedance Probability, or 'AEP'. This represents the probability of an event of this, or greater, severity occurring **in any given year**. These probabilities may also be expressed as odds (e.g. 100 to 1) of the event occurring in any given year.

Flood maps have been developed for the current scenario, and also for two potential future scenarios; the Mid-Range Future Scenario (MRFS) and the High-End Future Scenario (HEFS), taking into account the potential impacts of climate change and other possible future changes. These scenarios include for changes as set out in Table 2.

Parameter	MRFS	HEFS
Extreme Rainfall Depths	+ 20%	+ 30%
Peak Flood Flows	+ 20%	+ 30%
Mean Sea Level Rise	+ 500 mm	+ 1000 mm
Land Movement	- 0.5 mm / year[1]	- 0.5 mm / year[1]
Urbanisation	No General Allowance – Reviewed on Case-by-Case Basis	No General Allowance – Reviewed on Case-by-Case Basis
Forestation	- 1/6 Tp[2]	- 1/3 Tp[2] + 10% SPR[3]

Table 1.9.1 - Allowances in Flood Parameters for the Mid-Range and High-End Future Scenarios

The High-End Future Scenario has been considered for the fluvial flood assessment in each bog.

1.9.2 Arterial Drainage Schemes

The OPW has carried out a number of arterial drainage schemes on catchments under the Arterial Drainage Act 1945. The Brosna (Westmeath, Offaly and Laois) was the first scheme which commenced in 1947. The last schemes were completed in the 1990's. Arterial Drainage schemes cover approximately 20% of the country, typically the flattest areas. The OPW is required to maintain Arterial Drainage schemes under sections 37 and 38 of the Arterial Drainage Act, 1945 and subsequent amendments.

The Arterial Drainage Schemes were carried out to improve land and to mitigate flooding. Rivers lakes, weirs and bridges were modified to enhance conveyance of flood waters, and embankments were built to control the movement of flood water. The stated purpose of the schemes was to improve land for agricultural use and to ensure that the 3yr flood was retained in bank. Flood protection in the benefiting lands was increased as a result of the Arterial Drainage Schemes.

1.9.3 Drainage Districts

Drainage Districts were carried out by the Commissioners of Public Works under a number of drainage and navigation acts from 1842 to the 1930's to improve land for agriculture and to mitigate flooding. Channels and lakes were deepened and widened, weirs removed, embankments constructed, bridges replaced or modified and various other work was carried out.
The purpose of the schemes was to improve the land for agriculture by lowering water levels. Drainage Districts cover approximately 10% of the country, typically the flattest areas. Local authorities are charged with the responsibility to maintain Drainage Districts.

1.9.4 Land Commission

The Land Commission took over a number of embankments as part of its work. These embankments were created by landowners to reclaim land from rivers or the sea, typically in the 19th century. The purpose of the schemes was to create land for agriculture. In some cases embankments were created and the area behind was allowed to flood and flush out a number of times to reduce the salt content of the soil. The Minister and Land Commission were exempted from any responsibility for maintenance of land sold by the Land Commission under Section 10 of the Land Act, 1965, and this responsibility falls on the current landowners, in line with the provisions of the Land Acts. The OPW carried out a survey of these embankments in 1939 and 1940 as part of the work of the Browne Commission. Part IV of the Arterial Drainage Act, 1945 created a provision for embankments to be absorbed into drainage schemes.

1.10 Pluvial Flood Risk

Pluvial flooding occurs when the amount of rainfall exceeds the capacity of the drainage systems or the ground to absorb it. This excess water flows overland, ponding in natural or man-made hollows and low-lying areas or behind obstructions. This occurs as a rapid response to intense rainfall before the flood waters eventually enter a piped or natural drainage system or infiltrate to ground. This type of flooding is driven in particular by short, intense rain storms.

The majority of the bogs assessed in this report are direct rainfall fed systems and are generally susceptible to pluvial ponding during rainfall events and particularly where peat extraction has resulted in forming a topographically depressed area.

The existing surface water regime utilises the open drainage and piped drainage network available on site. There is currently a network of parallel surface water drains running at 15 metre centres which drain the peat production fields. These drains discharge from the site to watercourses via piped outfalls from silt ponds. During high rainfall events the flat gradient of the drains and pipes will provide storage capacity and attenuation and will slow the discharge from the bog.

As peat production can only takes place in dry weather conditions it is a seasonal and intermittent activity and peat extraction does not take place when rainfall is forecast. As such, pluvial flooding that may occur on the bog due to a more extreme rainfall event will not impact on operations and production will cease until water levels drop and the production fields dry out.

In order to assess pluvial flooding on the bog a modelling exercise was carried out as detailed below.

Pluvial Modelling

The modelling carried out assumes the following:

- All inflow into the bog is rainfall falling on the basin during the rainfall event;
- The outflow from the bog during the event is limited to the estimated greenfield flood runoff rate;
- The difference between the inflow and the outflow represents the onsite storage;

The rainfall information used for the model was obtained from Met Eireann information. The FSU Depth Duration Frequency (DDF) model developed by Met Éireann (Fitzgerald, 2007) consists of an index (median) rainfall and a log-logistic growth curve. Growth curve parameters were determined at each rainfall station using the DDF model and these were interpolated and mapped on a 2km grid. The growth curve provides a multiplier of the median rainfall for any required return period. No allowance is made for the effects of climate change on the rainfall regime. The OPW recommend a climate change factor of 20% to be added to the rainfall depth for extreme events under the mid-range future scenario (MRFS) and 30% under the Higher End future scenario (HEFS). This 30% increase in rainfall was used for the climate change modelling event.

The FSU DDF model does not provide predicted rainfall depths beyond the 250-year return period. Fitzgerald (2007) stated that the model may be used with fair confidence for return periods up to 250 years but beyond this model outputs should be treated with caution, especially for shorter durations. For the purposes of assessing the flood risk to infrastructure and buildings on the bog, the 1000 year storm event was calculated by extrapolating the available 100 year and 250 year rainfall data.

Rainfall data for 12 hour, 18 hour, 24 hour and 36 hour duration is compiled for a 100 year and 250 year rainfall event. The basins considered for each bog are the areas in each bog that discharge from each surface water discharge point.

For each flood event and duration, the following is calculated:

1. The volume of water generated by the flood event is calculated from the rainfall data x basin area. (This is the Volume In)
2. The volume of green field runoff (Volume Out)
3. The volume of water stored on the catchment.

The volume of green field runoff, QBAR (in m^3/s), is calculated for each catchment using the following formula from 'The Institute of Hydrology Report no. 124 (IH 124, 1994)':

$QBAR = 0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$
Where:
AREA (in km2) is the catchment plan area
SAAR (in mm) is the standard average annual rainfall for the particular location (this is obtained from Met Éireann/EPA Hydronet)
SOIL is the soil index, defined as:

$$SOIL = \frac{(0.15S_1 + 0.30S_2 + 0.40S_3 + 0.45S_4 + 0.5S_5)}{(S_1 + S_2 + S_3 + S_4 + S_5)}$$

$S_{1,\ 2....}$ denote the proportions of catchment covered by each of the soil classes 1 to 5. Soil class 1 has a low runoff potential and soil class 5 has a high runoff potential.
Soil type 2 (i.e. low runoff potential) has been selected for all bog catchments included in this report.

The rainfall duration that is modelled is the event that generated the maximum storage volumes and this generally tends to be the 18 hour or 24 hour duration.

Three scenarios are modelled for each bog

- 100 year return period;
- 100 year return period plus additional 30% to account for climate change;
- 1000 year return period.

The topographical data used in the Flood Risk Modelling is derived from a combination of a LiDAR survey completed in 2008 and field surveying carried out on the active production fields in 2015. The 2015 survey data, where available, was used to update the digital terrain model from the LiDAR data. For each active production field, the difference between the 2008 and 2015 data, was used to reprofile the digital terrain model. The resulting digital terrain model is referred throughout this report as the 'topographical model'.

Each modelling event is plotted on a map and the impact of the flood levels are assessed for each bog. Due to the topography and flat terrain of the bog there is generally significant available storage.

Pumped Bogs
Where there are existing surface water pumps on the bog, these pumps are disregarded for the purpose of the flood event modelling. An additional modelling exercise has been carried out to demonstrate the extent of flooding that will occur if the pumps break down or are turned off.

1.10.1 **Climate Change**

The 2009 Planning Guidelines identifies that there is a great deal of uncertainty in relation to the potential effects of climate change and therefore recommends that a precautionary approach should be taken in relation to Flood Risk Assessment. This precautionary approach includes recognising that significant changes in the flood extent may arise from an increase in rainfall or tide events, that levels of structures such as flood defences are sufficient to cope with the effects of climate change and ensuring that structure and the development are capable of adaptation to the effects of climate change.

Climate change scenarios suggest for UK and Ireland fluvial floods in the 2080's increasing by up to 10% (low and medium low scenarios) or by up to 20% (medium high and high scenarios). Present recommendations are to include in the design flow a 20% increase in flood peaks over 50 years return period as a result of climate change. This scenario based on the Irish growth curve will result in a present day 100-year flood becoming a 25-year flood in approximately 50-years' time. The extent and expected levels of flooding are derived based on these flows.

Other predicted climate change effects for the UK are:
- A 4mm to 5 mm per annum rise in mean sea level
- Additional intensity of rainfall of 20%
- An additional 30% Winter rainfall by the 2080's
- A reduction of 35%/45% rainfall in Summer
- The 1 in 100 year rainfall storm to increase by 25%

DEFRA Guidance

In the UK research is ongoing to assess regional variations in flood allowances and the rate of future change. Current research thus far does not provide any evidence for the rate of future change let alone consider regional variations in such a rate. The UK Flood and Coastal Defence Appraisal Guidance (DEFRA, 2006) gives the climate change ranges as per Table 3 below and as a pragmatic approach it is suggested that 10% should be applied up to 2025, rising to 20% beyond 2025.

In Ireland, general practice is to use a medium range climate change allowance for flood flows of 20% over the next 100 years.

Notwithstanding the above precautionary principle, the flood risk zones defined in the Flood Risk Planning Guidelines are based on the present-day assessment of the 100-year (1%) and 1000-year (0.1%) return period for fluvial flooding and the 200-year and 1000-year for tidal flooding. The OPW provide specific guidance as to the allowances in their publication entitled "Assessment of Potential Future Scenarios, Flood Risk Management Draft guidance, 2009 and these allowances are summarised in the following table.

Table 4 Climate Change Allowances for Future Scenarios 100 year Criteria	**Mid-Range Future Scenario MRFS**	**High-End Future Scenario HEFS**
Mean Sea Level Rise	+500mm	+1000mm
Land Movement	-0.5mm/year	-0.5mm/year
Extreme Rainfall Depths	+20%	+30%
Flood Flows	+20%	+30%

Table 1.10.1 - Climate Change Allowances for Future Scenarios 100 year

As set out in Section 1.6 above pluvial modelling for each bog has been considered for a 100 year storm plus 30% additional rainfall to account for climate change.

FLOOD RISK ASSESSMENT – CHAPTER 2
Boora Bog Group

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2 FLOOD RISK ASSESSMENTS – BOORA BOG GROUP

2.1 Boora Bog Group - IPC Licence (ref P0500-01).

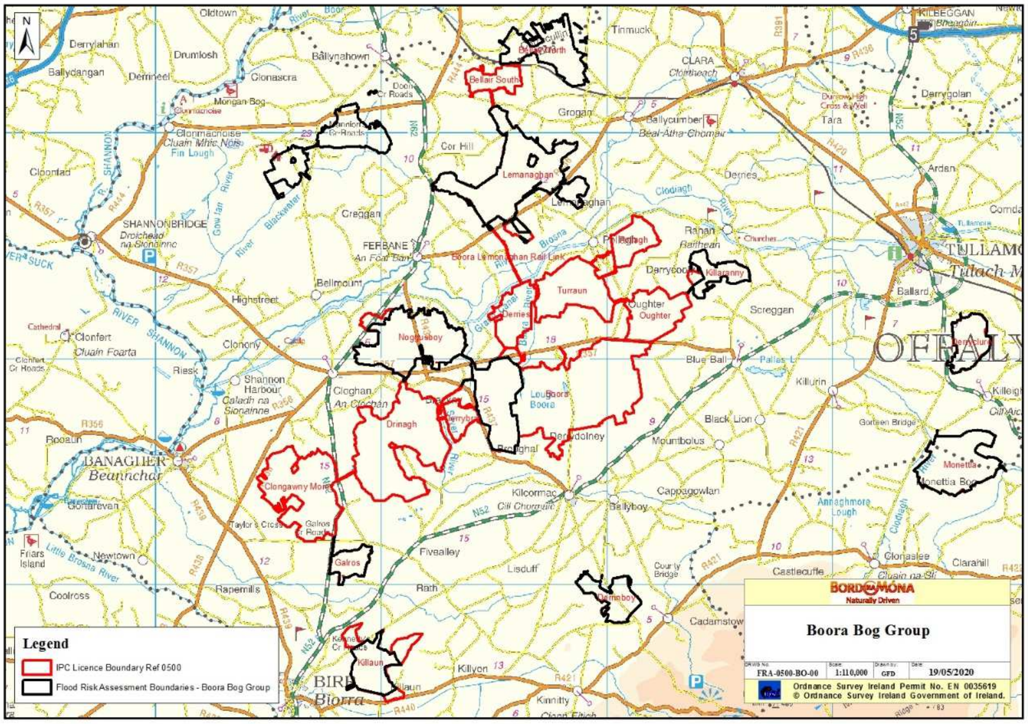
The Boora group of bogs are sited between Killeigh (Offaly) in the East to Banagher (Offaly) in the West and between Kinnitty (Offaly) in the south and Clara (Offaly) in the North. Bord na Móna's licence for the Boora Bog Group (Ref. PO500-001) was granted to Bord na Móna Energy Limited on 18 May 2000 and regulates Bord na Móna's activities across 18 bog units. Of these 18 bogs units, 10 are included in the Substitute Consent applications and in this Flood Risk Assessment Report

The ten Boora bogs included in this report are:

- Bellair North – Counties Offaly and Westmeath;
- Lemanaghan – County Offaly;
- Noggusboy – County Offaly;
- Boora Bog – County Offaly
- Galros – County Offaly
- Killaun – County Offaly;
- Derrinboy - County Offaly;
- Derryclure – County Offaly;
- Monettia – Counties Offaly and Laois.
- Killaranny – County Offaly

Some of the bogs in the Boora Bog Group commenced milled peat production in 1955 to supply peat to the Ferbane power station which opened in 1957. Peat from these bogs also supplied the Derrinlough Briquette factory which was in full scale production by 1960. The drainage of Boora Bog, Noggusboy and Lemanaghan commenced in the 1950s with Bellair and Moniettia commencing in the 1970s. Drainage works commenced in Galros, Killaranny, Derrinboy and Derryclure in the 1980's and Killaun Bog development works commenced in 1996.

The River Shannon is the major river catchment for the area with a smaller area lying within the Barrow catchment as shown on the map below. Noggusboy, Boora Bog, Galros, Killaun, Derrinboy, Derryclure, and Killaranny are fully located in the Shannon Lower catchment. Bellair North and Lemanaghan are located between the Shannon Upper and Shannon Lower river catchments. Monettia is located between the River Barrow and the Shannon Lower catchment.


Legend
IPC Licence Boundary Ref 0500
Flood Risk Assessment Boundaries - Boora Bog Group
BORD NA MÓNA
Naturally Driven
Boora Bog Group
FRA-0500-BO-00
1:110,000
GFD
19/05/2020
Ordnance Survey Ireland Permit No. EN 0035619
© Ordnance Survey Ireland Government of Ireland.

2.2 Bellair North Bog

2.2.1 Introduction

Bellair North Bog is part of the Bord na Móna Boora Bog Group operated under an Integrated Pollution Control Licence (ref P0500-01). The Bog is used primarily to produce milled peat and the total area within Bord na Móna ownership is 568 Hectares.

2.2.2 Site Location

Bellair North is located between Counties Westmeath and Offaly, circa 3 km south of Moate. The site is within the Lower Shannon 25A and Upper Shannon 25G catchments, (Hydrometric Area 25).

The Bellair North Bog site location is highlighted in red in the Figure below and is 568Hectares.

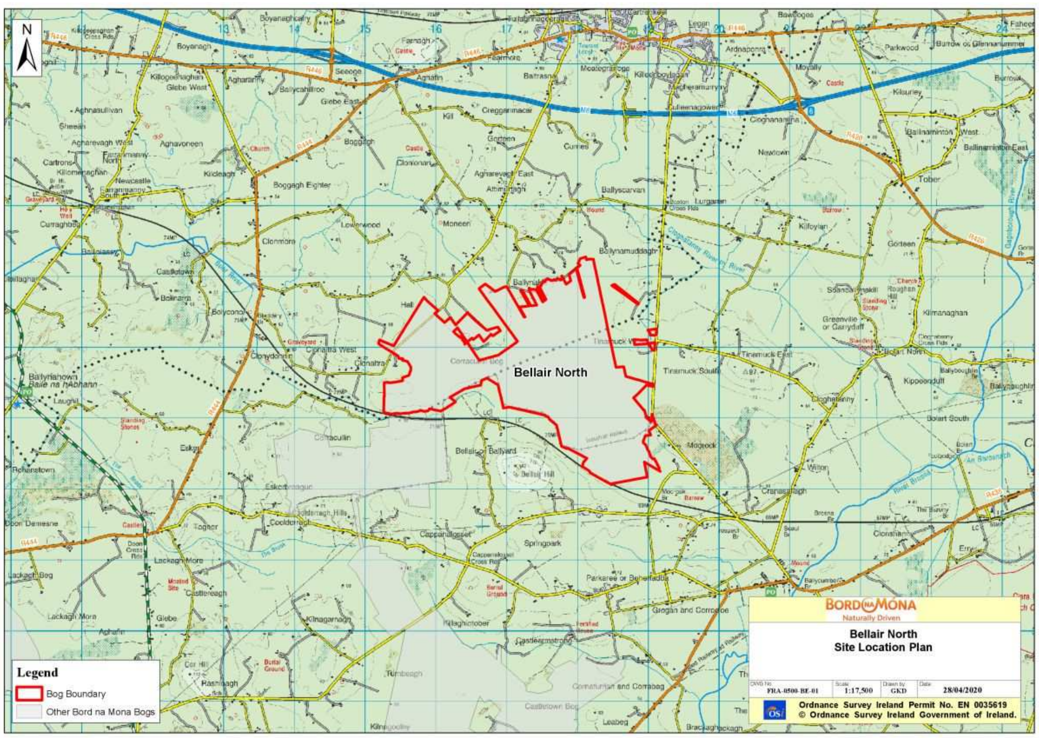


Figure 2.2.1 Bellair North Bog Site Location

2.2.3 Bog Description

Bellair North Bog supplied fuel peat for the West Offaly Power station in the past and in future will produce horticultural peat. The bog primarily consists of active peat production fields with some domestic turf cutting areas to the north of the bog with areas of high bog remnants. This bog was drained by Bord na Móna in 1970 with peat production commencing in 1976.

The existing ground levels of the peat production areas range from 63.7mOD in the north-east corner of the site to 58.8mOD in the centre of the site. There is a works area in the south-east area of the bog and this includes a lorry tippler, welfare facilities, car parking and storage area. The access point to the bog is off the public road R446 into the works area.

There are 5 surface water discharges from this bog, 4 of which are gravity flow. There is also an area drained by pumping and this water flows through a silt pond before discharging through SW37. Bellair North Bog drainage layout is shown in the Figure below.

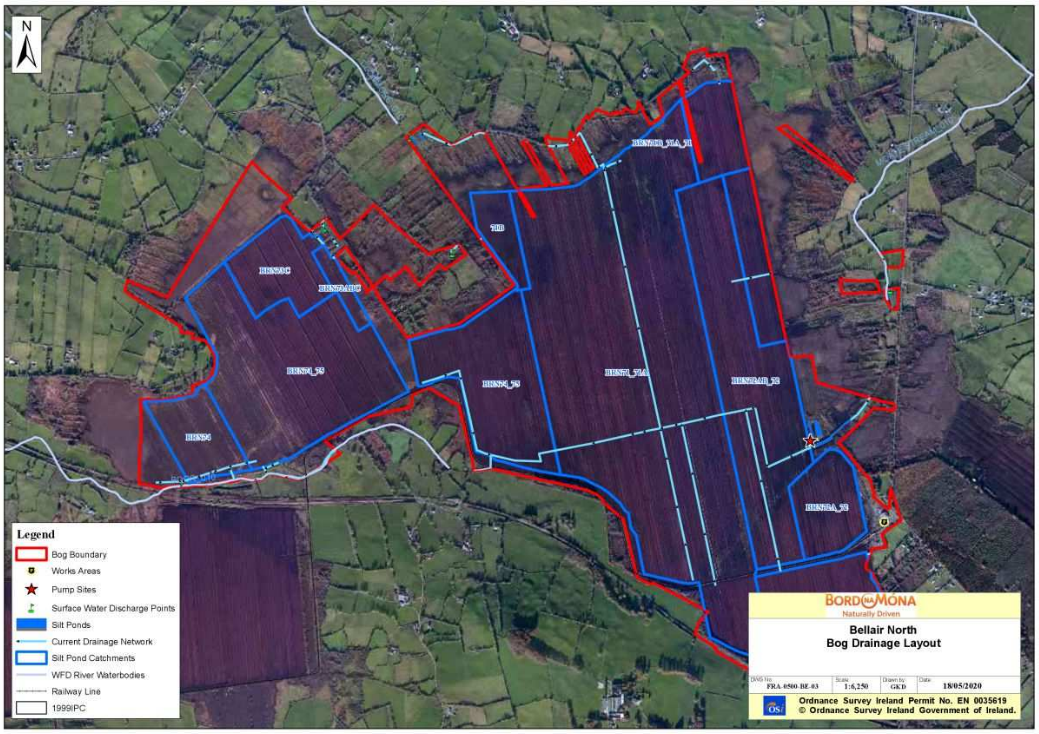


Figure 2.2.2 Bellair North Bog Drainage Layout

2.2.4 **Regional Hydrology**

Bellair North Bog is within in the Lower Shannon 25A and Upper Shannon 25G catchments (Hydrometric Areas 25 and 26).

The Lower Shannon 25A catchment covers an area of 1,248km² and is characterised by relatively flat topography with extensive areas of bog lands in the low-lying areas. The Lower Shannon (Brosna) catchment comprises 12 sub catchments with 60 river water bodies, four lakes and 18 groundwater.

The Upper Shannon 25G is a small catchment and covers an area of 383km² and is comprised of the catchment area from Athlone to Shannonbridge. The catchment is characterised by flat topography and expanses of bogs and flood prone areas. The Upper Shannon (Mid Shannon) catchment comprises three sub catchments with 13 river water bodies and eight groundwater bodies.

There are 5 surface water discharges from this bog and 3 of these surface water discharge into the Clonmore_010 and into the sub-catchment Shannon Lower_SC_010. One discharges into the Moate Stream_010 and into the sub-catchment Shannon Lower_SC_010. The remaining surface water discharges into the Boor_010 and into the Shannon Lower_ SC_010. There are 4 gravity flow surface water outflows and, associated silt ponds, in Bellair North Bog. There is also an area of the bog drained by pump P15-10 and this pumped water flows through a series of silt ponds before discharging through SW37.

The Clonmore_010 sub basin is north of the bog, outfall SW36 discharges within 50m of this waterbody, outfall SW37A is within 650m and outfall SW37C is within 670m. The Moate Stream _010 sub basin is east of the bog and outfall SW37 discharges directly into this waterbody. The Boor_010 sub basin is west of the bog and outfall SW37B discharges directly into this waterbody.

The catchment areas, water courses and District Drainage Schemes are shown in the Figures below.

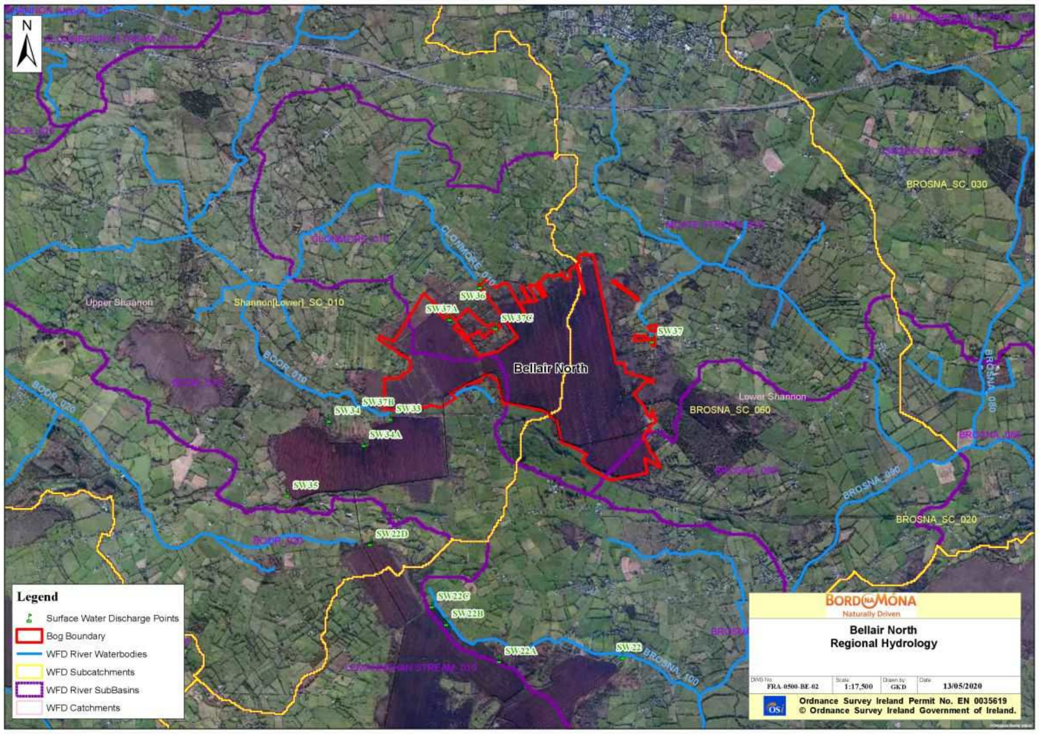


Figure 2.2.3 Bellair North Bog Regional Hydrology

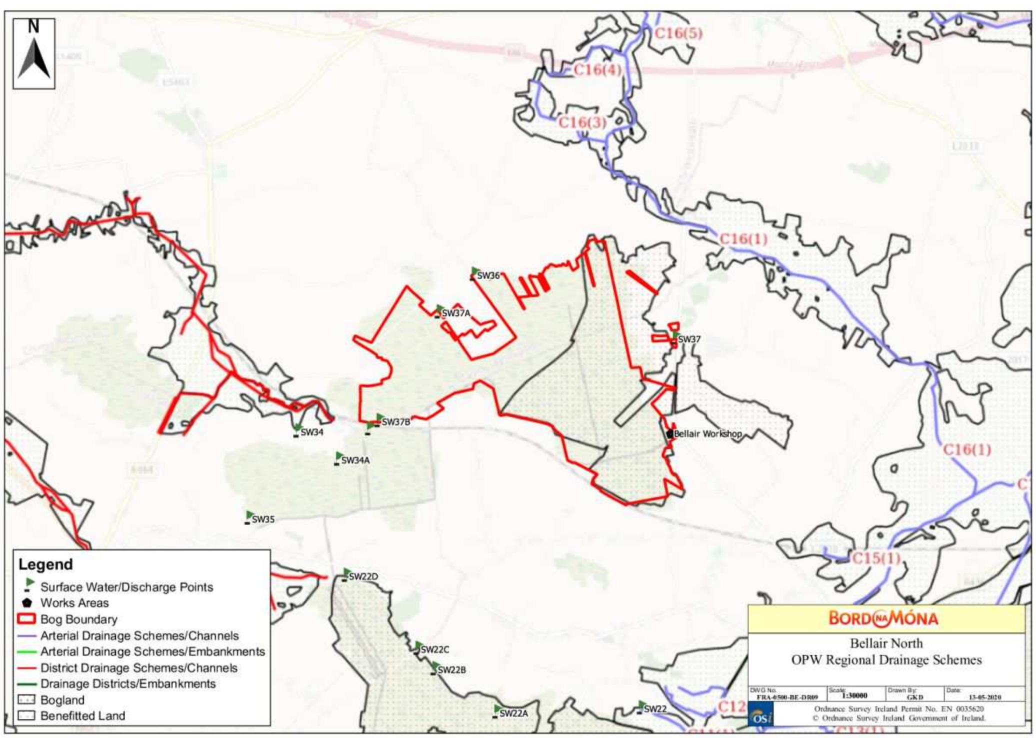


Figure 2.2.4 Bellair North Bog District Drainage Schemes

The benefitted land from District Drainage Schemes is also highlighted demonstrating that there are limited benefitting lands associated with this scheme in the area of these bogs.

There is one groundwater aquifer underlying Bellair North Bog. The aquifer is categorised as *Ll – Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones.* This is discussed further in section 2.2.6
The Standard Annual Average Rainfall (SAAR) in this location is 908mm.

2.2.5 **Historical Flooding**

The OPW https://www.floodinfo.ie website provides some limited information on flood records throughout the country. A map of historical flooding contained for the area, in the vicinity, of Bellair North Bog is shown in the Figure below.

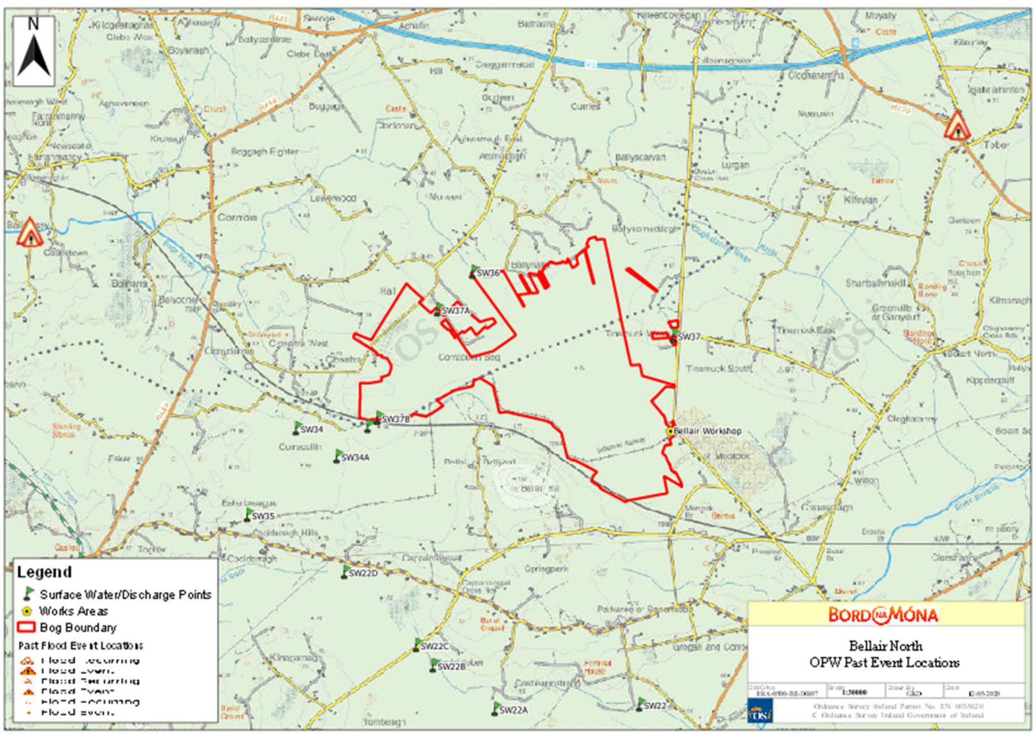


Figure 2.2.5 Bellair North Bog Historical Flooding

The OPW Past Flood Events show no records of any flooding events in the vicinity of Bellair North Bog.

Bord na Móna operatives familiar with Bellair North Bog have confirmed that during periods of heavy rainfall, when the pump P15-10 is pumping, flooding occurs downstream of the silt pond that discharges through outfall SW37. Bord na Móna mitigates this issue by switching off the pump in periods of wet weather and consequently flooding occurs to the production areas. There is available storage capacity in the peat production area for these flood events.

2.2.6 **Groundwater Flood Risk**

There is one groundwater aquifer underlying Bellair North Bog. The aquifer is categorised as *Ll – Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones.* The aquifer has a moderate vulnerability code.

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below.

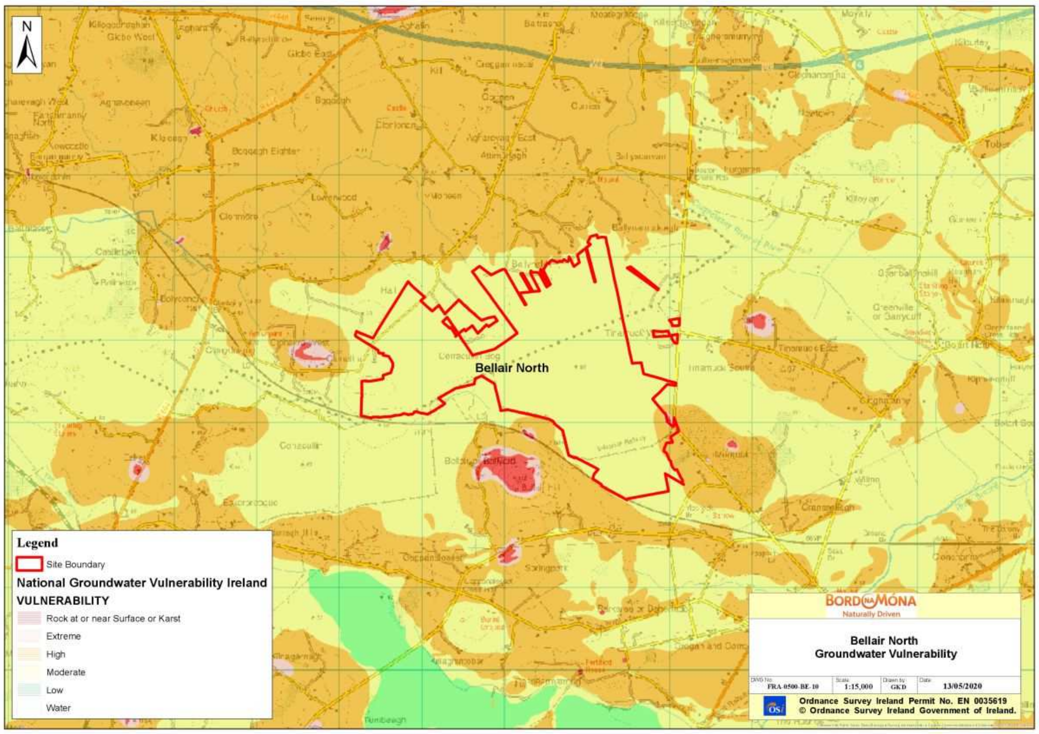


Figure 2.2.6 Bellair North Bog Groundwater vulnerability

The GSI https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx website provides information on groundwater throughout the country. The well shown to the south east of Bellair North Bog was recorded as having been dug in 1962. According to the GSI website the accuracy for this location is 1Km and information from Bord na Móna operatives familiar with Bellair North Bog confirmed that this well is not located within the bog boundary.

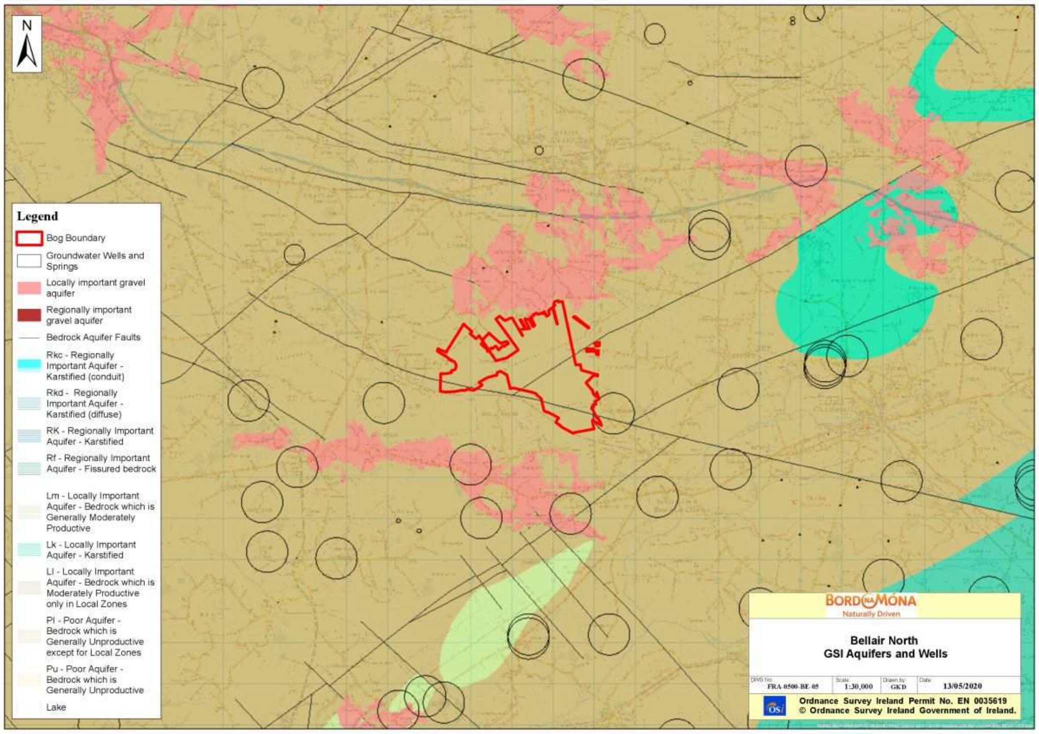


Figure 2.2.7 Bellair North Bog Aquifers, Karst Features, Wells

Information from Bord na Móna operatives familiar with Bellair North Bog confirmed that groundwater seepage has not been identified as a source of flooding within the bog

2.2.7 **Fluvial Flood Risk**

The rivers and streams in the vicinity of Bellair North Bog are are described in terms of regional hydrology in section 2.2.4

The 5 surface water outfalls in Bellair North Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameters of these outfalls are shown in the Table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW36	0.600
SW37	0.450
SW37A	0.450
SW37B	0.600
SW37C	0.450

Table 2.2.1: Bellair North Bog Surface Water Outfalls

Information from Bord na Móna operatives familiar with Bellair North Bog confirmed that outfalls will become submerged when the water levels are high. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Bellair North Bog. River Flood Events High Range mapping has been examined in the region of this bog. Mapping carried out for the Brosna river predicts that any flooding will be at a distance in excess of 2km from Bellair North Bog.

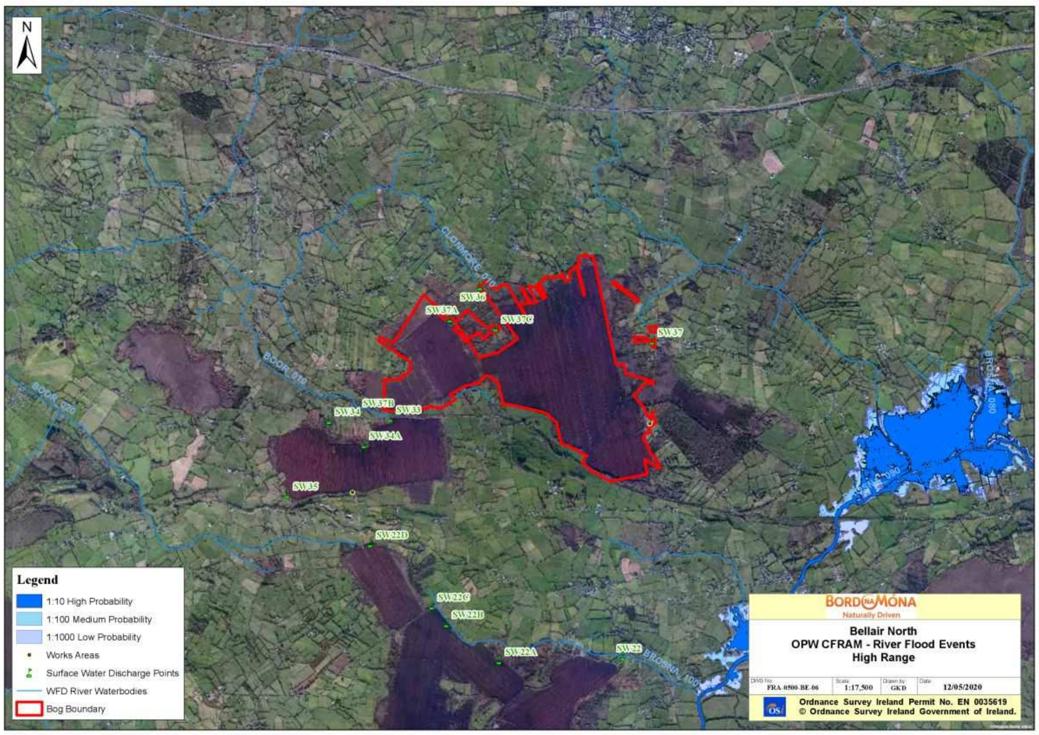


Figure 2.2.8 Bellair North Bog Flood Events High Range

2.2.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.
The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)

- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below.

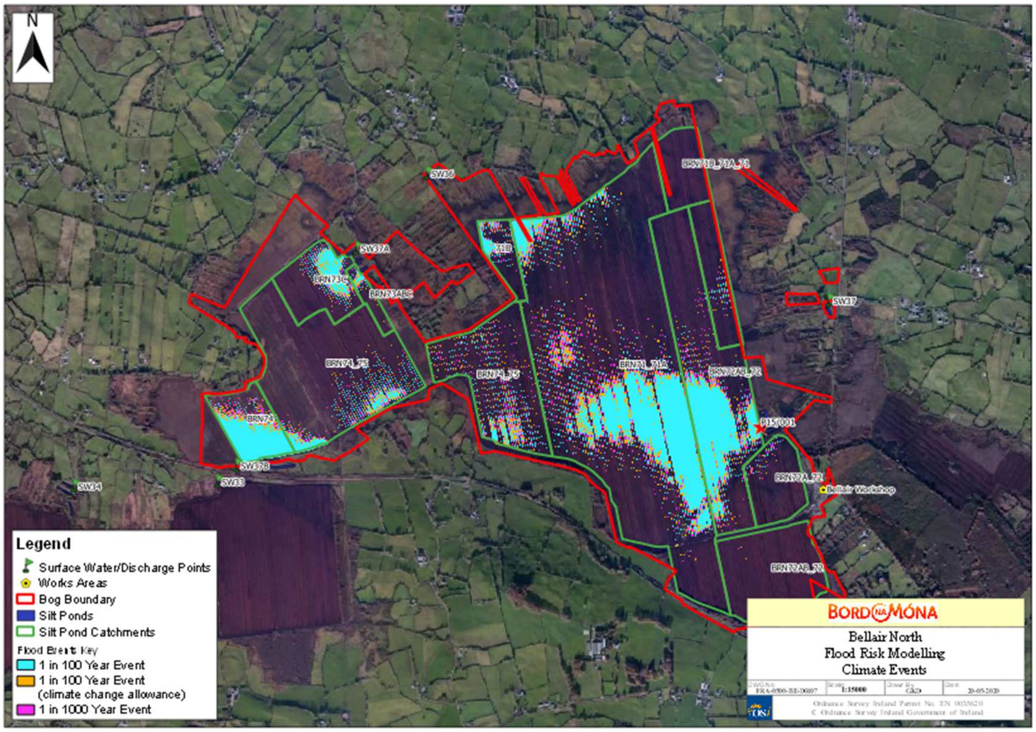


Figure 2.2.9 Bellair North Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the Surface water discharge points in the bog. Bellair North Bog is modelled for 5 separate basins BRN71_71A and BRN71N_71A_71, BRN72AB_72, BRN72A_72, BRN72AB_72 and NP, BRN73C, BRN73ABC, BRN74 and BRN74_75 and 71B. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

The model shows that flood waters are collecting in local areas in the northern, western and southerly parts of the bog. The most extensive flooding is shown in the central southern section, where rainfall generated over the basin is drained. The maximum flood level in this area for the 1000year event is 60.85mOD and the maximum flood level for the western area for the same event is 60.30mOD. The flood level in the north of the bog varies from 59.75 to 60.7mOD from east to west for the same event.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, it is assumed in the model that the discharges from the flood area to the silt ponds are limited to green field run- off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events

The existing ground level of the works area located to the south east of the bog is above 65.4m OD and the finished floor levels of the buildings are higher than 65.5mOD. The elevation of these buildings is higher than the modelled flood waters in the vicinity of the works area.

From this model that Bellair North Bog works area which includes a workshop, welfare facilities, oil storage facilities and lorry tippler is not as risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	**BRN71_71A and BRN71B_71A_71**	**BRN71B**	**BRN72AB_72 BRN72A_72 and NP**	**BRN73C and BRN73ABC**	**BRN74 and BRN74_75**
mOD	**m^3**	**m^3**	**m^3**	**m^3**	**m^3**
57.50	0	0	0	0	31
57.75	0	0	0	0	82
58.00	0	1	0	0	227
58.25	0	20	0	0	537
58.50	0	86	0	0	1090
58.75	1	256	4	3	2108
59.00	21	687	46	16	4200
59.25	145	1644	247	57	8528
59.50	1061	3575	970	222	17650
59.75	6398	7162	3251	729	34499
60.00	26185		10308	1990	61522
60.25	73017		26459	4781	103102
60.50	158039		55361	11289	168225
60.75	286308		98237	23336	266604
61.00			154160	39537	

Table 2.2.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Bellair North Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

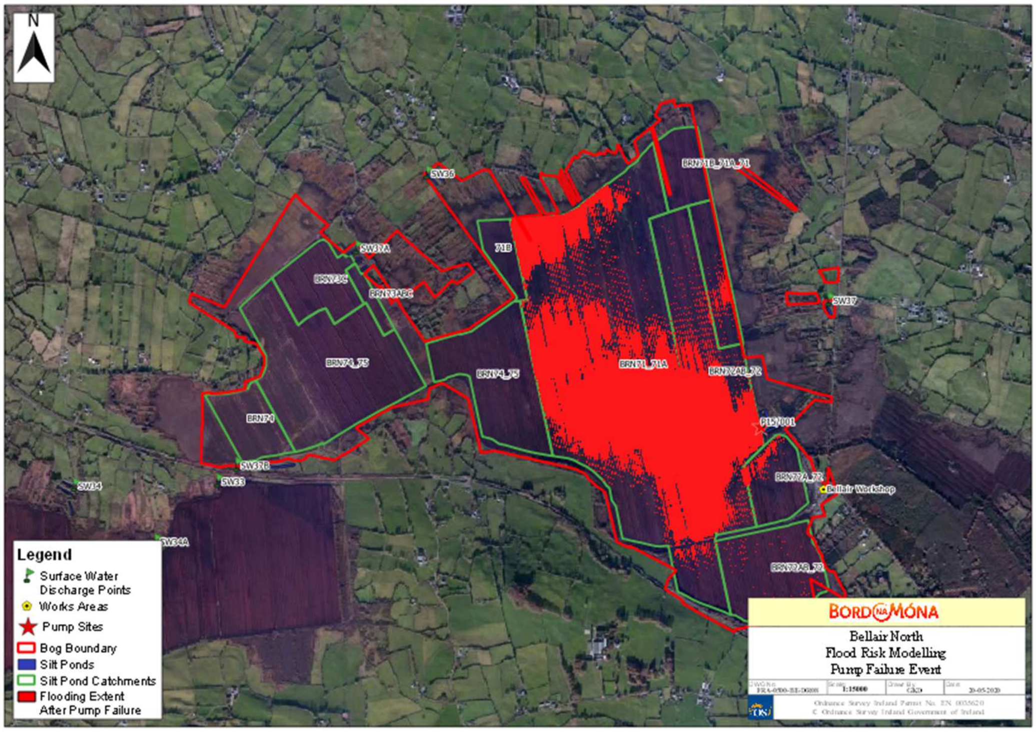


Figure 2.2.10 Bellair North Bog Pluvial Flooding, Pump Failure

Bellair North Bog has a pump in the eastern area of the bog for the pumping of surface water from low lying areas. This pump has been dis-regarded for the flood modelling of the extreme rainfall events set out above as these pumps are not designed for such events. The pump is an 44kw pump with an inlet pipe invert level of 57.35mOD and an outfall level of 61.25 mOD.

The pump discharges into a drain that flows by gravity into the silt ponds upstream of surface water outfall SW37. In the event that this pump fails, the surface water will pond in low lying areas on the bog to a level where it can discharge by gravity flow. The above figure models the flooding that will occur in the event that this pump is turned off or breaks down. The expected flood water level in this situation is plotted in red. All flooding caused by the failure of this pump will be retained within the bog peat production area.

2.2.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 2.2.8 above, the pluvial flood risk modelling using rainfall data for 1 in 100year event plus 30% climate change allowance (High End Emissions Scenario). In the climate change model run case, the maximum rainfall for the 100year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 2.2.7, the High Emissions Future Scenario (HEFS) has been considered which takes into account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

2.2.10 Conclusions

The Flood Risk Assessment for Bellair North Bog identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** During periods of heavy rainfall, when the pump P15-10 is pumping, flooding occurs downstream of the silt pond that discharges through outfall SW37. Bord na Móna mitigates this issue by switching off the pump in periods of wet weather and consequently flooding occurs to the production areas. There is available storage capacity in the peat production area for these flood events.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the rivers into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the adjoining water courses if their levels ever rise during flood events. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings and peat lorry loading area would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Works Area in Bellair North Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Bellair North Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 2.2.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Belair North Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been taken into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Bellair North Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management

2.3 Lemanaghan Bog

2.3.1 **Introduction**

Lemanaghan Bog is part of the Bord na Móna Boora Bog Group operated under an Integrated Pollution Control Licence (ref P0500-01). The Bog is used primarily to produce milled peat and the total area within Bord na Móna ownership is 1300 Hectares.

2.3.2 **Site Location**

Lemanaghan Bog is located in County Offaly approximately 4km east of Ferbane. The site is within the Lower Shannon 25A and Upper Shannon 25G catchments.

The Lemanaghan Bog site location is highlighted in red in the Figure below and is 1300 Hectares.

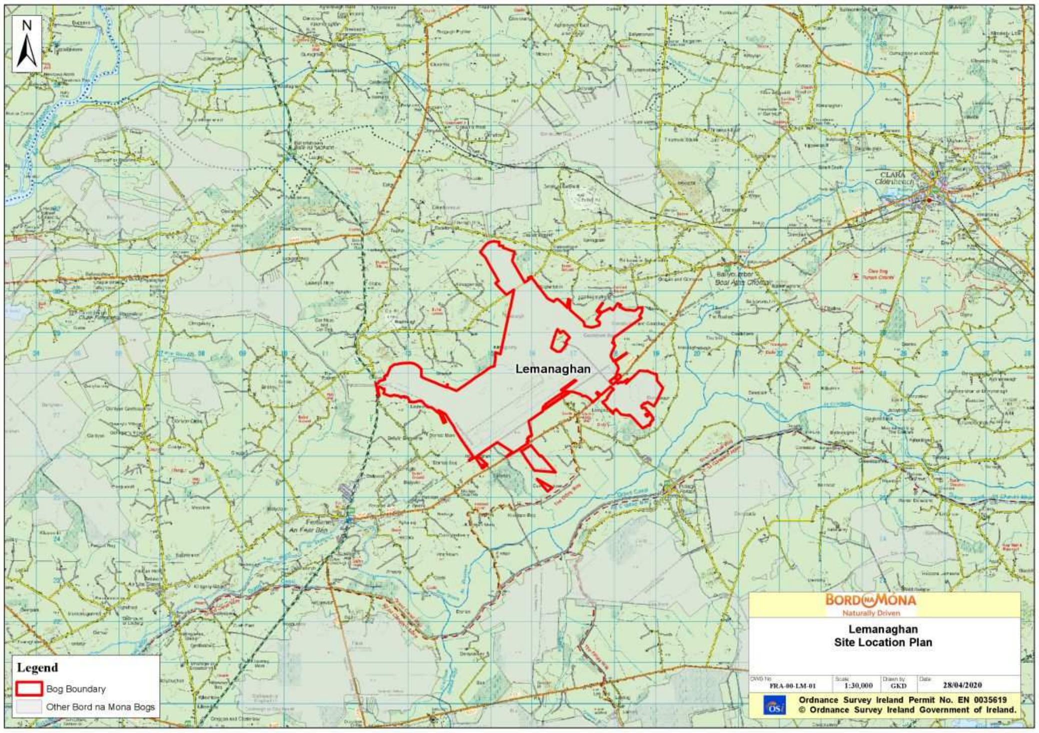


Figure 2.3.1 Lemanaghan Bog Site Location

2.3.3 **Bog Description**

Lemanaghan is a large bog with the main section of the bog located to the north of the R436 Ferbane to Ballycumber road. A smaller area of the bog is located to the south of this road and a section of the bog to the north is also separated from the main bog by a county road. Mille peat production has now ceased in both of these areas and the remainder of the production fields are used to supply peat to the Derrinlough Briquette factory. A mineral island consisting of farmland is located close to the centre of the main section of the bog. This bog was drained by Bord na Móna in 1951 with peat production commencing in 1955.

There is a works area in the central area of the bog and this includes welfare facilities, hard standing area and a number of containers used for storage. A workshop is also located in the south west corner of the bog. The main access point to the bog is off the public road R436 into the works area. There are 9 surface water discharges from this bog and while much of the flow is by gravity, there are two pumps located within the bog that pump water from low lying areas. Both of these pumps are located upstream of the silt ponds and outfalls. Lemanaghan bog drainage layout is shown in the Figure below.

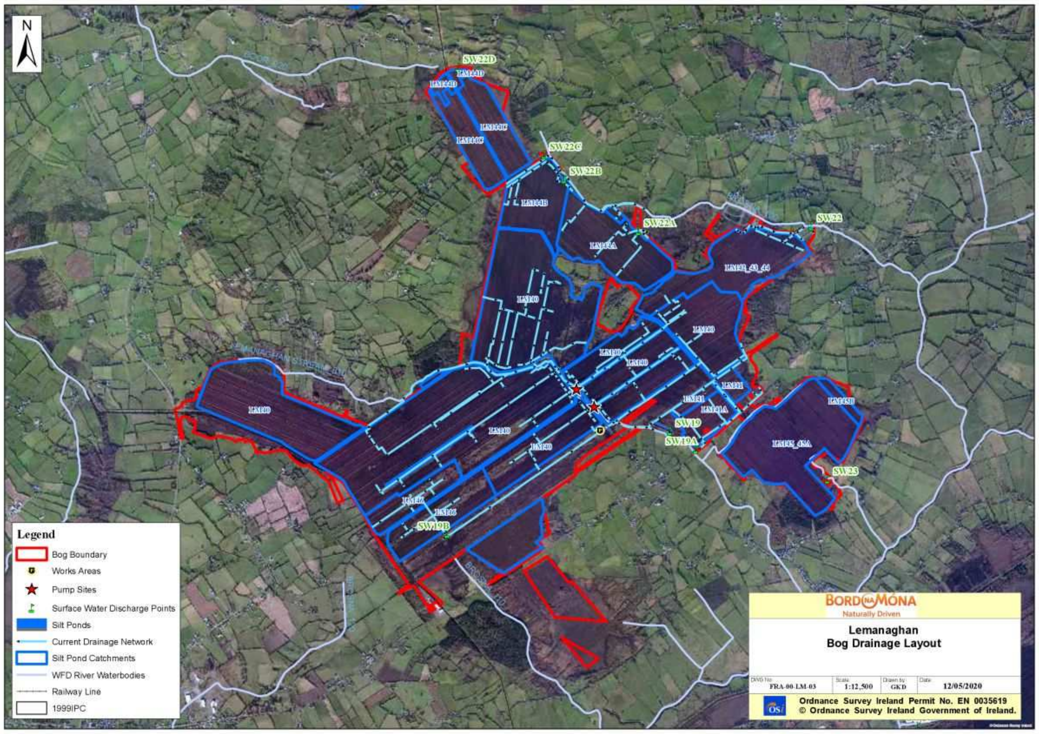


Figure 2.3.2 Lemanaghan Bog Drainage Layout

2.3.4 **Regional Hydrology**

Lemanaghan Bog is within in the Lower Shannon 25A and Upper Shannon 25G catchments (Hydrometric Areas 25 and 26).
The Lower Shannon 25A catchment covers an area of 1,248km² and is characterised by relatively flat topography with extensive areas of bog lands in the low-lying areas. The Lower Shannon (Brosna) catchment comprises 12 sub catchments with 60 river water bodies, four lakes and 18 groundwater.
The Upper Shannon 25G is a small catchment and covers an area of 383km² and is comprised of the catchment area from Athlone to Shannonbridge. The catchment is characterised by flat topography and expanses of bogs and flood prone areas. The Upper Shannon (Mid Shannon) catchment comprises three sub catchments with 13 river water bodies and eight groundwater bodies

There are 9 surface water discharges from this bog and 6 of these discharge into the Lemanaghan Stream_010 and into the sub-catchment Brosna_SC_060. One discharges into the Brosna_100 and one discharges into the Brosna_110 and both into sub-catchment Brosna_SC_060. The remaining surface water discharges into the Boor_020 and into the Shannon Lower_ SC_010.

There are 8 gravity flow surface water outflows and, associated silt ponds, in Lemanaghan Bog. There is also a central area of the bog drained by pumps P15-03 and P15-04 and this pumped outfall flows through a series of silt ponds before discharging through SW19.

The proximity of the surface water outfall locations to the relevant waterbody is detailed below:

Outfall ref:	Waterbody	Distance from Outfall to Waterbody (m)
SW19	Lemanaghan Stream_010	40
SW19A	Lemanaghan Stream_010	Discharges directly into waterbody
SW19B	Brosna_110	280
SW22	Brosna_100	Discharges directly into waterbody
SW22A	Brosna_100	200
SW22B	Brosna_100	50
SW22C	Brosna_100	100
SW22D	Boor_020	200
SW23	Lemanaghan Stream_010	Discharges directly into waterbody

Table 2.3.1 Lemanaghan Bog distance from Outfalls to Waterbodies

The catchment areas, water courses and District Drainage Schemes are shown in the Figures below.

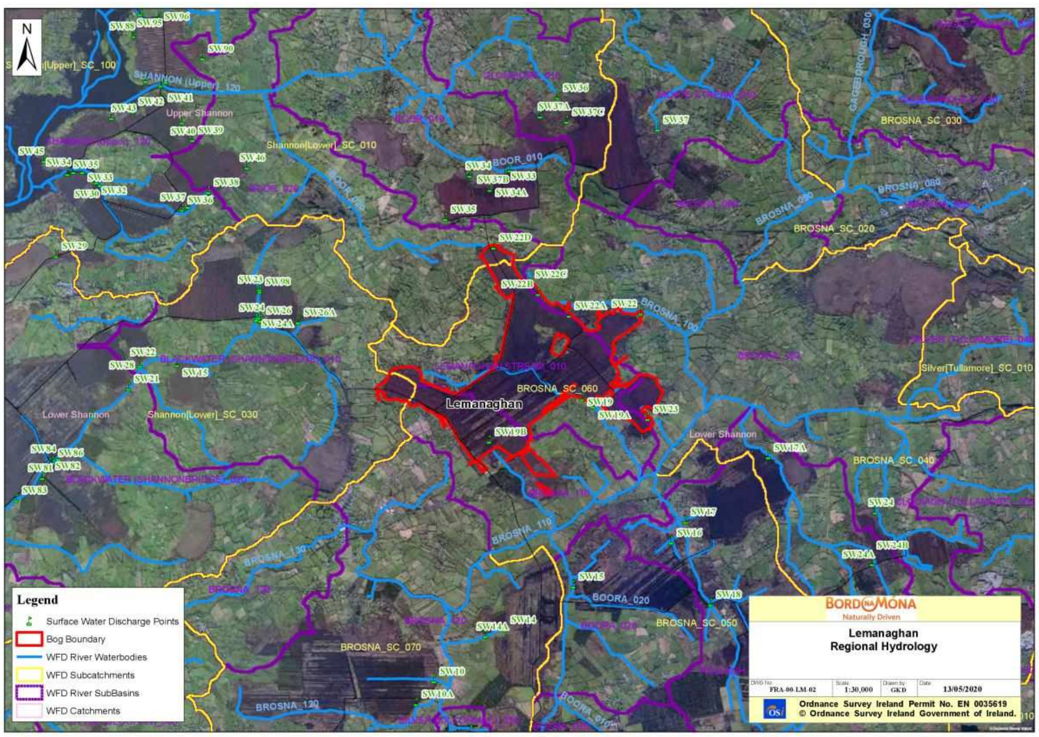


Figure 2.3.3 Lemanaghan Bog Regional Hydrology

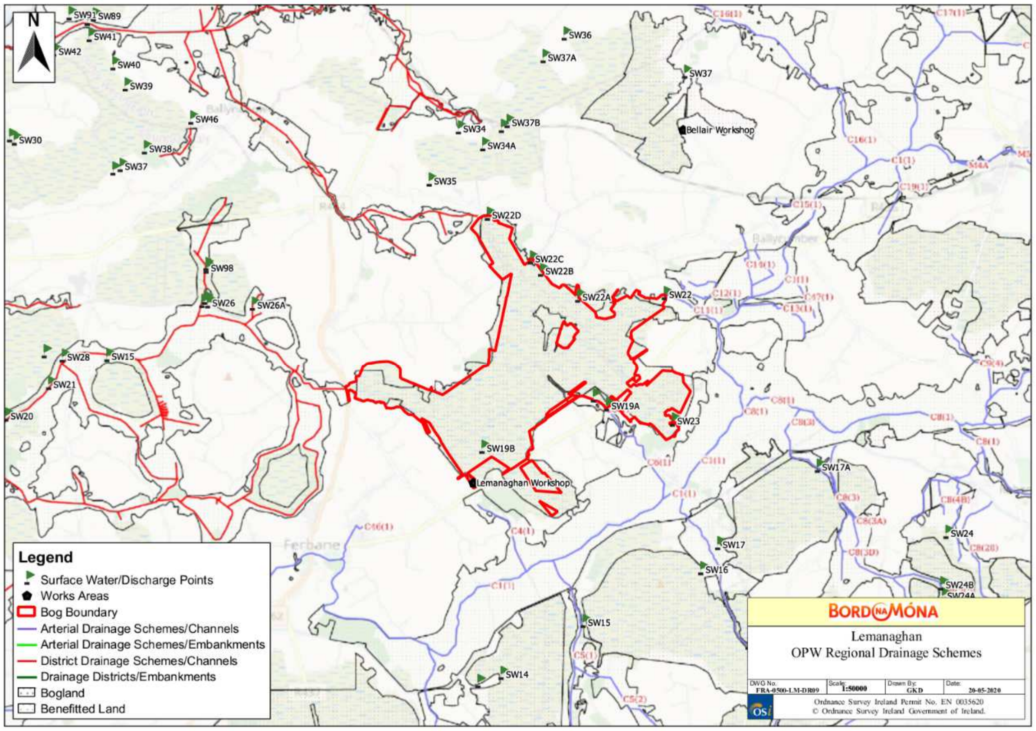


Figure 2.3.4 Lemanaghan Bog District Drainage Schemes

The benefitted land from the District Drainage Schemes is also highlighted demonstrating that there are limited benefitting lands associated with this scheme in the area of these bogs.

There are two groundwater aquifers underlying Lemanaghan Bog. The aquifer underlying much of the bog is categorised as *Ll – Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones.* The aquifer underlying the section in the middle of the bog is categorised as *Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive.* This is discussed further in section 2.3.6.

The Standard Annual Average Rainfall (SAAR) in this location is 897mm.

2.3.5 **Historical Flooding**

The OPW https://www.floodinfo.ie website provides some limited information on flood records throughout the country. A map of historical flooding contained for the area, in the vicinity, of Lemanaghan Bog is shown in the Figure below.

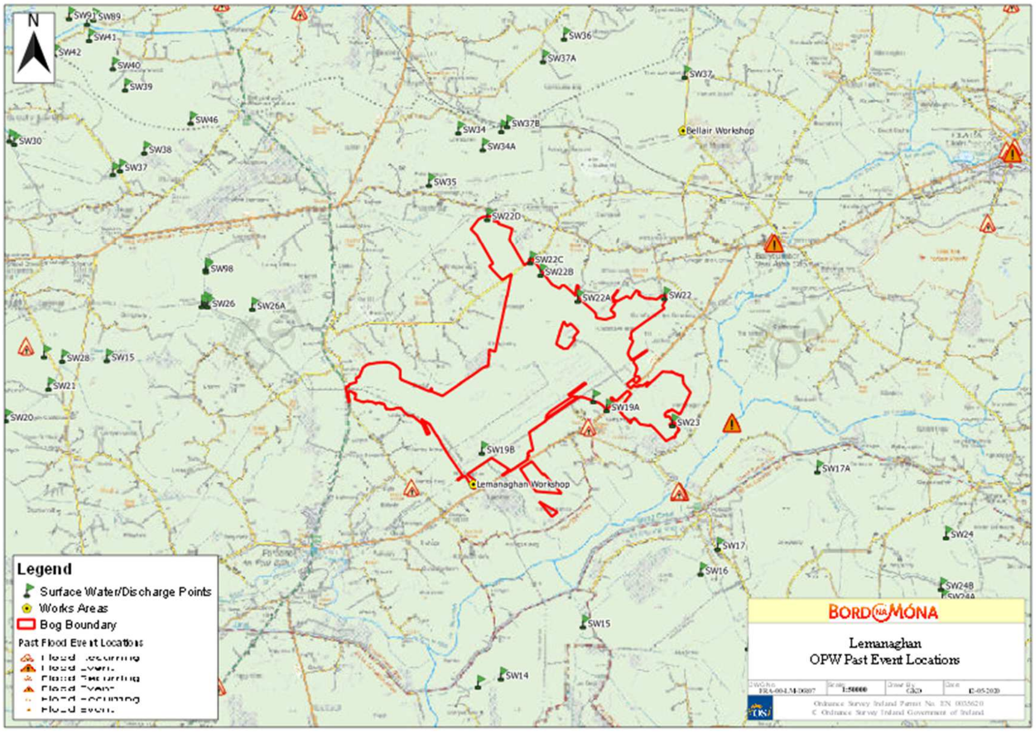


Figure 2.3.5 Lemanaghan Bog Historical Flooding

The OPW Past Flood Events show no records of any flooding events encroaching into Lemanaghan Bog. The flooding events to the south of Lemanaghan bog are identified in the *Offaly County Council - Oral Report -Area Engineer- Ferbane, dated 01/11/2005.* In these minutes the flooding around Lemanaghan is described as follows:

'*F11. Lemanaghan- Low lying flat land floods after heavy rain every year. Road is liable to flood.*'

Figure 2.3.6 Lemanaghan Bog November 2009Flood Event

Information from Bord na Móna operatives familiar with Lemanaghan Bog confirmed that surface water flooding has, on occasion, occurred in the production area where blockages to the existing drainage network have occurred over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production fields on an annual basis as part of the winter works schedule.

In addition, aerial imagery from a November 2009 flood event shows flooding in the central low lying area of Lemanaghan Bog. This flooding is in the vicinity of the two pumps and may be pluvial flooding that exceeded the capacity of the two pumps or outfalls backing up due to fluvial flooding.

2.3.6 **Groundwater Flood Risk**

There are two groundwater aquifers underlying Lemanaghan Bog. The aquifer underlying much of the bog is categorised as *Ll – Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones.* The aquifer underlying the section in the middle of the bog is categorised as *Lm - Locally Important Aquifer - Bedrock which is Generally Moderately Productive.* Both aquifers have a low vulnerability.

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below.

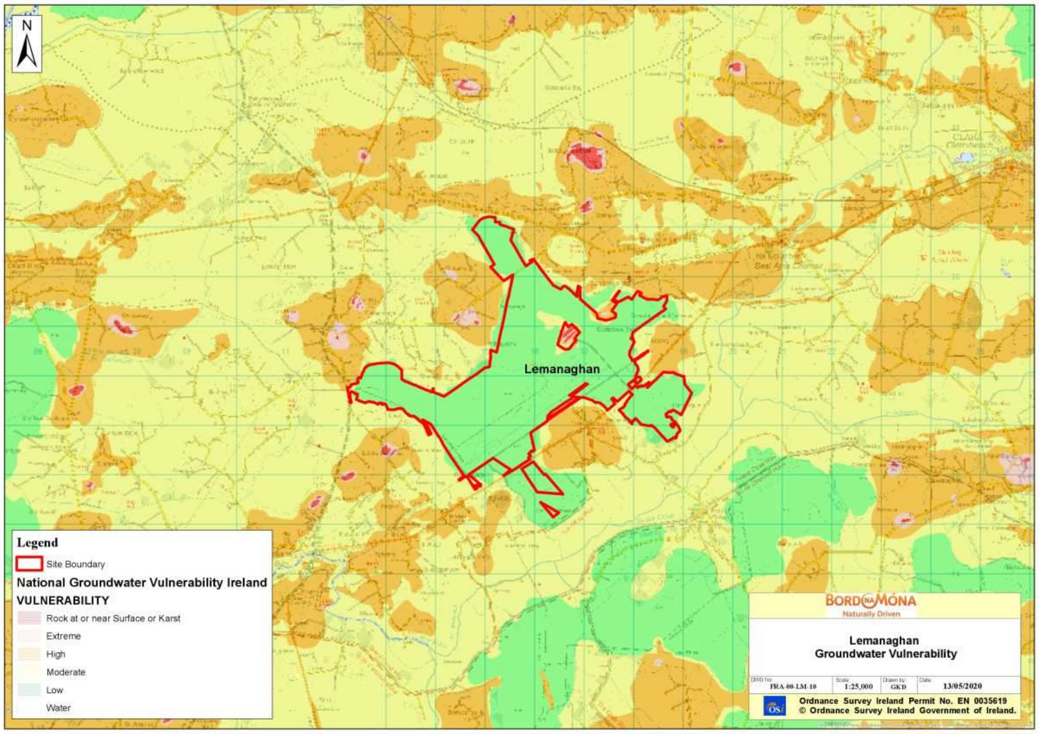


Figure 2.3.7 Lemanaghan Bog Groundwater vulnerability

The GSI https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx website provides information on groundwater throughout the country. The wells shown along the southern boundary of Lemanaghan Bog are recorded as having been dug in the 1960's and, the well to the north, in 1899. According to the GSI website the accuracy for these locations is 1Km and Information from Bord na Móna operatives familiar with Lemanaghan Bog confirmed that these wells are not located within the bog boundary.

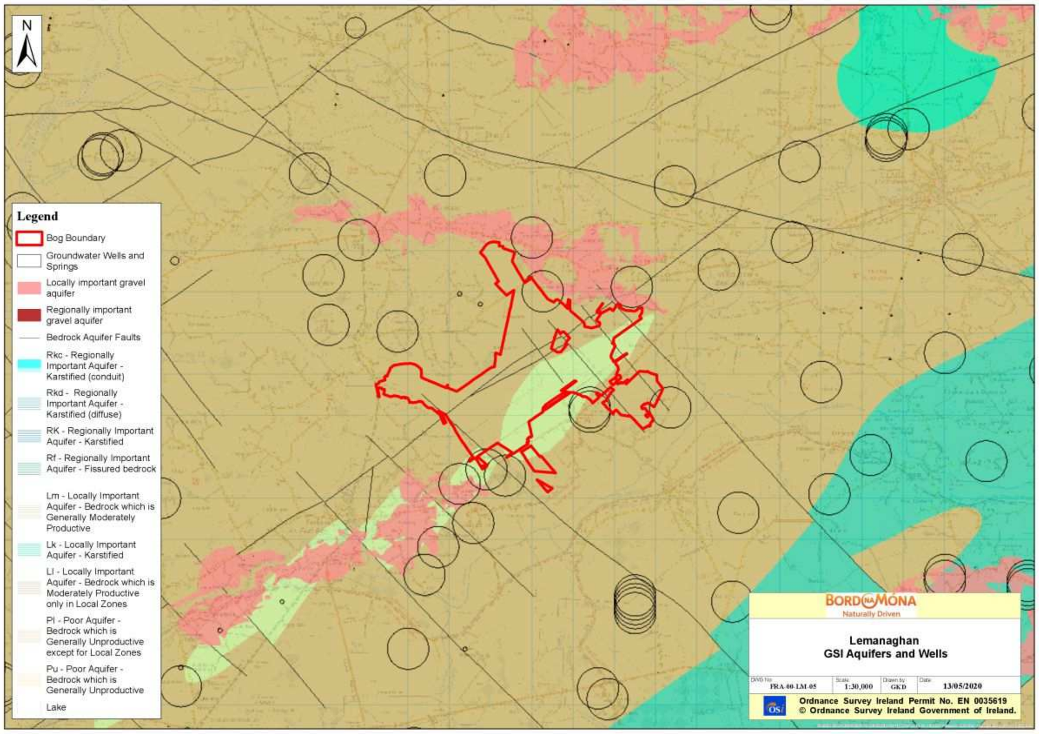


Figure 2.3.8 Lemanaghan Bog Aquifers, Karst Features, Wells

Information from Bord na Móna operatives familiar with Lemanaghan Bog confirmed that groundwater seepage has not been identified as a source of flooding within the bog

2.3.7 Fluvial Flood Risk

The rivers and streams in the vicinity of Lemanaghan Bog are described in terms of regional hydrology in section 2.3.4.

The 9 surface water outfalls in Lemanaghan Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameters of these outfalls are shown in the Table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW19	0.450
SW19A	0.450
SW19B	0.450
SW22	0.450
SW22A	0.450
SW22B	0.450
SW22C	0.450
SW22D	
SW23	0.600

Table 2.3.2 Lemanaghan Bog Surface Water Outfalls

Information from Bord na Móna operatives familiar with Lemanaghan Bog confirmed that outfalls will become submerged when the water levels of the watercourses into which they are discharging are high. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Lemanaghan Bog. River Flood Events High Range mapping has been examined in the region of this bog. Mapping was carried out for the Brosna river. This flooding is not predicted to encroach into Lemanaghan bog with the High Probability event predicted to be in excess of 100m from the southern boundary of the bog. There is no mapping available for the other rivers in the vicinity of the bog.

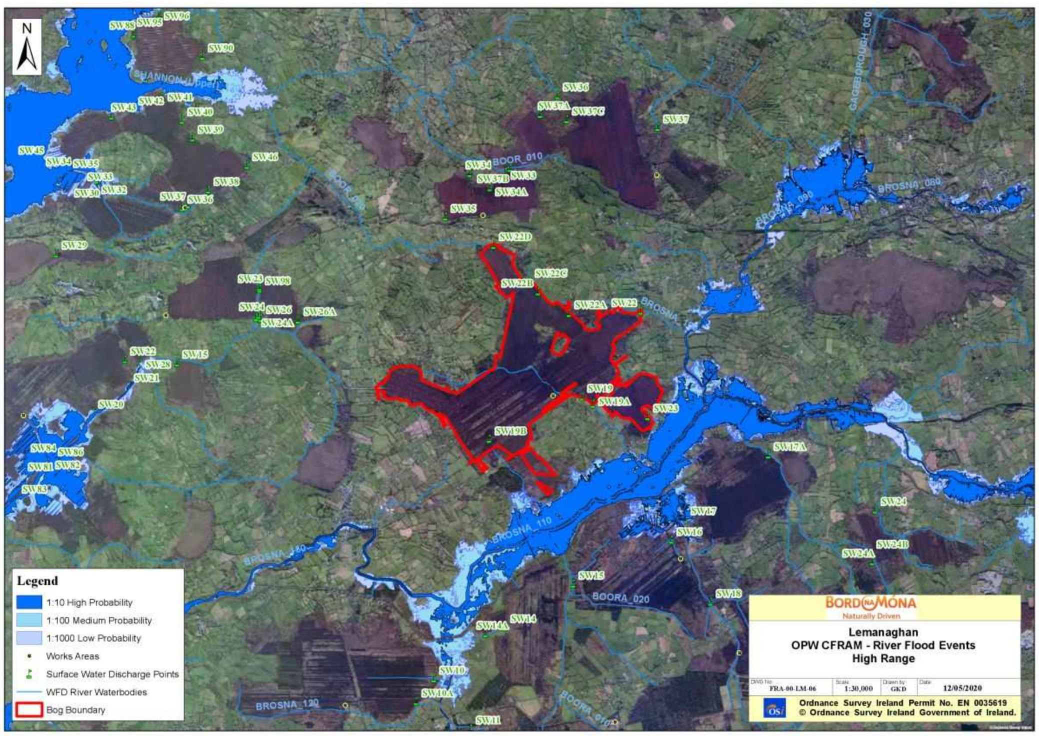


Figure 2.3.9 Lemanaghan Bog River Flood Events High Range

2.3.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event

- 1 in 100yr rainfall event (+30% climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below.

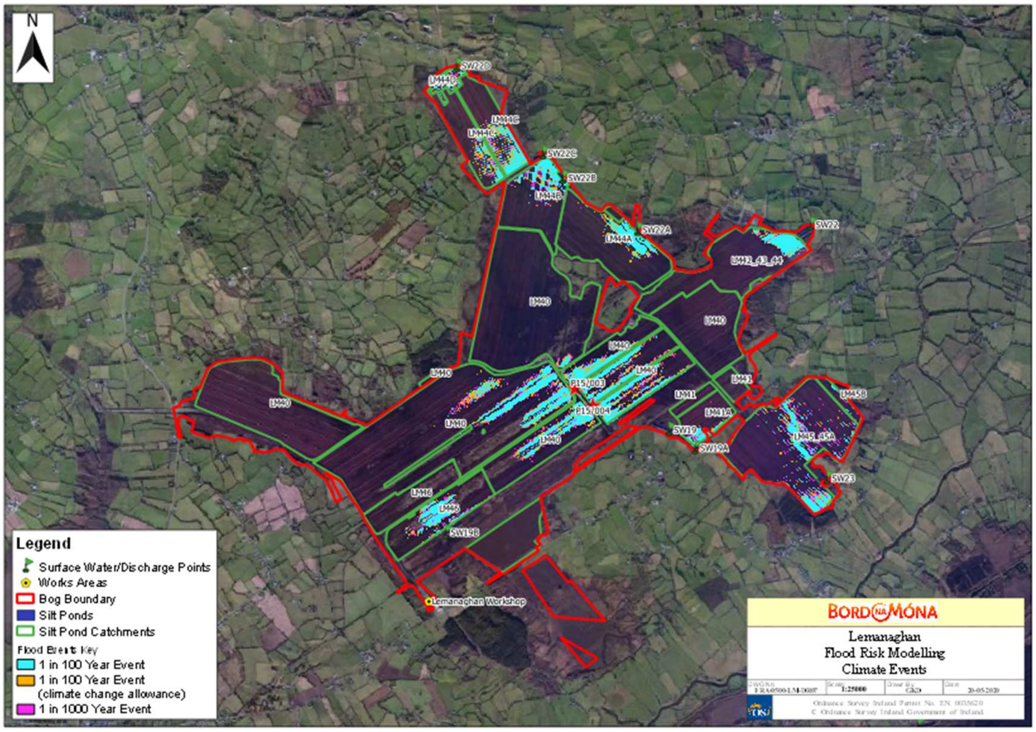


Figure 2.3.10 Lemanaghan Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the Surface water discharge points in the bog. Lemanaghan Bog is modelled for 8 separate basins, LM44A, LM44B, LM44C, LM44D, LM40, LM41 & 41A, LM45_45B and LM46. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

The model shows that flood waters are collecting in local areas in the northern, western and central parts of the bog. The most extensive flooding is shown in the central section, where rainfall generated over this basin is drained. The maximum flood level in this area for the 1000year event is 48.48mOD. The maximum flood levels increase in the northern area of the bog. The level in the extreme north of the bog for the 1000year event is 56.85mOD, however due to the topography of the bog, this flood level will be retained in this area.

The modelled flood area in the central area of the bog is similar to the flooding that was visible from the aerial imagery of the 2009 flood event.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, it is assumed in the model that the discharges from the flood area to the silt ponds are limited to green field run- off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The existing ground level of the works area located centrally in the bog is above 49.55m OD and the finished floor levels of the buildings in this area are around 49.75mOD. The elevation of these buildings is higher than the modelled flood waters in the vicinity of the works area.

From this model the Lemanaghan Bog works area which includes welfare facilities and storage containers is not as risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	**LM44A**	**LM44B**	**LM44C**	**LM44D**	**LM40**	**LM41 and41A**	**LM45A_45B**	**LM46**
mOD	**m^3**	**m^3**	**m^3**	**m^3**	**m^3**	**m^3**	**m^3**	**m^3**
48.00	0	0	0	0	258091	2328	1923	41
48.25	0	0	0	0	372075	5419	3987	166
48.50	0	0	0	0	519328	9670	7789	1050
48.75	0	0	0	0		15443	14130	4371
49.00	0	0	0	0		22753	24470	11461
49.25	0	0	0	0		31876	41399	23171
49.50	1	0	0	0			69583	40033
49.75	4	0	0	0			117295	63467
50.00	22	0	0	0				94599
50.25	103	0	0	0				
50.50	299	0	0	0				
50.75	730	0	0	0				
51.00	1699	0	0	0				
51.25	3796	0	0	0				
51.50	7800	31	0	0				
51.75	14870	481	0	0				
52.00	25476	1766	0	0				
52.25	40587	4541	0	0				
52.50	61633	9841	0	0				
52.75		19694	0	0				
53.00		36637	0	0				
53.25			0	0				
53.50			4	0				
53.75			37	0				
54.00			166	0				
54.25			588	0				

54.50			1847	0				
54.75			5024	0				
55.00			12573	0				
55.25			30168	0				
55.50			65244	0				
55.75				3				
56.00				22				
56.25				128				
56.50				734				
56.75				3055				

Table 2.3.3 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Lemanaghan Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

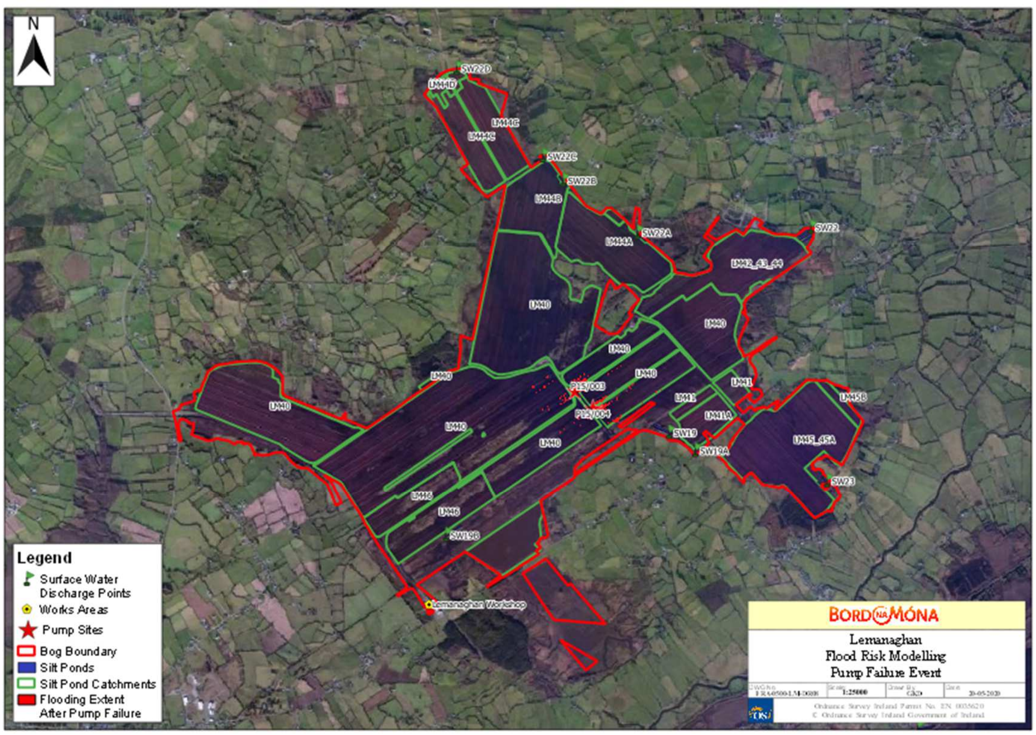


Figure 2.3.11 Lemanaghan Bog Pluvial Flooding, Pump Failure

Lemanaghan Bog has two pumps centrally located in the bog for the pumping of surface water from low lying areas. These pumps have been dis-regarded for the flood modelling of the extreme rainfall events set out above as these pumps are not designed for such events. Pump P15-03 is a 5.5kw pump with an outfall level of 46.78mOD and pump P15-03 is a 7.5kw pump with an outfall level of 46.35mOD

The pump discharges into a drain that flows by gravity into the silt ponds upstream of surface water outfall SW19. In the event that this pump fails, the surface water will pond in low lying areas on the bog to a level where it can discharge by gravity flow. The above figure models the flooding that will occur in the event that this pump is turned off or breaks down. The expected flood water level in this situation is plotted in red. All flooding caused by the failure of this pump will be retained within the bog peat production area.

2.3.9 Climate Change

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 2.3.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100year event plus 30% climate change allowance (High End Emissions Scenario).* In the climate change model the maximum rainfall for the 100year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current greenfield runoff rates. This scenario resulted in less flooding than the 1000year flood event which is addressed in the modelling section above

When considering fluvial flooding in Section 2.3.7, the High-Emissions Future Scenario (HEFS) has been considered which considers the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

2.3.10 Conclusions

The Flood Risk Assessment for Lemanaghan Bog identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** The 2009 aerial imagery are the only historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area does occur on occasion.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the rivers into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the adjoining water courses if their levels ever rise during flood events. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Works Area in Lemanaghan Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in a Flood Zone C.

This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Lemanaghan Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 2.3.4 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

3. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
4. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(v) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(vi) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(vii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design,*

implementation and funding of any future flood risk management measures and provisions for emergency services access; and

(viii) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.

Following on from the completion of this flood risk assessment for Lemanaghan Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the Works Area including the buildings are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Lemanaghan Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

2.4 Kilaranny

2.4.1 Introduction

Kilaranny Bog is part of the Bord na Móna Boora Bog Group operated under an existing Integrated Pollution Control licence (ref P0500-01). This bog is primarily used for milled peat production for supply to the Derrinlough Briquette Factory and the total area within Bord na Móna ownership is 273.4 Hectares.

2.4.2 Site Location

Kilaranny Bog is located approximately 10 kilometres west of Tullamore, Co Offaly and 4 kilometres north of the R357 Blueball to Cloghan Road.
The site is within the Lower Shannon 25A catchment, (Hydrometric Area 25).
The Kilaranny Bog site location is highlighted in red in the Figure below and is 273.4 Hectares.

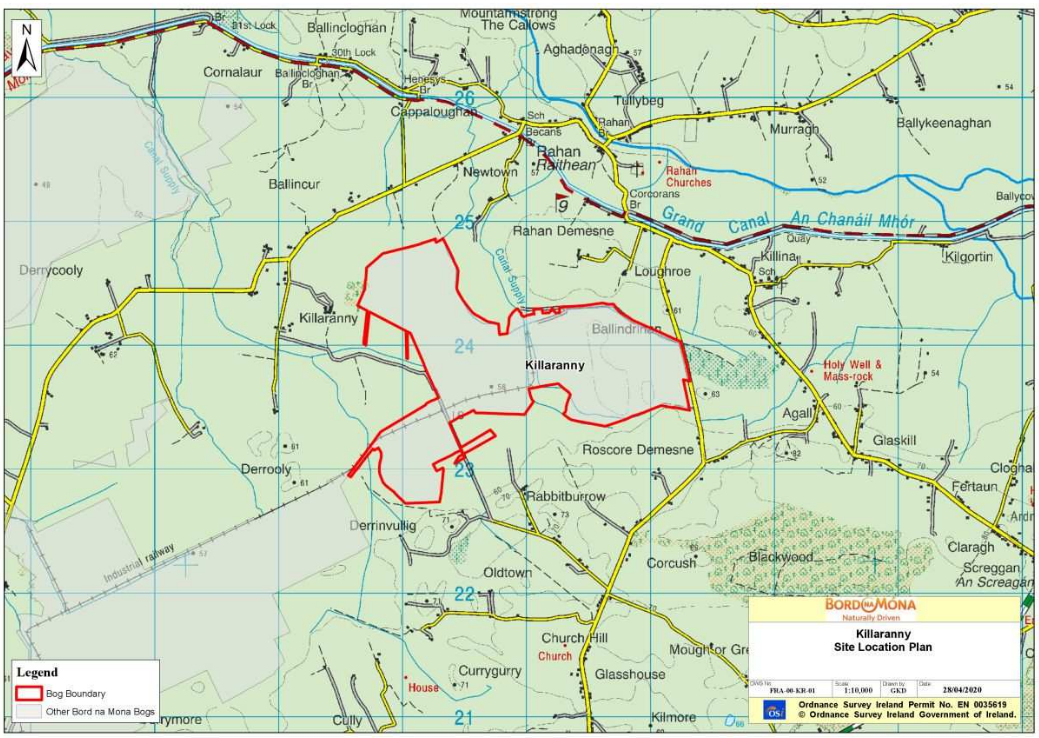


Figure 2.4.1 Kilaranny Bog Site Location

2.4.3 Bog Description

Kilaranny Bog is used for milled peat production for supply to the Derrinlough Briquette Factory. An area in the east of the bog has been provided to the National Parks and Wildlife Services for the re-location of turf-cutters from Clara Bog which was designated as a Special Area of Conservation. There is a small area of raised bog remnant and an area of cutover bog that has become vegetated. This bog was drained by Bord na Móna in 1983 with peat production commencing in 1989.

There is a works area in the west of the bog and this consists of a welfare and office facility and a hardstanding area. The main access point to the bog is off the public road R357 into the works area. There are 3 surface water discharges from this bog all of which are gravity flow. Kilaranny bog drainage layout is shown in the Figure below.

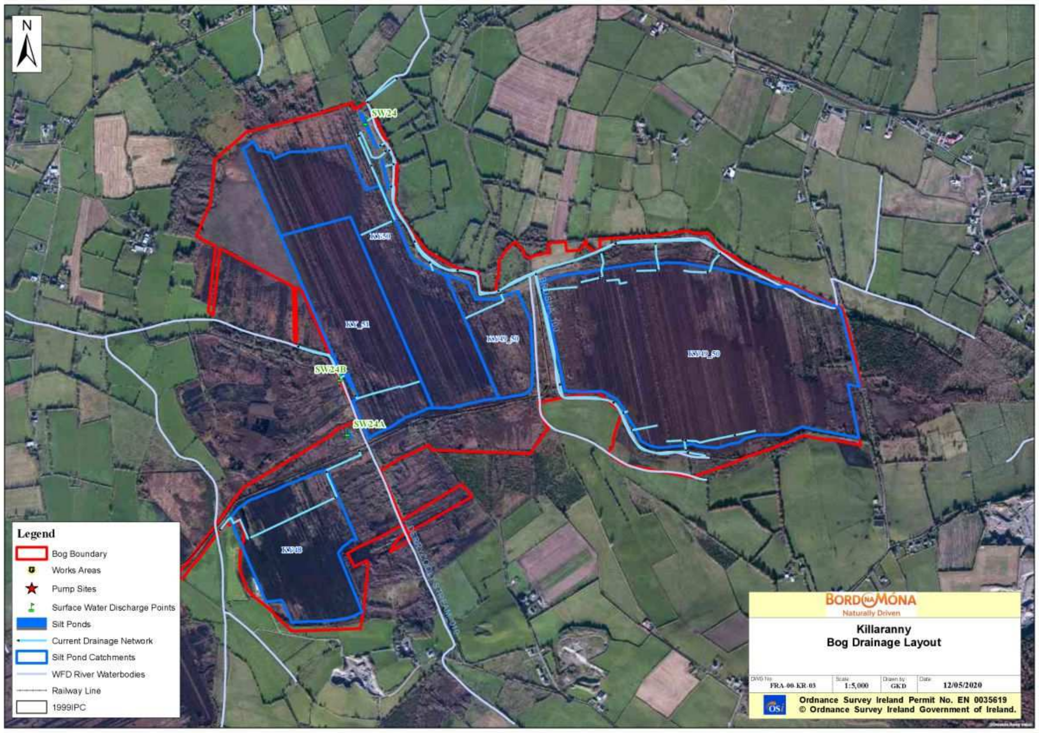


Figure 2.4.2 Kilaranny Bog Drainage Layout

2.4.4 **Regional Hydrology**

Kilaranny Bog is within in the Lower Shannon 25A (Hydrometric Area 25). The Lower Shannon 25A catchment covers an area of 1,248km² and is characterised by relatively flat topography with extensive areas of bog lands in the low-lying areas. The Lower Shannon (Brosna) catchment comprises 12 sub catchments with 60 river water bodies, four lakes and 18 groundwater.

There 3 surface water discharges from Kilaranny bog. The northern outfall SW24 discharges into the Brosna_100 and into the sub-catchment Brosna_SC_040. The two western outfalls SW24a and SW24B discharge into the Derrycooly Stream_010 and into the sub-catchment Brosna_SC_040.

The catchment areas, water courses and District Drainage Schemes are shown in the Figures below.

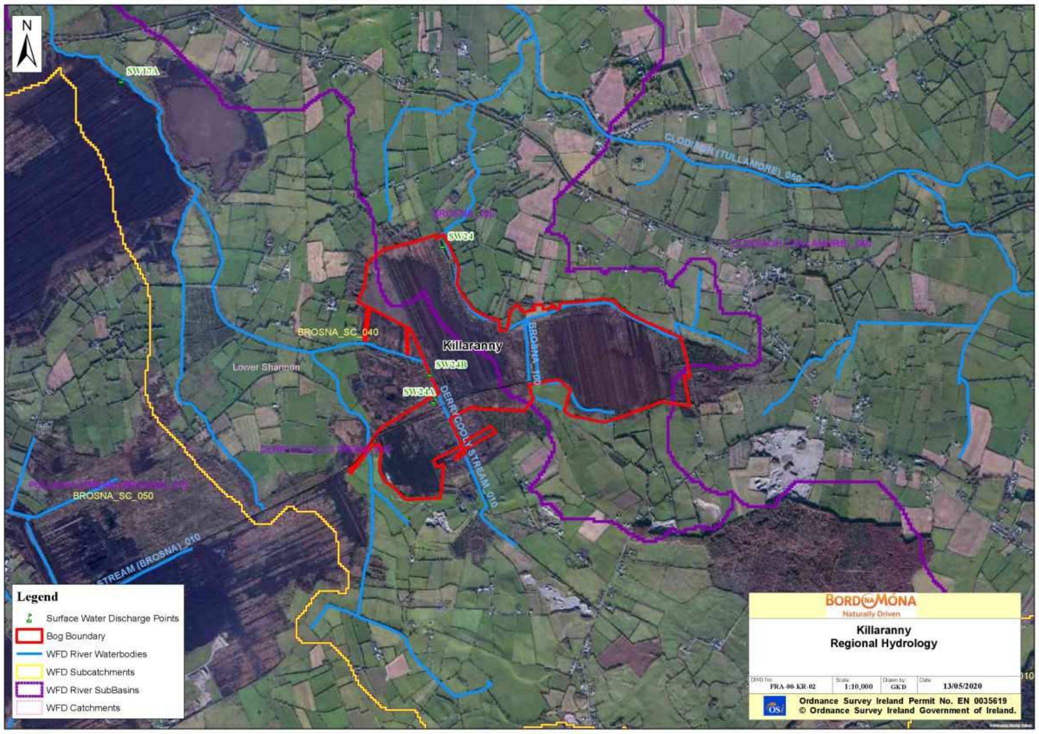


Figure 2.4.3 Kilaranny Bog Regional Hydrology

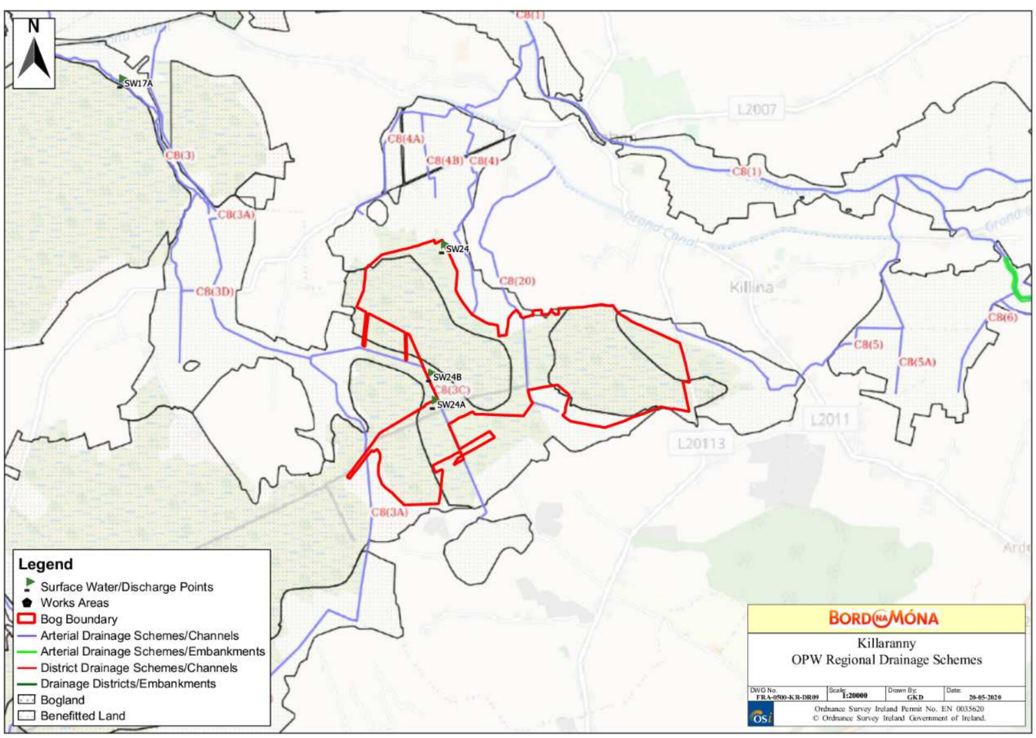


Figure 2.4.4 Kilaranny Bog District Drainage Schemes

The benefitted land from the District Drainage Scheme is also highlighted demonstrating that there are limited benefitting lands associated with this scheme in the area of these bogs.

The aquifer underlying much of the southern section of the bog is categorised as *Ll – Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones.* The aquifer underlying the northern tip of the bog is categorised *as Rkd – Regionally Important Aquifer - Karstified (diffuse).* This is discussed further in section 2.4.6.

The Standard Annual Average Rainfall (SAAR) in this location is 873mm.

2.4.5 **Historical Flooding**

The OPW https://www.floodinfo.ie website provides some limited information on flood records throughout the country. A map of historical flooding contained for the area, in the vicinity, of Kilaranny Bog is shown in the Figure below.

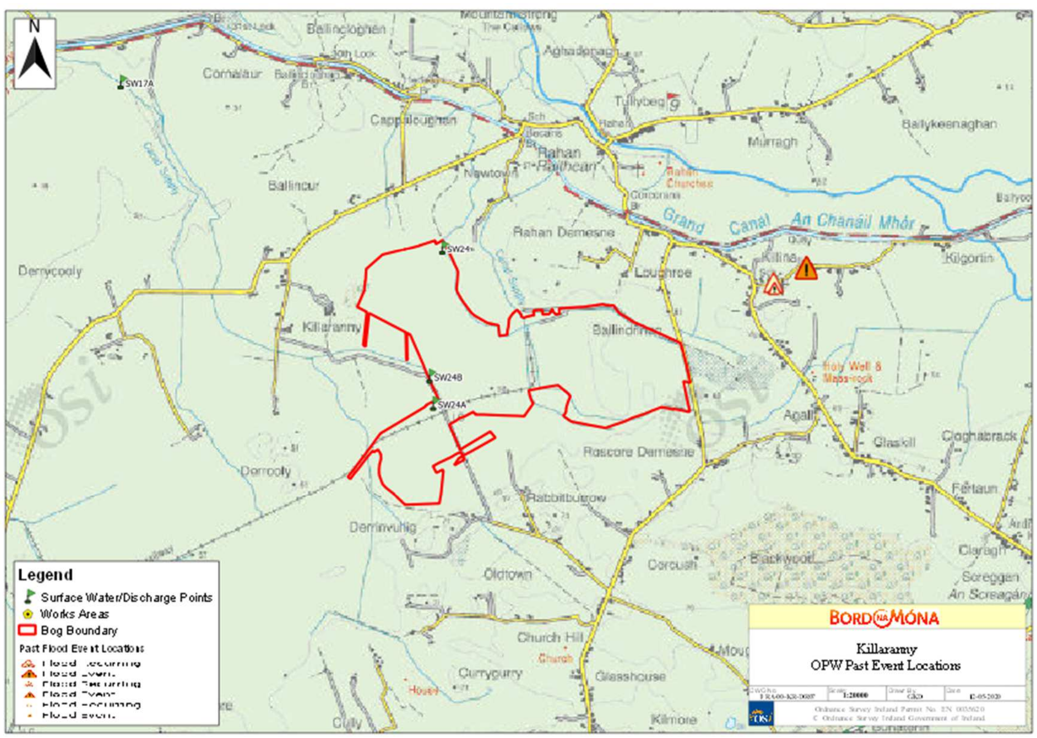


Figure 2.4.5 Kilaranny Bog Historical Flooding

The OPW Past Flood Events show no records of any flooding events encroaching into Kilaranny Bog. The flooding events to the north east of Kilaranny Bog are identified in the *Offaly County Council - Oral Report -Area Engineer- Ferbane, dated 01/11/2005.* In these minutes the flooding in this area is identified as *Killina Recurring* and is described as follows: *'Killina - Low lying land floods after heavy rain every tear. Road is liable to flood. Council have put in a soak pit.'*

There is little anecdotal evidence to suggest any historical flooding of the site. However, information from Bord na Móna operatives familiar with Killaranny Bog confirmed that surface water flooding has, on occasion, occurred over the winter months in the production area and associated with blockages to the existing drainage network. Drainage maintenance works are carried out to minimise flooding to the peat production fields on an annual basis as part of the winter works schedule.

2.4.6 **Groundwater Flood Risk**

There are two groundwater aquifers underlying Kilaranny Bog. The aquifer underlying much of the southern section of the bog is categorised as *Ll – Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones.* The aquifer underlying the northern tip of the bog is categorised *as Rkd – Regionally Important Aquifer - Karstified (diffuse).* Both aquifers have a low vulnerability.

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below.

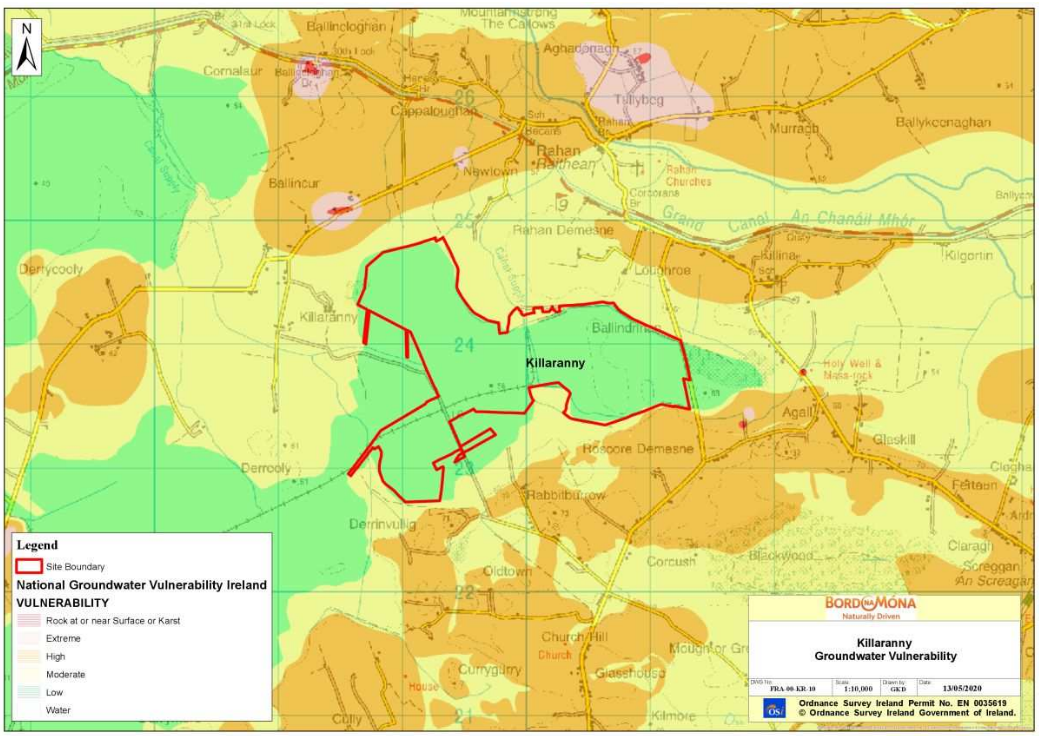


Figure 2.4.6 Killaranny Bog Groundwater vulnerability

The GSI https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx website provides information on groundwater throughout the country. The borehole shown south of Kilaranny Bog is recorded as having been dug in 1962 and the well to the north of the bog is recorded as having been dug in 1899. According to the GSI website the accuracy for these locations is 1Km and information from Bord na Móna operatives familiar with Kilaranny Bog confirmed that these wells are not located within the bog boundary.

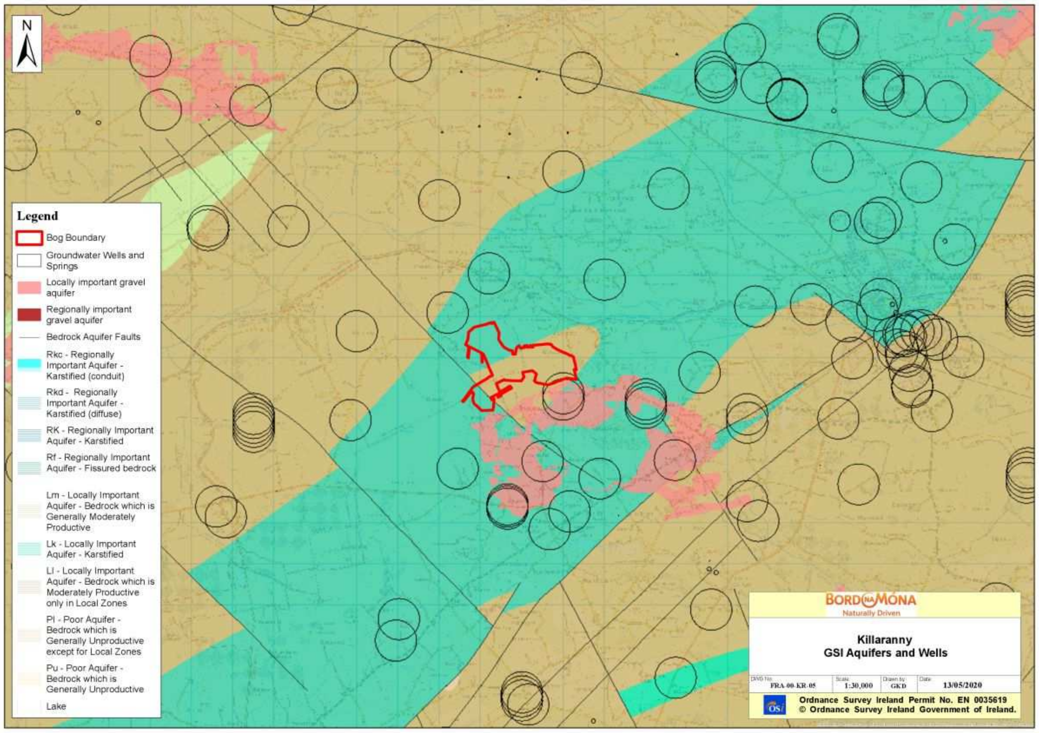


Figure 2.4.7 Kilaranny Bog Aquifers, Karst Features, Wells

Information from Bord na Móna operatives familiar with Kilaranny Bog confirmed that groundwater seepage has not been identified as a source of flooding within the bog.

2.4.7 **Fluvial Flood Risk**

The rivers and streams in the vicinity of Killaranny Bog are described in terms of regional hydrology in section 2.4.4.

The Brosna_100 sub basin is located along the northern boundary of the bog and diverges into two. It is located within 70m of the outfall SW24. The Derrycooly Stream _010 sub basin also diverges into two and is located within 90m of outfall SW24A and 40m of outfall SW24B.

The 3 surface water outfalls in Kilaranny Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameters of these outfalls are shown in the Table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW24	0.450
SW24A	0.450
SW24B	0.450

Table 2.4.1 Kilaranny Bog Surface Water Outfalls

Information from Bord na Móna operatives familiar with Kilaranny Bog confirmed that outfalls will become submerged when the water levels are high. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Kilaranny Bog. River Flood Events High Range mapping has been examined in the region of this bog. Mapping was carried out for the Clodiagh (Tullamore)_050 river. This flooding is not predicted to encroach into Kilaranny bog with the High Probability event predicted to be in excess of 800m from the eastern boundary of the bog. There is no mapping available for the other rivers in the vicinity of the bog.

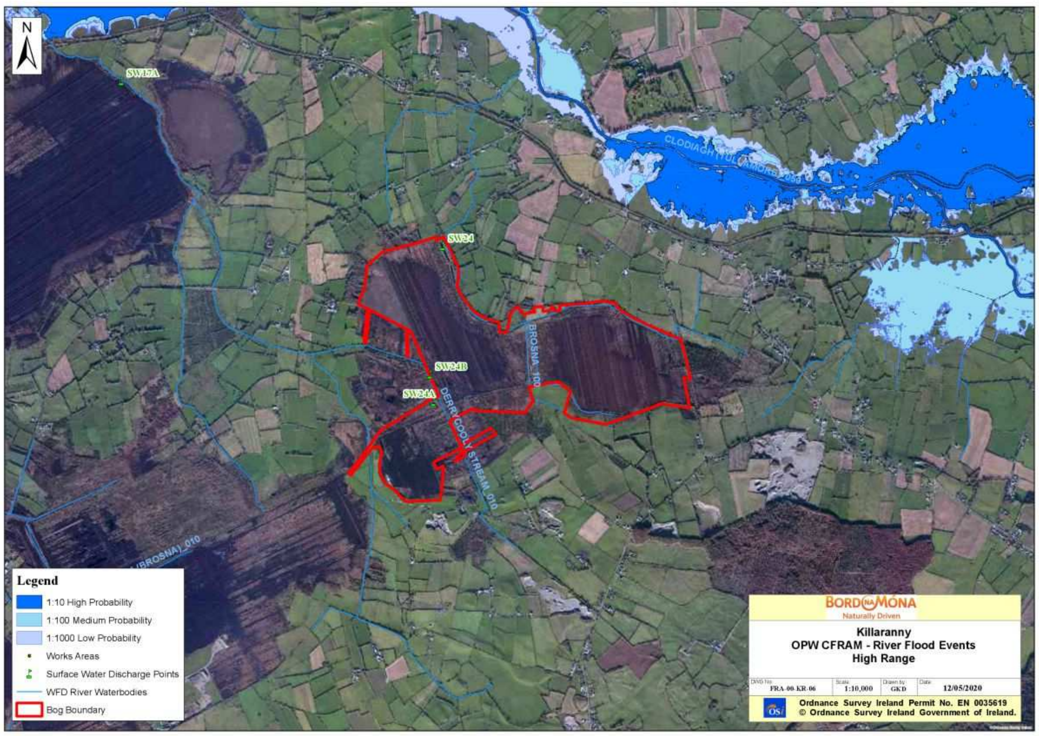


Figure 2.4.8 Kilaranny Bog River Flood Events High Range

2.4.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below.

Figure 2.4.9 Kilaranny Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the Surface water discharge points in the bog. Kilaranny Bog is modelled for three separate basins KY49_50&KY50, KY48 and KY51. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green-field run-off rate through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The model shows that flood waters are collecting in local areas in the north-eastern and south-western parts of the bog. The most extensive flooding is shown in the eastern section, where rainfall generated over this basin is drained. The maximum flood level in this area for the 1000year event is 53.98mOD. The maximum flood level for the 1000year event in the western parts of the bog is in the range of 53.4 to 53.72mOD.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field rate run-off and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate.

The existing ground level of the works area located centrally in the bog is around 55.2mOD and the finished floor levels of the buildings are 55.42mOD. The elevation of these buildings is higher than the modelled flood waters in the vicinity of the works area.

From this model Kilaranny Bog works area which consists of a welfare and office facility and hard standing area is not as risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	**KY_51**	**KY48**	**KY49_50 and KY50**
mOD	**m^3**	**m^3**	**m^3**
51.50	0	0	0
51.75	0	0	171
52.00	2	0	1334
52.25	10	0	4105
52.50	147	0	9470
52.75	1383	0	17374
53.00	5462	82	27693
53.25	12957	2296	40556
53.50	24042	8515	55989
53.75		18716	74422
54.00			97141

Table 2.4.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Kilaranny Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

2.4.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 2.4.8 above, the pluvial flood risk modelling using rainfall data for 1 in 100year event plus 30% climate change allowance (High End Emissions Scenario). In the climate change model run case, the maximum rainfall for the 100year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario

resulted in less flooding than the 1000year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 2.4.7, the High Emissions Scenario (HEFS) has been considered which considers the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

2.4.10 **Conclusions**

The Flood Risk Assessment for Kilaranny Bog identifies the sources of flood risk and their impact. Historical information was also reviewed.

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area does occur on occasion.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the rivers into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the adjoining water courses if their levels ever rise during flood events. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Works Area in Kilaranny Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low Risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Kilaranny Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 2.4.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

5. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
6. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
    - *(ix) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
    - *(x) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
    - *(xi) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
    - *(xii) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Kilaranny Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the Works Area including the buildings and storage containers are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Kilaranny Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

2.5 Noggusboy Bog

2.5.1 Introduction

Noggusboy Bog is part of the Bord na Móna Boora Bog Group operated under an existing Integrated Pollution Control Licence (ref P0500-01). The Bog is used primarily to produce milled peat and the total area within Bord na Móna ownership is 982.5 Hectares.

2.5.2 Site Location

Noggusboy Bog is located in County Offaly approximately 3 km south of Ferbane. The site is within the Lower Shannon 25A catchment, (Hydrometric Area 25).

The Noggusboy Bog site location is highlighted in red in the Figure below and is 982.5 Hectares.

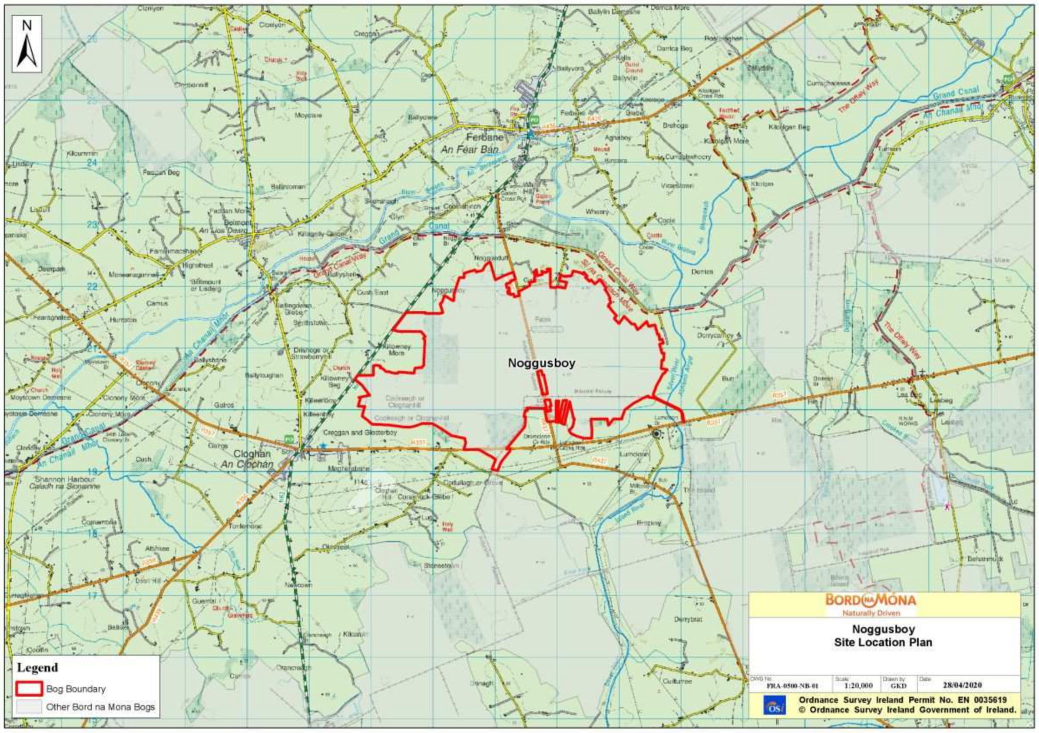


Figure 2.5.1 Noggusboy Bog Site Location

2.5.3 **Bog Description**

Noggusboy Bog is divided in two by the R437 Ferbane to Tullamore and the area to the west of this road is no longer used for milled peat production and is developing as a wetland. A community group based in Cloghan are actively managing parts of the site for recreation purposes including the rearing of ducks and pheasants and development of a fishing lake. Some walking paths have also been developed in the area. Milled peat production is carried out in some of the eastern section of the bog for supply to the Derrinlough Briquette Factory.

This bog was drained by Bord na Móna in 1951 with peat production commencing in 1955.

There is a works area in the west of the bog and this includes welfare facilities, car parking and storage area. The main access point to the bog is off the public road R437 into the works area.

There are 2 surface water discharges from this bog and a Pump site P15-02 which is no longer in operation. The drainage layout for Noggusboy Bog is shown in the Figure below.

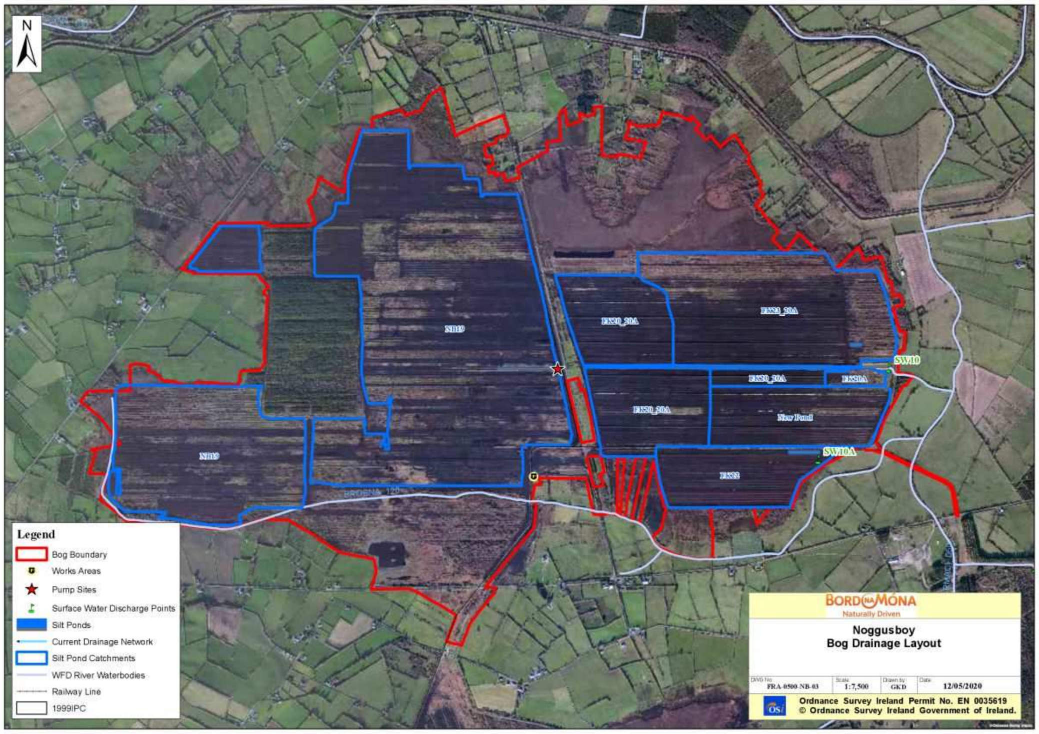


Figure 2.5.2 Noggusboy Bog Drainage Layout

2.5.4 **Regional Hydrology**

Noggusboy Bog is within in the Lower Shannon 25A catchment (Hydrometric Areas 25). This catchment covers an area of 1,248km² and is characterised by relatively flat topography with extensive areas of boglands in the low-lying areas. The Lower Shannon (Brosna) catchment comprises 12 sub-catchments with 60 river water bodies, four lakes and 18 groundwater bodies.

There are 2 surface water discharges from this bog and both are discharging into the Brosna_120 and into the sub catchment Brosna_SC_070.

The catchment areas, water courses and District Drainage Schemes are shown in the Figures below.

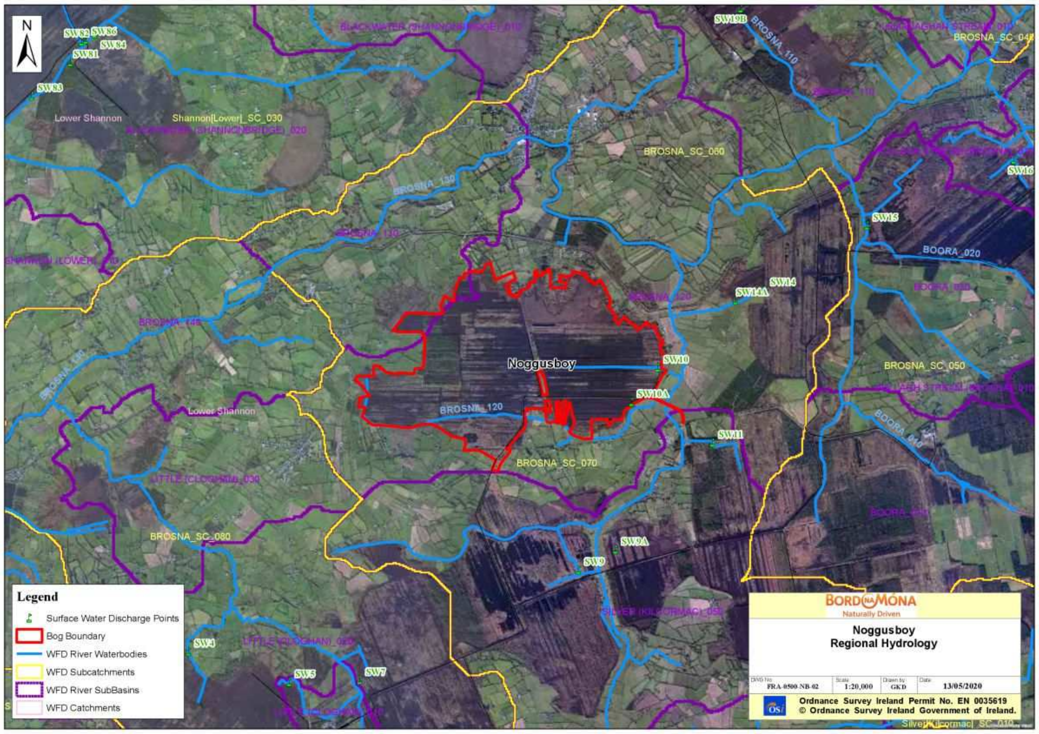


Figure 2.5.3 Noggusboy Bog Regional Hydrology

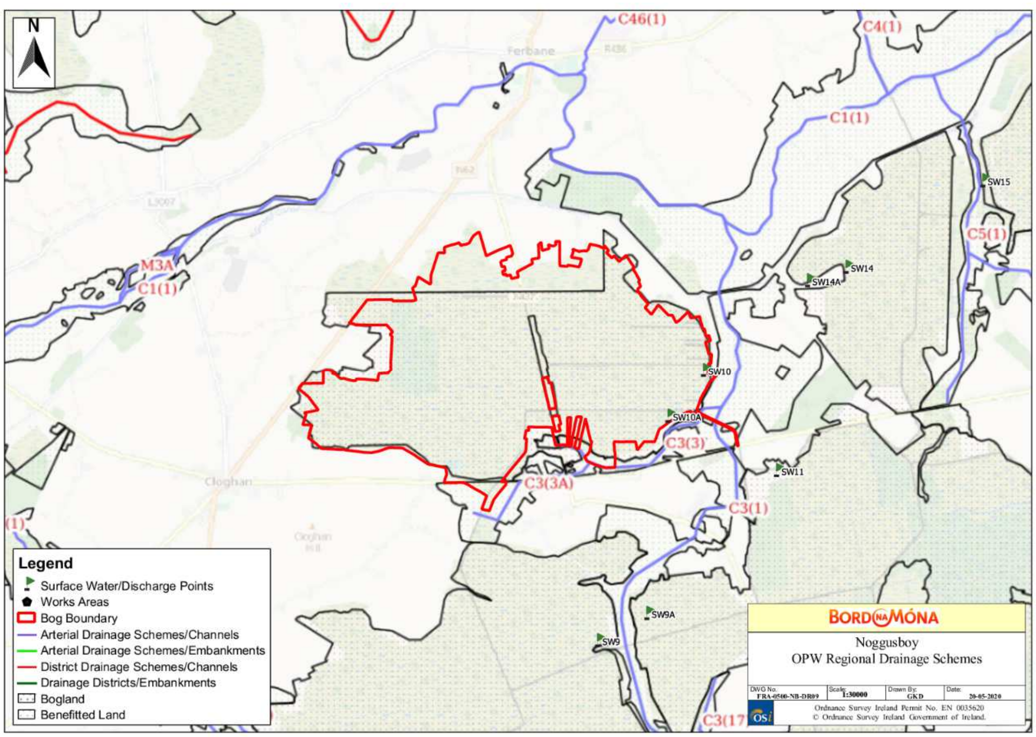


Figure 2.5.4 Noggusboy Bog District Drainage Schemes

The benefitted land from the District Drainage Scheme is also highlighted demonstrating that there are limited benefitting lands associated with this scheme in the area of these bogs.

There is one groundwater aquifer underlying Noggusboy Bog. The aquifer is categorised as *Ll – Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones.* This is discussed further in section 2.5.6.
The Standard Annual Average Rainfall (SAAR) in this location is 896mm

2.5.5 **Historical Flooding**

The OPW https://www.floodinfo.ie website provides some limited information on flood records throughout the country. A map of historical flooding contained for the area, in the vicinity, of Noggusboy Bog is shown in the Figure below.

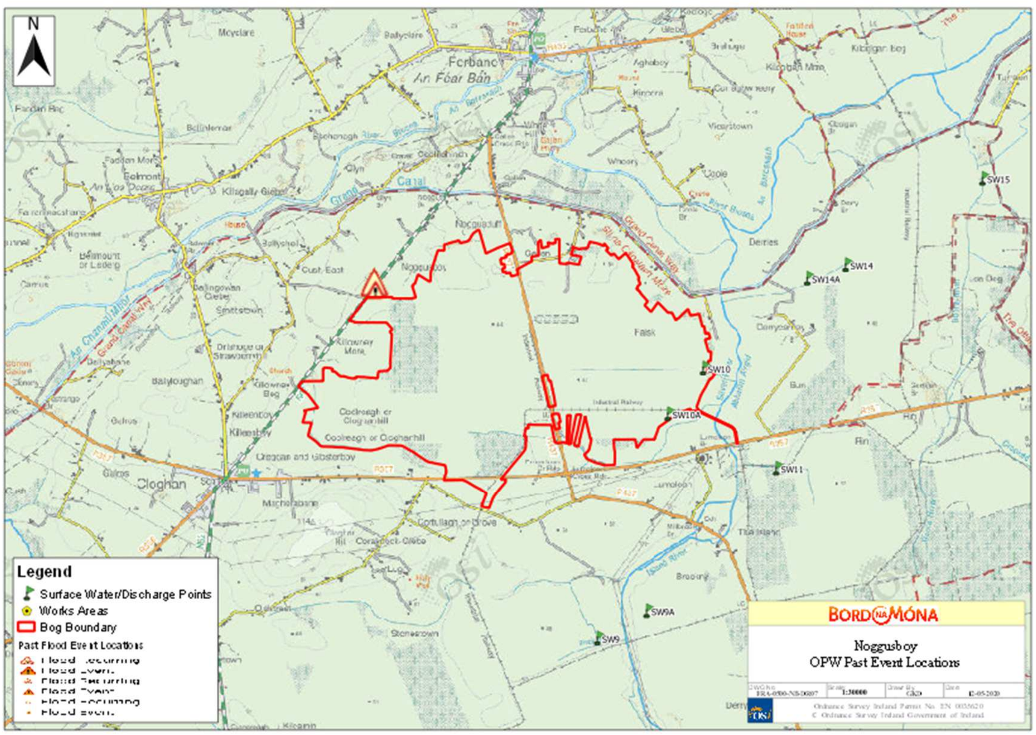


Figure 2.5.5 Noggusboy Bog Historical Flooding

The OPW Past Flood Events show no records of any flooding events encroaching into Noggusboy Bog. The flooding events to the north west of Noggusboy Bog are identified in the *Offaly County Council - Oral Report -Area Engineer- Ferbane, dated 01/11/2005.* In these minutes the flooding around Noggusboy is described as follows:
'F10. Noggus- Low lying flat land floods after heavy rain every year. The water flows from Bog. Road is liable to flood.'

Satellite imagery from the November 2009 flood event shows flooding on the bog to the west of the public road. At this time this area of the bog was in production and the pump would have been in operation to drain this bog area. The imagery from this event also shows some flooding in the north east corner of the eastern area of the bog.

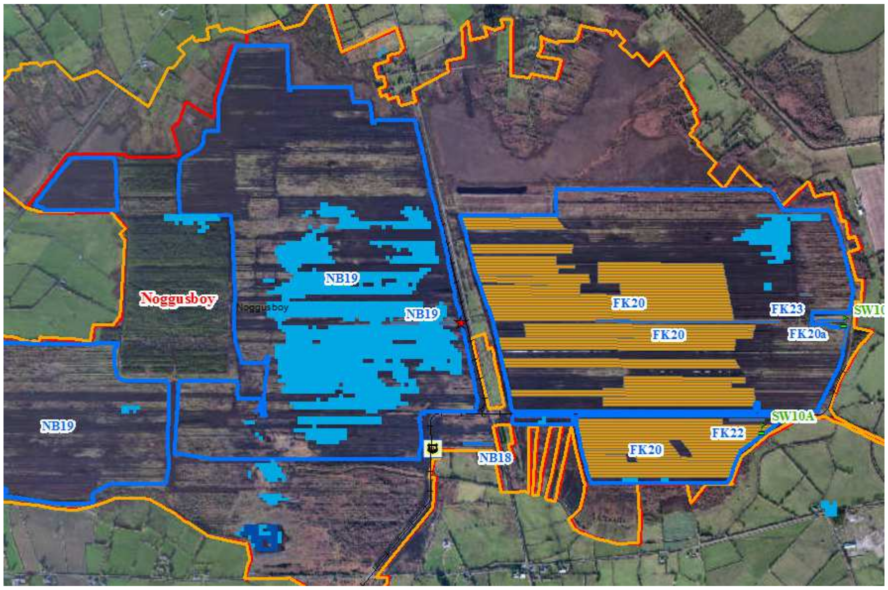


Figure 2.5.6 Nogguusboy Bog 2009 Flood Event – Aerial Imagery

Information from Bord na Móna operatives familiar with Noggusboy Bog confirmed that surface water flooding has, on occasion, occurred in the production area where blockages to the existing drainage network have occurred over winter months or during extreme rainfall events. Drainage maintenance works are carried out to minimise flooding to the peat production.

2.5.6 **Groundwater Flood Risk**

There is one groundwater aquifer underlying Noggusboy Bog. The aquifer is categorised as *Ll – Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones.* This aquifer has moderate to high vulnerability.

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below.

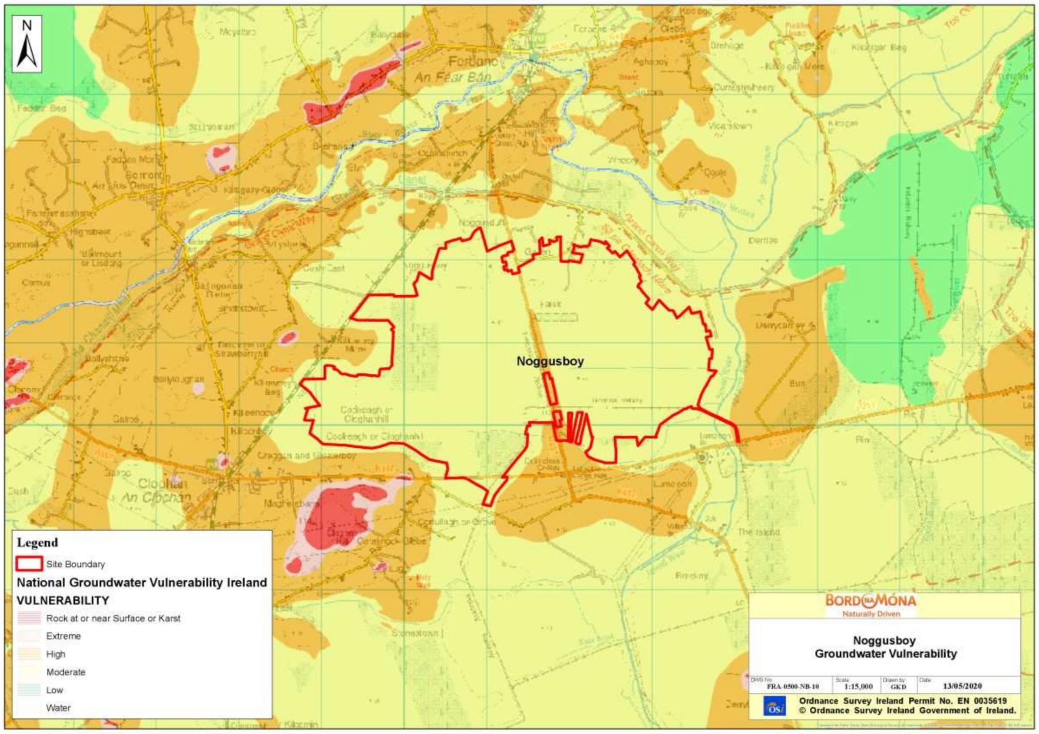


Figure 2.5.7 Noggusboy Bog Groundwater vulnerability

The GSI https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx website provides information on groundwater throughout the country. The well shown to the east of Noggusboy Bog is recorded as having been dug in 1962. According to the GSI website the accuracy for these locations is 1Km and information from Bord na Móna operatives familiar with Noggusboy Bog confirmed that this well is not located within the bog boundary.

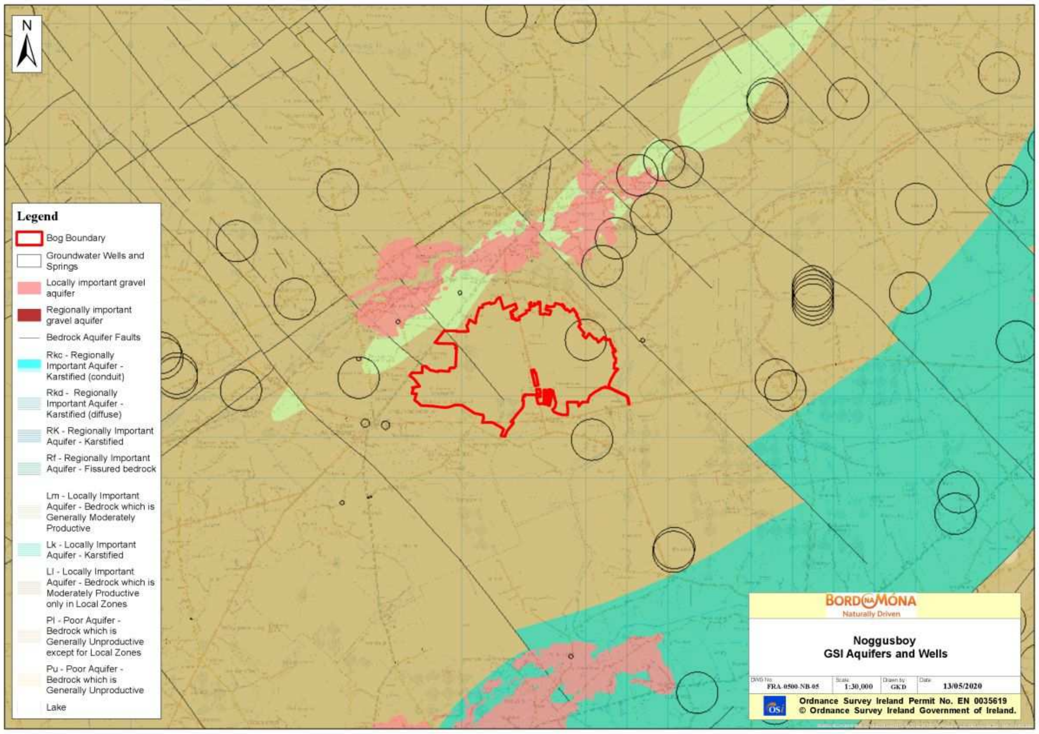


Figure 2.5.8 Noggusboy Bog Aquifers, Karst Features, Wells

Information from Bord na Móna operatives familiar with Noggusboy Bog confirmed that groundwater seepage has not been identified as a source of flooding within the bog. It should be noted, however that since the existing pump has been turned off, areas of the western bog have remained under water. While this may be due to the surface water levels in the area, groundwater may also be contributing to this water level.

2.5.7 **Fluvial Flood Risk**

The rivers and streams in the vicinity of Noggusboy Bog are described in terms of regional hydrology in section 2.5.4.

The 2 surface water outfalls in Noggusboy Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameters of these outfalls are shown in the Table below, however it should also be noted that the inlet pipes into the silt ponds are 450mm diameter.

Surface Water Outfall ref:	Pipe Diameter (m)
SW10	0.600
SW10A	0.600

Table 2.5.1 Noggusboy Bog Surface Water Outfalls

Information from Bord na Móna operatives familiar with Noggusboy Bog confirmed that outfalls will become submerged when the water levels of the rivers into which they are discharging are high. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Noggusboy Bog. River Flood Events High Range mapping has been examined in the region of this bog. Mapping carried out for the Brosna river identifies the potential for flooding along the eastern boundary of the site. While this predicted flooding for the High Emission Future Scenario, (which includes climate change allowance) shows pluvial flooding close to the bog boundary, this flooding is not predicted to encroach into Noggusboy bog. There is no mapping available for the other rivers in the vicinity of the bog.

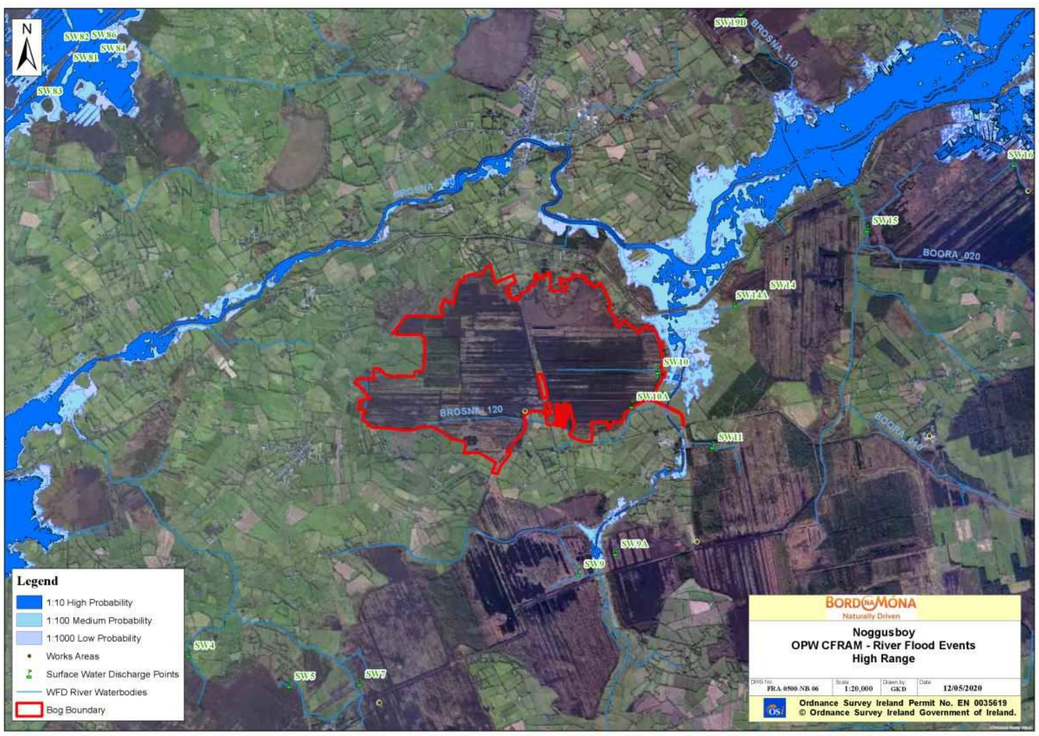


Figure 2.5.9 Noggusboy Bog River Flood Events High Range

2.5.8 Pluvial Flood Risk

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below.

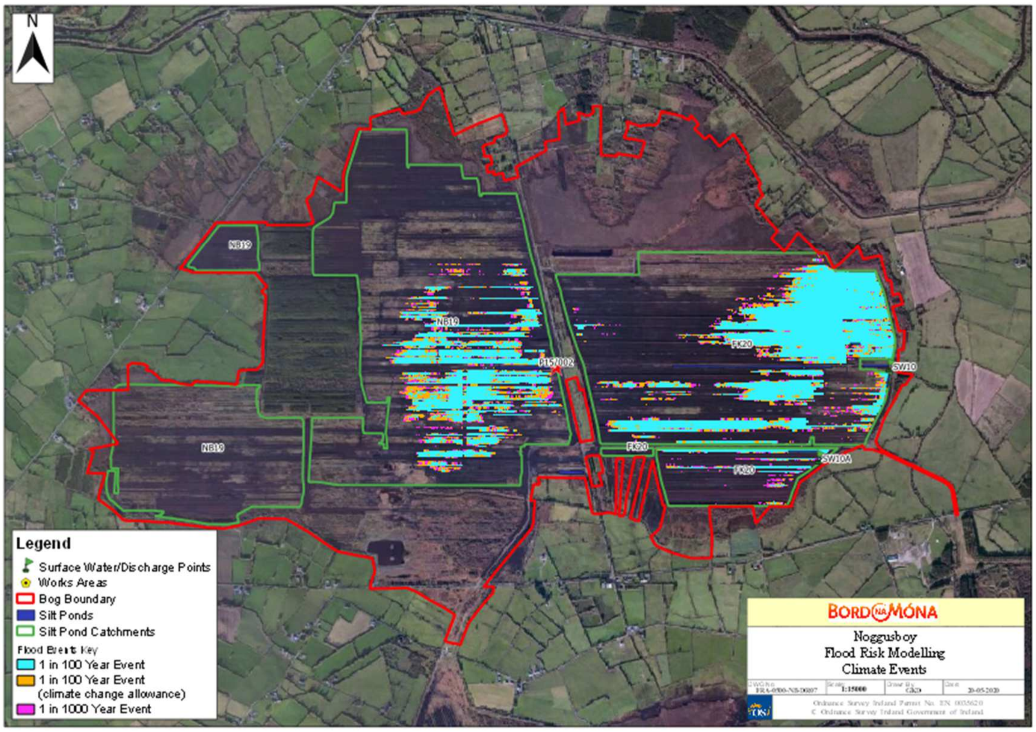


Figure 2.5.10 Noggusboy Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the Surface water discharge points in the bog. Noggusboy Bog is modelled for 2 basins, FK20(South) and NB19 &FK20(North). Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

The model shows that flood waters are collecting in local areas in the central and eastern parts of the bog. The most extensive flooding is shown in the eastern section, where rainfall generated over this basin is drained. The maximum flood level in this area for the 1000year event is 46.24mOD. The maximum flood level for the 1000year event west of the public road is 45.32mOD.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green-field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events

The finished floor levels of the buildings in the Noggusboy Works area are 48.92mOD. The elevation of these buildings is higher than the modelled flood waters in the bog.

From this model Noggusboy Bog works area which includes welfare facilities and storage containers is not as risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	FK20 South	NB19 & FK20 North
mOD	m^3	m^3
45.00	0	193918
45.25	18	396671
45.50	632	706263
45.75	4704	
46.00	13243	
46.25	27077	

Table 2.5.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Noggusboy Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

2.5.9 Climate Change

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 2.5.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100year event plus 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case, the maximum rainfall for the 100year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 2.5.7, the High Emissions Scenario (HEFS) has been considered which considers the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

2.5.10 Conclusions

The Flood Risk Assessment for Noggusboy Bog identifies the sources of flood risk and their impact. Historical information was also reviewed.

- ***Historical Flooding:*** The aerial imagery of the 2009 flood event shows flooding in the western area of the bog and a small area in the eastern section. The western area is now developing as a wetland as the pump is no longer in operation. There are no other historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area does occur on occasion.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the rivers into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the adjoining water courses if their levels ever rise during flood events. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Works Area in Noggusboy Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Noggusboy Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 2.5.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

7. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
8. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
    - *(xiii) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
    - *(xiv) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
    - *(xv) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
    - *(xvi) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Noggusboy Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning

procedures further ensure minimal risk to people, property, the economy and the environment;

- The flood modelling carried out in this assessment shows that the Works Area including the welfare facilities and storage containers are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Noggusboy Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

2.6 Boora Bog

2.6.1 **Introduction**

Boora Bog is part of the Bord na Móna Boora Bog Group operated under an existing Integrated Pollution Control Licence (ref P0500-01). The overall area of Boora Bog within the ownership of Bord na Móna is 1848 Hectares, however the area included in the Substitute Consent application and considered in this report is the western portion of the bog, with an area of 537 hectares. This is the only area where peat production has been carried out since 2012 with the remainder of the bog used for agriculture, forestry and or recreational use. The Bog is used primarily to produce milled peat to supply the Derrinlough Briquette Factory.

2.6.2 **Site Location**

Boora Bog is located in County Offaly approximately 4km north-west of Kilcormac. The site is within the Lower Shannon 25A catchment, (Hydrometric Area 25).

The Boora Bog site location is highlighted in red in the Figure below.

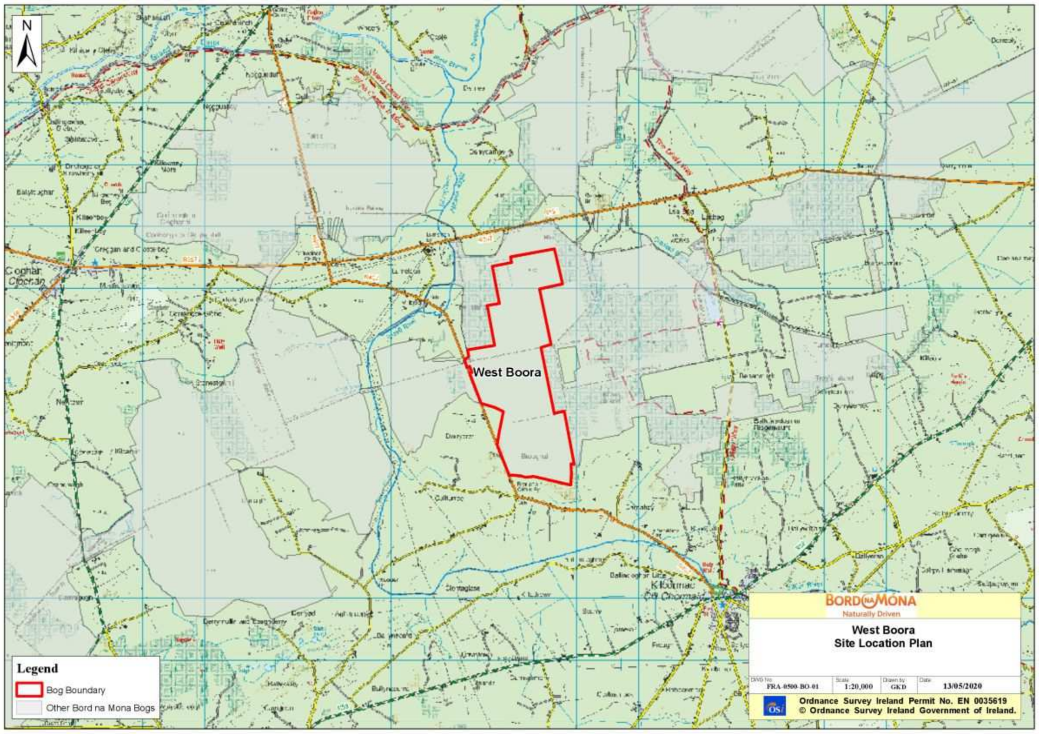


Figure 2.6.1 Boora Bog Site Location

2.6.3 **Bog Description**

Boora bog was one of the earliest to be developed by Bord na Móna and much of the bog has been out of production for many years. Much of the cutaway bog has been rehabilitated as agricultural grassland, conifer plantation and recreational use including the Lough Boora Discovery Park. An area of this bog is managed by the NPWS for the Grey Partridge conservation project. Milled peat production is carried out in the west of Boora Bog for supply to the Derrinlough Briquette Factory. This bog was drained by Bord na Móna in 1954 with peat production commencing in 1959.

There is a works area in the west of the bog and this includes welfare facilities and a storage container. The main access point to the bog is off the public road R437 into the works area. There is 1 gravity flow surface water outflow and an associated silt pond in Boora Bog. There are no pumped outfalls. The bog drainage layout is shown in the Figure below.

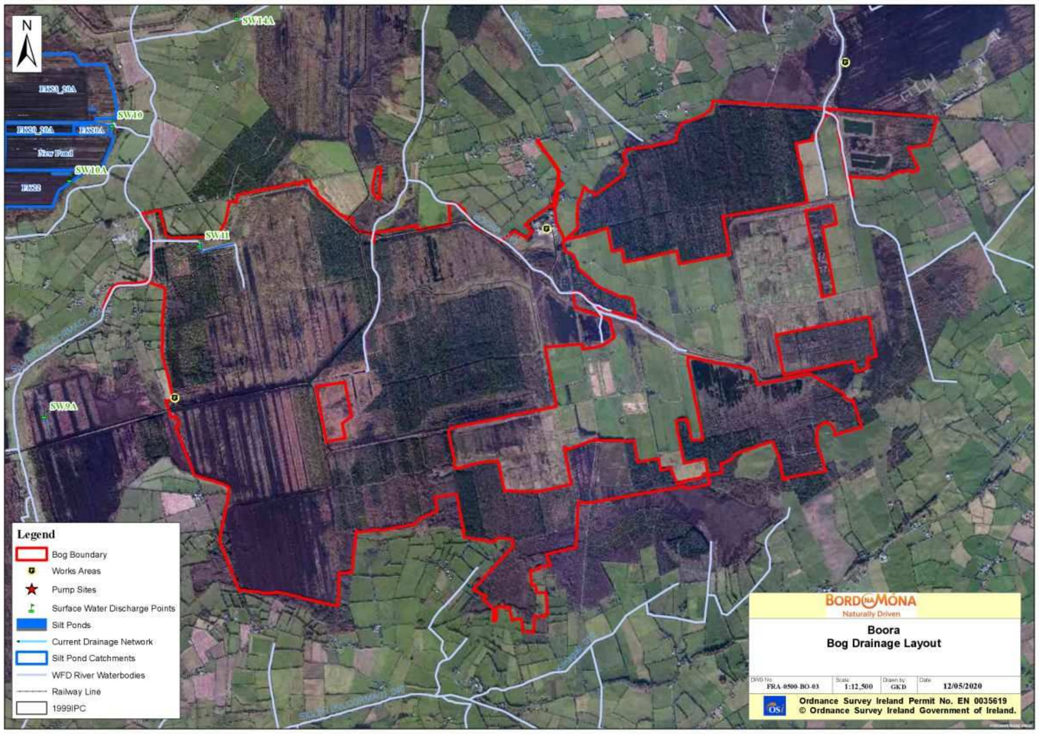


Figure 2.6.2 Boora Bog Drainage Layout

2.6.4 **Regional Hydrology**

Boora Bog is within in the Lower Shannon 25A (Hydrometric Area 25). The Lower Shannon 25A catchment covers an area of 1,248km² and is characterised by relatively flat topography with extensive areas of bog lands in the low-lying areas. The Lower Shannon (Brosna) catchment comprises 12 sub catchments with 60 river water bodies, four lakes and 18 groundwater.

There is 1 surface water discharge from Boora bog into the Silver (Kilcormac)_050 which is in the sub-catchment Brosna_SC_070.
The catchment areas, water courses and District Drainage Schemes are shown in the Figures below.

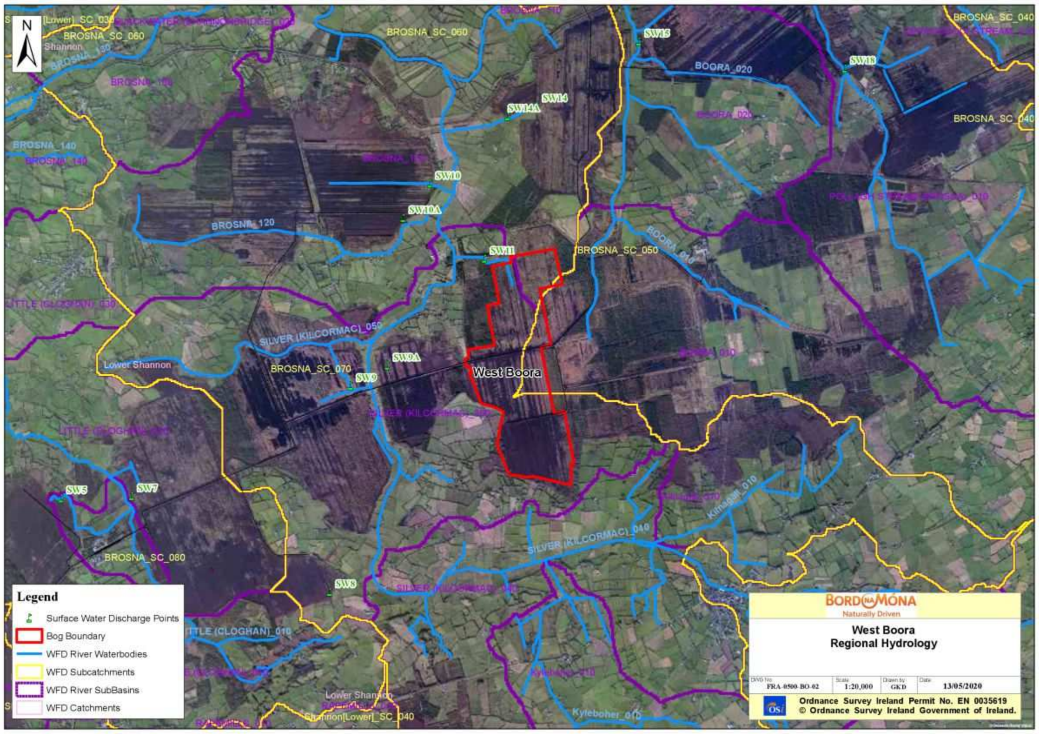


Figure 2.6.3 Boora Bog Regional Hydrology

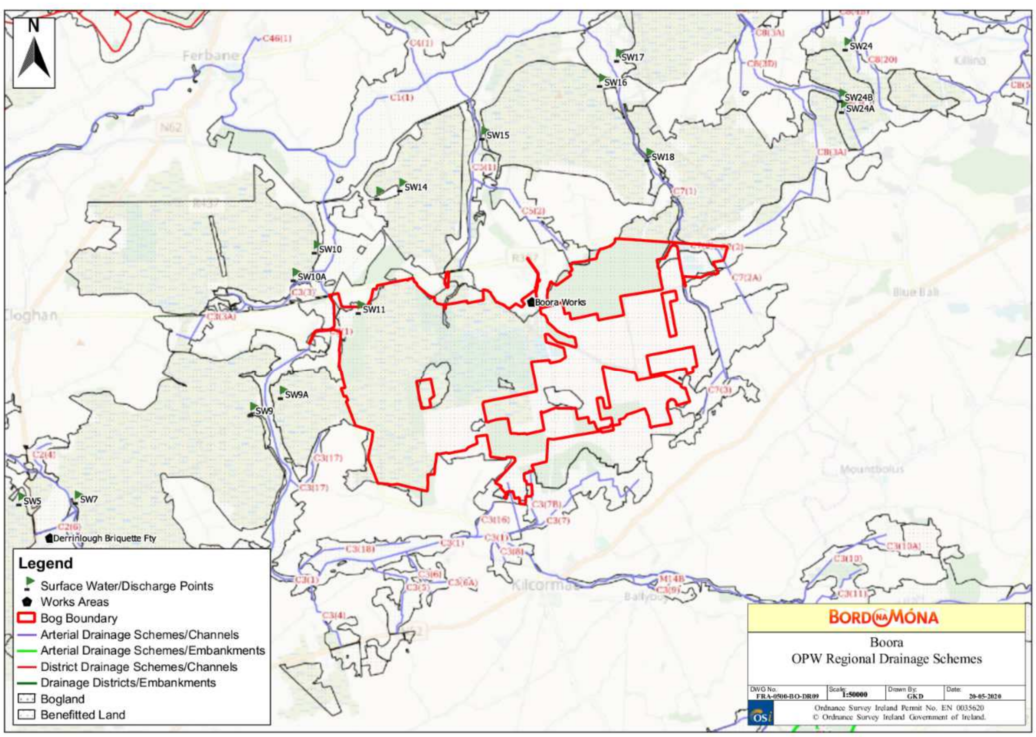


Figure 2.6.4 Boora Bog District Drainage Schemes

The benefitted land from the District Drainage Schemes is also highlighted demonstrating that there are limited benefitting lands associated with this scheme in the area of these bogs.

There aquifer underlying Boora Bog is categorized as *Ll – Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones.* This is discussed further in section 2.6.6.

The Standard Annual Average Rainfall (SAAR) in this location is 915mm.

2.6.5 **Historical Flooding**

The OPW https://www.floodinfo.ie website provides some limited information on flood records throughout the country. A map of historical flooding contained for the area, in the vicinity, of Boora Bog is shown in the Figure below.

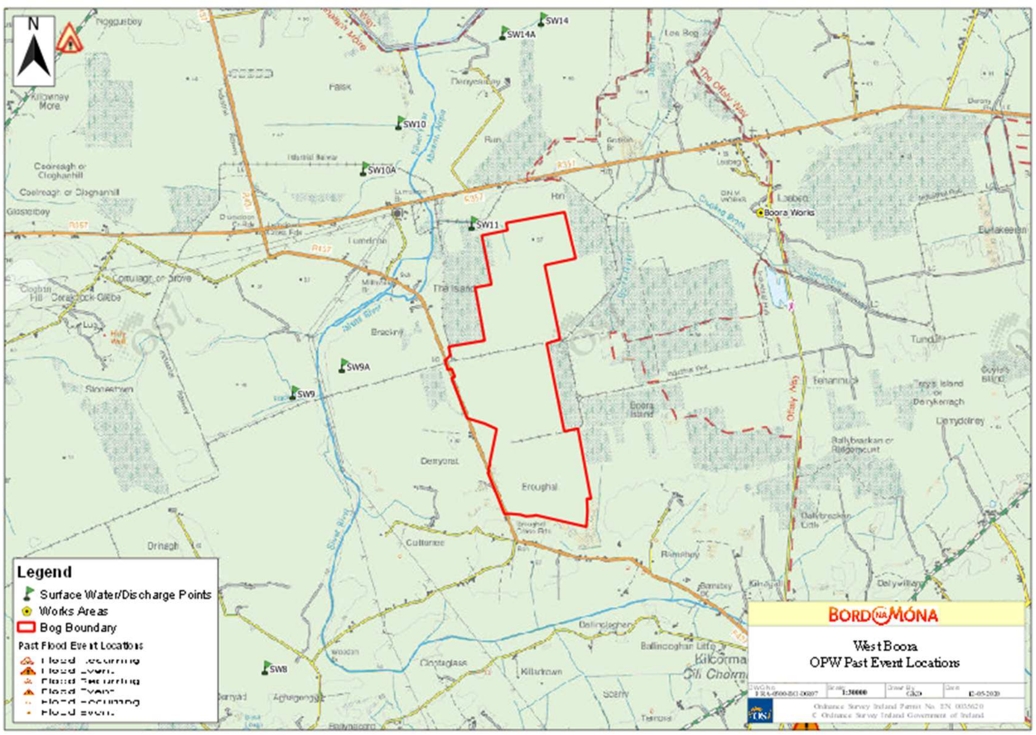


Figure 2.6.5 Boora Bog Historical Flooding

The OPW Past Flood Events show no records of any flooding events encroaching into Boora Bog.

Aerial imagery from the November flood event shows small areas of water in the southern areas of the bog.

There is little anecdotal evidence to suggest historical flooding of the site. Information from Bord na Móna operatives familiar with Boora Bog confirmed that surface water flooding has, on occasion, occurred in the production area where blockages to the existing drainage network have occurred over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production on an annual basis as part of the winter works schedule.

2.6.6 **Groundwater Flood Risk**

There aquifer underlying Boora Bog is categorized as *Ll – Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones.* This aquifer has a moderate vulnerability

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below.

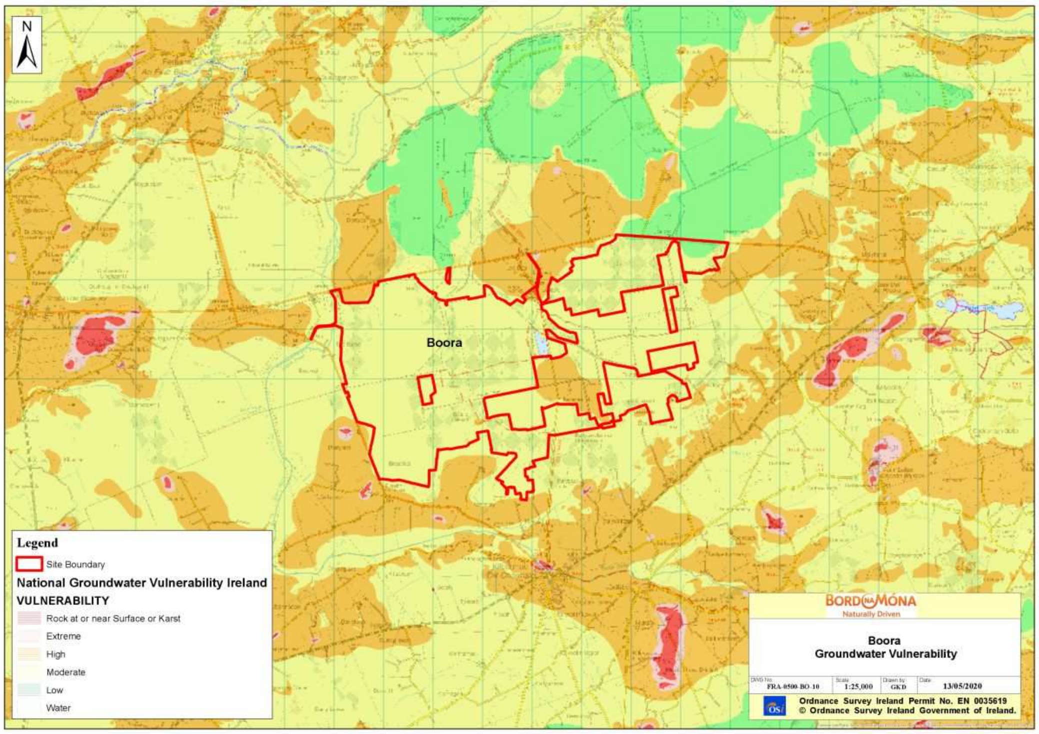


Figure 2.6.6 Boora Bog Groundwater vulnerability

The GSI https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx website provides information on groundwater throughout the country. The borehole shown to the north of Boora Bog is recorded as having been dug in 1905. According to the GSI website the accuracy for these locations is 1Km and information from Bord na Móna operatives familiar with Boora Bog confirmed that this well is not located within the bog boundary.

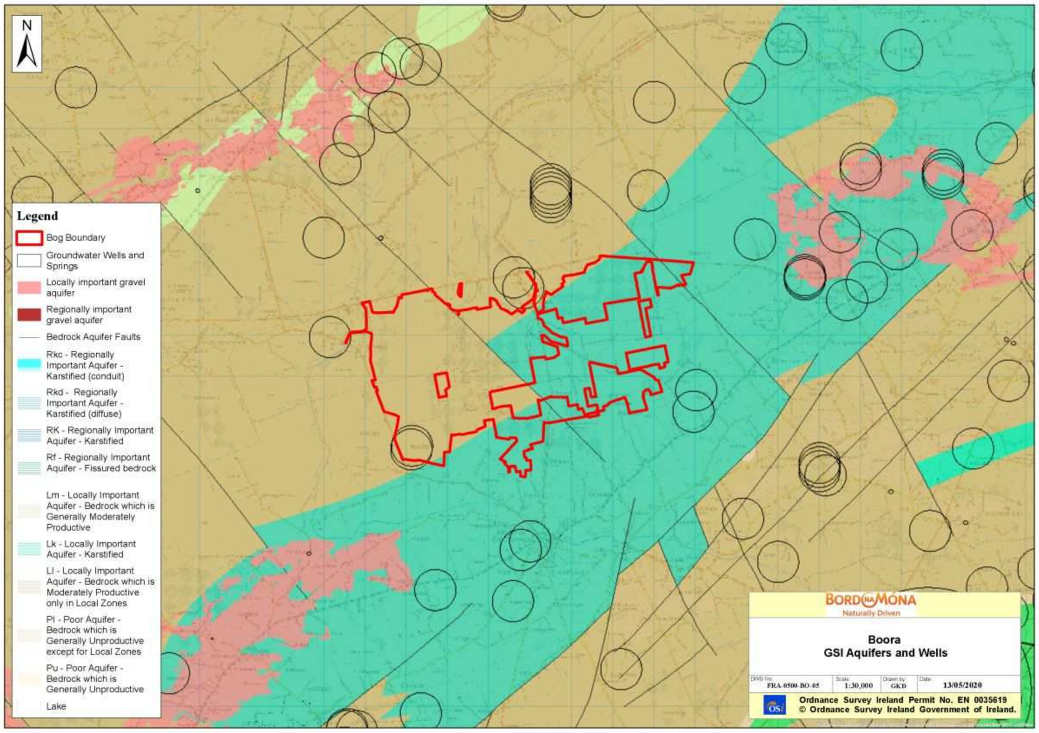


Figure 2.6.7 Boora Bog Aquifers, Karst Features, Wells

Information from Bord na Móna operatives familiar with Boora Bog confirmed that groundwater seepage has not been identified as a source of flooding within the bog.

2.6.7 Fluvial Flood Risk

The rivers and streams in the vicinity of Boora Bog are described in terms of regional hydrology in section 2.6.4**Error! Reference source not found.**.
The surface water outfall in this western area of Boora Bog limits outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameter of this outfall is shown in the Table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW11	0.600

Table 2.6.1 Boora Bog Surface Water Outfalls

Information from Bord na Móna operatives familiar with Boora Bog confirmed the outfall will become submerged when the water levels are high. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in

1000 year events) associated with Boora Bog. River Flood Events High Range mapping has been examined in the region of this bog. Mapping carried out for the Brosna river identifies the potential for very limited flooding along the western boundary of the site. This flooding is not predicted to encroach into Boora bog. There is no mapping available for the other rivers in the vicinity of the bog.

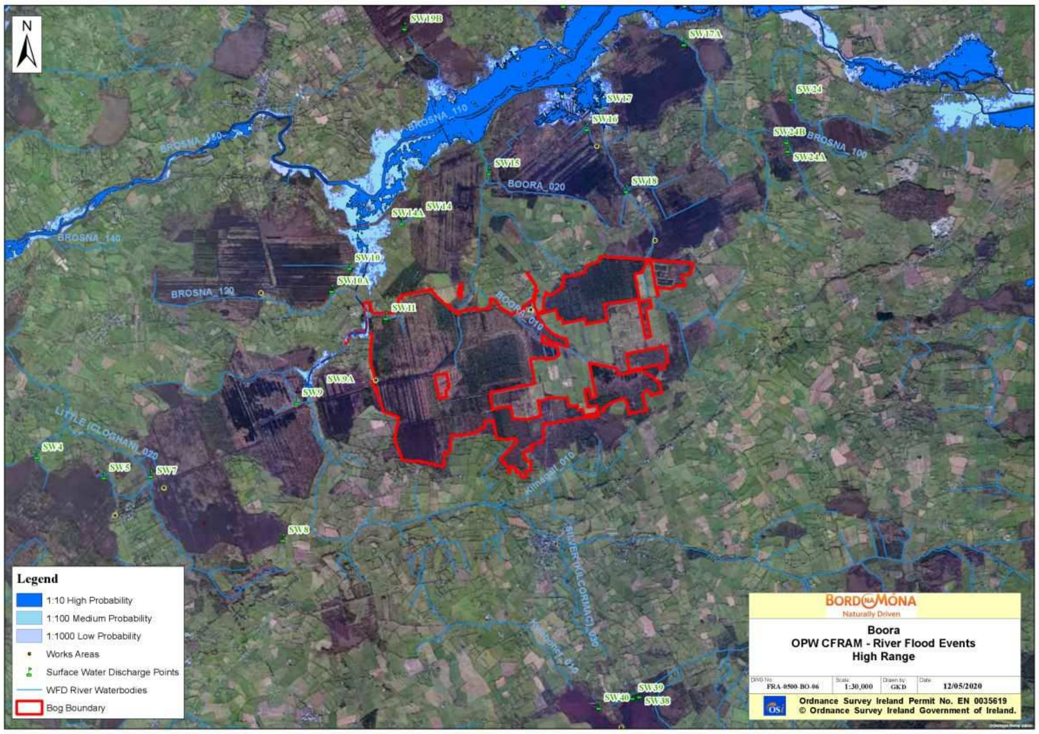


Figure 2.6.8 Boora Bog River Flood Events High Range

2.6.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below.

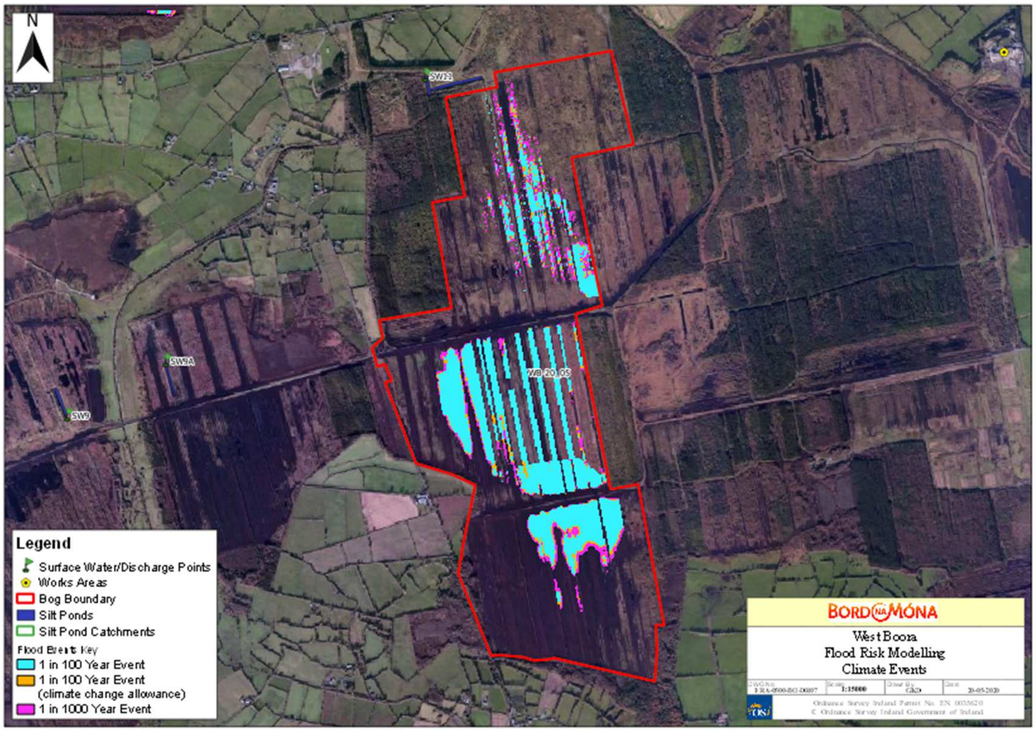


Figure 2.6.9 Boora Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the Surface water discharge points in the bog. The area of Boora Bog under consideration is modelled as one basin WB-20_05. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The model shows that flood waters are collecting in local areas in the south west and north west parts of the bog. The most extensive flooding is shown in the south west section, where ground levels are lowest. The maximum flood level in this area for the 1000year event is 48.93mOD.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The finished floor levels of the buildings in the Works Area are higher than 53.93mOD. The elevation of these buildings is higher than the modelled flood waters in the bog. From this model Boora Bog works area which includes a welfare facilities and a storage container is not as risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	***WB-20_05***
mOD	***m^3***
48.00	*3863*
48.25	*26434*
48.50	*87398*
48.75	*196443*
49.00	*368826*

Table 2.6.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Boora Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

2.6.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 2.6.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100year event plus 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case, the maximum rainfall for the 100year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfall at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 2.6.7, the High Emissions Scenario (HEFS) has been considered which considers the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

2.6.10 **Conclusions**

The Flood Risk Assessment for Boora Bog identifies the sources of flood risk and their impact. Historical information was also reviewed.

- ***Historical Flooding:*** The aerial imagery of the November 2009 flood event shows some minor flooding in the centre of the bog. There are no other historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area does occur on occasion.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.

- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the rivers into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the adjoining water courses if their levels ever rise during flood events. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Works Area in Boora Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low Risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Boora Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 2.6.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.
Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as

Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

9. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
10. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
    - *(xvii) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
    - *(xviii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
    - *(xix) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
    - *(xx) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Belair North Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development:
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the Works Area which consists of welfare facilities and a storage container are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management

Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Boora Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

2.7 Galros Bog

2.7.1 Introduction

Galros Bog is part of the Bord na Móna Boora Bog Group which operates under an Integrated Pollution Control licence (ref P0500-01). The Bog is primarily used to supply the Derrinlough Briquette Factory and the total area within Bord na Móna ownership is 193 Ha.

2.7.2 Site Location

Galros Bog is located in County Offaly approximately 5 km north of Birr. The site location is highlighted in red in the Figure below.

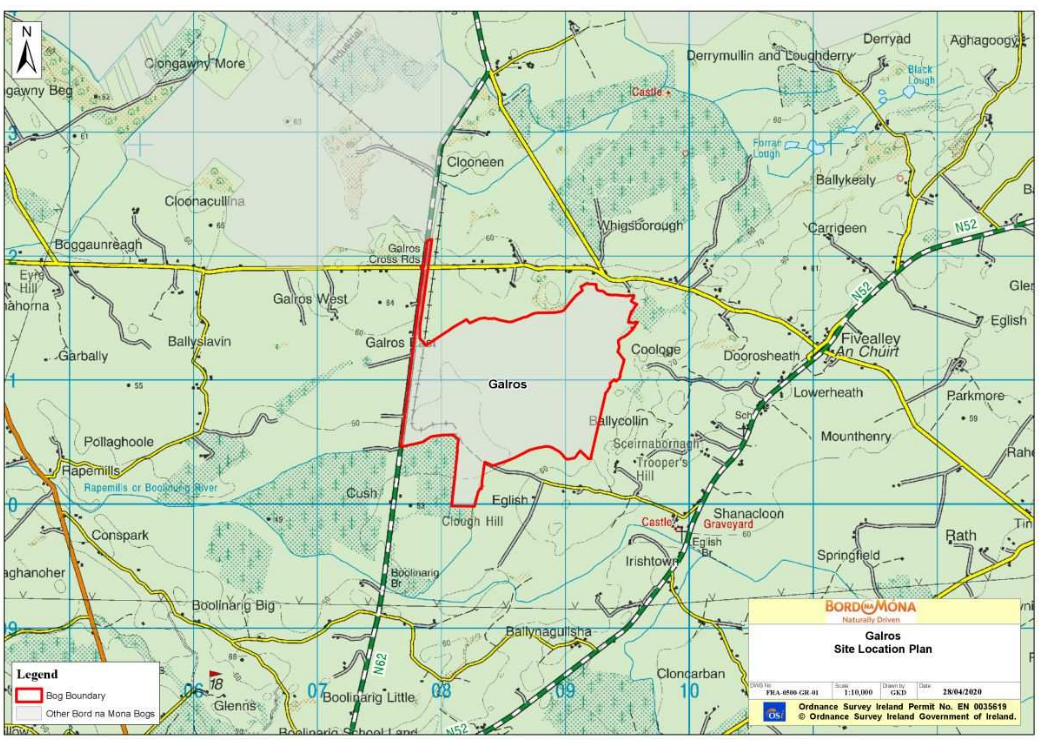


Figure 2.7.1 Galros Bog Site Location

2.7.3 **Bog Description**

The bog layout is shown in the figure below.

Figure 2.7.2 Galros Bog Drainage Layout

Gravity drainage development commenced in Galros Bog in circa 1983, with peat production then beginning in 1988. The land use surrounding the bog is comprised of mature Coillte forestry and agriculture. There is an operational quarry located adjacent to the north-eastern corner of the site.

The existing ground levels of the peat production areas range from 46.5mOD in the south-western corner of the site to 53.5mOD in the northern end of the site. Although this site does not have a dedicated works area, there is a small welfare centre consisting of a portacabin unit located at the north-western corner of the site adjacent to the public road, with a finished floor level of 49.65mOD.

The majority of Galros Bog is entirely in production with only the edge habitats left undisturbed. These edge habitats range from woodland to remnant sections of raised bog and cutaway bog. Some of these habitats are old and are mature.

In Galros Bog there is one surface water gravity outfall, with associated silt ponds, which discharges along the southern boundary of the site. There are no pumped outfalls and all flow in Galros Bog is via gravity. The outfall from Galros bog drains surface water into the West Galros watercourse which in turn drains into the Rapemills river.

2.7.4 Regional Hydrology

The catchment areas, water courses and District Drainage Schemes are shown in the Figures below.

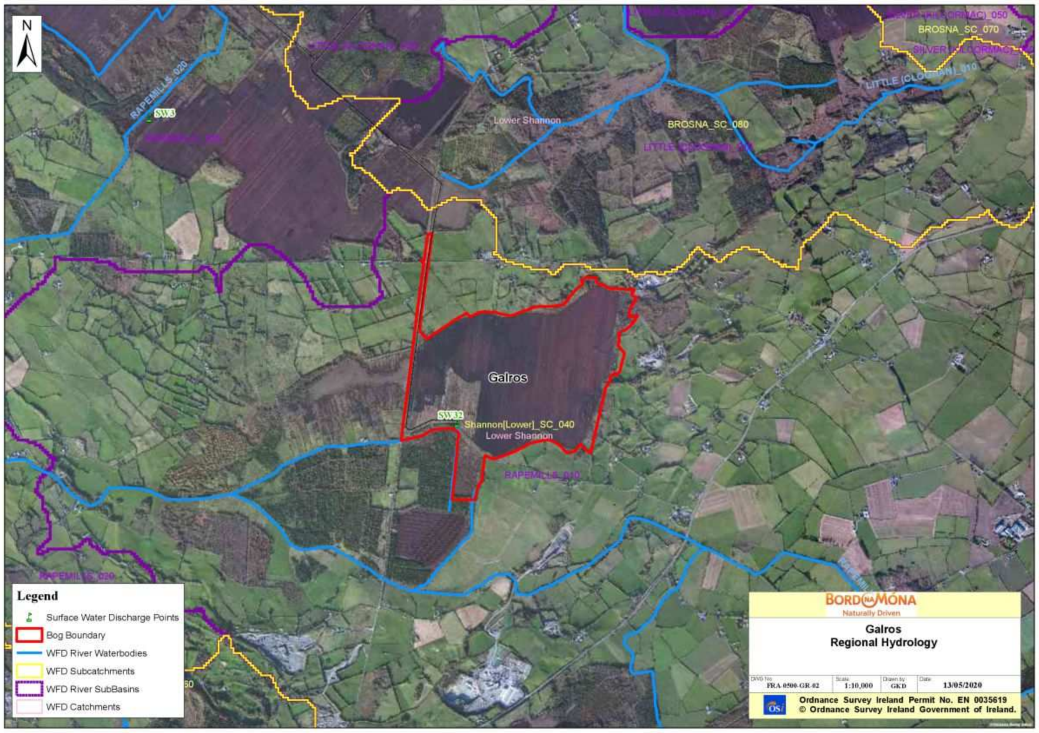


Figure 2.7.3 Galros Bog Regional Hydrology

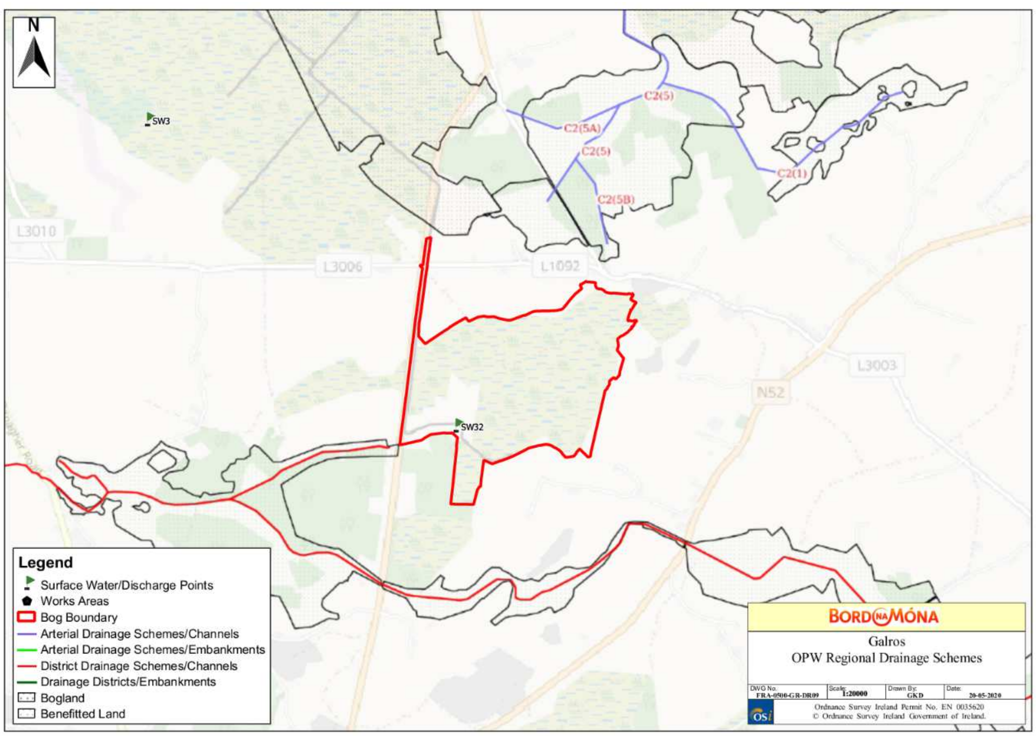


Figure 2.7.4 Galros Bog District Drainage Schemes

Galros Bog is within in the Lower Shannon 25B catchment (Hydrometric Area 25). The Lower Shannon 25B catchment covers an area of 982 km² and is characterised by a wide flat limestone plain, and an upland region of sandstones in the east comprising the western slopes of the Slieve Bloom Mountains and the low hills to the southwest of Roscrea.

The outfall from Galros bog is located at the southern end of the bog (SW32) and drains surface water into the West Galros watercourse which in turn drains into the Rapemills river. The WFD Sub-basin, and sub-catchment for the bog catchment are referred to as Rapemills_010 and Shannon Lower_SC_040 respectively.

The Arterial Drainage and District Drainage schemes near Galros Bog are shown in the figures provided. The benefitted land from the Drainage District Scheme is also highlighted demonstrating the enhanced flood protection, as a result of this scheme, for the lands between Galros Bog and Rapemills river.

The Standard Annual Average Rainfall (SAAR) in this location is 880mm.

2.7.5 **Historical Flooding**

A map of historical flooding is shown in the Figure below.

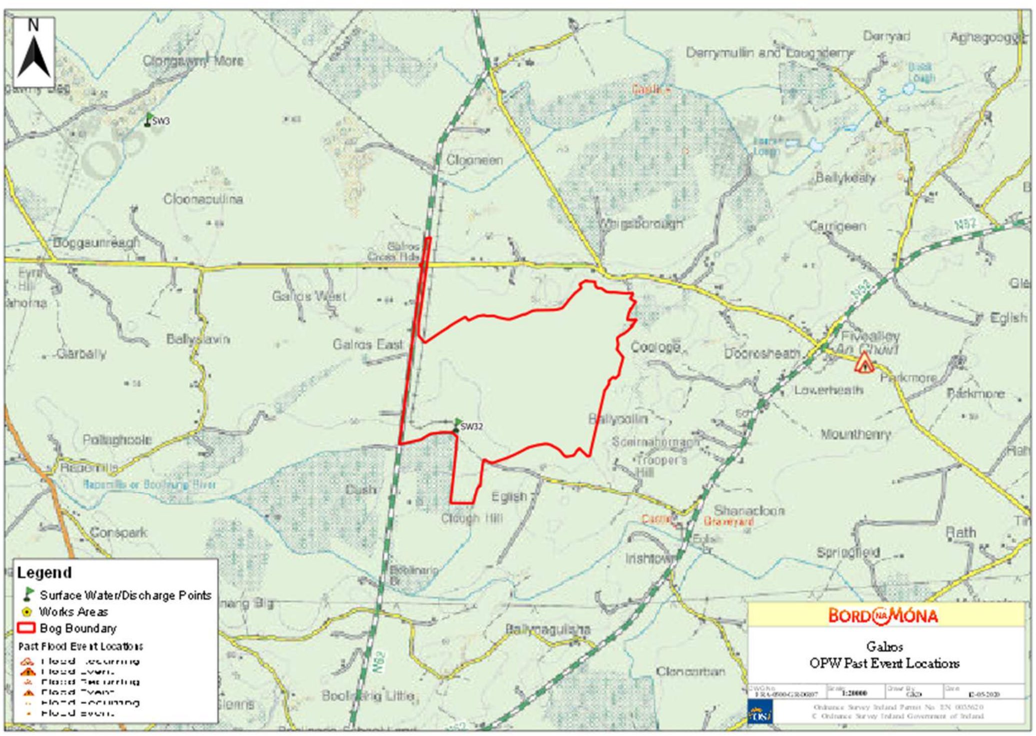


Figure 2.7.5 Galros Bog Historical Flooding

Information from Bord na Móna operatives indicates that flooding has occurred across Galros bog in the past. This is believed to be due to rising water levels in the receiving waters immediately south of the bog which leads to water rising in the internal drainage network and then occasionally flooding lower parts of the production area in the south. Historical investigations by local operatives have indicated that there are restrictions (piped culverts) along the route of the Rapemills_010, also known as the West Galros watercourse, which restrict the flow in this channel during periods of prolonged rainfall and impact on water levels.

Photographic records (Google street-view facility) indicates flooding has occurred at the north-western corner of the bog in March of 2019.

Photo 2.7.1 Galros Bog, flooding at north-western corner of bog

Historical flood records are taken from the OPW website, https://www.floodinfo.ie. Records of past flood events are given for locations at Birr, Fivealley and Banagher. The closest flooding event occurred at Fivealley, approximately 2km east of the site boundary. This recurring event was recorded in 2005 in an oral report given by Offaly Co. Council as part of an OPW project (OPW Flood Hazard Mapping – Phase 1) and notes that the "*low lying land floods after heavy rain every year".* Flooding at Birr and Banagher is associated with flooding of the River Shannon.

Historical OSI 25" mapping was also examined for this area. There is no additional record of flooding to be taken from these maps for Galros bog.

2.7.6 **Groundwater Flood Risk**

A map of aquifers, karst features and known wells is shown in the Figure below.

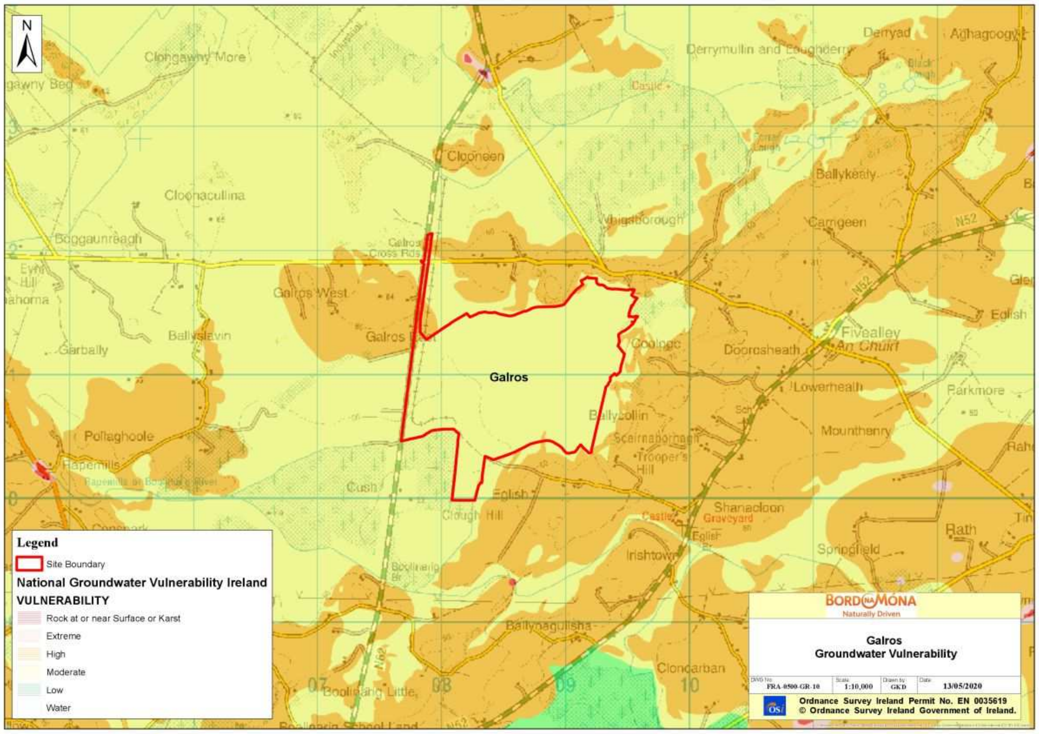


Figure 2.7.6 Galros Bog Groundwater Vulnerability

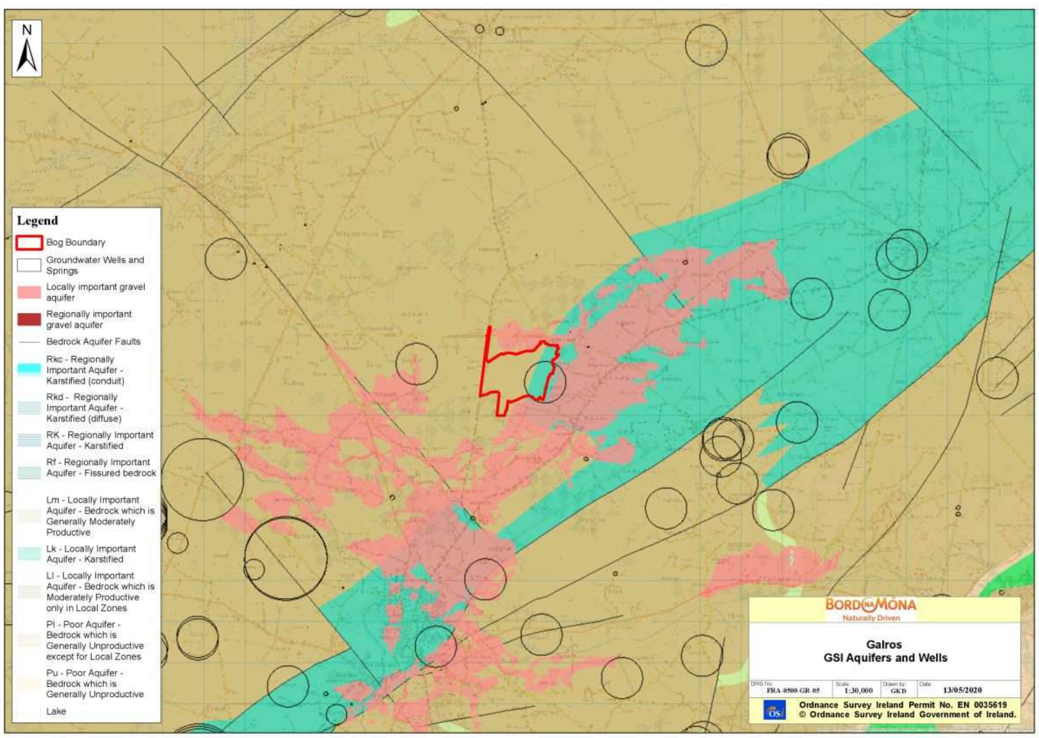


Figure 2.7.7 Galros Bog Aquifers, Karst Features, Wells

There are two groundwater aquifers underlaying the Galros Bog area. In the west, the aquifer is a *Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll).* In the eastern part of the site the aquifer is a *Regionally Important Aquifer - Karstified (diffuse) (Rkd).* Both of these aquifers have a moderate vulnerability code.

There is no record of any karst landforms within the bog or its surrounds. Geological Survey of Ireland records indicated a well (GSI Name: 2021SWW010) located adjacent to the eastern boundary of the site. This well was drilled in 1970 and is classified as a Poor GSI Yield Class.

There are no Bord na Móna records or local anecdotal evidence to suggest groundwater flooding has ever occurred at this bog.

2.7.7 Fluvial Flood Risk

The rivers and streams in the vicinity of Galros Bog are described in terms of regional hydrology in section 2.7.4. The surface water outfall in Galros Bog will limit outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameter of this outfall is shown in the Table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW32	0.600

Table 2.7.1 Galros Bog Surface Water Outfalls

Information from Bord na Móna operatives indicates that flooding has occurred in the southern end of Galros bog in the past. Rising water levels in the West Galros watercourse are known to rise above the outfall level at this location and backwaters the outfall reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with the 'High-End Future Scenario extents' (generated taking in the potential effects of climate change using an increase in rainfall of 30% and sea level rise of 1,000 mm (40 inches))

Flooding is identified for the Rapemills watercourse but only at a distance of circa 6km from the boundary of the site. There are no identified flooded areas along the Rapemills watercourse upstream of this location, nor are there any flooded areas identified along the West Galros watercourse. There is no risk of flooding identified within the Bord na Móna Galros Bog boundary

CFRAM flood mapping is shown in the Figure below.

Figure 2.7.8 Galros Bog River Flood Events High Range

2.7.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below.

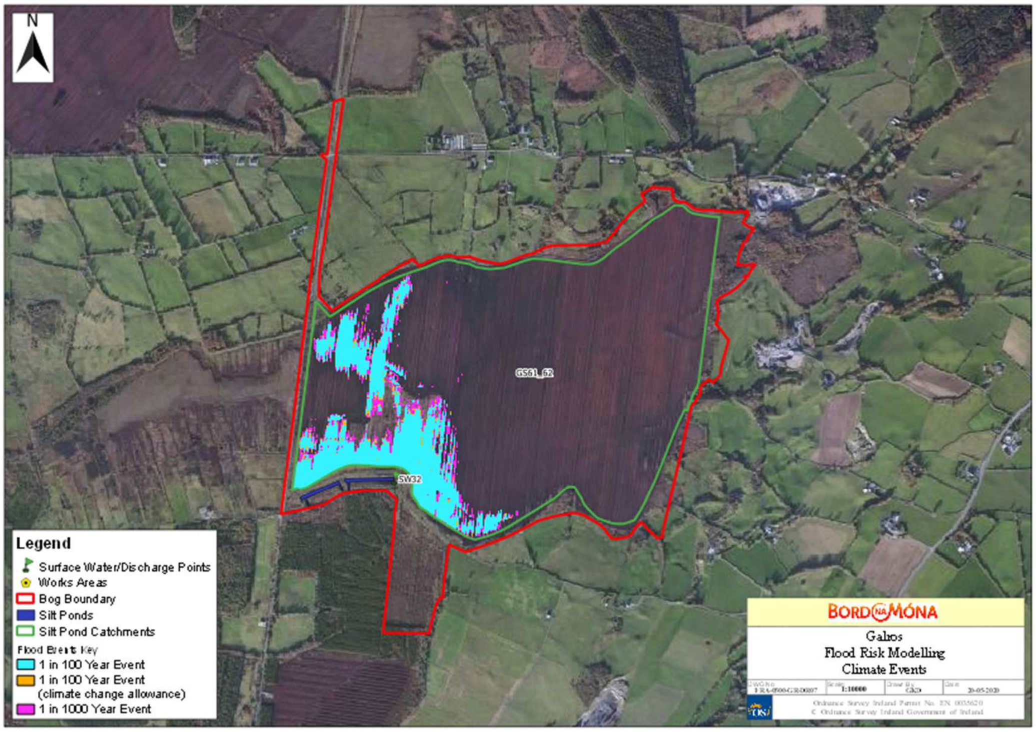


Figure 2.7.9 Galros Bog Pluvial Flooding, Rainfall Events

GIS modelling carried out for Galros bog is presented here. The basins used in the model are the extent of the catchments that discharge through the surface water discharge points in the bog. Galros Bog is modelled for a single basin, GS61_62. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, , and as outfalls are piped as described above, this is a reasonable assumption.

It is evident from the modelling that there is potential for flooding to occur primarily in the southwestern corner of the site at the outfall location. This is to be expected, given the lower elevations of the production areas in this location. The flooding towards the northwest corner of the bog is indicative of a low-lying area here also. Drainage of this area would normally occur through the internal gravity network of open drains and pipes however if this network was either blocked or was not available due to high water levels, such flooding could occur. Modelling indicates flood water levels of the order of 47.84mOD in this catchment in a 1 in 1000-year event.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The existing welfare cabin at the northern end of the site has a finished floor level of 49.65mOD. This is above the maximum predicted 1 in 1000year flood level in this area.

As outlined in section 2.7.7, Information from Bord na Móna operatives indicates that flooding has occurred in the southern end of Galros bog in the past. Photographic records indicate flooding has occurred in the northern end of the site also. This evidence is broadly in line with the findings of the GIS modelling carried out.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	**GS61_62**
mOD	**m^3**
47.00	6250
47.25	22128
47.50	52921
47.75	100797

Table 2.7.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Galros Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

2.7.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 2.7.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100year event plus 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case the maximum rainfall for the 100year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000-year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 2.7.7, the High-Emissions Future Scenario (HEFS) has been considered which takes in account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

2.7.10 **Conclusions**

The Flood Risk Assessment for Galros Bog identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local Bord na Móna knowledge flooding of the peat production area has occurred, particularly at the lower, southern end of the site.

- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the adjoining water courses if their levels ever rise during flood events. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels indicated that flooding will not impact areas outside of the production areas and that the welfare centre at the northern end of the site is above the predicted flood level.

This Flood Risk Assessment indicates that the peat production fields and drains in Galros Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 2.7.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Galros Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- Flood modelling carried out in this assessment shows that the main site access point and the existing welfare centre are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been taken into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change

- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Galros Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

2.8 Killaun Bog

2.8.1 Introduction

Killaun Bog is part of the Bord na Móna Boora Bog Group operated under an existing Integrated Pollution Control licence (ref P0500-01). The bog has been used by Bord na Móna for the extraction of milled peat since 2003 and this peat is primarily used to produce milled horticultural peat and the total area within Bord na Móna ownership is 360 Hectares.

2.8.2 Site Location

Killaun Bog is located in County Offaly approximately 5km east of Birr. The site is within the Lower Shannon 25B catchment, (Hydrometric Area 25).

The Killaun Bog site location is highlighted in red in the Figure below and is 360 Hectares

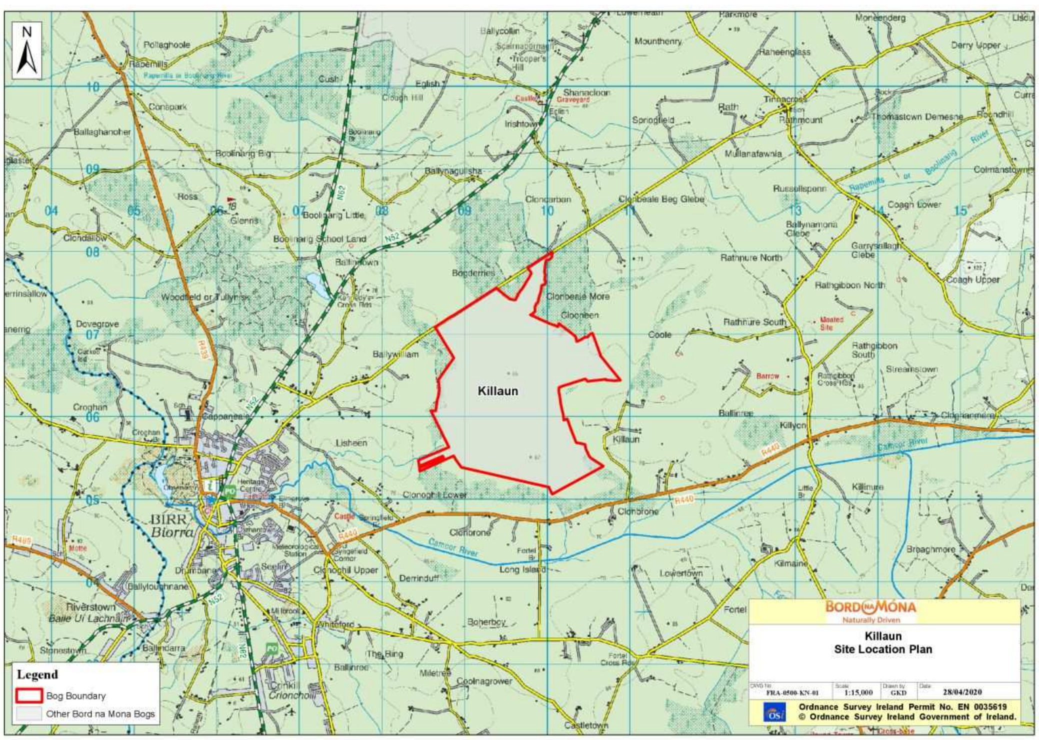


Figure 2.8.1 Killaun Bog Site Location

2.8.3 **Bog Description**

The majority of Killaun Bog is in production with only the edge habitats left undisturbed. These edge habitats range from woodland to remnant sections of raised bog and cutaway bog. The land use surrounding the bog is comprised of mature woodland and agriculture with a section along the eastern boundary owned by Erin Peat which is also harvested for horticultural peat. This bog was drained by Bord na Móna in 1996 with peat production commencing in 2003.

The existing ground levels of the peat production areas range from 60.5OD in the northeast end of the bog to 63.6mOD in the south-eastern end of the site.

There is a works area in the northeast corner of the bog and this includes a lorry tippler, welfare facilities, car parking and storage area. The finished floor levels of the buildings range from 63.0 to 63.6mOD. The main access point to the bog is off the public road, that runs between Birr and Rath, into the works area. There are 3 gravity flow surface water outflows, with associated silt ponds, in Killaun Bog. Two outflows are located along the south westerly boundary of the site and one outflow along the north easterly boundary. There are no pumped outfalls and all flow in Killaun Bog is gravity. Details of the existing drainage layout is shown in the Figure below.

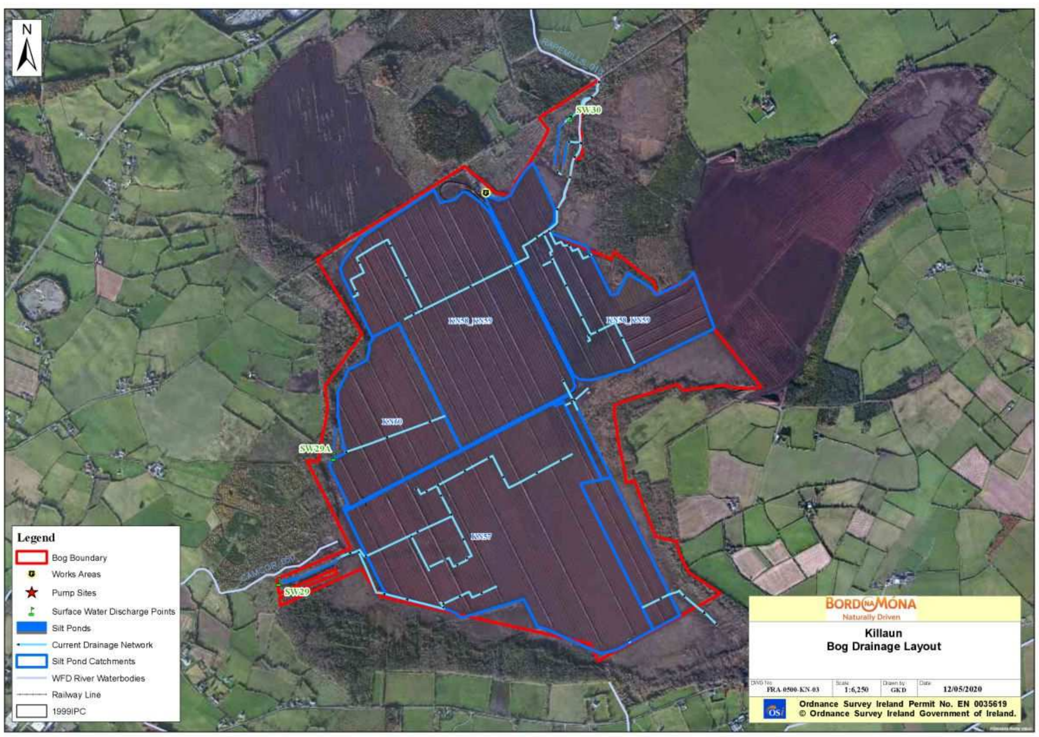


Figure 2.8.2 Killaun Bog Drainage Layout

2.8.4 **Regional Hydrology**

Killaun Bog is within in the Lower Shannon 25B catchment (Hydrometric Area 25). The Lower Shannon 25B catchment covers an area of 982 km² and is characterised by a wide flat limestone plain, and an upland region of sandstones in the east comprising the western slopes of the Slieve Bloom Mountains and the low hills to the southwest of Roscrea.

The Camcor_050 is located along the southwest site boundary, SW29 discharges directly into this water and SW29A discharges within 500m. This waterbody is located in the Camcor_SC_010 sub catchment. At the northern eastern end of the bog Rapemills_010 is located along the site boundary and SW30 discharges within 90m of this waterbody which is located in the Shannon(Lower)_SC_040 sub-catchment.
The catchment areas, water courses and District Drainage Schemes are shown in the Figures below.

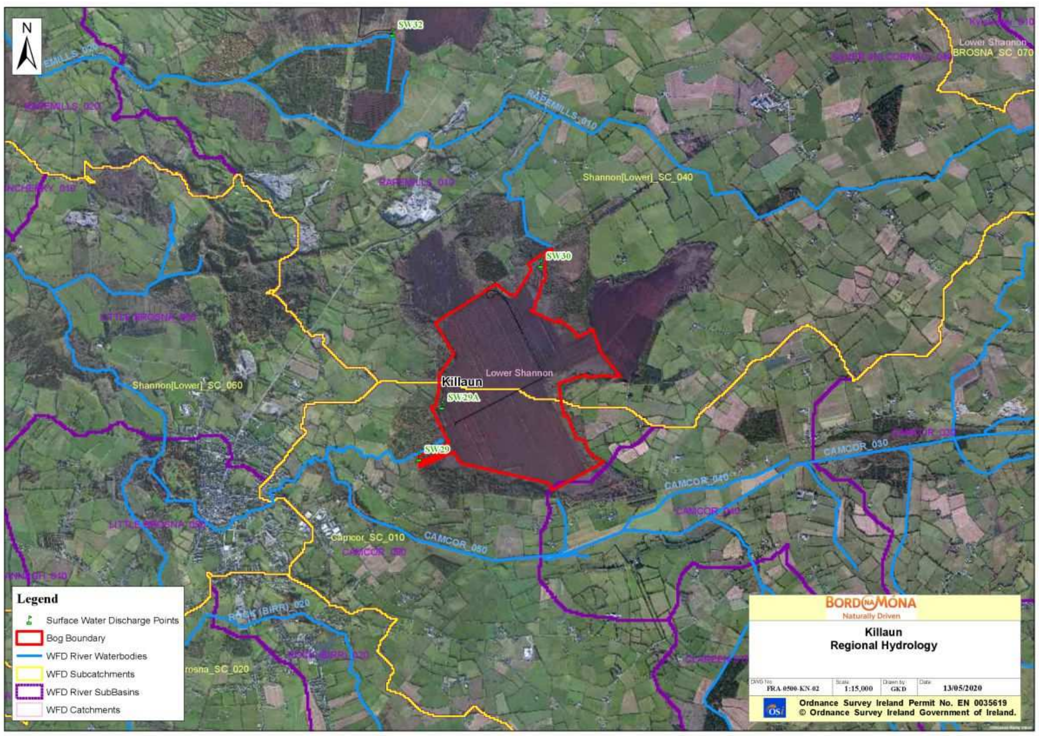


Figure 2.8.3 Killaun Bog Regional Hydrology

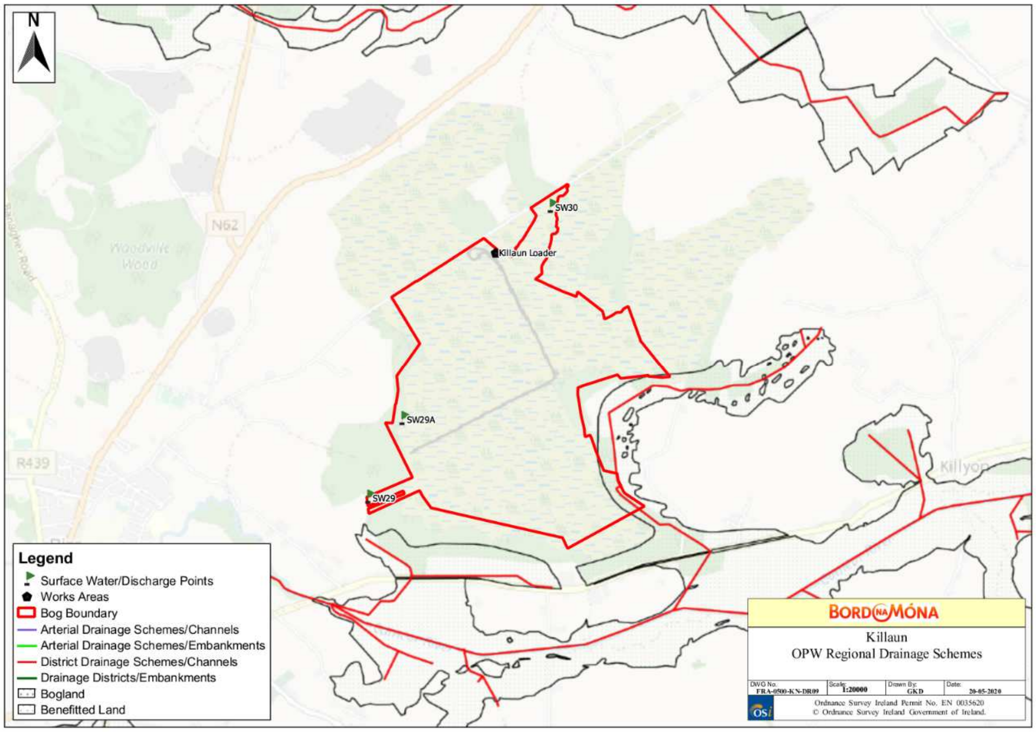


Figure 2.8.4 Killaun Bog District Drainage Schemes

The benefitted land from the District Drainage Scheme is also highlighted demonstrating that there are limited benefitting lands associated with this scheme in the area of these bogs.

The groundwater aquifer underlying Killaun Bog is categorised as follows: Ll – Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones. This is discussed further in section 2.8.6

The Standard Annual Average Rainfall (SAAR) in this location is 858mm.

2.8.5 **Historical Flooding**

The OPW https://www.floodinfo.ie website provides some limited information on flood records throughout the country. A map of historical flooding contained for the area, in the vicinity, of Killaun Bog is shown in the Figure below.

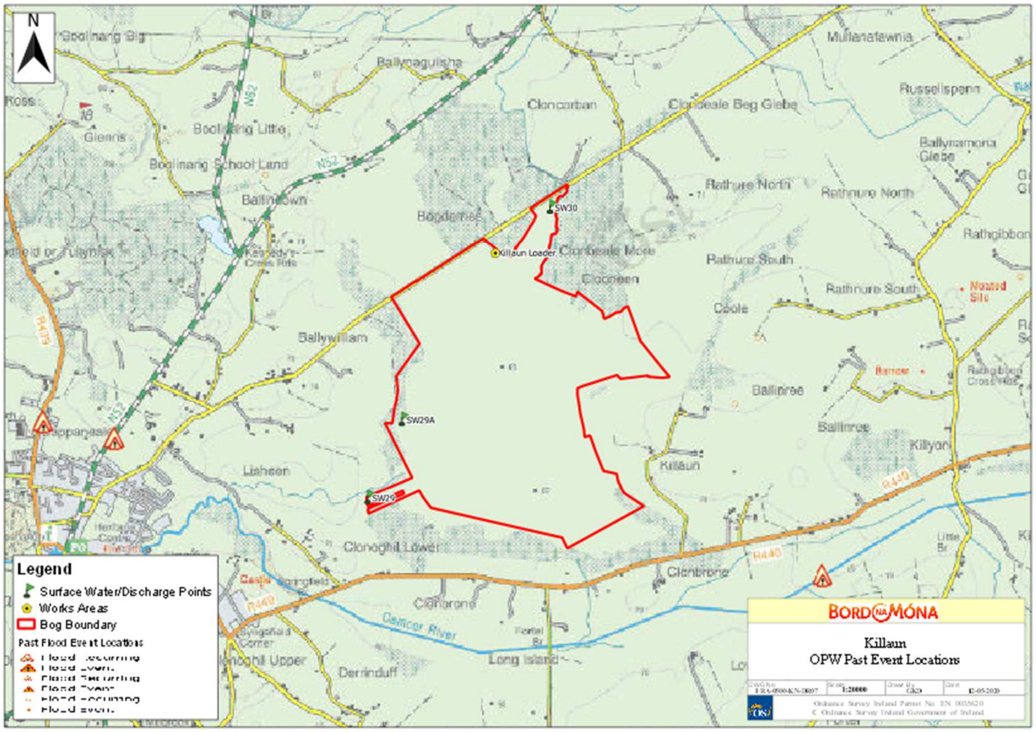


Figure 2.8.5 Killaun Bog Historical Flooding

The OPW Past Flood Events show no records of any flooding events encroaching into Killaun Bog.

There is no anecdotal evidence to suggest any historical flooding of the site. Information from Bord na Móna operatives familiar with Killaun Bog confirmed that surface water flooding has, on occasion, occurred in the production area where blockages to the existing drainage network have occurred over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production.

2.8.6 **Groundwater Flood Risk**

The groundwater aquifer underlying Killaun Bog is categorised as follows: Ll – Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones. This aquifer has low vulnerability.

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below.

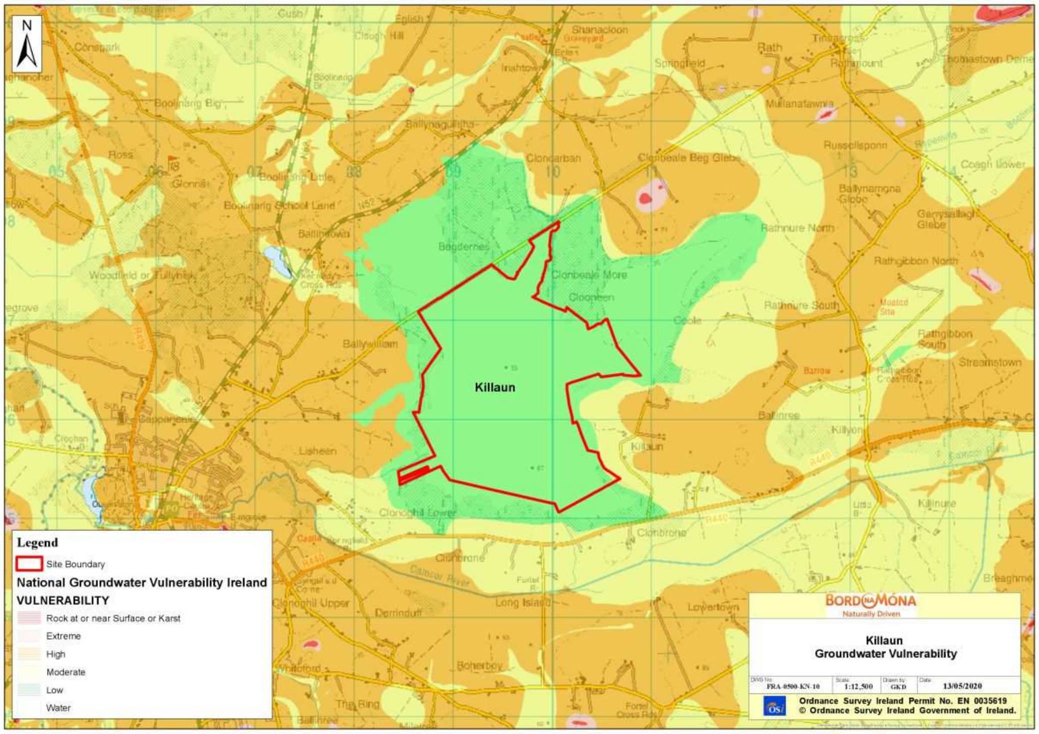


Figure 2.8.6 Killaun Bog Groundwater vulnerability

The GSI https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx website provides information on groundwater throughout the country. The boreholes shown to the west of Killaun Bog are recorded as having been dug in the early 1960's and the well to the northeast of the bog dates back to 1970. According to the GSI website the accuracy for these locations is 1Km and information from Bord na Móna operatives familiar with Killaun Bog confirmed that these boreholes are not located within the bog boundary.

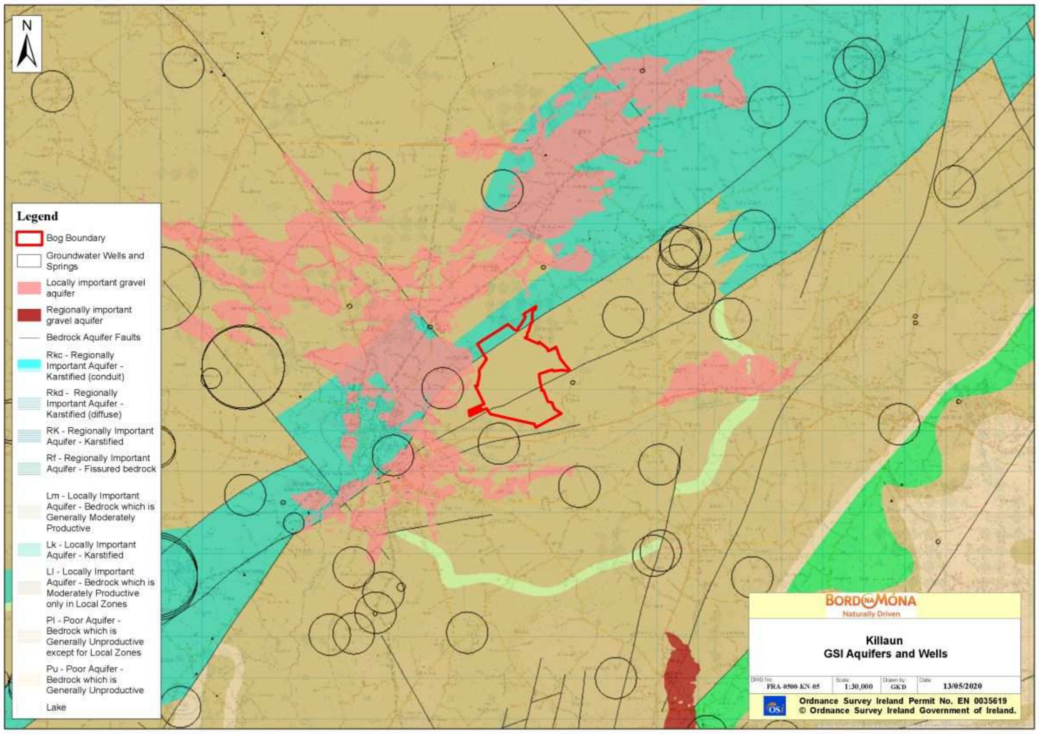


Figure 2.8.7 Killaun Bog Aquifers, Karst Features, Wells

Information from Bord na Móna operatives familiar with Killaun Bog confirmed that groundwater seepage has not been identified as a source of flooding within the bog.

2.8.7 **Fluvial Flood Risk**

The rivers and streams in the vicinity of Killaun Bog are described in terms of regional hydrology in section 2.8.4.

The 3 surface water outfalls in Killaun Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameter of this outfall is shown in the Table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW29	0.600
SW29A	0.450
SW30	0.600

Table 2.8.1 Killaun Bog Surface Water Outfalls

Information from Bord na Móna operatives familiar with Killaun Bog confirmed the outfall will become submerged when the water levels of the rivers into which they are discharging are high. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Killaun Bog. River Flood Events High Range mapping has been examined in the region of this bog. Mapping carried out for the Camcor river identifies the potential for flooding along the southwestern boundary of the site. This flooding is not predicted to encroach into Boora bog. There is no mapping available for the other rivers in the vicinity of the bog.

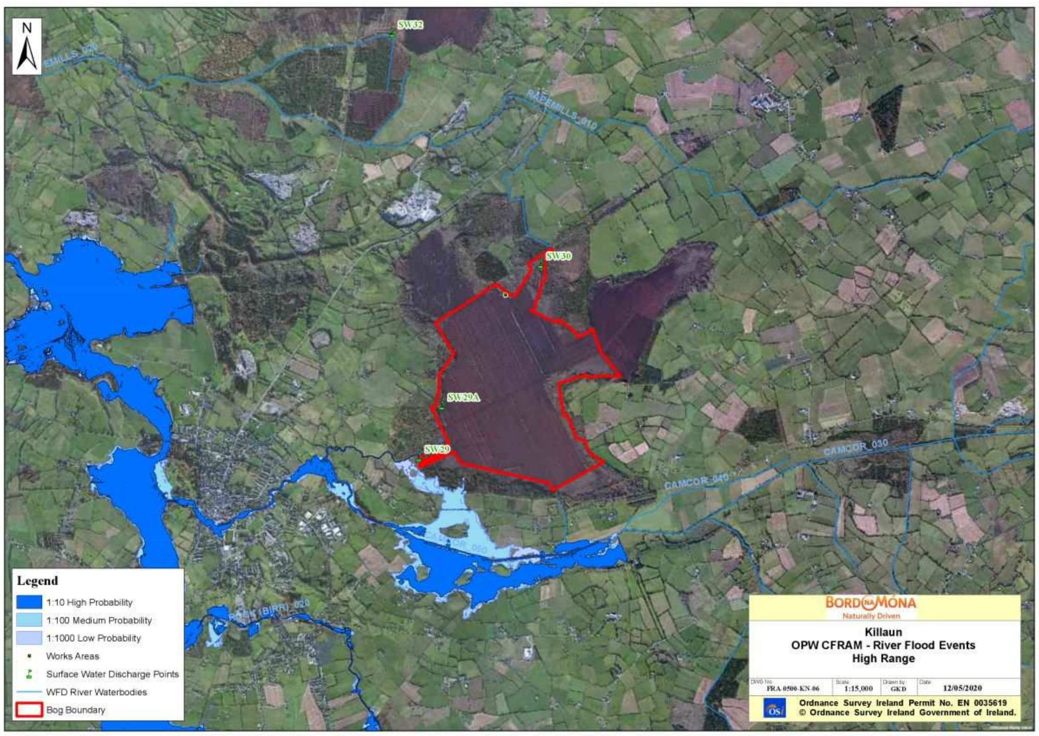


Figure 2.8.8 Killaun Bog River Flood Events High Range

2.8.8 Pluvial Flood Risk

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below.

Figure 2.8.9 Killaun Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the Surface water discharge points in the bog. Killaun Bog is modelled for 3 basins, KN57, KN58_KN59 and KN60. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

The model shows that flood waters are collecting in local areas in the south west, central and northeast parts of the bog. Extensive flooding is shown in the south west and north east sections of the bog where rainfall generated over the basins is drained. The maximum flood level in the north east, where the works area is located, for the 1000year event is 61.49mOD. The maximum flood level in the south west area is 62.81mOD and in the central area is 62.73mOD for the same flood event.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt

ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The existing ground level of the works area located in the north-east section of the bog ranges from 63.0mOD to 63.6mOD. The elevation of these buildings is higher than the modelled flood waters in the vicinity of the works area. From this model Killaun Bog works area which includes a workshop, welfare facilities and oil storage facilities is not as risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	**KN58 KN59**	**KN60**	**KN57**
mOD	**m^3**	**m^3**	**m^3**
61.00	29105	0	249
61.25	59303	22	744
61.50	113256	201	1992
61.75		788	5310
62.00		2305	12420
62.25		5918	25395
62.50		13993	48529
62.75		30471	87781

Table 2.8.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Killaun Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

2.8.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 2.8.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100year event + 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case, the maximum rainfall for the 100year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 2.8.7, the High Emissions Future Scenario (HEFS) has been considered which takes into account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

2.8.10 **Conclusions**

The Flood Risk Assessment for Boora Bog identifies the sources of flood risk and their impact. Historical information was also reviewed.

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area does occur on occasion.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the adjoining water courses if their levels ever rise during flood events. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings area would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Works Area in Killaun Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low Risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Killaun Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 2.8.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
    - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
    - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
    - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
    - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Killaun Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then

discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;

- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Killaun Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

2.9 Derrinboy Bog

2.9.1 Introduction

Derrinboy Bog is part of the Bord na Móna Boora Bog Group operated under an existing Integrated Pollution Control Licence (ref P0500-01). The bog is a relatively young production bog and is been used by Bord na Móna for the extraction of milled peat for horticultural use. The total area within Bord na Móna ownership is 309 Hectares.

2.9.2 Site Location

Derrinboy Bog is located in County Offaly approximately 3.5 km south of Kilcormac. The site is within the Lower Shannon 25A catchment, (Hydrometric Area 25).
The Derrinboy Bog site location is highlighted in red in the Figure below and is 309 Hectares.

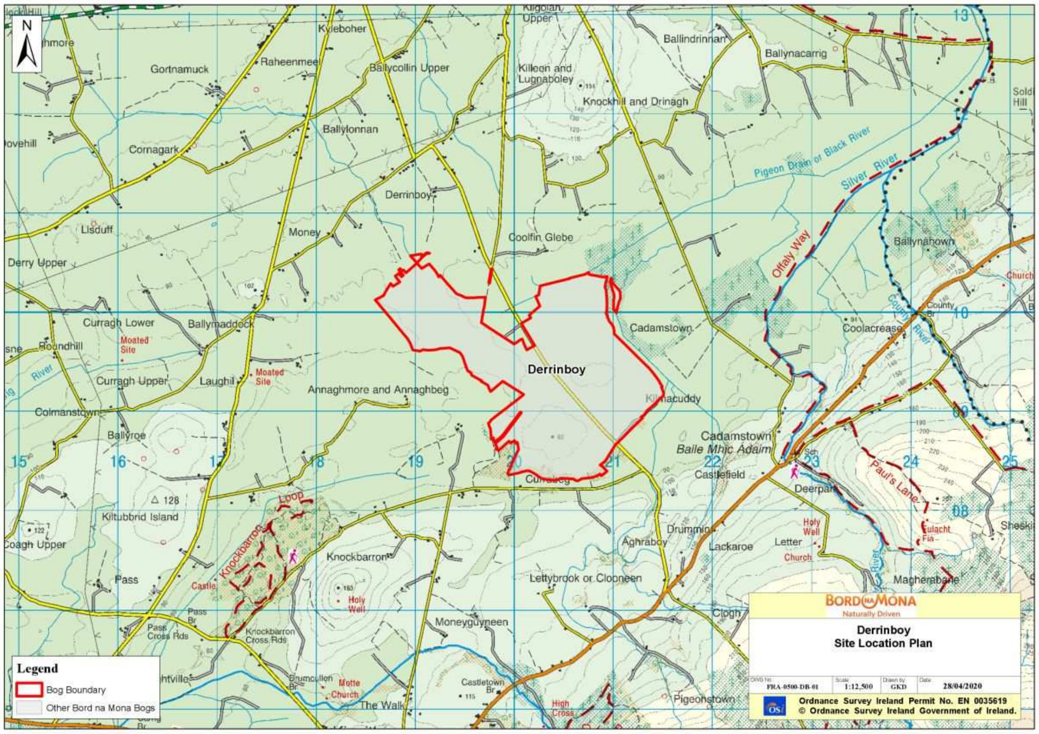


Figure 2.9.1 Derrinboy Bog Site Location

2.9.3 **Bog Description**

The local landscape is relatively flat and the surrounding area is dominated by farmland. The foothills of the Slieve Bloom mountains are relatively close with the ground beginning to rise in height to the south of Derrinboy bog. This bog was drained by Bord na Móna in 1998 with peat production commencing in 2003.

There is a works area in the central area of the bog and this includes welfare facilities, car parking and storage area. The main access point to the bog is off the road known as Ballyboy Road which is off the public road R421 into the works area. There is no rail line and peat is stockpiled adjacent to the public road for loading into lorries for transport.

The existing ground levels of the peat production areas range from 82.5mOD in the north-eastern corner of the site to 89.2mOD in the northern-western end of the site. There is a Works Area located in the centre of the site adjacent to the public road, with buildings with finished floor levels of circa 85.6m OD. This Works Area consists of a welfare facility, storage containers and two bunded diesel tanks.

There are 3 gravity flow surface water outflows, with associated silt ponds, in Derrinboy Bog all of which are located on the northern end of the bog. There is also an area drained by pumping and this water flows through a silt pond before discharging through SW39. Details of the existing drainage layout is shown in the Figure below.

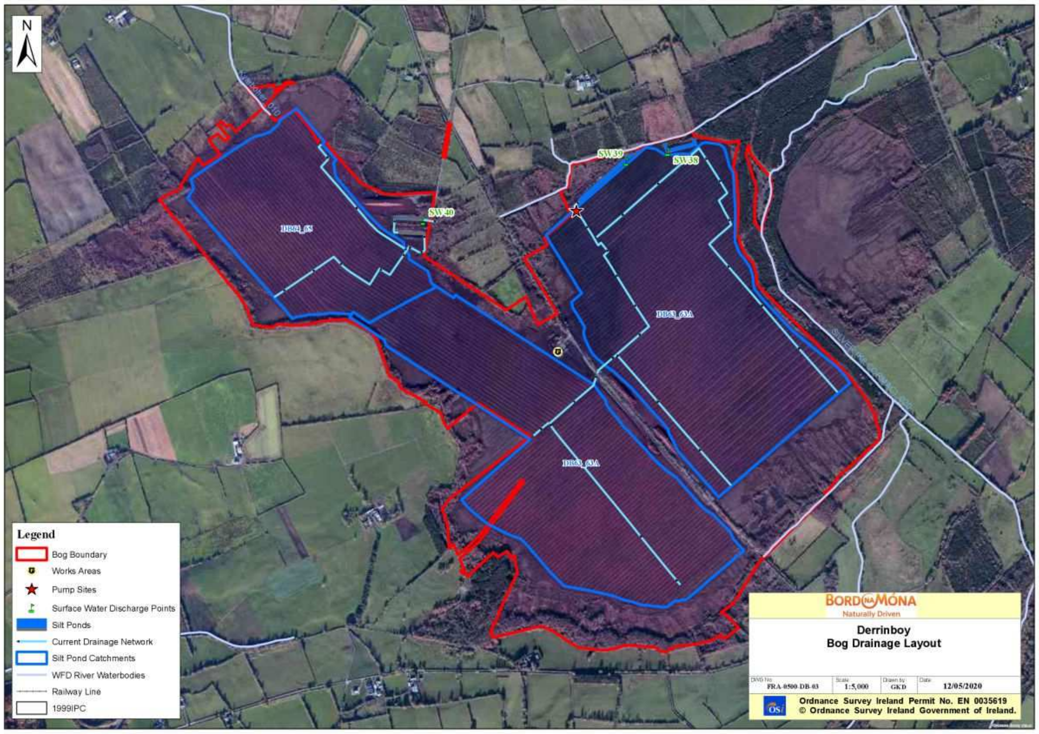


Figure 2.9.2 Derrinboy Bog Drainage Layout

2.9.4 **Regional Hydrology**

Derrinboy Bog is within in the Lower Shannon 25A catchment (Hydrometric Area 25). This catchment covers an area of 1,248km² and is characterised by relatively flat topography with extensive areas of boglands in the low-lying areas. The Lower Shannon (Brosna) catchment comprises 12 subcatchments with 60 river water bodies, four lakes and 18 groundwater bodies.

There are three gravity flow surface water outflows, SW40, SW39 and SW38 and associated silt ponds in Derrinboy Bog. There is also an area drained by pumping and this water flows through a silt pond before discharging through SW39. The surface water outfall SW39 flows into SW39 and discharges directly into Silver (Kilcormac)_020 waterbody which is in the Silver(Kilcormac)_010 sub-catchment. SW40 also discharges into this waterbody.

The catchment areas, water courses and District Drainage Schemes are shown in the Figures below.

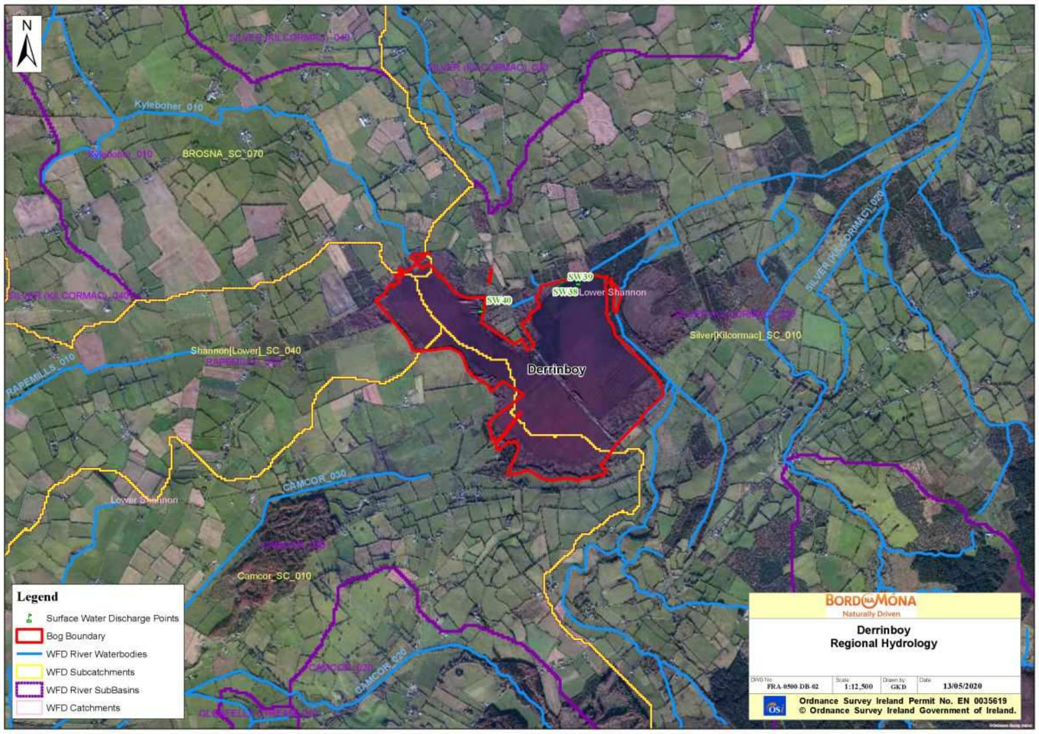


Figure 2.9.3 Derrinboy Bog Regional Hydrology

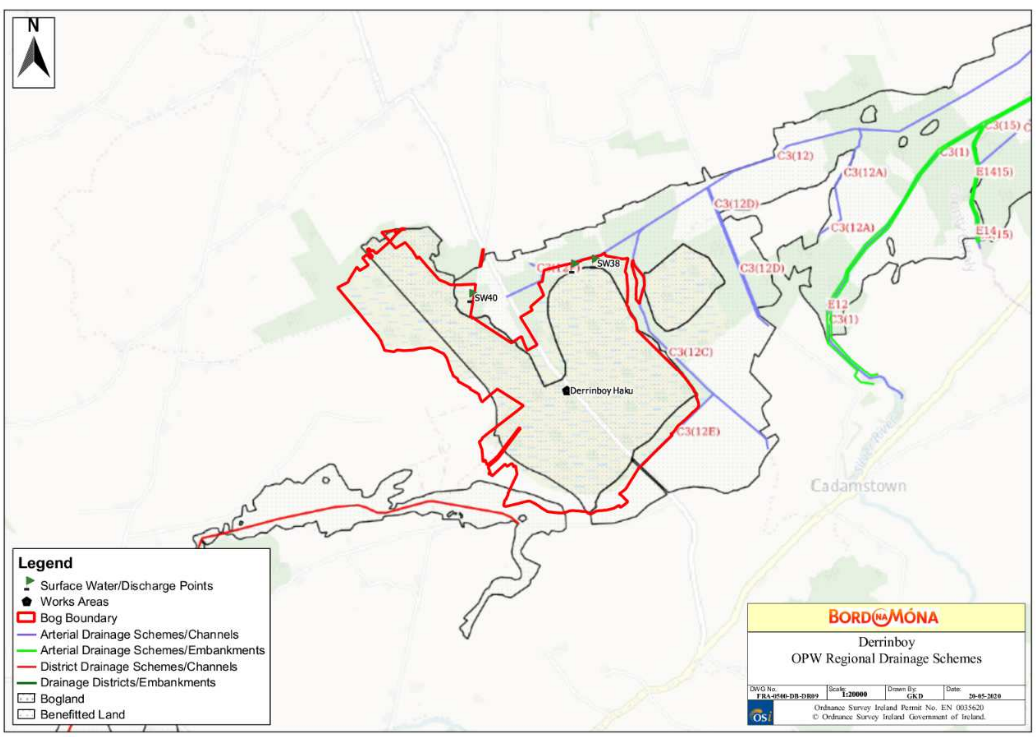


Figure 2.9.4 Derrinboy Bog District Drainage Schemes

The benefitted land is also highlighted demonstrating that there are limited benefitting lands associated with this scheme in the area of these bogs.

The groundwater aquifer underlying Derrinboy Bog is categorised as *Ll – Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones.* This is discussed further in section 2.6.6.

The Standard Annual Average Rainfall (SAAR) in this location is 912mm.

2.9.5 **Historical Flooding**

The OPW https://www.floodinfo.ie website provides some limited information on flood records throughout the country. A map of historical flooding contained for the area, in the vicinity, of Boora Bog is shown in the Figure below.

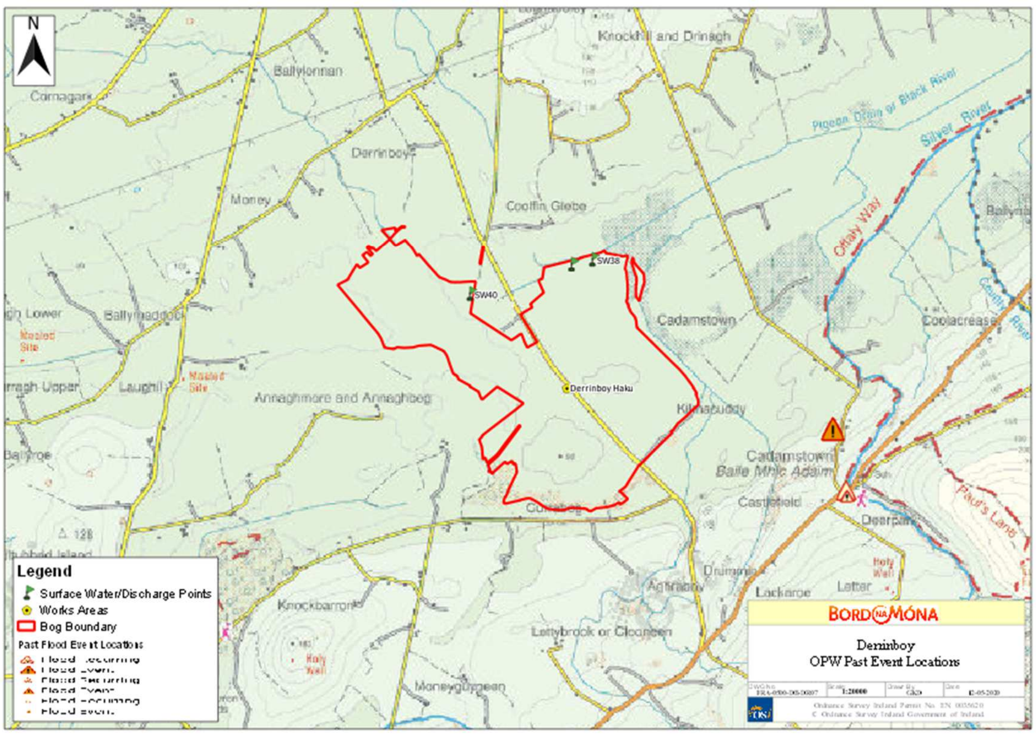


Figure 2.9.5 Derinboy Bog Historical Flooding

The OPW Past Flood Events show no records of any flooding events encroaching into Derrinboy Bog.

There is no anecdotal evidence to suggest any historical flooding of the site. Information from Bord na Móna operatives familiar with Derrinboy Bog confirmed that surface water flooding has, on occasion, occurred in the production area where blockages to the existing drainage network have occurred over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production.

2.9.6 **Groundwater Flood Risk**

The groundwater aquifer underlying Derrinboy Bog is categorised as *Ll – Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones.* This aquifer has a low vulnerability code.

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below.

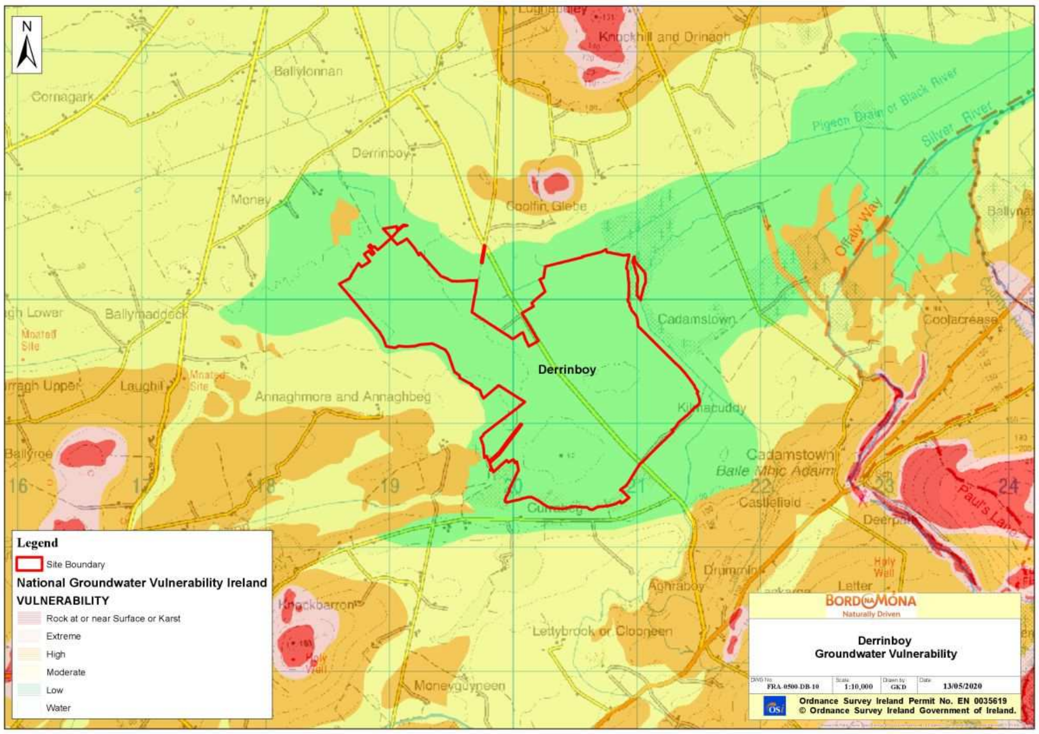


Figure 2.9.6 Derrinboy Bog Groundwater vulnerability

The GSI https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx website provides information on groundwater throughout the country. The borehole shown to the northeast of Derrinboy Bog was recorded as having been dug in 1973. According to the GSI website the accuracy for this location is 1Km and Information from Bord na Móna operatives familiar with Derrinboy Bog confirmed that this borehole is not located within the bog boundary.

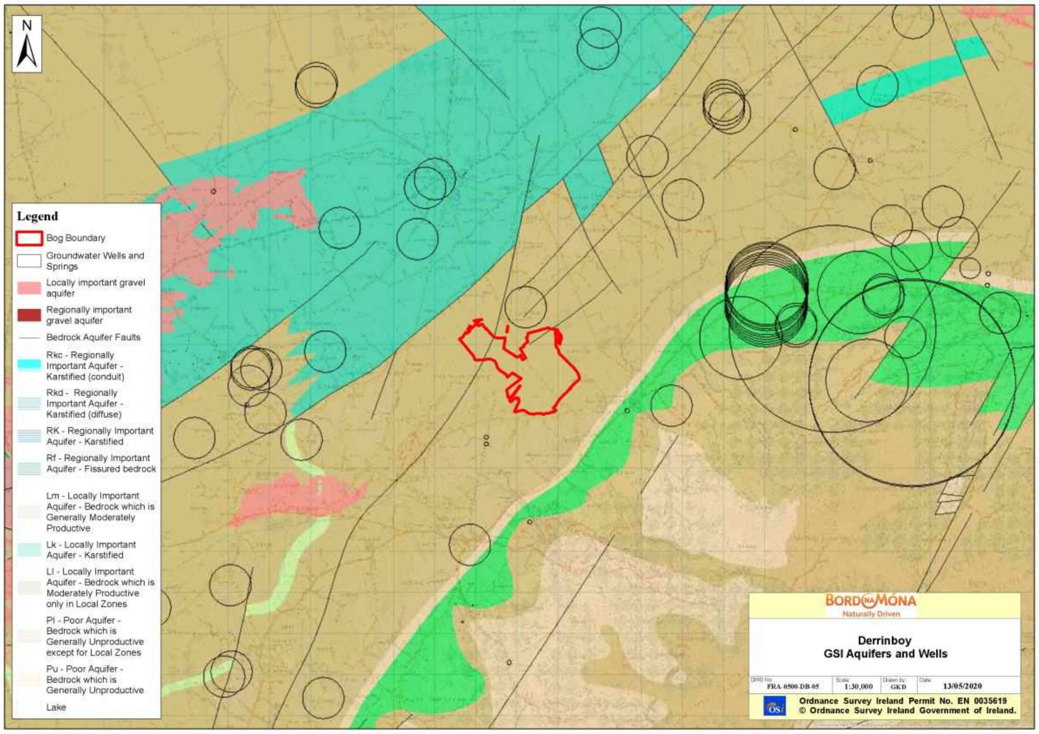


Figure 2.9.7 Derrinboy Bog Aquifers, Karst Features, Wells

Information from Bord na Móna operatives familiar with Derrinboy Bog confirmed that groundwater seepage has not been identified as a source of flooding within the bog

2.9.7 Fluvial Flood Risk

The rivers and streams in the vicinity of Derrinboy Bog are described in terms of regional hydrology in section 2.9.4.

The 3 surface water outfalls in Derrinboy Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameter of these outfalls is shown in the Table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW38	0.450
SW39	0.450
SW40	0.450

Table 2.9.1 Derrinboy Bog Surface Water Outfalls

Information from Bord na Móna operatives familiar with Derrinboy Bog confirmed the outfalls will become submerged when the water levels of the rivers into which they are discharging are high. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Boora Bog. River Flood Events High Range mapping has been examined in the region of this bog. Mapping carried out for the Silver (Cormac) river predicts flooding will be in excess of 10 km from the site and is not predicted to encroach into Derrinboy bog. There is no mapping available for the other rivers in the vicinity of the bog.

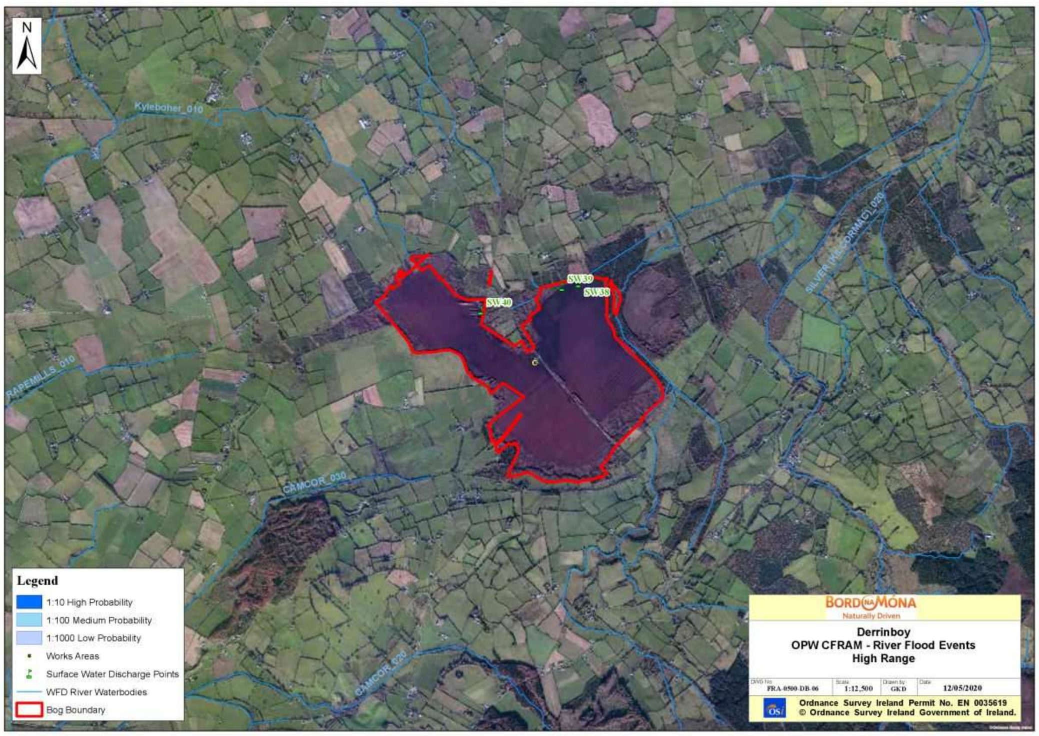


Figure 2.9.8 Derrinboy Bog River Flood Events High Range

2.9.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below.

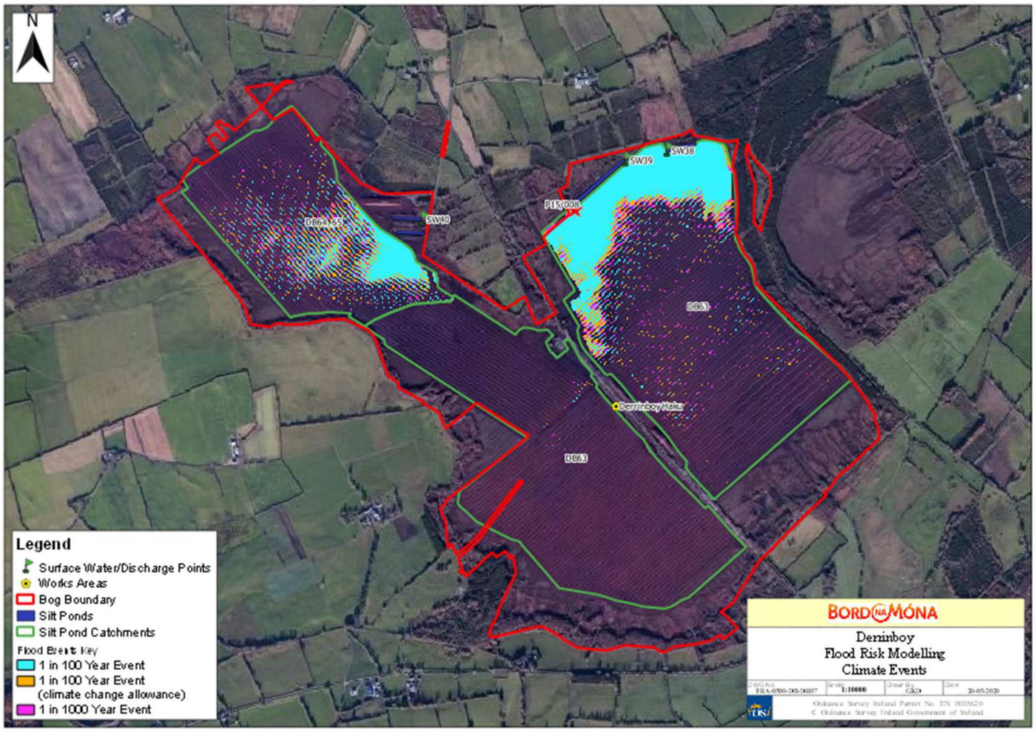


Figure 2.9.9 Derrinboy Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the Surface water discharge points in the bog. Derrinboy Bog is modelled for 2 basins DB63 and DB64_65 and further details on the modelling is set out in the Appendix. Basin DB63 includes an area to the west of the public road which is connected by a culvert under the road.

The above model is based on the assumption that the flood water, other than the green field runoff rate through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

The model shows that flood waters are collecting in local areas in the north west and north east parts of the bog. The maximum flood level in the northeast part of the bog area for the 1000year event is 83.92mOD and in the north west for the same flood event is 87.64mOD. The high flood level in the north-western section of the bog (catchment DB64_65) is due to the higher ground levels in this area and due to the topography of the bog, this flood level will be retained in this basin.The most extensive flooding is shown in the north west and north east sections, where rainfall generated over these basins is drained.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The finished floor levels of the buildings in the Works Area are circa 85.6mOD. The elevation of these buildings is higher than the modelled flood waters in the vicinity of the works area. While the modelled flood level in the north-western section of the bog exceeds this finished floor level, this is due to the high ground levels in this area. This flood water will be retained within the modeled basin due to the ground levels that separate basin DB64_65 and DB63 and will not impact on the Works Area. From this model Derrinboy Bog works area which includes welfare facilities, car parking and oil storage facilities is not as risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	**DB63**	**DB64_65**
mOD	**m^3**	**m^3**
83.00	34945	0
83.25	64211	0
83.50	102876	0
83.75	150288	0
84.00	208330	0
84.25		0
84.50		0
84.75		1
85.00		5
85.25		19
85.50		59
85.75		157
86.00		368
86.25		894
86.50		2252
86.75		5081
87.00		10393
87.25		19668
87.50		35950
87.75		64433

Table 2.9 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Derrinboy Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

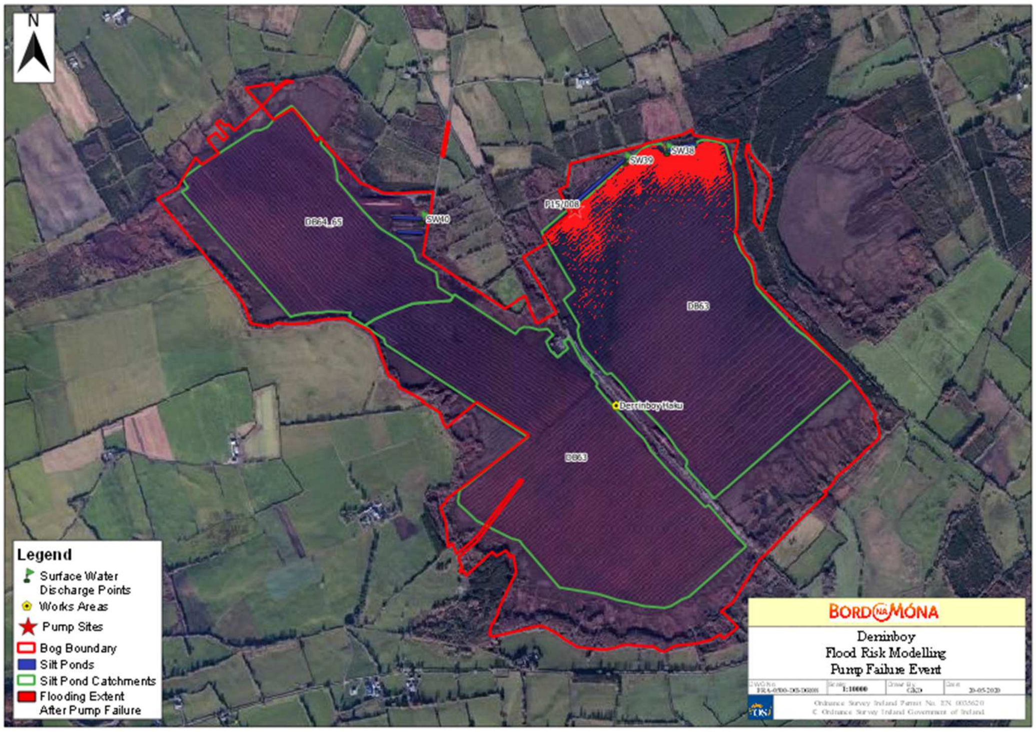


Figure 2.9.10 Derrinboy Bog Pluvial Flooding, Pump Failure

Derrinboy Bog has a pump P15-08 located in the east of the bog for the pumping of surface water from low lying areas. This pump has been dis-regarded for the flood modelling of the extreme rainfall events set out above as these pumps are not designed for such events. Pump P15-08 is an 18kw pump with an outfall level of 81.79mOD.

The pump discharges into a drain that flows by gravity into the silt ponds upstream of surface water outfall SW39. In the event that this pump fails, the surface water will pond in low lying areas on the bog to a level where it can discharge by gravity flow. The above figure models the flooding that will occur in the event that this pump is turned off or breaks down. The expected flood water level in this situation is plotted in red. All flooding caused by the failure of this pump will be retained within the bog peat production area

2.9.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 2.9.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100year event + 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case, the maximum rainfall for the 100year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 2.9.7, the High Emissions Scenario (HEFS) has been considered which considers the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

2.9.10 **Conclusions**

The Flood Risk Assessment for Derrinboy Bog identifies the sources of flood risk and their impact. Historical information was also reviewed.

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area does occur on occasion.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the adjoining water courses if their levels ever rise during flood events. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings area would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Works Area in Derrinboy Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low Risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Derrinboy Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 2.9.2 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Derrinboy Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped

outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;

- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Derrinboy Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

2.10 Derryclure

2.10.1 **Introduction**

Derryclure Bog is part of the Bord na Móna Boora Bog Group which operates under an Integrated Pollution Control Licence (ref P0500-01). The Bog is used primarily to produce milled horticultural peat and the total area within Bord na Móna ownership is 330 Ha.

2.10.2 **Site Location**

Derryclure Bog is located in County Offaly, 6 Km south of Tullamore. The N80 national primary road from Tullamore to Mountmellick passes along the western edge of the Bog. The site is within the Lower Shannon 25A catchment, (Hydrometric Area 25).

The Derryclure Bog location is highlighted in red in the Figure below.

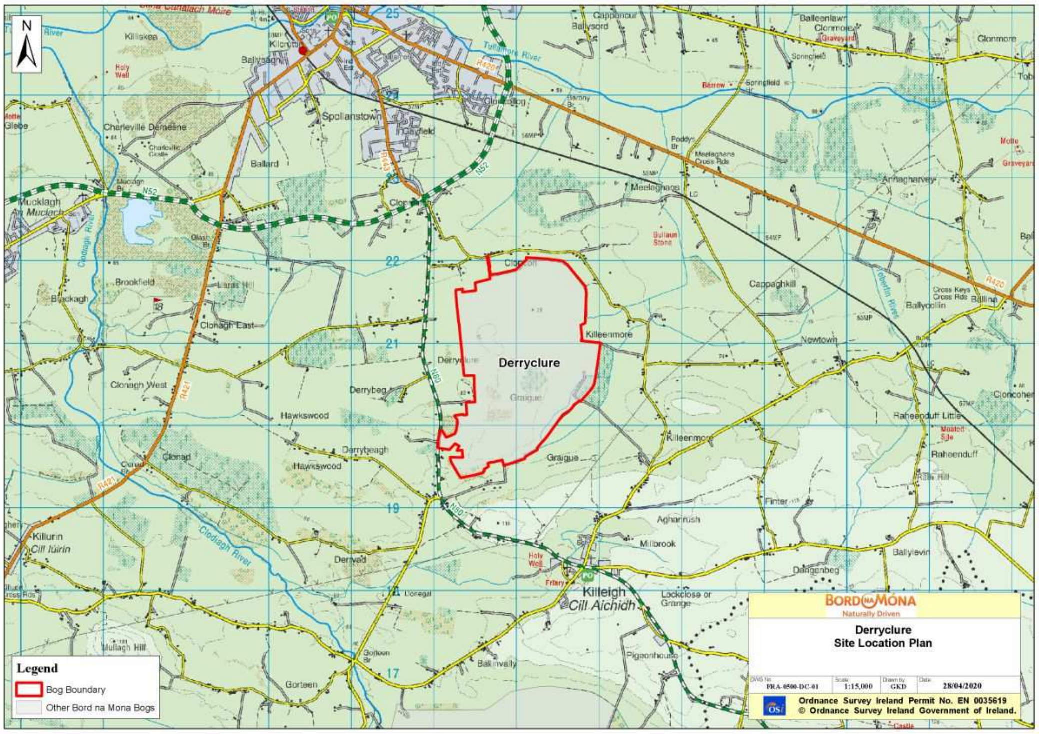


Figure 2.10.1 Derryclure Bog Site Location

2.10.3 **Bog Description**

Derryclure bog has been used by Bord na Móna for the extraction of milled peat and this peat is primarily for horticultural use. The production bog is made up of a mosaic of different land uses with active production areas predominating and a section of remnant mostly wooded raised bog. Some former production areas have revegetated or regenerated. Some sections of wet grassland, Birch woodland and cutover bog are located along the edges of the bog. There is some domestic turfcutting along the south-eastern margins of the bog. This bog was drained by Bord na Móna in 1987 with peat production commencing in 1992.

The existing ground levels of the peat production areas range from 77.5mOD in the north-western corner of the site to 75.8mOD in the northern-eastern corner of the site. There is a works area in the south west corner of the bog and this includes welfare facilities, car parking and storage area. The finished floor level of the buildings in this Works Area is circa 78.5mOD. The main access point to the bog is off the public road N80 into the works area. There is no rail line on this bog and peat is stockpiled close to the Works Area for loading into lorries.

There are 2 gravity flow surface water outflows, with associated silt ponds, in Derryclure Bog SW27 located in the east of the bog and SW28 located in the north.

Details of the existing drainage layout is shown in the Figure below.

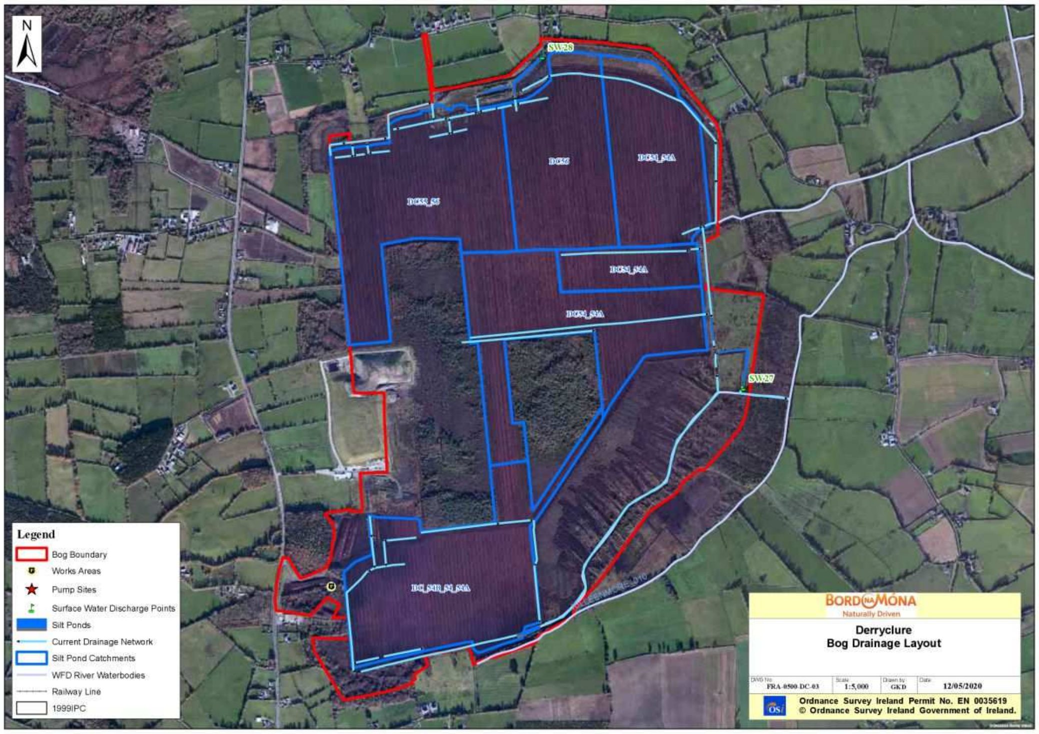


Figure 2.10.2 Derryclure Bog Drainage Layout

2.10.4 **Regional Hydrology**

Derryclure Bog is within in the Lower Shannon 25A catchment (Hydrometric Area 25). The Lower Shannon 25A catchment covers an area of 1,248km² and is characterised by relatively flat topography with extensive areas of boglands in the low-lying areas. The Lower Shannon (Brosna) catchment comprises 12 sub catchments with 60 river water bodies, four lakes and 18 groundwater bodies.

There are two gravity flow surface water outflows, with associated silt ponds in Derryclure Bog. SW28 is located along the northerly boundary of the site and SW27 along the easterly boundary. There are no pumped outfalls and all flow in Derryclure Bog is gravity. SW28 outfall discharges into the Tullamore_030 and the SW27 discharges into the Killeenmore_010 and both of these water bodies are in the Tullamore_SC_010 sub catchment. The Tullamore_030 is located approximately 750m north of SW28. The Killeenmore_010 is located within 50m of SW27.

The catchment areas, water courses and District Drainage Schemes are shown in the Figures below.

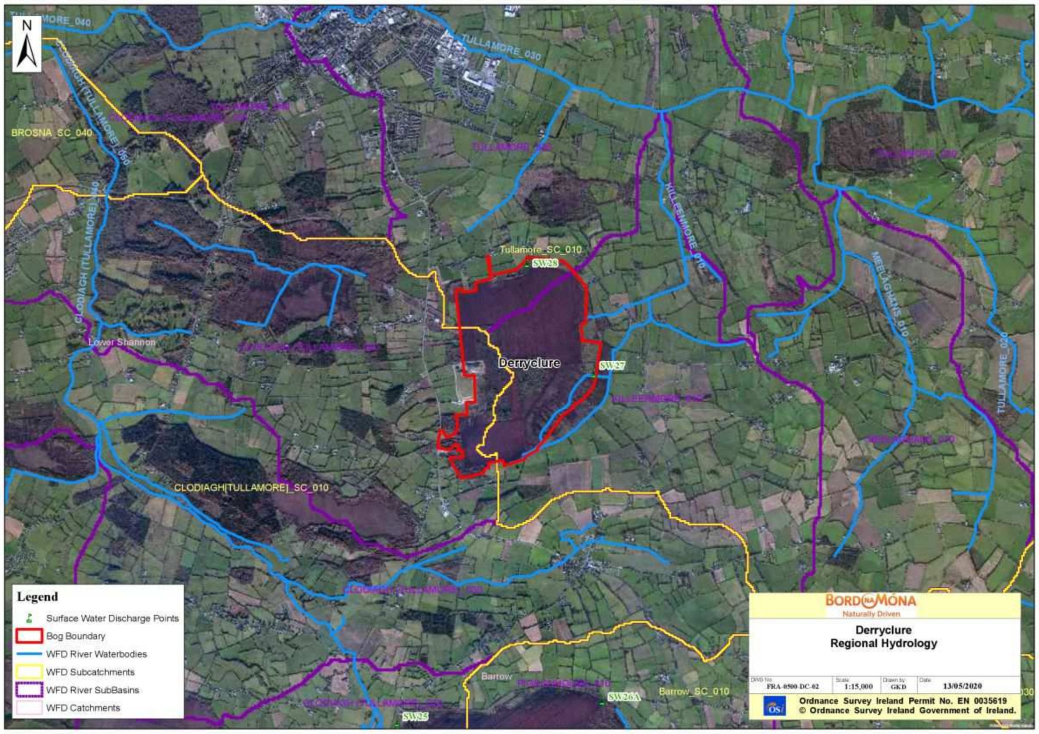


Figure 2.10.3 Derryclure Bog Regional Hydrology

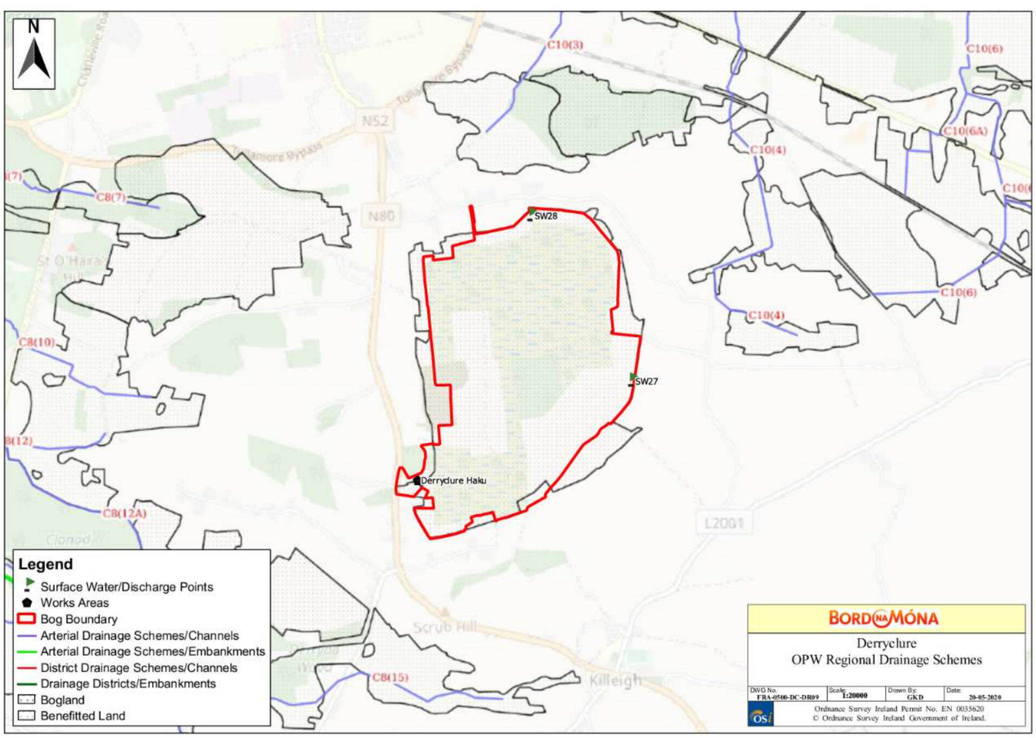


Figure 2.10.4 Derryclure Bog District Drainage Schemes

The benefitted land from District Drainage Schemes is also highlighted demonstrating that there are limited benefitting lands associated with this scheme in the area of these bogs.

The groundwater aquifer underlying Derryclure Bog is categorised as Ll - *Locally Important Aquifer- Bedrock which is moderately Productive only in Local Zones.* This is discussed further in section 2.10.6.

The Standard Annual Average Rainfall (SAAR) in this location is 918mm.

2.10.5 **Historical Flooding**

The OPW https://www.floodinfo.ie website provides some limited information on flood records throughout the country. A map of historical flooding contained for the area, in the vicinity, of Derryclure Bog is shown in the Figure below.

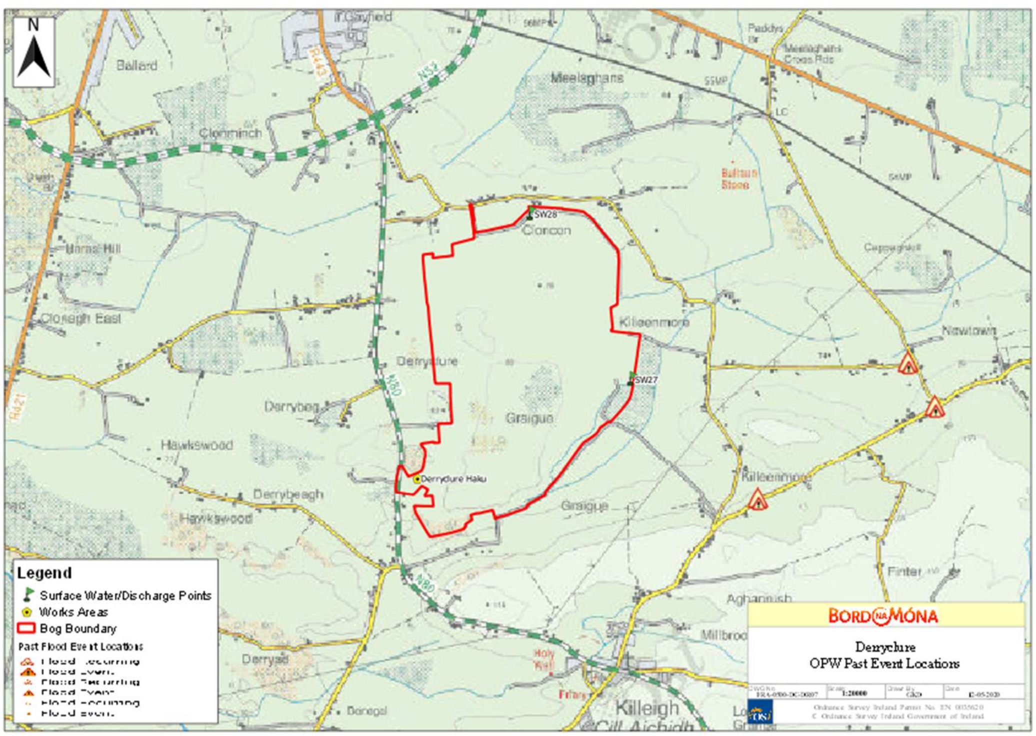


Figure 2.10.5 Derryclure Bog Historical Flooding

The OPW Past Flood Events show no records of any flooding events encroaching into Derryclure Bog.

The flooding events to the east of Derryclure bog are identified in the *Tullamore Area Engineer-Minutes of meeting identifying areas subject to flooding – Offaly Tullamore, dated*

26/10/2005. In these minutes the flooding is described as '*Killeenmore – Stream overflows after heavy rain every year. Road is liable to flood*.'

There is no anecdotal evidence to suggest any historical flooding of the site. Information from Bord na Móna operatives familiar with Derryclure Bog confirmed that surface water flooding has, on occasion, occurred in the production area where blockages to the existing drainage network have occurred over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production.

2.10.6 **Groundwater Flood Risk**

The groundwater aquifer underlying Derryclure Bog is categorised as Ll - *Locally Important Aquifer- Bedrock which is moderately Productive only in Local Zones.* This aquifer has moderate vulnerability.

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below.

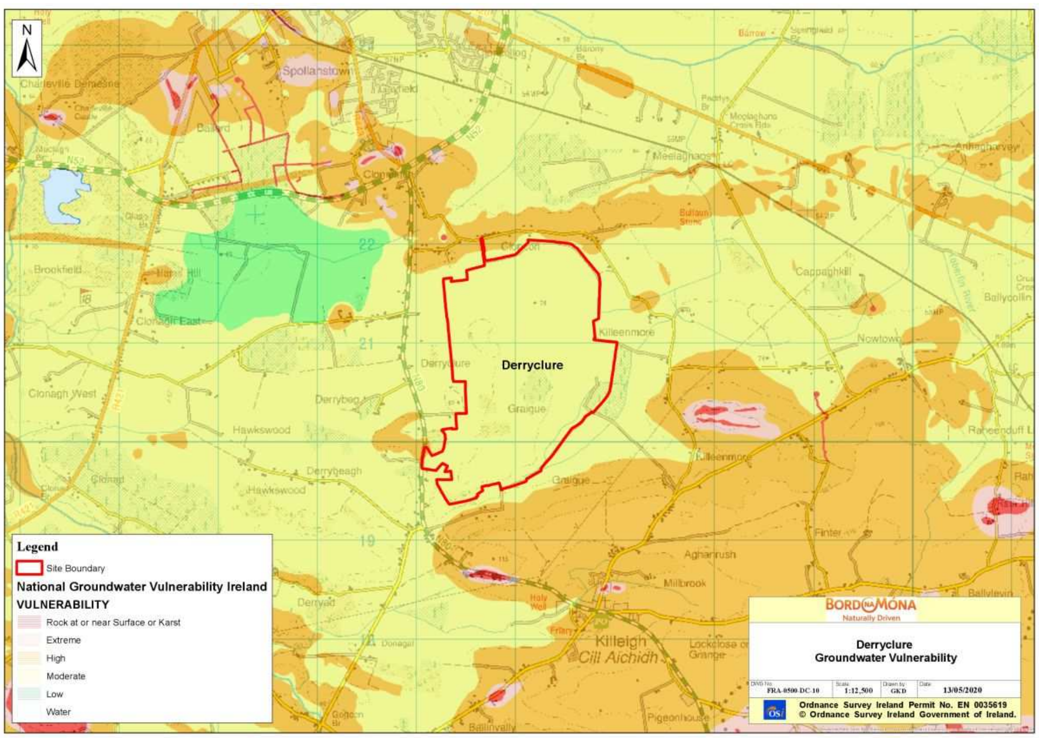


Figure 2.10.6 Derryclure Bog Groundwater vulnerability

The GSI https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx website provides information on groundwater throughout the country. There are a number of boreholes shown to the north east of Derryclure Bog and are recorded as having been dug in the 1960's. According to the GSI website the accuracy for this location is 1Km and Information from Bord na Móna operatives familiar with Derryclure Bog confirmed that this well is not located within the bog boundary.

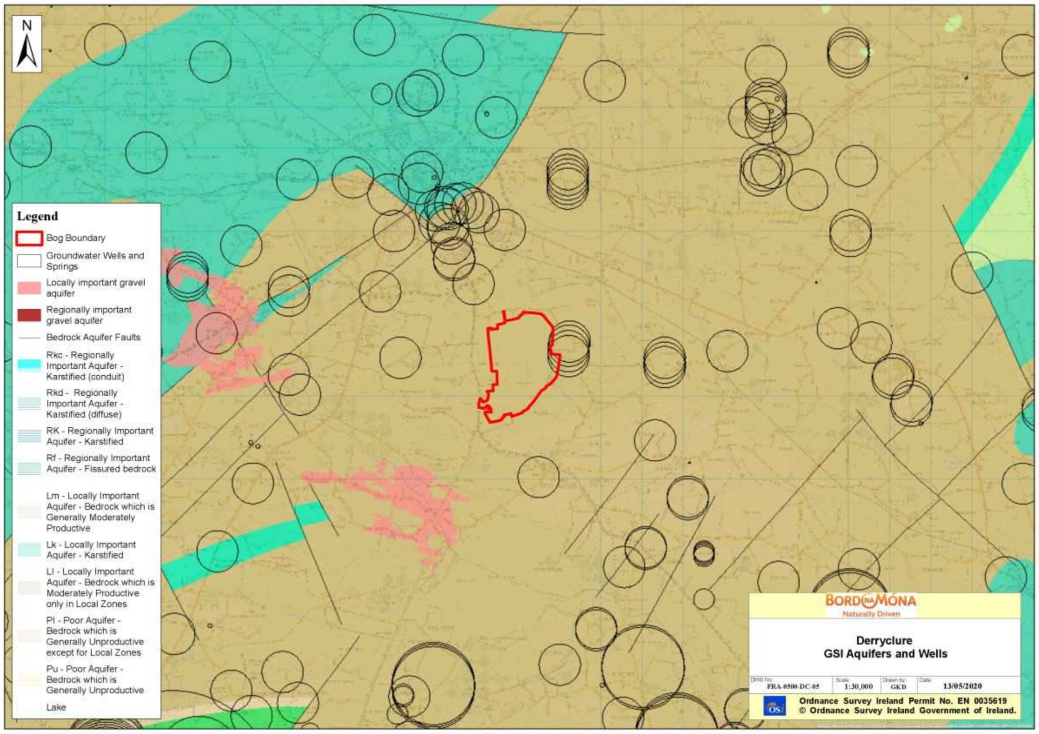


Figure 2.10.7 Derryclure Bog Aquifers, Karst Features, Wells

Information from Bord na Móna operatives familiar with Deryclure Bog confirmed that groundwater seepage has not been identified as a source of flooding within the bog

2.10.7 **Fluvial Flood Risk**

The rivers and streams in the vicinity of Derryclure Bog are described in terms of regional hydrology in section 2.10.4.**Error! Reference source not found.**

The 2 surface water outfalls in Derryclure Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameters of these outfalls is shown in the Table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW27	0.600
SW28	0.600

Table 2.10.1 Derryclure Bog Surface Water Outfalls

Information from Bord na Móna operatives familiar with Derryclure Bog confirmed the outfalls will become submerged when the water levels of the rivers into which they are discharging are high. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Boora Bog. River Flood Events High Range mapping has been examined in the region of this bog. Mapping carried out for the Clodiagh (Tullamore) river predicts flooding will be in excess of 2 km from the site and is not predicted to encroach into Derryclure bog. There is no mapping available for the other rivers in the vicinity of the bog.

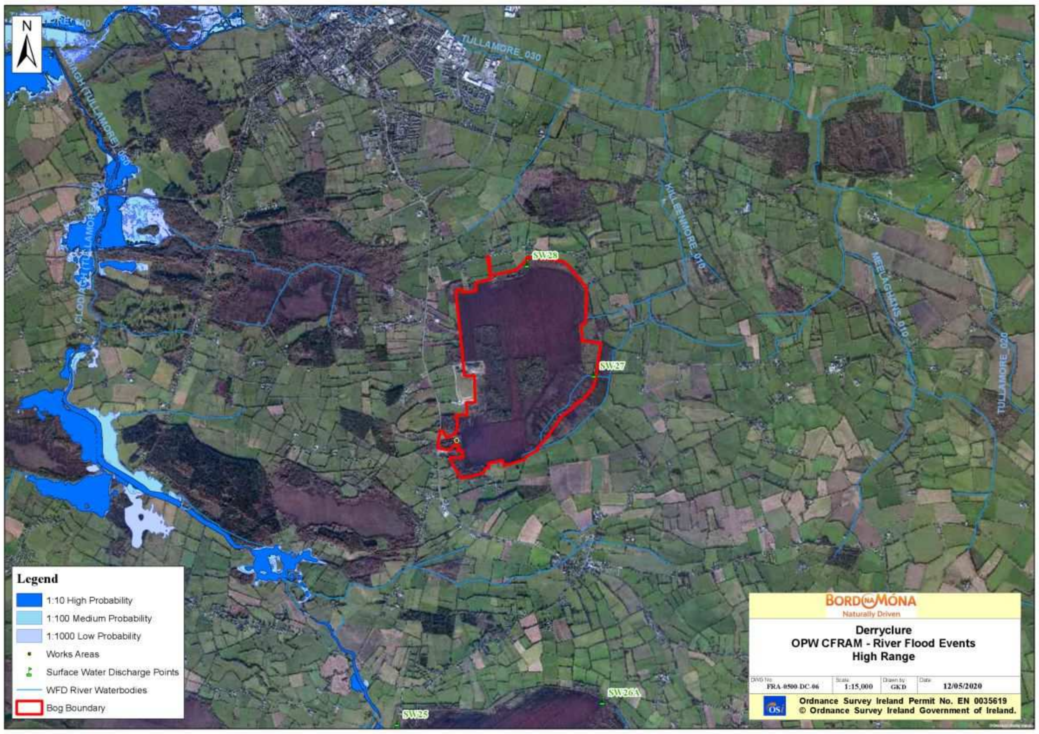


Figure 2.10.8 Derryclure Bog River Flood Events High Range

2.10.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.
The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)
- 1 in 1000yr rainfall
-

The results of flood risk analysis results are presented in the Figure below.

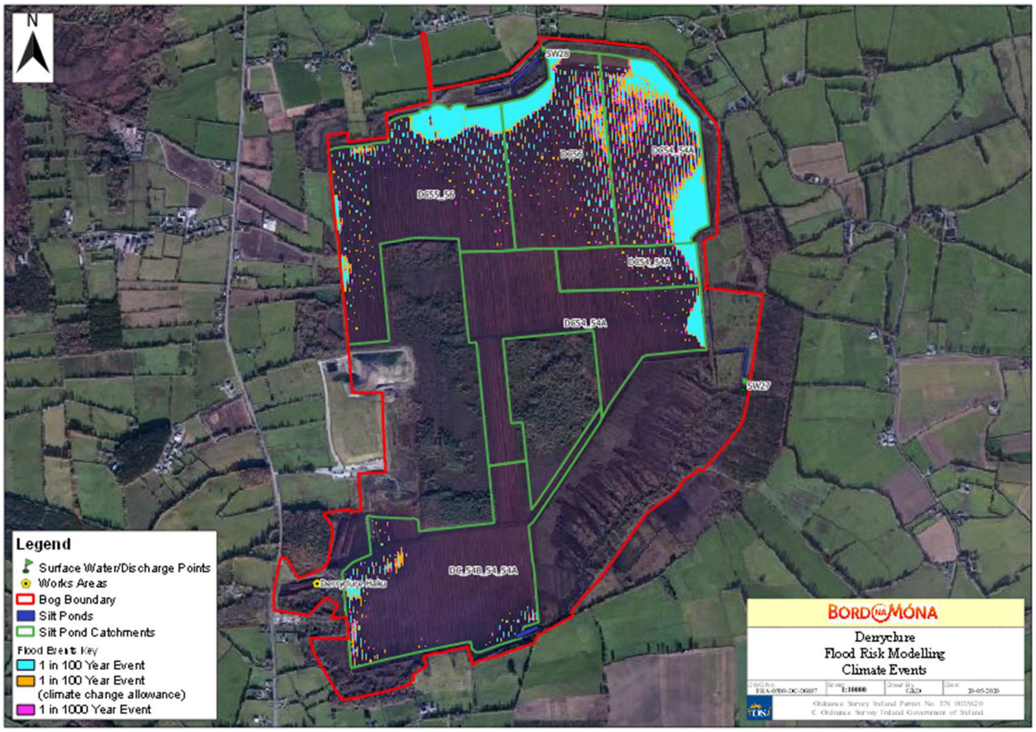


Figure 2.10.9 Derryclure Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the Surface water discharge points in the bog. Derryclure Bog is modelled for 2 basins, DC54_54A & DC54_54A_54B and DC56 &DC 55_56. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, , and as outfalls are piped as described above, this is a reasonable assumption.

The model shows that flood waters are collecting in local areas in the east and north parts of the bog and a smaller area of flooding in the south west corner. The most extensive flooding is shown in the east section, where rainfall generated over this basin is drained. The maximum flood level in this area for the 1000year event is 76.79mOD. The maximum flood level for the same event in the northern part of the bog is 76.95mOD

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The finished floor levels of the buildings are circa 78.5mOD. The elevation of these buildings is higher than the modelled flood waters in the vicinity of the works area. From this model Derryclure Bog works area which includes a workshop, welfare facilities and oil storage facilities is not as risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	**DC54_54A_0**	**DC55_56**
mOD	**m^3**	**m^3**
75.00	1629	8
75.25	4379	35
75.50	9217	141
75.75	16756	564
76.00	27431	2317
76.25	41969	7623
76.50	62201	18876
76.75	93353	36526

Table 2.10.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Derryclure Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

2.10.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 2.10.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100year event + 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case, the maximum rainfall for the 100year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 2.10.7, the High Emissions Future Scenario (HEFS) has been considered which takes into account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

2.10.10 **Conclusions**

The Flood Risk Assessment for Derryclure Bog identifies the sources of flood risk and their impact. Historical information was also reviewed.

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area does occur on occasion.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the adjoining water courses if their levels ever rise during flood events. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings area would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Works Area in Derryclure Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Derryclure Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 2.10.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

3. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
4. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(v) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(vi) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(vii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(viii) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Derryclure Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning

procedures further ensure minimal risk to people, property, the economy and the environment;

- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Derryclure Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

2.11 Monettia Bog

2.11.1 **Introduction**

Monettia Bog is part of the Bord na Móna Boora Bog Group which operates under an Integrated Pollution Control Licence (ref P0500-01). The Bog is used primarily to produce milled horticultural peat and the total area within Bord na Móna ownership is 709 Hectares.

2.11.2 **Site Location**

Monettia Bog is located on the Offaly/Laois county boundary approximately 3 kilometres south/west of Killeigh and 11.5 kilometres south of Tullamore. The site is within the Lower Shannon 25A and Barrow 14 catchments, (Hydrometric Areas 25 and 14).
The Monettia Bog site location is highlighted in red in the Figure below and is 709 Hectares.

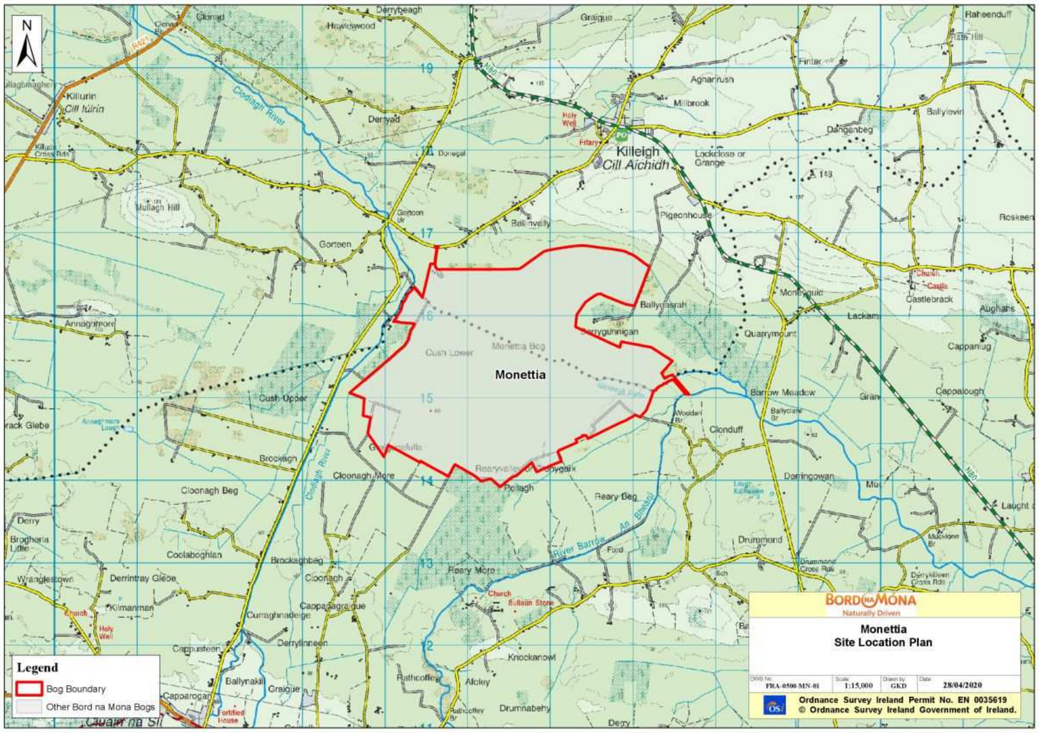


Figure 2.11.1 Monettia Bog Site Location

2.11.3 Bog Description

Monettia bog is used primarily for the production of milled horticultural peat. There is also some private domestic sod peat cutting around the margins, with large sections of cutover bog located along the southern and western boundaries of the site. The site boundary of the site extends at the south-east corner to the River Barrow channel. This bog was drained by Bord na Móna in 1976 with peat production commencing in 1982.

There is an outloading facility present at the northern end of the site which includes a workshop, welfare facilities and a mechanical tippler for outloading peat to HGVs. The main access to the site is via the L2002 to the north which serves this outloading facility. Access to the bog area is available via machine track and rail line directly at the rear of the works area. The existing ground levels of the peat production areas range from 79.1mOD in the southeast end of the site to 82.9mOD in the western end of the site
Monettia bog is divided into 3 drainage basins that each drain to a separate surface water outfall.

The bog drainage layout is shown in the Figure below.

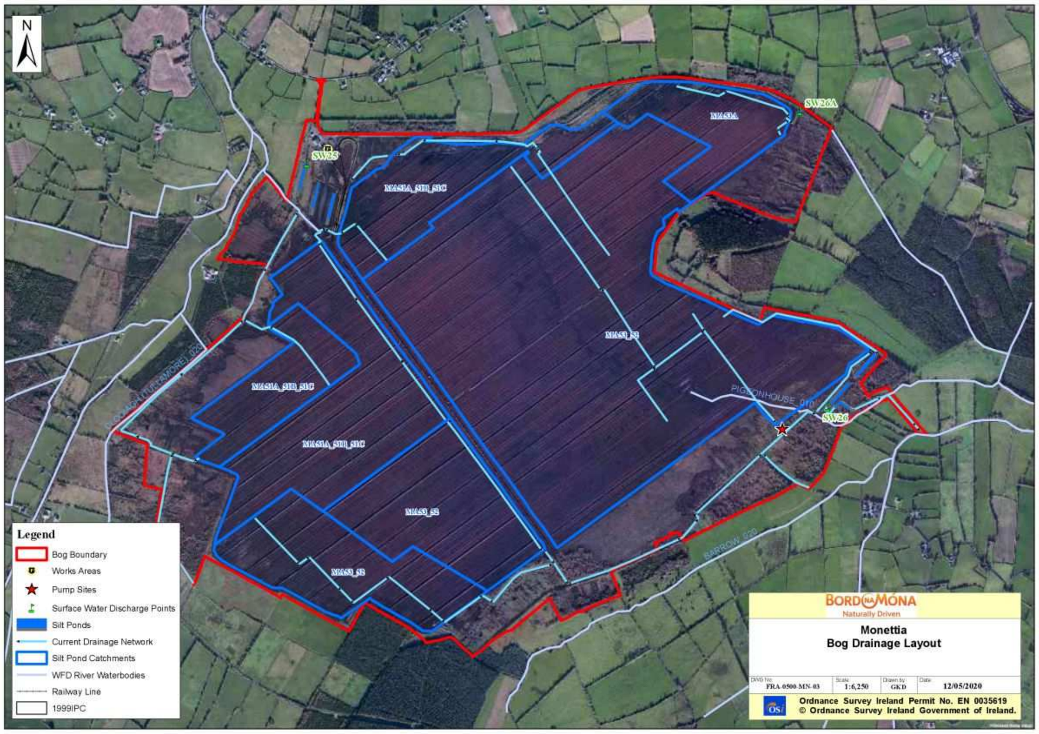


Figure 2.11.2 Monettia Bog Drainage Layout

2.11.4 **Regional Hydrology**

Monettia Bog is within in the Lower Shannon 25A and Barrow 14 catchments (Hydrometric Areas 25 and 14). The Lower Shannon 25A catchment covers an area of 1,248km² and is characterised by relatively flat topography with extensive areas of boglands in the low-lying areas. The Lower Shannon (Brosna) catchment comprises 12 sub catchments with 60 river water bodies, four lakes and 18 groundwater bodies.

The Barrow catchment includes the area drained by the River Barrow draining an area of 3,025km^2. The surface water and groundwater are closely and complexly linked in this catchment particularly south of Monasterevin. The catchment comprises 20 sub-catchments with 145 river water bodies, 6 transitional water bodies and 29 ground water bodies.
There are 2 gravity flow surface water outfalls, SW25 and SW26A, with associated silt ponds in Monettia Bog and they are located along the northern boundary of the site. There is a pump site, P15-05, located upstream of outfall SW26 which is located along the south easterly boundary of the bog.

The SW25 outfall discharges into the Clodiagh (Tullamore)_020 sub basin in the Clodiagh (Tullamore)_SC_010 sub catchment. The Clodiagh Tullamore_020 is located to the north west of the Bog and is 20m west of outfall SW25. SW26 surface water outfall discharges into the Barrow_020 sub basin which flows to the south of the bog and is 8m south of outfall SW26. SW26A surface water outfall discharges into the Pigeonhouse_010 sub basin which flows to the east of the bog and is 40m south of outfall SW26A.

The catchment area and water courses are shown in Figure 2.11.3 The district drainage schemes are shown in Figure 2.11.4

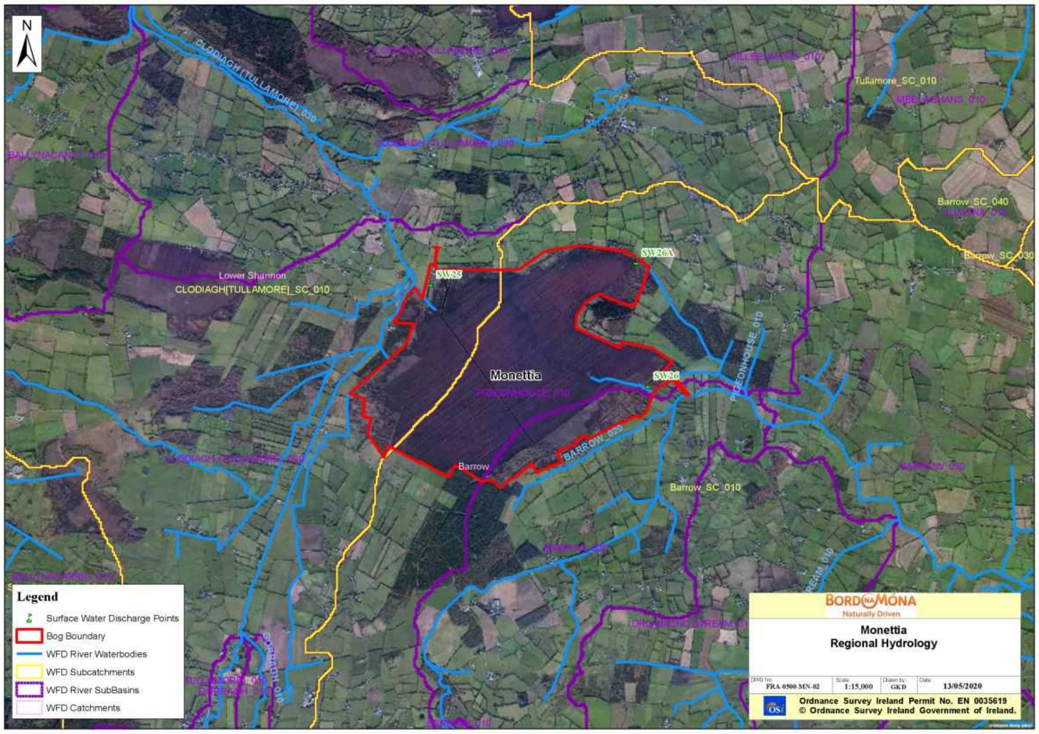


Figure 2.11.3 Monettia Bog Regional Hydrology

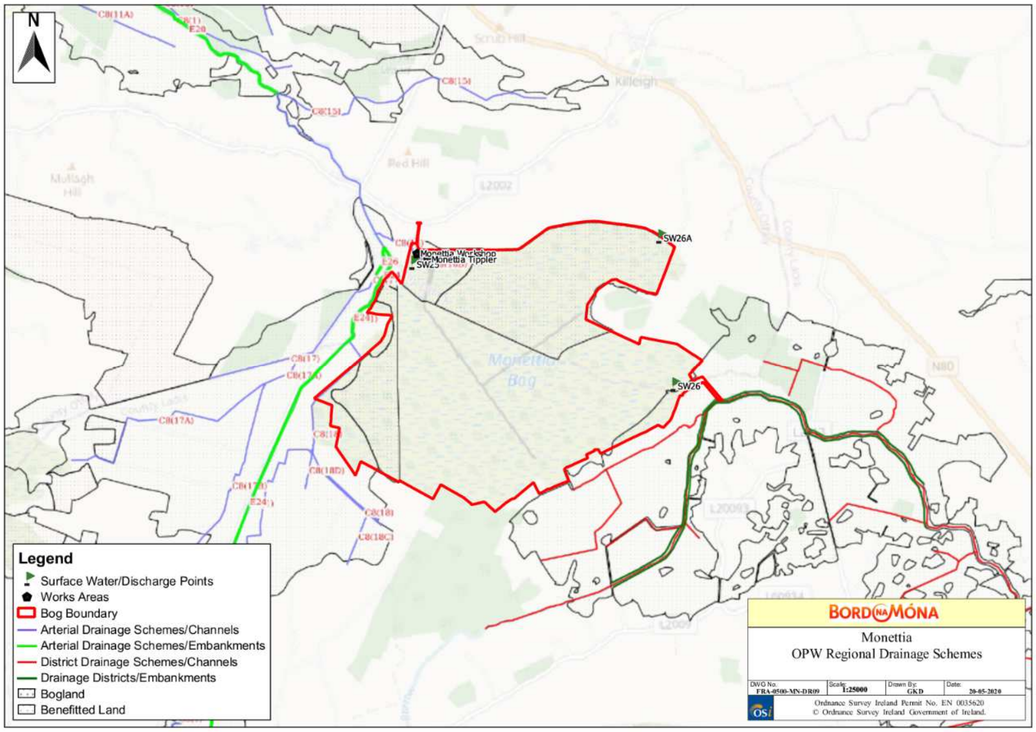


Figure 2.11.4 Monettia Bog District Drainage Schemes

The embankments that form part of the above Drainage schemes are walls of soil or sods that were erected to prevent flood water from entering land. The benefitted land from District Drainage Schemes is also highlighted demonstrating that there are limited benefitting lands associated with this scheme in the area of these bogs.

The groundwater aquifer underlying Monettia Bog is categorised as Ll - *Locally Important Aquifer- Bedrock which is moderately Productive only in Local Zones.* This is discussed further in section 2.11.6
The Standard Annual Average Rainfall (SAAR) in this location is 973mm.

2.11.5 **Historical Flooding**

The OPW, ***Floodinfo.ie***, website provides some limited information on flood records throughout the country. The Figure below shows the flood records contained for the area, in the vicinity, of Monettia Bog.

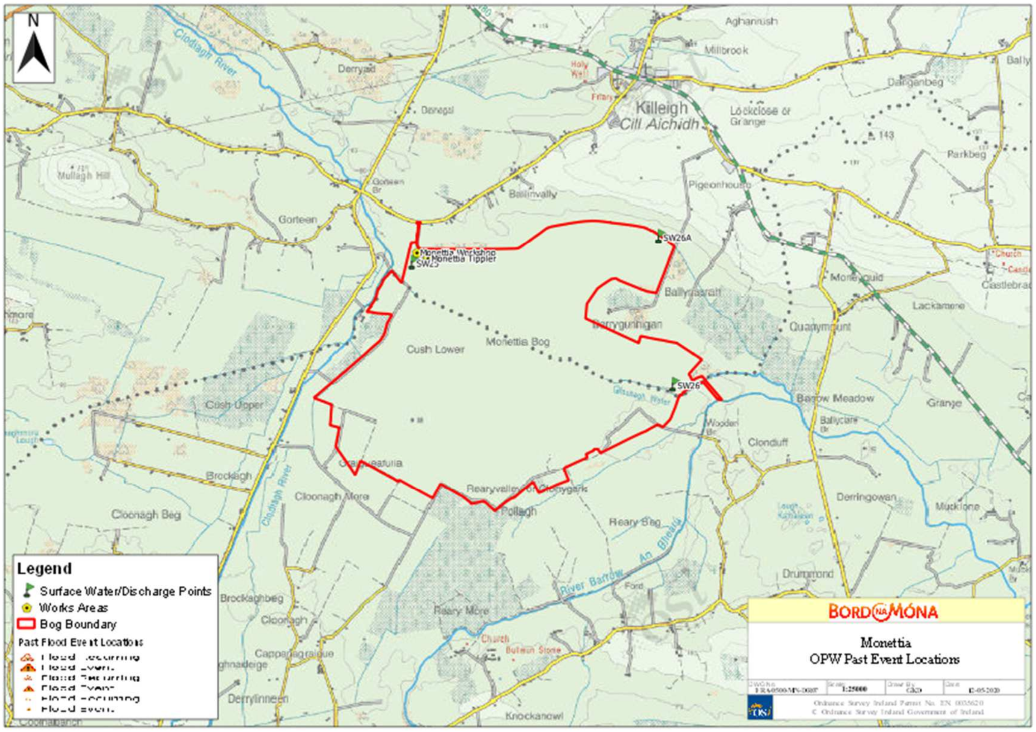


Figure 2.11.5 Monettia Bog Historical Flooding

The OPW Past Flood Events show no records of any flooding events, in the vicinity, of Monettia Bog.

There is no anecdotal evidence to suggest any historical flooding of the site. Local knowledge confirmed that surface water flooding has, on occasion, occurred over the winter months in the production area and associated with blockages to the existing drainage network. Drainage maintenance works are carried out to minimise flooding to the peat production fields on an annual basis as part of the winter works schedule.

2.11.6 **Groundwater Flood Risk**

The groundwater aquifer underlying Monettia Bog is categorised as Ll - *Locally Important Aquifer- Bedrock which is moderately Productive only in Local Zones.* This aquifer has a low vulnerability code throughout most of the bog. In the eastern corner of the bog in the vicinity of SW26 discharge point, the aquifer vulnerability code is moderate.

The local knowledge for Monettia Bog confirmed that groundwater seepage has not been identified as a source of flooding within the bog.

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below:

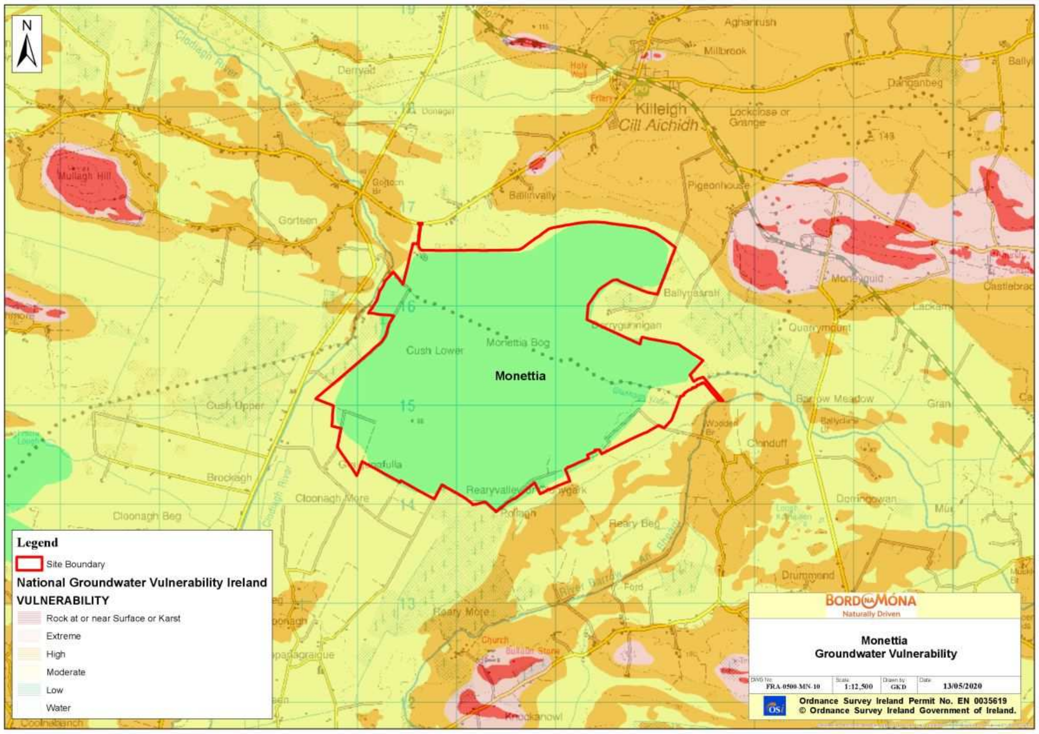


Figure 2.11.6 Monettia Bog Groundwater vulnerability

The GSI https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx website provides information on groundwater throughout the country. There are a no wells or boreholes shown in proximity to Monettia Bog.Information from Bord na Móna operatives familiar with Monettia Bog confirmed that this well is not located within the bog boundary.

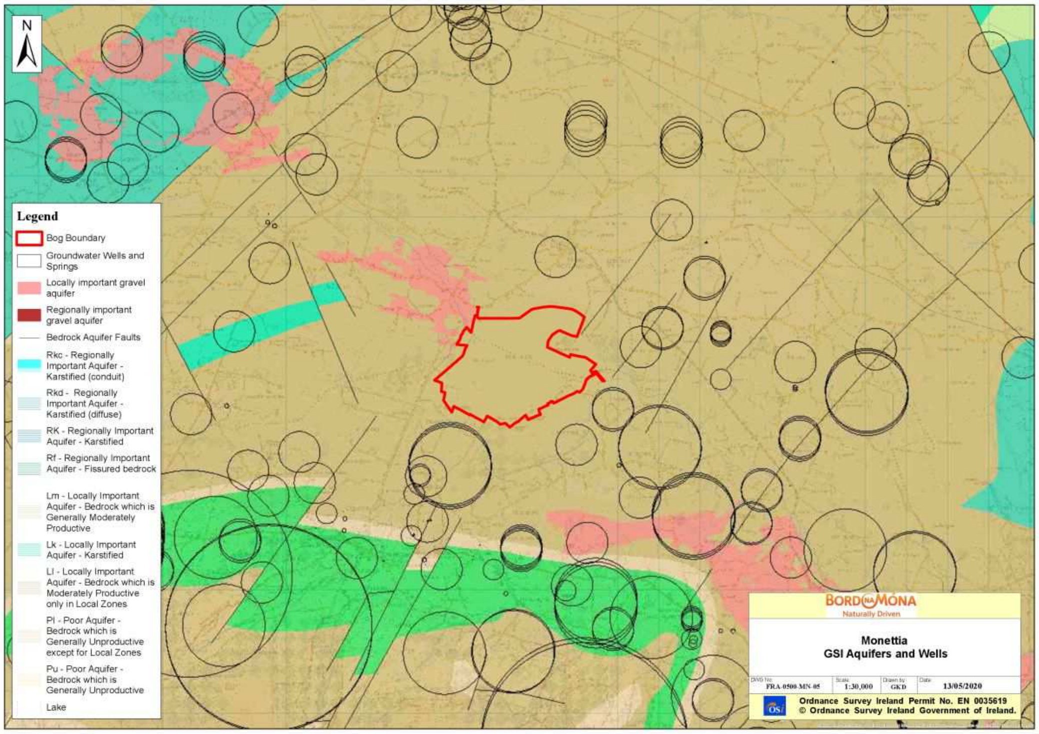


Figure 2.11.7 Monettia Bog Aquifers, Karst Features, Wells

2.11.7 **Fluvial Flood Risk**

The rivers and streams in the vicinity of Monettia Bog are described in terms of regional hydrology in section 2.11.4.

The 3 surface water outfalls in Monettia Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameters of these outfalls are shown in the Table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW25	0.600
SW26	0.450
SW26A	0.450

Table 2.11.1 Monettia Bog Surface Water Outfalls

Information from Bord na Móna operatives familiar with Monettia Bog confirmed that outfalls will become submerged when the water levels of the rivers into which they are discharging are high. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in

1000 year events) associated with Monettia Bog. River Flood Events High Range mapping has been examined in the region of this bog. Mapping carried out for the Clodiagh river identifies the potential for flooding along the western boundary of the site. This flooding is not predicted to encroach into Monettia bog. There is no mapping available for the other rivers in the vicinity of the bog.

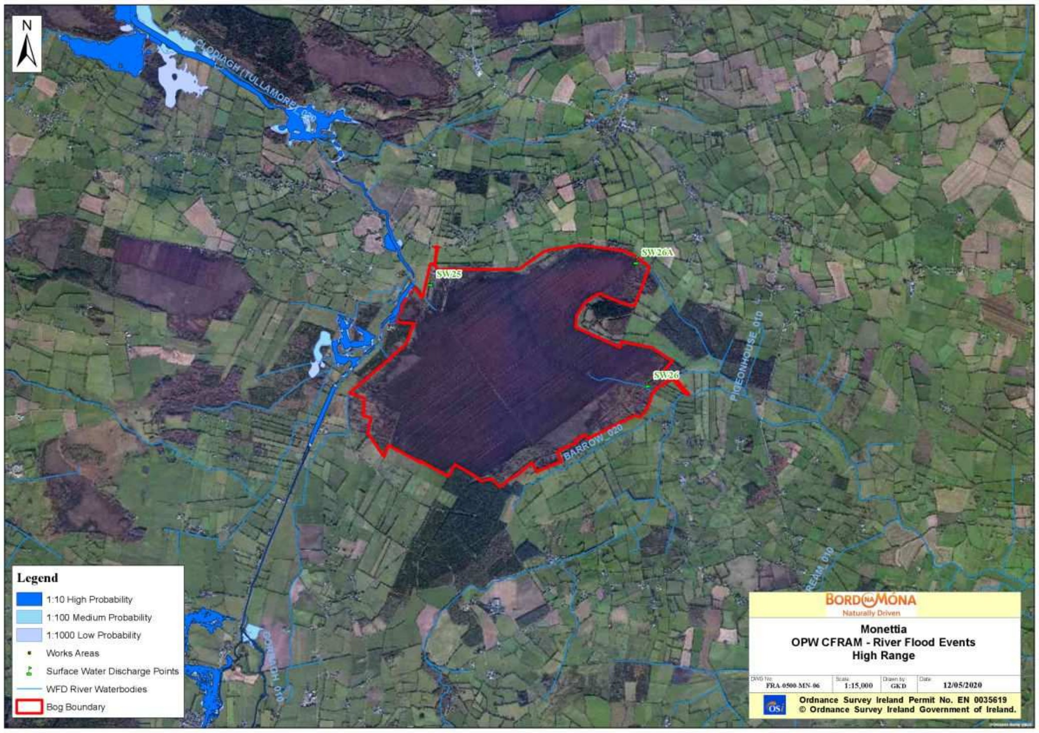


Figure 2.11.8 Monettia Bog Flood Events High Range

2.11.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below.

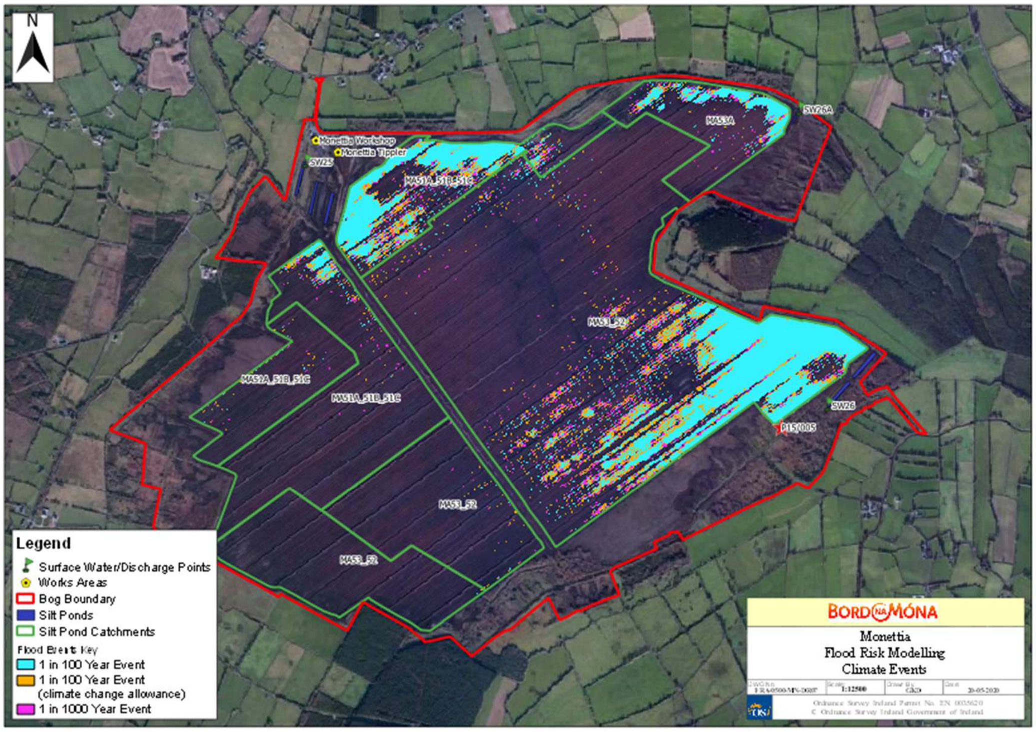


Figure 2.11.9 Monettia Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the Surface water discharge points in the bog. Moniettia Bog is modelled for three separate basins MA53A, MA53_52 and MA51A_51B_51C. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

The model shows that flood waters are collecting in local areas in the northern and south-eastern parts of the bog. The most extensive flooding is shown in the southeast, where rainfall generated over the eastern basin is drained to this corner of the bog. The maximum flood level in this area for the 1000year event is 80.64mOD and the maximum flood level for the area to the south of the works area for the same event is 80.82mOD. The flood level in the extreme north east of the bog is 82.42 mOD however due to the topography of the bog, this flood level will be retained in this area.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The existing ground level of the works area located to the north west of the bog is above 81.00 mOD and the finished floor levels of the buildings are higher than 81.6 mOD. The elevation of these buildings is higher than the modelled flood waters in the vicinity of the works area. While the flood water level in the basin to the east of the bog is higher that the buildings finished floor level, this is due to the topography of the bog in this area and will not cause flooding of the works area due to high ground between the two basins.

From this model that Moniettia Bog works area which includes a workshop, welfare facilities, oil storage facilities and a lorry tippler for loading of peat is not as risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	**MA51A_51B_51C**	**MA53_52**	**MA53A**
mOD	**m^3**	**m^3**	**m^3**
78.00	0	0	0
78.25	1	0	0
78.50	10	12	0
78.75	52	245	0
79.00	279	2079	0
79.25	1006	8164	0
79.50	3308	25861	0
79.75	9415	58300	0
80.00	21090	105975	0
80.25	40858	173072	0
80.50	71555	270398	0
80.75	116105	415497	0
81.00	178129		18
81.25			154
81.50			661
81.75			2532
82.00			6965
82.25			15477
82.50			29531

Table 2.11.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Monettia Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

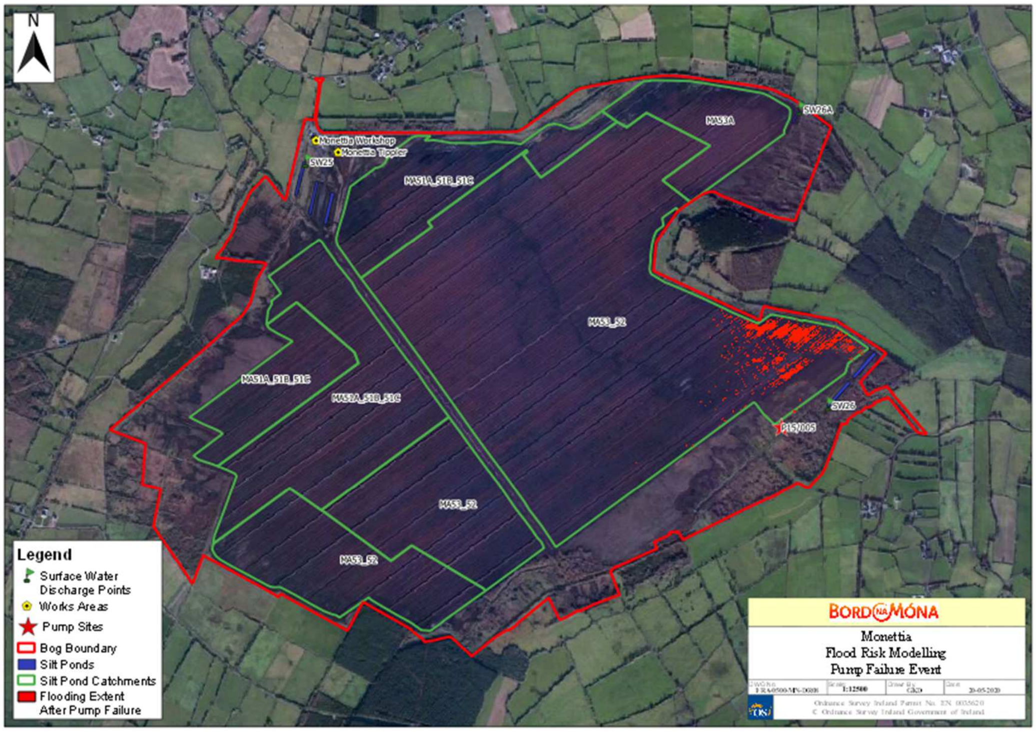


Figure 2.11.10 Monettia Bog Pluvial Flooding, Pump Failure

Moniettia Bog has a pump in the south-eastern area of the bog for pumping of surface water from low lying areas. This pump has been dis-regarded for the flood modelling of the extreme rainfall events set out above as these pumps are not designed for such events. The pump is an 18kw pump with an outfall level of 79.29 mOD.

The pump discharges into a drain that flows by gravity into the silt ponds upstream of surface water outfall SW26. In the event that this pump fails, the surface water will pond in low lying areas on the bog to a level where it can discharge by gravity flow. The above figure models the flooding that will occur in the event that this pump is turned off or breaks down. The expected flood water level in this situation is plotted in red. All flooding caused by the failure of this pump will be retained within the bog peat production area.

2.11.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 2.11.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100year event + 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case, the maximum rainfall for the 100year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 2.11.7, the High Emissions Future Scenario (HEFS) has been considered which takes into account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

2.11.10 **Conclusions**

The Flood Risk Assessment for Monettia Bog identifies the sources of flood risk and their impact. Historical information was also reviewed.

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area does occur on occasion.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the rivers into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the adjoining water courses if their levels ever rise during flood events. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings and peat lorry loading area would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Works Area in Monettia Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Monettia Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 2.11.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

3. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
4. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(v) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(vi) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(vii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(viii) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Monettia Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped

outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;

- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Monettia Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

FLOOD RISK ASSESSMENT – CHAPTER 3
Derrygreenagh Bog Group

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3 FLOOD RISK ASSESSMENTS – DERRYGREENAGH BOG GROUP

3.1 Derrygreenagh Bog Group - IPC License 501

The Derrygreenagh group of bogs are sited between Rochfortbridge, Co. Westmeath in the west to Ballivor Co. Meath in the east and between Delvin Co. Westmeath in the north and Daingean, Co. Offaly in the south. Bord na Móna's licence for the Derrygreenagh Bog Group (Ref. PO501-001) was granted to Bord na Móna Energy Limited on 26 April 2000 and regulates Bord na Móna's activities across 11 bog units. Of these 11 bogs units, 5 are included in the Substitute Consent applications and in this Flood Risk Assessment Report. The five Derrygreenagh bogs included in this report are:

- Bracklin – County Westmeath
- Carranstown – Counties Meath and Westmeath
- Ballivor – Counties Meath and Westmeath
- Kinnegad – County Meath
- Ballybeg – County Offaly

From available records it appears that peat extraction commenced in Ballivor Bog and Ballybeg Bog in the 1950's. Drainage of the remaining three bogs was carried out in the 1970's with peat extraction commencing in the 1980's. Peat from these bogs have been used to supply Ballivor Horticultural Plant and fuel peat to Edenderry Power Station.

The River Boyne is the major river catchment for the area with all bogs located in this catchment. A small area of bog in the southern section of Ballybeg is located in the River Barrow catchment.

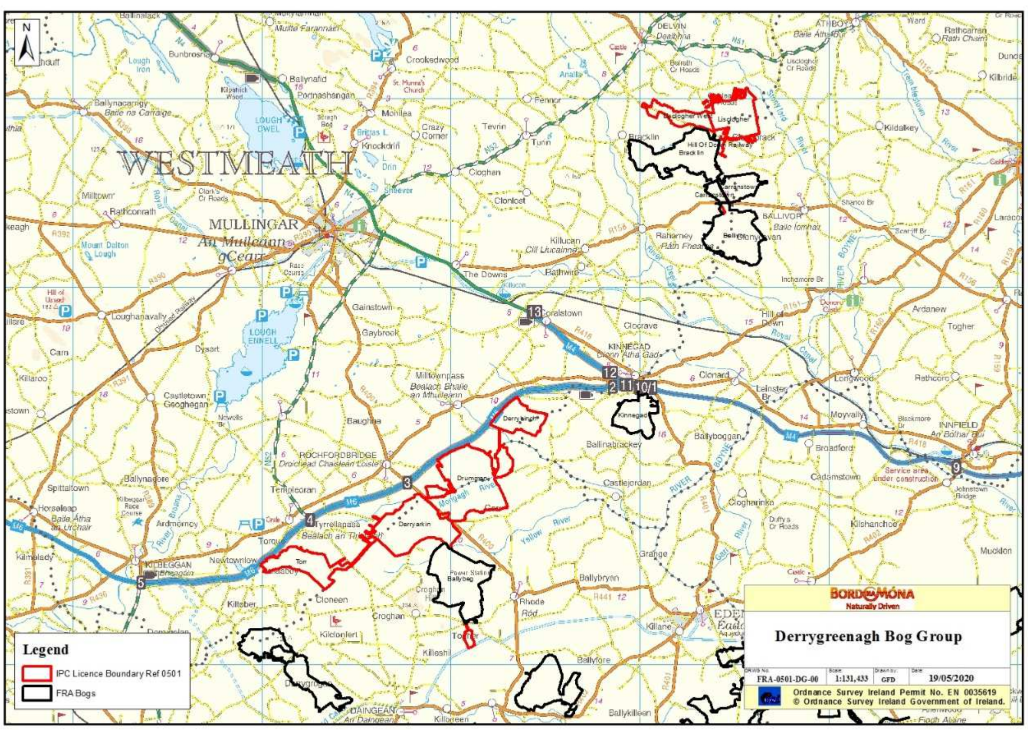

Figure 3.1-1 - FRA, Derrygreenagh Bog Group

3.2 Bracklin Bog

3.2.1 Introduction

Bracklin bog is part of the Bord na Móna Derrygreenagh Bog Group which operates under an Integrated Pollution Control licence (ref P0501-01). This bog supplies horticultural peat and has a permanent rail line that runs south to the horticultural peat factory at Ballivor bog. The overall area of Bracklin Bog within the ownership of Bord na Móna is 755 hectares, however the area included in the Substitute Consent application and considered in this report is the western portion of the bog only. This is the only area where peat production has been carried out since 2012 with the remainder of the bog out of production for many years.

3.2.2 Site Location

The Bracklin site location is highlighted in red in the Figure below. Bracklin Bog is located in County Westmeath and is approximately 5.5 km south of Delvin and 3 km north of Raharney. This bog is one of a cluster of five Bord na Mona bogs, all of which are part of the Derrygreenagh Group.

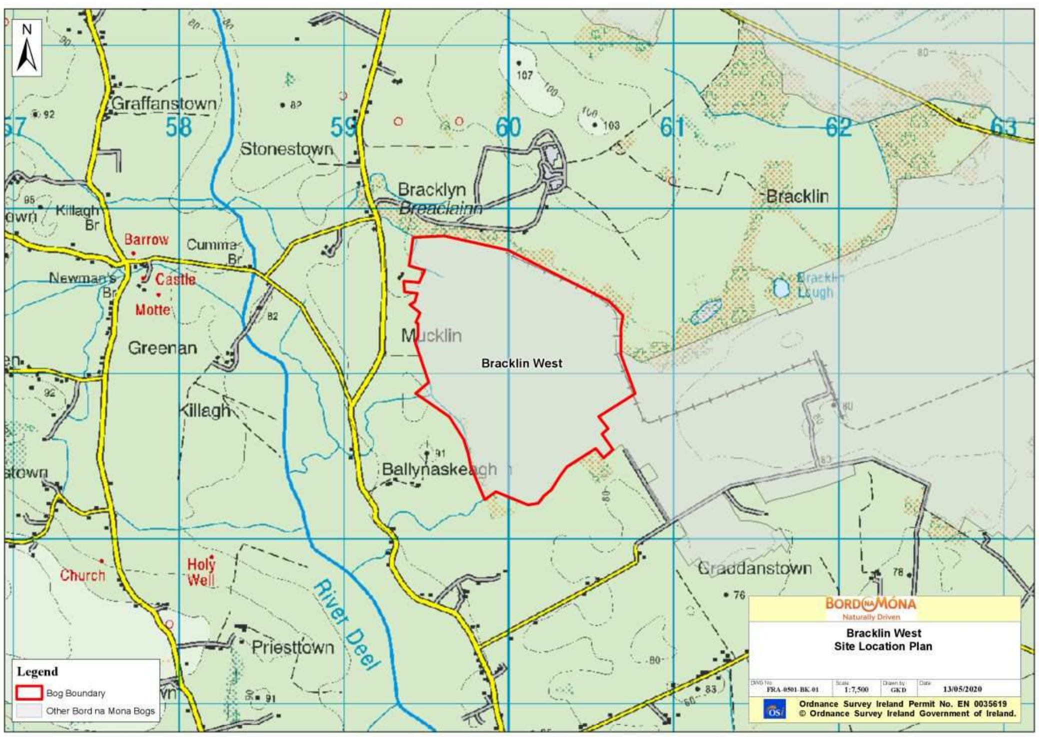

Figure 3.2-1 Bracklin Site Location

3.2.3 Bog Description

The bog layout is shown in the Figure.

Figure 3.2-2 Bracklin Layout

This bog supplies horticultural peat and has a permanent rail line that runs south to the production centre in Ballivor Bog. Drainage development took place in 1979, with the bog initially developed for turf extraction before later being developed for milled peat extraction once the horticultural peat factory at Ballivor bog was developed in 1985. The land use surrounding the bog is comprised of peat harvesting on surrounding bogs and agriculture.

The majority of the western portion of Bracklin Bog site is currently in active peat production. The area of Bracklin bog, to the east of this general area is now cutover and has revegetated to a large extent. There are some edge habitats present around the periphery of the bog. These edge habitats are typically remnant sections of raised bog and cutaway bog. Some of these habitats are old and are mature.

Ground levels are higher around the periphery of the bog and are typically 84 to 85.5mOD, with levels falling to approx. 81.0mOD in the centre of the bog. This bog does not have a dedicated works area and access is available only across machine access routes through Carranstown bog. There are no access points off public roads.

In Bracklin, there are four surface water gravity outfalls from the bog, with associated silt ponds, which discharge along the western and southern boundary of the site. There are no pumped outfalls and all flow in Bracklin Bog is via gravity.

3.2.4 **Regional Hydrology**

The catchment area and water courses are shown in the figures presented here.

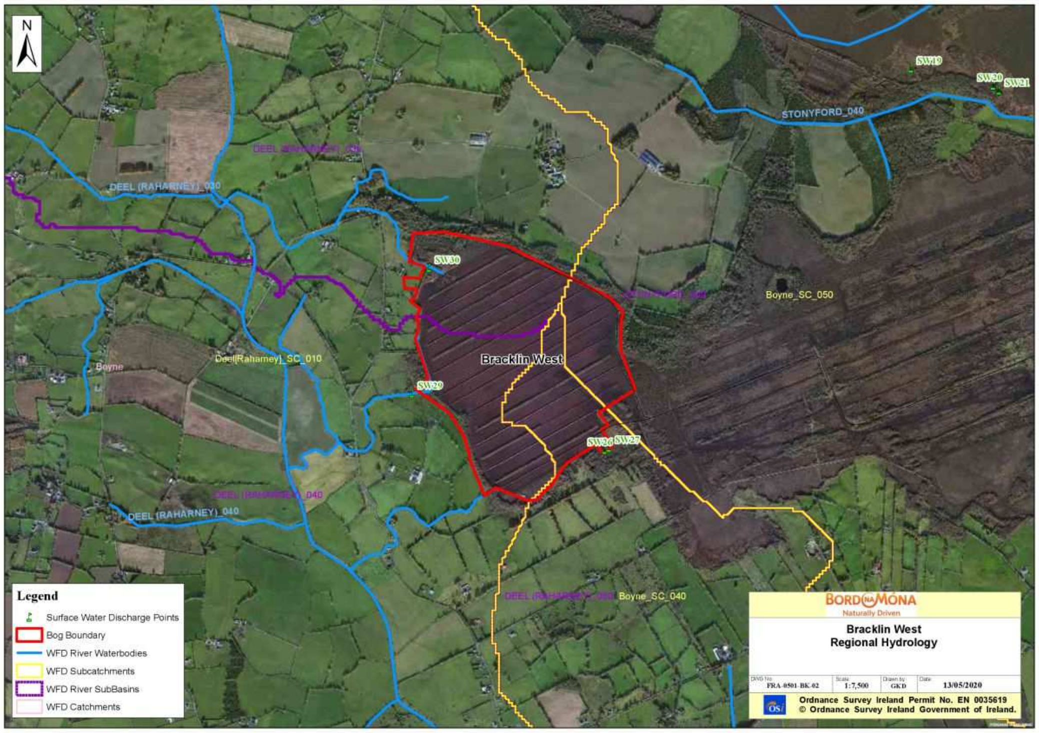

Figure 3.2-3 Bracklin Bog Regional Hydrology

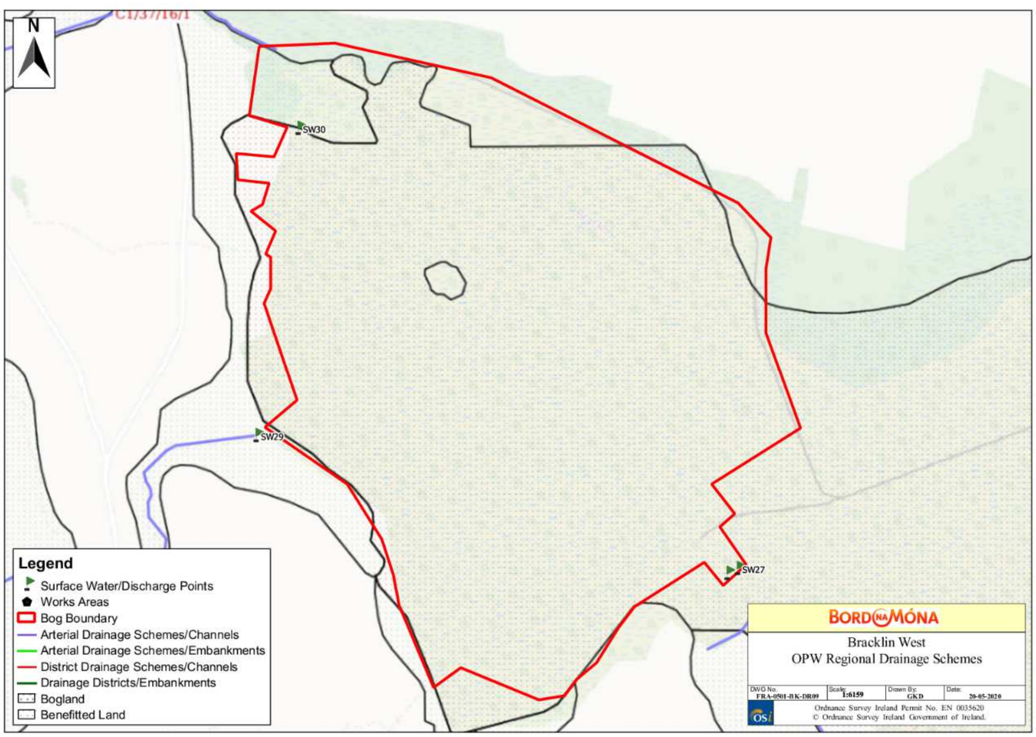

Figure 3.2-4 Bracklin Bog District Drainage Schemes

Bracklin Bog is within the Boyne 07 catchment. The Boyne 07 catchment drains a total area of 2,694km^2 and is characterised by an undulating landscape in the south which changes to a more hummocky, drumlin topography (steep-sided, lenticular hills) in the north. The catchment is underlain by metamorphic rocks in the north and limestone bedrock in the centre and south of the catchment. The Boyne catchment comprises 20 sub-catchments with 114 river water bodies, 11 lakes, one transitional and three coastal water bodies, and 25 groundwater bodies.

The outfalls SW29, SW26 and SW27 discharge to the Dell (Raharney)_040 water course to the west of the bog and SW30 discharges to the Deel (Raharney)_030 water course to the north of the bog. Both watercourses are located in the sub-catchment Deel(Raharney)_SC_010 with the River Deel located circa 800m to the west of the bog.

.

The Arterial Drainage and District Drainage schemes near Bracklin Bog is shown in the figure below. The benefitted land from the Drainage District Scheme is also highlighted demonstrating the enhanced flood protection, as a result of this scheme, for the lands between Bracklin Bog and the River Deel.

The Standard Annual Average Rainfall (SAAR) in this location is 935mm.

3.2.5 **Historical Flooding**

A map of historical flooding is shown in the Figure.

Figure 3.2-5 Bracklin Bog Historical Flooding

There is no anecdotal evidence to suggest any historical flooding of the site. Information from Bord na Móna operatives confirmed that surface water has occurred in the past where blockages to the existing drainage network have occurred over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production fields on an annual basis as part of the winter works schedule. There is no knowledge of flooding where water levels in receiving waters rise above outfall levels.

Historical flood records are taken from the OPW website, https://www.floodinfo.ie. Records of past flood events are given for locations at Delvin, Raharney and Ballivor. The closest flooding event occurred at Wadestown, west of Raharney village and was recorded in 2005 in an oral report given by Westmeath Co. Council as part of an OPW project (OPW Flood Hazard Mapping – Phase 1) and notes that *"Low lying area floods after heavy rain every year. The road is liable to flood if road side drainage is not maintained"*.

Historical OSI 25" mapping was also examined for this area. There is no additional record of flooding to be taken from these maps for Bracklin.

3.2.6 **Groundwater Flood Risk**

A map of aquifers, karst features and known wells is shown in the Figure.

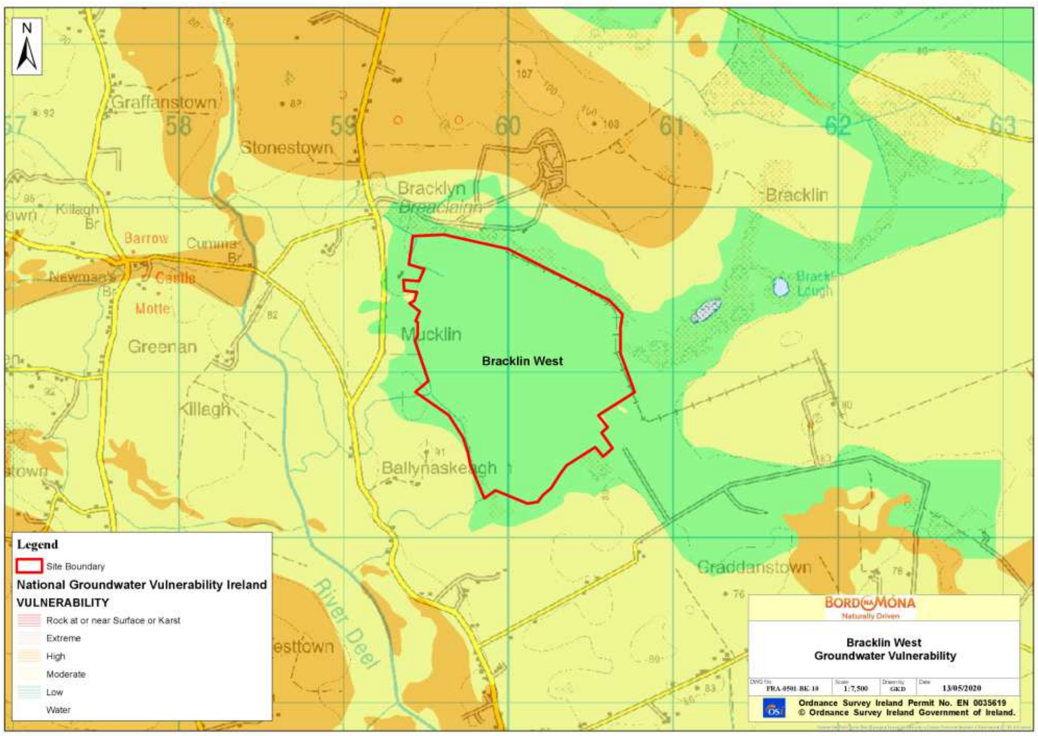

Figure 3.2-6 Bracklin Bog Groundwater Vulnerability

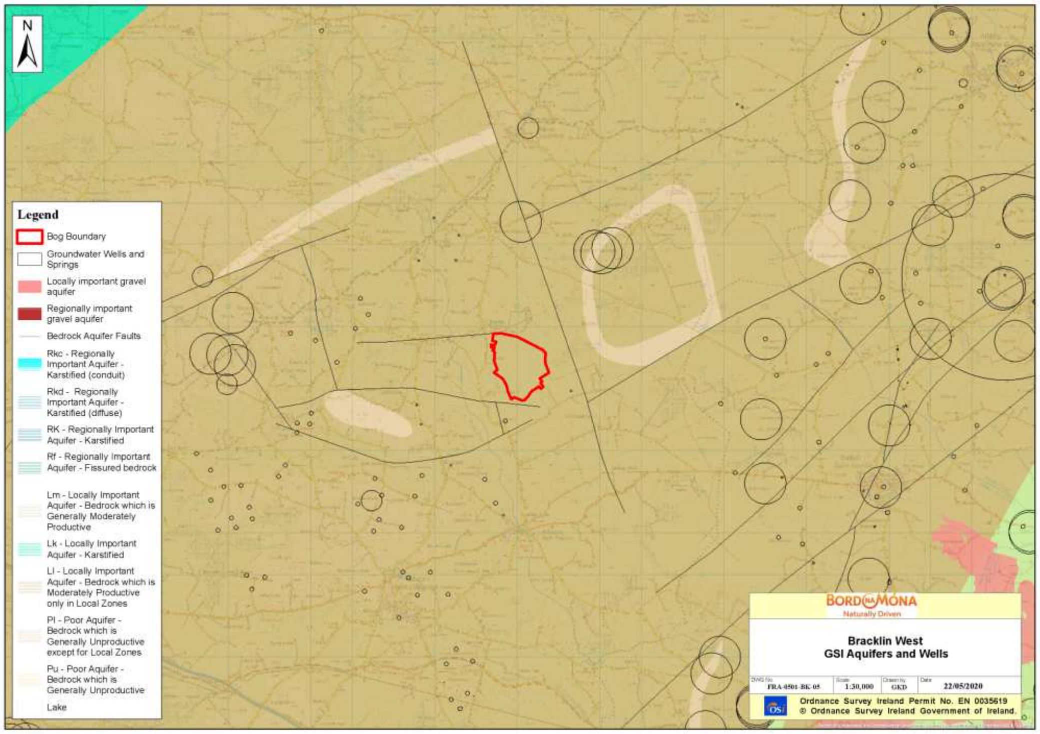

Figure 3.2-7 Bracklin Bog Aquifers, Karst Features, Wells

There is a single aquifer underlaying the Bracklin Bog area. This is known as a *Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll).* Groundwater vulnerability rating for the area is given as Low.

There is no record of any karst landforms within the bog or its surrounds. Geological Survey of Ireland records indicated a borehole (GSI Name: 2625SWW200) located outside the eastern site boundary.

There are no Bord na Móna records or local anecdotal evidence to suggest groundwater flooding has ever occurred at this bog.

3.2.7 **Fluvial Flood Risk**

CFRAM flood mapping is shown in the Figure below.

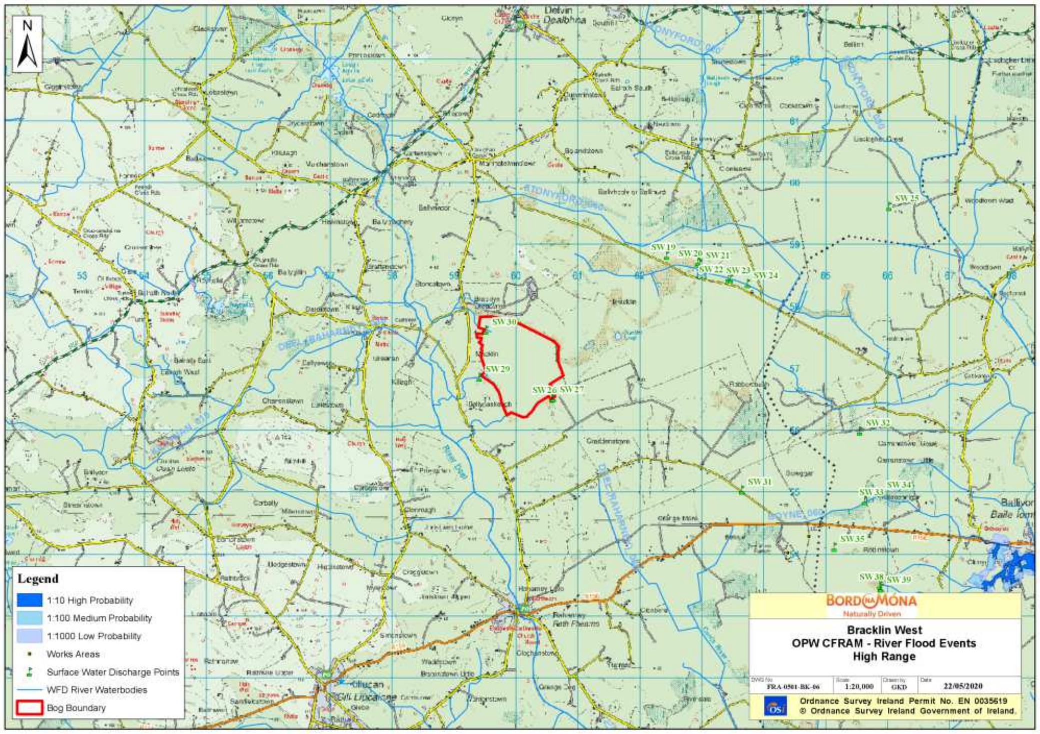

Figure 3.2-8 Bracklin Bog CFRAM Flood Mapping

The rivers and streams in the vicinity of Bracklin Bog are described in terms of regional hydrology in section 3.2.4.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with the 'High-End Future Scenario extents' (generated taking in the potential effects of climate change using an increase in rainfall of 30% and sea level rise of 1,000 mm (40 inches))

Flooding is not identified for the River Deel or any of the upstream watercourses which serve to drain Bracklin bog. Downstream of the River Deel, flooding at the River Boyne is evident. This is to the east of Ballivor, circa 6km to the southeast of the site boundary. There is no risk of flooding identified within the Bracklin Bog boundary.

There are no Bord na Móna records or local anecdotal evidence to suggest fluvial flooding has ever occurred at this bog. In such an event, outfalls would become submerged if water levels in receiving water were to rise. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events. In the event of flooding in receiving waters, any such flow into the bog would be limited to the capacity of the outfall pipes from the bogs. The pipe diameter of these outfall pipes are shown in the table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW26	0.600

SW27	0.600
SW29	0.600
SW30	0.600

Table 3.2.1 Bracklin Bog Surface Water Outfalls

It is noted that the limited pipe diameter will also restrict run-off rates from the bog to the receiving waters.

3.2.8 Pluvial Flood Risk

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100 year and 1000 year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices

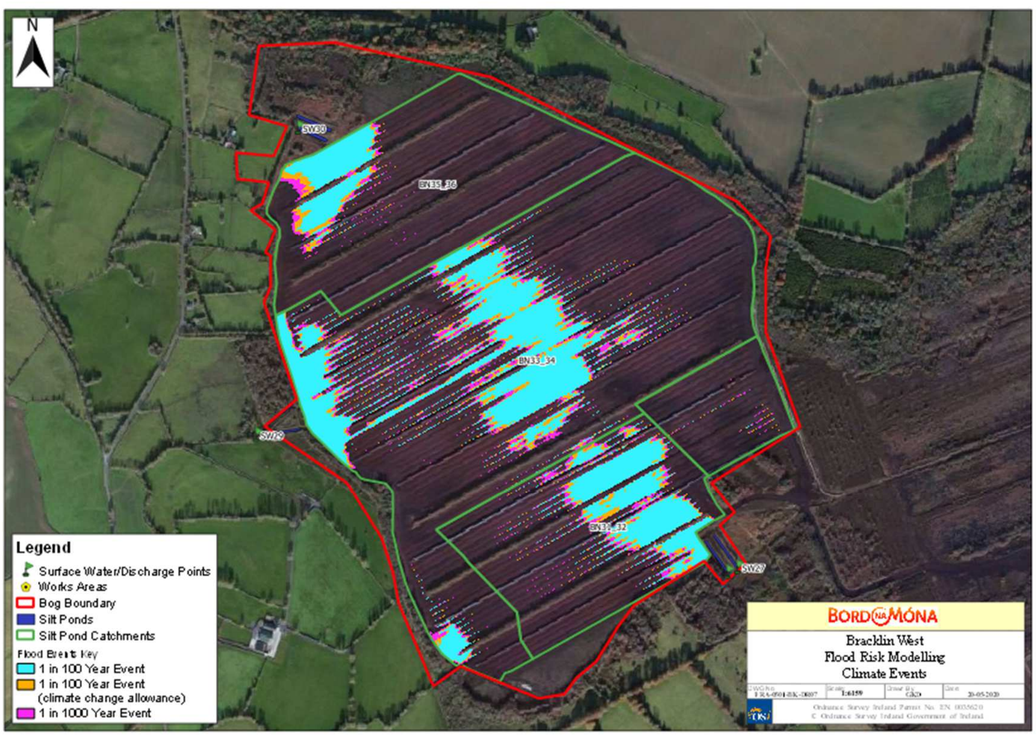

Figure 3.2-9 Bracklin Bog Pluvial Flooding, Rainfall Events

Flooding modelling carried out for Bracklin bog is presented here. The basins used in the model are the extent of the catchments that discharge through the surface water discharge points in the bog. Bracklin Bog is modelled for three basins, BN31_32, BN33_34, and BN35_36. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

It is evident from the modelling that there is potential for flooding to occur primarily in the centre of the site, with some potential flooding also noted around the periphery of the bog. This is to be expected given the lower elevations of the production areas in this location. The 1 in 1000-year event was the most onerous in terms of flood levels. Modelling indicates flood water levels of the order of 82.25-82.28m OD in catchments BN31_32 and BN33_34 which extends to the majority of the bog. In the north, a flood level of 80.83mOD was found in this lower catchment. Catchments are separated within the bog by topographical features such as ridges in surface levels and locally elevated rail lines and elevated peat fields.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	***BN35_36***	***BN33_34***	***BN31_32and E.Catch***
mOD	***m^3***	***m^3***	***m^3***
78.00	4	0	0
78.25	23	0	0
78.50	77	0	0
78.75	229	0	0
79.00	629	1	0
79.25	1680	7	0
79.50	3833	19	0
79.75	7215	45	0
80.00	11717	118	1
80.25	17339	294	5
80.50	24084	631	22
80.75	32244	1228	109
81.00	41801	2515	372
81.25		5606	1313
81.50		12576	3867

81.75		26661	9730
82.00		51209	20101
82.25		88256	35079
82.50			54536

Table 3.2.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Bracklin Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

3.2.9 Climate Change

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 3.2.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100 year event plus 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case the maximum rainfall for the 100 year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000-year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 3.2.8, the High-Emissions Future Scenario (HEFS) has been considered which takes in account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

3.2.10 Conclusions

The Flood Risk Assessment for Bracklin Bog identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local Bord na Móna knowledge flooding of the peat production area has occurred locally only and is remedied by ongoing maintenance of drains.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. There is no record of this having occurred previously on this site. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall

depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels indicated that flooding will not impact areas outside of the production areas.

This Flood Risk Assessment indicates that the peat production fields and drains in Bracklin Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 3.2.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*

(iii) *The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*

(iv) *The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Bracklin Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- Flood modelling carried out in this assessment shows that the main site access point (to the west of the bog, through cutover Bord na Mona bog) would not be impacted by maximum predicted flood levels. There are no buildings or Works Area within this bog that could be impacted by flooding;
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Bracklin Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

3.3 Carranstown Bog

3.3.1 Introduction

Carranstown bog is part of the Bord na Móna Derrygreenagh Bog Group which operates under an Integrated Pollution Control licence (ref P0501-01). This bog supplies horticultural peat and has a permanent rail line that runs south to the horticultural peat factory at Ballivor bog. The total area of the bog is 115 Ha.

3.3.2 Site Location

The Carranstown site location is highlighted in red in the Figure below.

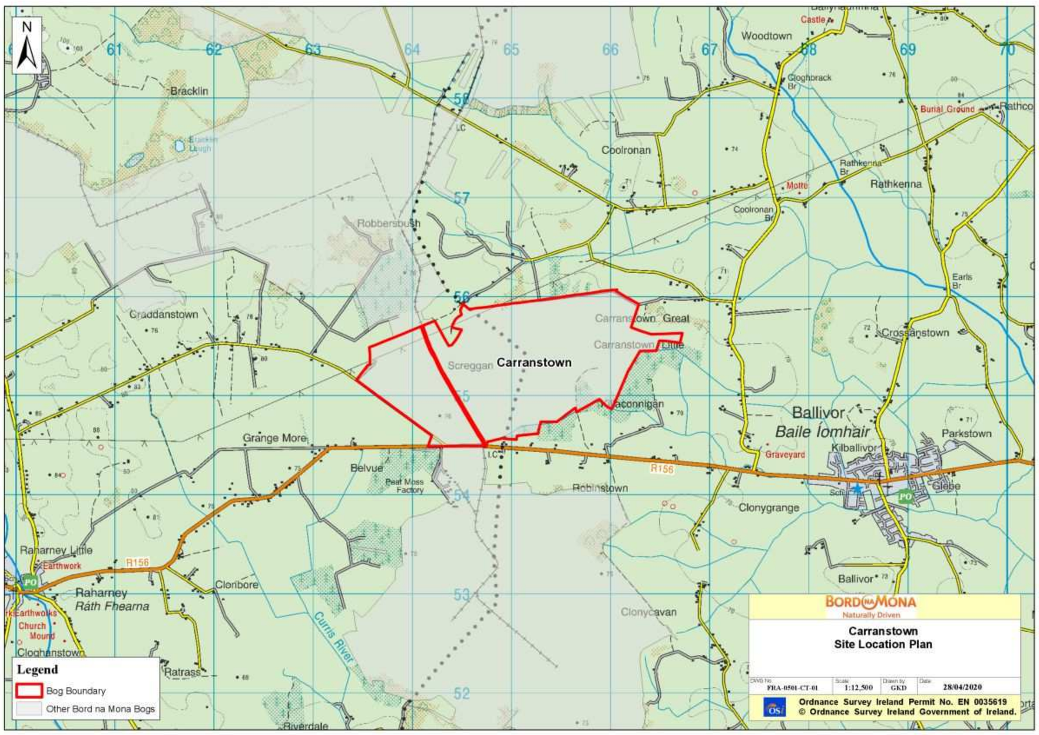

Figure 3.3-1 Carranstown Site Location

Carranstown Bog is located in County Westmeath and is approximately 2 km west of Ballivor and 4 km east of Raharney. The R156 regional road is immediately adjacent to the southern boundary of the bog, in an east-west direction. This bog is one of a cluster of five Bord na Mona bogs, all of which are part of the Derrygreenagh Group.

3.3.3 Bog Description

The bog layout is shown in the Figure.

Figure 3.3-2 Carranstown Layout

From available records it appears that pre-development gravity drainage commenced in 1979, with peat production commencing in 1985. The land use surrounding the bog is comprised of peat harvesting on surrounding bogs and agriculture. There is also some Coillte forestry located outside the southern boundary of the site.

The majority of the site to the west of the rail line is in active peat production. There are some edge habitats present around the periphery of the bog. These edge habitats are typically remnant sections of raised bog and cutaway bog. Some of these habitats are old and are mature.

Existing ground levels typically fall from west to east from 78.5mOD to approx. 73.5mOD along the eastern boundary. This bog does not have a dedicated works area and access is available via a machine pass located along the R156 to the south.

In Carranstown, there are four surface water gravity outfalls from the bog, with associated silt ponds (SW31, 32, 33 and 34), which discharge at various locations around the perimeter of the bog. There are no pumped outfalls and all flow in Carranstown Bog is via gravity.

3.3.4 **Regional Hydrology**

The catchment area and water courses are shown in the figures presented here.

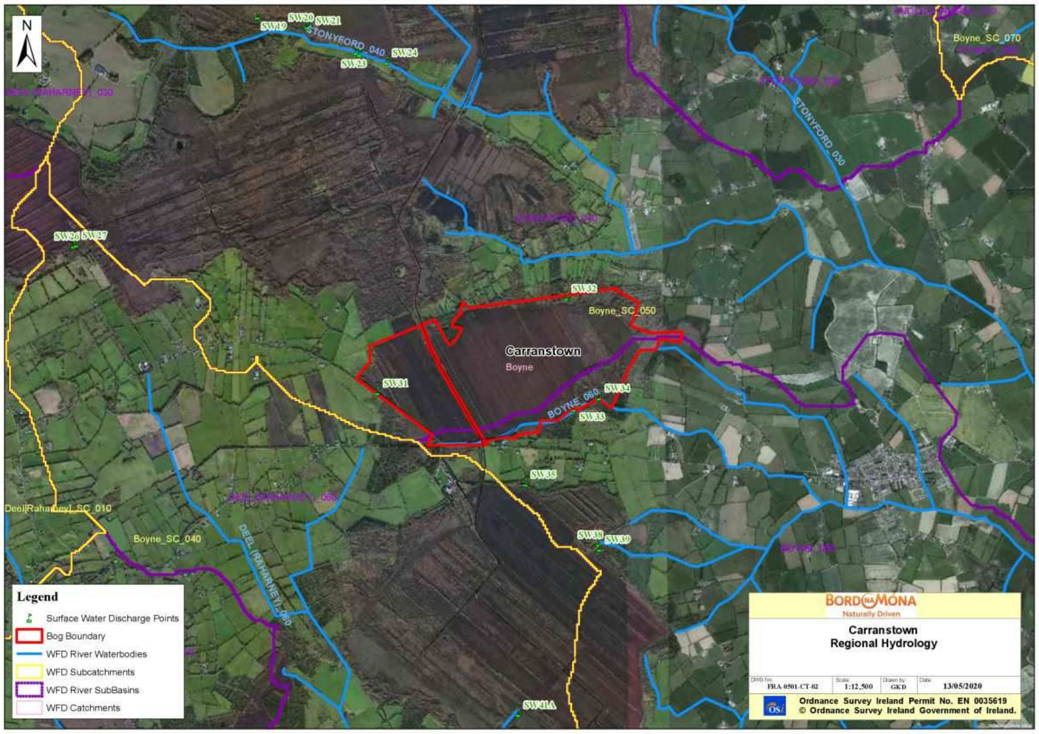

Figure 3.3-3 Carranstown Bog Regional Hydrology

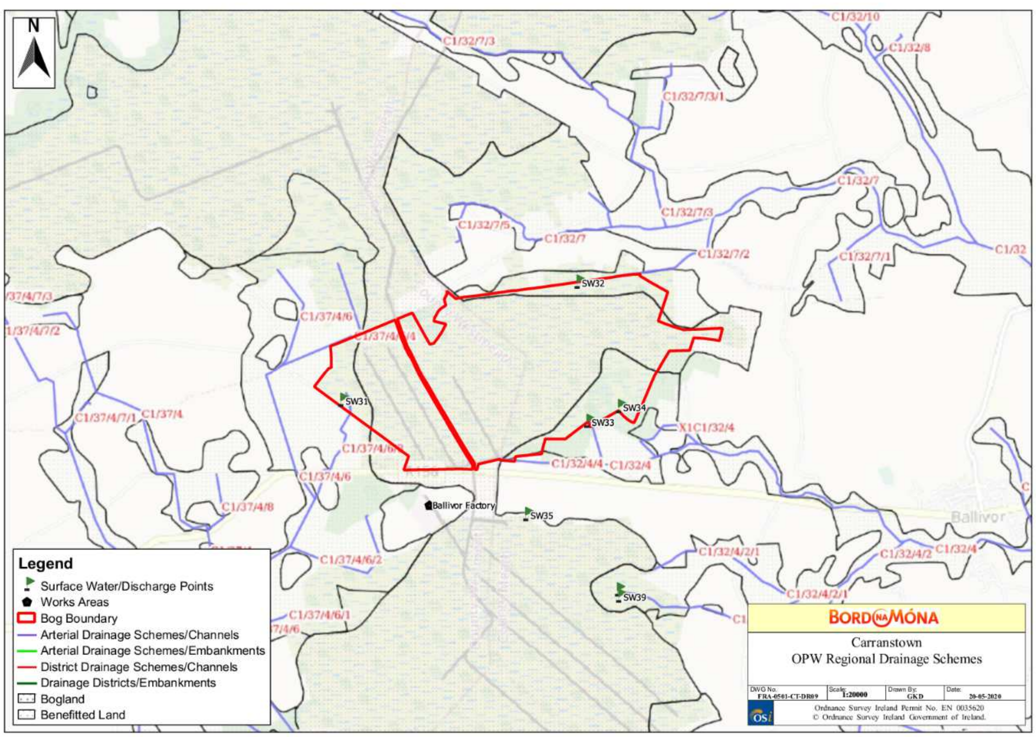

Figure 3.3-4 Carranstown Bog District Drainage Schemes

Carranstown Bog is within the Boyne 07 catchment. The Boyne 07 catchment drains a total area of 2,694km^2 and is characterised by an undulating landscape in the south which changes to a more hummocky, drumlin topography (steep-sided, lenticular hills) in the north. The catchment is underlain by metamorphic rocks in the north and limestone bedrock in the centre and south of the catchment. The Boyne catchment comprises 20 sub-catchments with 114 river water bodies, 11 lakes, one transitional and three coastal water bodies, and 25 groundwater bodies.

The outfall at SW31 along the western boundary of the site discharges surface water to an unnamed open channel which runs in a south westerly direction to the Deel (Raharney)_060 watercourse. Outfall SW32 discharges into the unnamed channel to the north and into the Stonyford_040 watercourse. The other two outfalls, SW33 and SW34 drain into the Boyne_060 watercourse to the south of the bog, which drains into the Ballivor watercourse and then into the Boyne approximately 5.8km east of the site. The outfall SW31 discharges into the Boyne_SC_040 subcatchment with the remaining outfalls from Carranstown bog discharging to the Boyne_SC_050 WFD Sub-catchment.

The Arterial Drainage and District Drainage schemes near Carranstown Bog is shown in the figures below. The benefitted land is also highlighted demonstrating the enhanced flood protection, as a result of this scheme, for the lands between Carranstown Bog and the River Boyne.

The Standard Annual Average Rainfall (SAAR) in this location is 901mm.

3.3.5 Historical Flooding

A map of historical flooding is shown in the Figure.

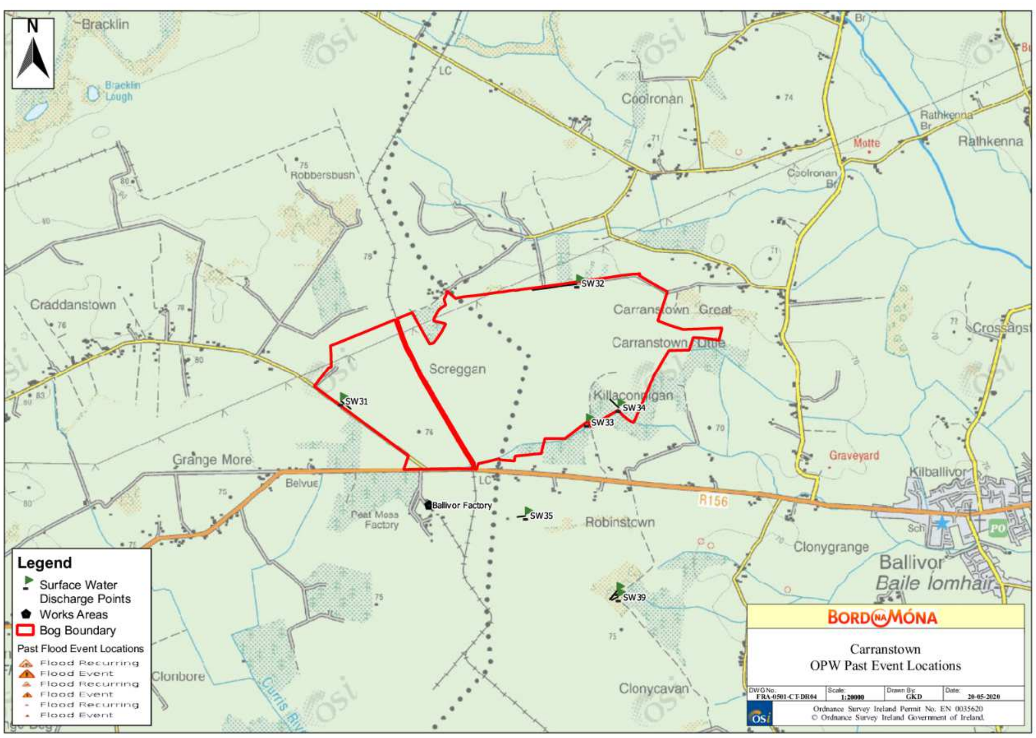

Figure 3.3-5 Carranstown Bog Historical Flooding

There is no anecdotal evidence to suggest any historical flooding of the site. Information from Bord na Móna operatives confirmed that local surface water flooding can occur where blockages to the existing drainage network have occurred over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production fields on an annual basis as part of the winter works schedule. There is no knowledge of flooding where water levels in receiving waters rise above outfall levels.

Historical flood records are taken from the OPW website, https://www.floodinfo.ie. Records of past flood events are given for locations at Delvin, Raharney and Ballivor. The closest flooding event occurred at Ballivor, approximately 2.5km east of the site boundary.

Historical OSI 25" mapping was also examined for this area. There is no additional record of flooding to be taken from these maps for Carranstown, however there are local areas of water and reeds identified within the area of the bog.

3.3.6 **Groundwater Flood Risk**

A map of aquifers, karst features and known wells is shown in the Figure.

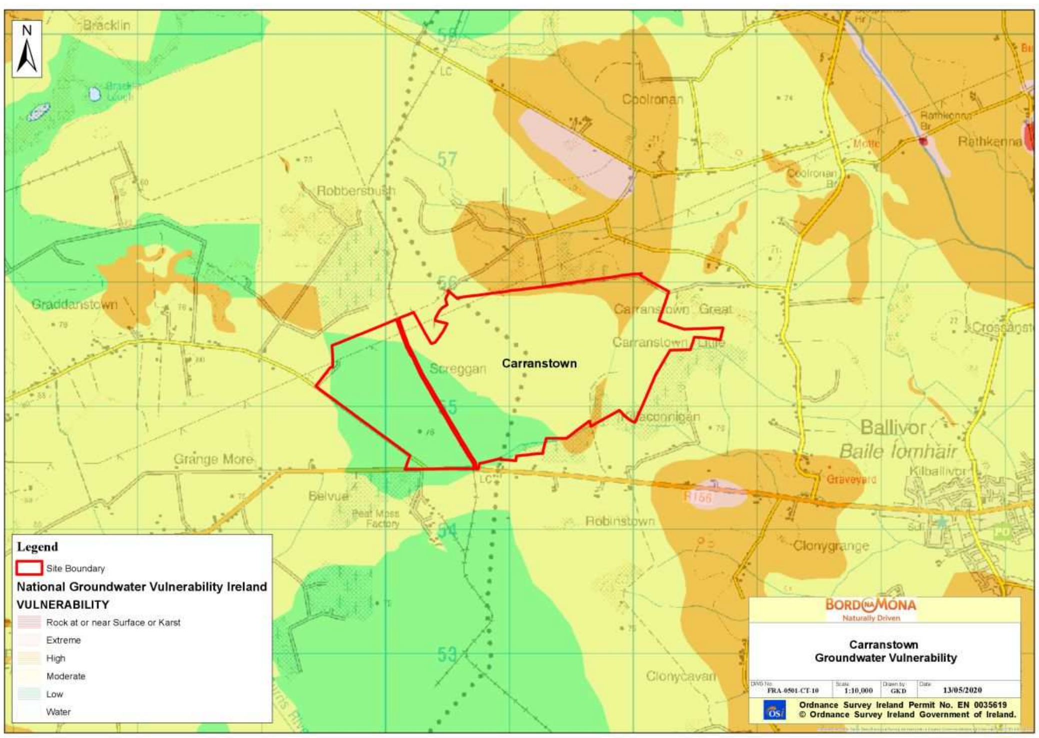

Figure 3.3-6 Carranstown Bog Groundwater Vulnerability

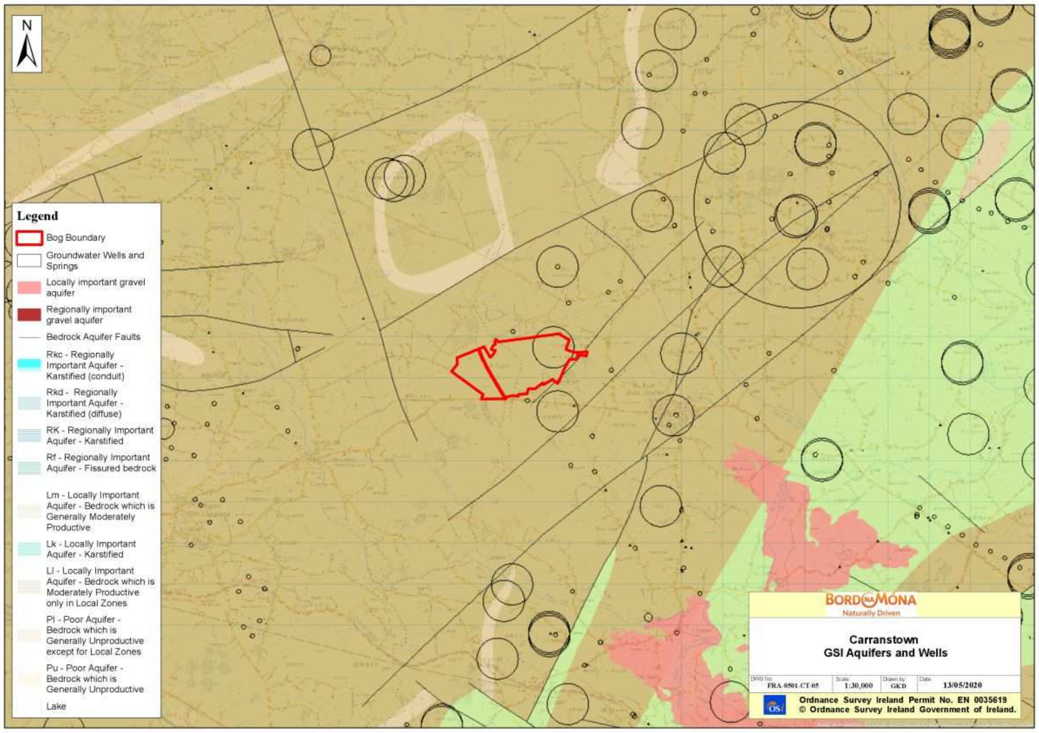

Figure 3.3-7 Carranstown Bog Aquifers, Karst Features, Wells

There is a single aquifer underlaying the Carranstown Bog area. This is known as a *Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll).* Groundwater vulnerability rating for the area is given as Low across the western side of the site and Moderate across the eastern side.

There are records of a number of wells around the western and southern perimeter of the site and along the R156 to the south. There is no record of any karst features in the area.

There are no Bord na Móna records or local anecdotal evidence to suggest groundwater flooding has ever occurred at this bog.

3.3.7 **Fluvial Flood Risk**

CFRAM flood mapping is shown in the Figure below.

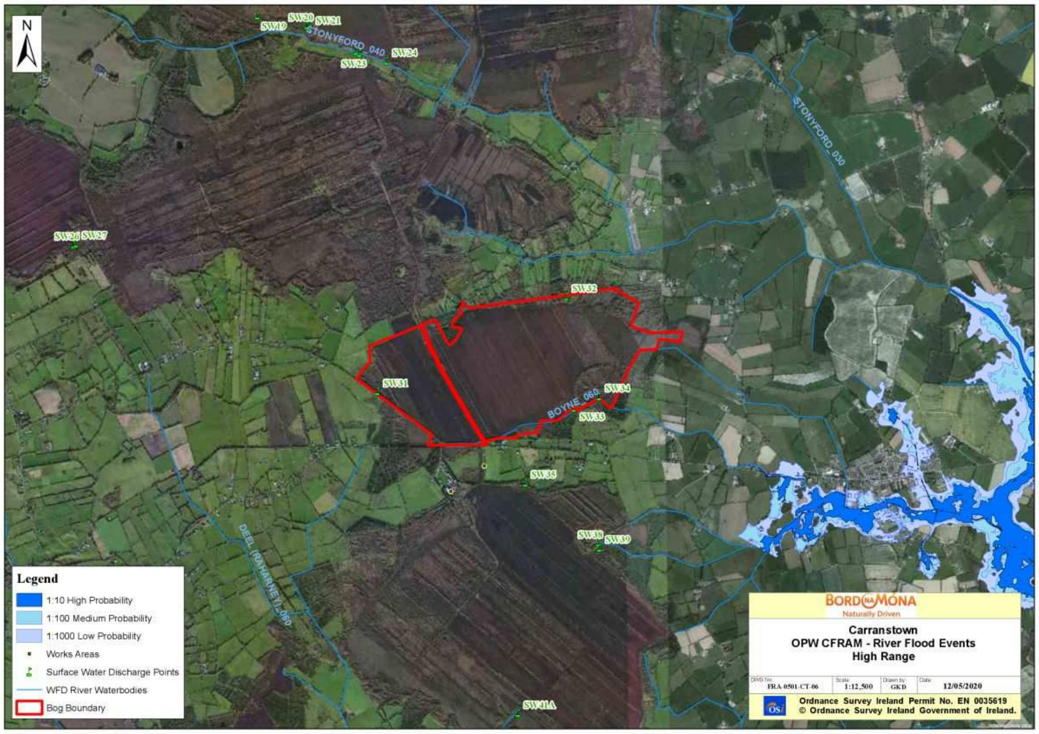

Figure 3.3-8 Carranstown Bog CFRAM Flood Mapping

The rivers and streams in the vicinity of Carranstown Bog are described in terms of regional hydrology in section 3.3.43.2.4.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with the 'High-End Future Scenario extents' (generated taking in the potential effects of climate change using an increase in rainfall of 30% and sea level rise of 1,000 mm (40 inches))

Flooding is identified in the Stonyford watercourse which drains the outfalls along the northern boundary, at approximately 3.5km east of the site. There is no flooding identified further upstream of this location. Similarly, there is flooding identified in the Killaconnigan watercourse at approximately 1.9km from the eastern boundary but no further flooding identified upstream of this location towards the southern outfalls.

There are no Bord na Móna records or local anecdotal evidence to suggest fluvial flooding has ever occurred at this bog. In such an event, outfalls would become submerged if water levels in receiving water were to rise. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events. In the event of flooding in receiving waters, any such flow into the bog would be limited to the capacity of the outfall pipes from the bogs. The pipe diameter of these outfall pipes are shown in the table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW31	-

SW32	0.450
SW33	0.600
SW34	0.450

Table 3.3.1 Carranstown Bog Surface Water Outfalls

It is noted that the limited pipe diameter will also restrict run-off rates from the bog to the receiving waters.

3.3.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100 year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices

Figure 3.3-9 Carranstown Bog Pluvial Flooding, Rainfall Events

Flooding modelling carried out for Carranstown bog is presented here. The basins used in the model are the extent of the catchments that discharge through the surface water discharge points in the bog. Carranstown Bog is modelled for four basins, CN37, CN38_39, CN40 and CN41. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

It is evident from the modelling that there is potential for flooding to occur primarily in the north-eastern corner of the site, with some potential flooding also noted around the periphery of the bog. This is to be expected given the lower elevations of the production areas in this location. The 1 in 1000-year event was the most onerous in terms of flood levels. Maximum flood levels between all catchments ranged from a low level of 72.65mOD in CN41 in the southeast to a high level of 75.50mOD in CN37 in the west of the bog. Catchments are separated within the bog by topographical features such as ridges in surface levels and locally elevated rail lines and local elevated peat fields.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	***CN37***	***CN38_39 and CN39***	***CN40***	***CN41***
mOD	***m^3***	***m^3***	***m^3***	***m^3***
69.00	0	36	0	0
69.25	0	164	0	0
69.50	0	590	0	0
69.75	0	1769	0	0
70.00	0	4165	0	0
70.25	0	7942	0	0
70.50	0	12948	0	0
70.75	0	18860	0	0
71.00	0	25562	0	0
71.25	0	32900	0	6
71.50	0	40850	0	71
71.75	0	49437	0	436
72.00	0	58845	2	1822
72.25	0	69356	17	4860
72.50	0	81415	99	9969

72.75	0	95932	740	18014
73.00	0	114783	2473	29001
73.25	0	140801	5809	
73.50	0	176930	10979	
73.75	0	226023	17958	
74.00	0			
74.25	0			
74.50	0			
74.75	3			
75.00	99			
75.25	914			
75.50	3918			
75.75	8953			

Table 3.3.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Carranstown Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

3.3.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 3.3.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100 year event plus 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case the maximum rainfall for the 100 year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000-year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 3.3.7, the High-Emissions Future Scenario (HEFS) has been considered which takes in account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

3.3.10 **Conclusions**

The Flood Risk Assessment for Carranstown Bog identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local Bord na Móna knowledge flooding of the peat production area has occurred locally only and is remedied by ongoing maintenance of drains.

- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. There is no record of this having occurred previously on this site. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels indicated that flooding will not impact areas outside of the production areas.

This Flood Risk Assessment indicates that the peat production fields and drains in Carranstown Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 3.3.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Carranstown Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- Flood modelling carried out in this assessment shows that the main site access point (to the south of the bog, directly off the R156) would not be impacted by maximum predicted flood levels. There are no buildings or Works Area within this bog that could be impacted by flooding;
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change;
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Carranstown Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

3.4 Ballivor Bog

3.4.1 Introduction

Ballivor bog is part of the Bord na Móna Derrygreenagh Bog Group which operates under an Integrated Pollution Control licence (ref P0501-01). This bog supplies horticultural peat and has a permanent rail line that runs north to the horticultural peat factory located at the northern end of the bog. The total area of the bog is 654 Ha.

3.4.2 Site Location

The Ballivor site location is highlighted in red in the Figure below.

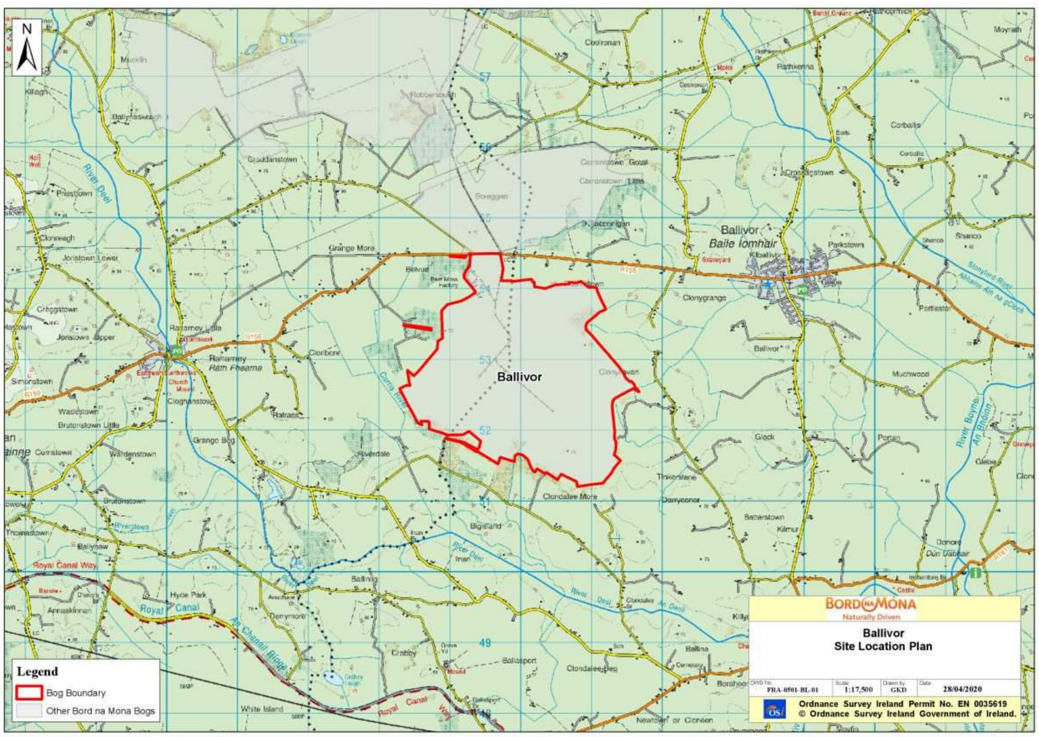

Figure 3.4-1 Ballivor Site Location

Ballivor Bog is located in County Westmeath and is approximately 2 km west of Ballivor and 3.5 km east of Raharney. The R156 regional road is immediately adjacent to the northern boundary of the bog, in an east-west direction. This bog is one of a cluster of five Bord na Mona bogs, all of which are part of the Derrygreenagh Group.

3.4.3 **Bog Description**

The bog layout is shown in the Figure.

Figure 3.4-2 Ballivor Layout

From the records available, it appears that pre-development gravity drainage was put in place around 1948, with the bog initially developed for turf extraction in 1953 before later being developed for milled peat extraction once the horticultural peat factory at Ballivor bog was developed in 1985. The land use surrounding the bog is comprised of peat harvesting on surrounding bogs and agriculture.

The majority of the bog is no longer in active peat production with production continuing in an area of circa 34 hectares in the centre of the bog and the much of the remaining bog in cutaway or cutover. There are local areas of remnant bog around the periphery of the bog. These edge habitats are typically remnant sections of raised bog and cutaway bog.

The existing ground levels range from 79.0 mOD in north, around the existing horticultural factory, to 70.0mOD at the southern end of the bog. Access to the bog is available via entrances off the R156 directly to the bog or via the horticultural peat factory. This factory is located off the R156 and occupies a small area in the north of the site. The factory area is occupied by a workshop, peat outloading tippler, welfare facilities and parking areas for HGVs and smaller goods vehicles and cars and as it is the subject of existing planning permissions, it is not included in this application.

In Ballivor, there are six surface water gravity outfalls from the bog, with associated silt ponds, which discharge along the eastern and southern boundaries of the site (SW35, 38 ,39, 40, 41 and 41A). There are no pumped outfalls and all flow in Ballivor Bog is via gravity.

3.4.4 **Regional Hydrology**

The catchment area and water courses are shown in the figures presented here.

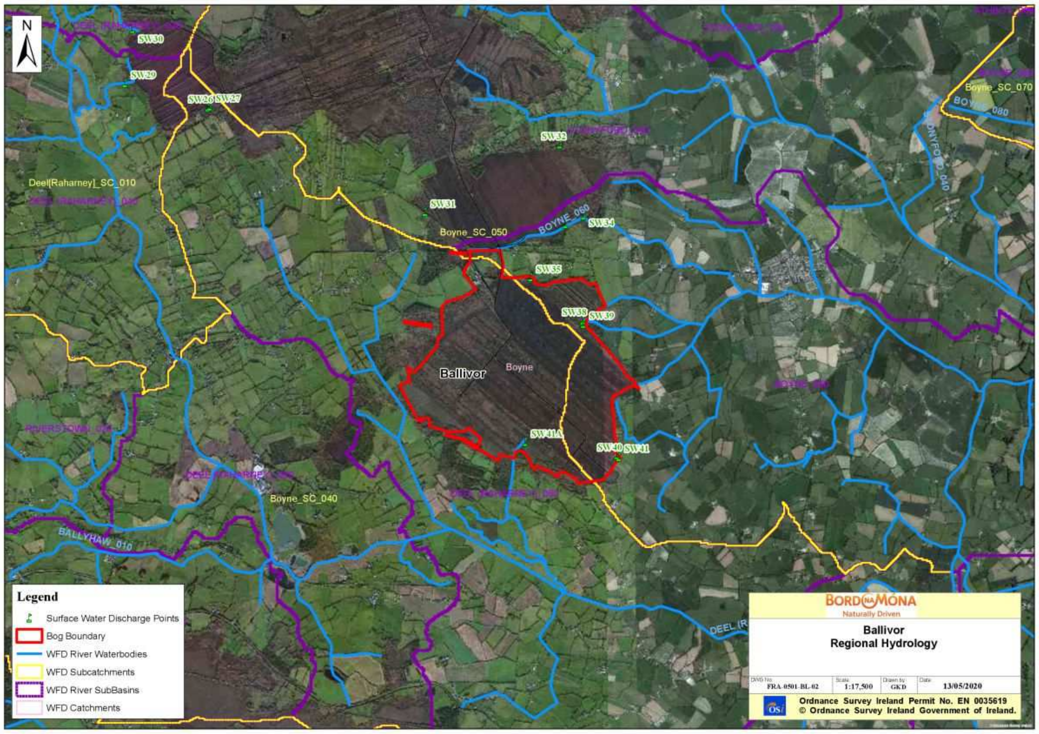

Figure 3.4-3 Ballivor Bog Regional Hydrology

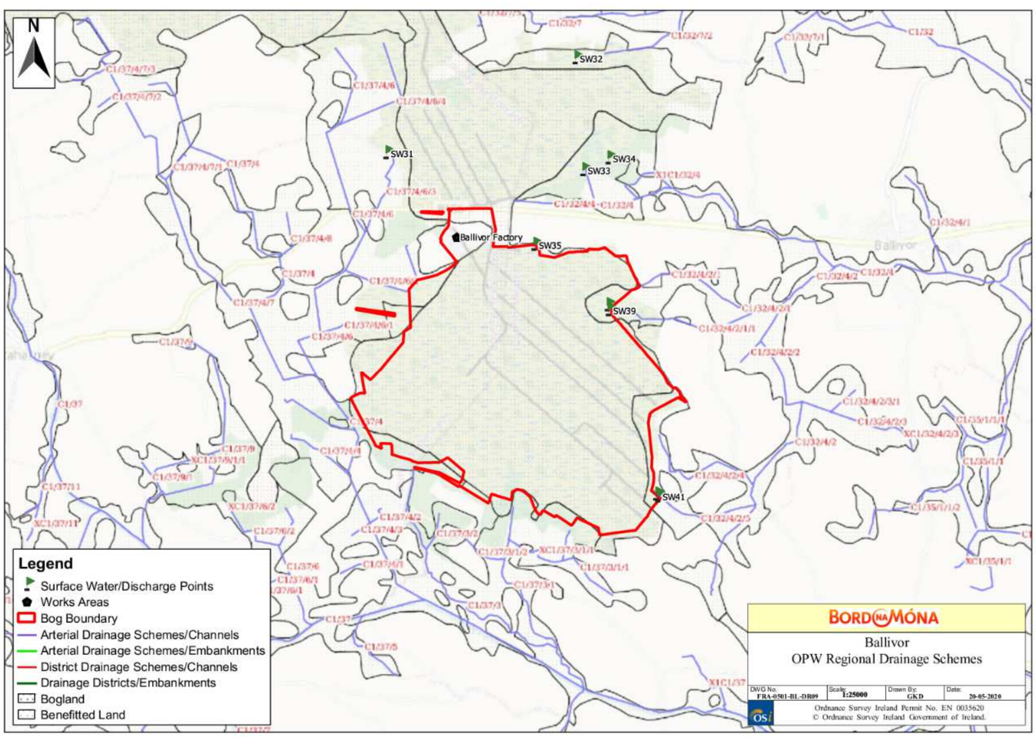

Figure 3.4-4 Ballivor Bog District Drainage Schemes

Ballivor Bog is within the Boyne 07 catchment. The Boyne 07 catchment drains a total area of 2,694km^2 and is characterised by an undulating landscape in the south which changes to a more hummocky, drumlin topography (steep-sided, lenticular hills) in the north. The catchment is underlain by metamorphic rocks in the north and limestone bedrock in the centre and south of the catchment. The Boyne catchment comprises 20 sub-catchments with 114 river water bodies, 11 lakes, one transitional and three coastal water bodies, and 25 groundwater bodies.

Outfalls are located along the eastern and southern boundaries of the bog. Five outfalls in the east (SW35, 38, 39, 40 and 41) discharge into channels which drain into tributaries of the Boyne_060 watercourse approximately 1.3km east of the bog, which then in turn drains into the Boyne approx. 5.8km east of the bog. These outfalls lie within the WFD Sub-basin and Sub-catchment of Boyne_060 and Boyne_SC_050 respectively. Outfall SW41A discharges to the south, within the Deel(Raharney)_060 sub-basin and the Boyne_SC_040 sub-catchment.

The Arterial Drainage and District Drainage schemes near Ballivor Bog is shown in the figures presented here. The benefitted land is also highlighted demonstrating the enhanced flood protection, as a result of this scheme, for the lands between the bog and the River Boyne.

The Standard Annual Average Rainfall (SAAR) in this location is 898 mm.

3.4.5 Historical Flooding

A map of historical flooding is shown in the Figure.

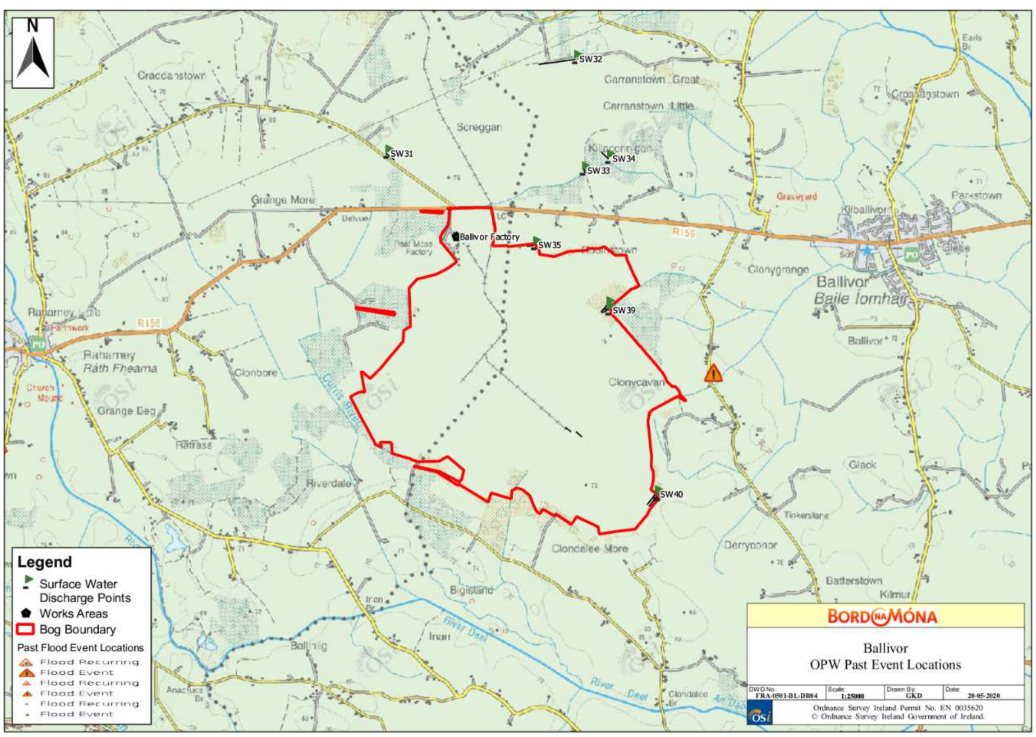

Figure 3.4-5 Ballivor Historical Flooding

There is no anecdotal evidence to suggest any historical flooding of the site. Information from Bord na Móna operatives confirmed that local surface water flooding can occur where blockages to the existing drainage network have occurred over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production fields on an annual basis as part of the winter works schedule. There is no knowledge of flooding where water levels in receiving waters rise above outfall levels.

Historical flood records are taken from the OPW website, https://www.floodinfo.ie. Records of past flood events are given for locations at Delvin, Raharney and Ballivor. The closest flooding event occurred at Ballivor, approximately 2km east of the site boundary.

Historical OSI 25" mapping was also examined for this area. There is no additional record of flooding to be taken from these maps for Ballivor, however there are local areas of water and reeds identified within the area of the bog.

3.4.6 Groundwater Flood Risk

A map of aquifers, karst features and known wells is shown in the Figure.

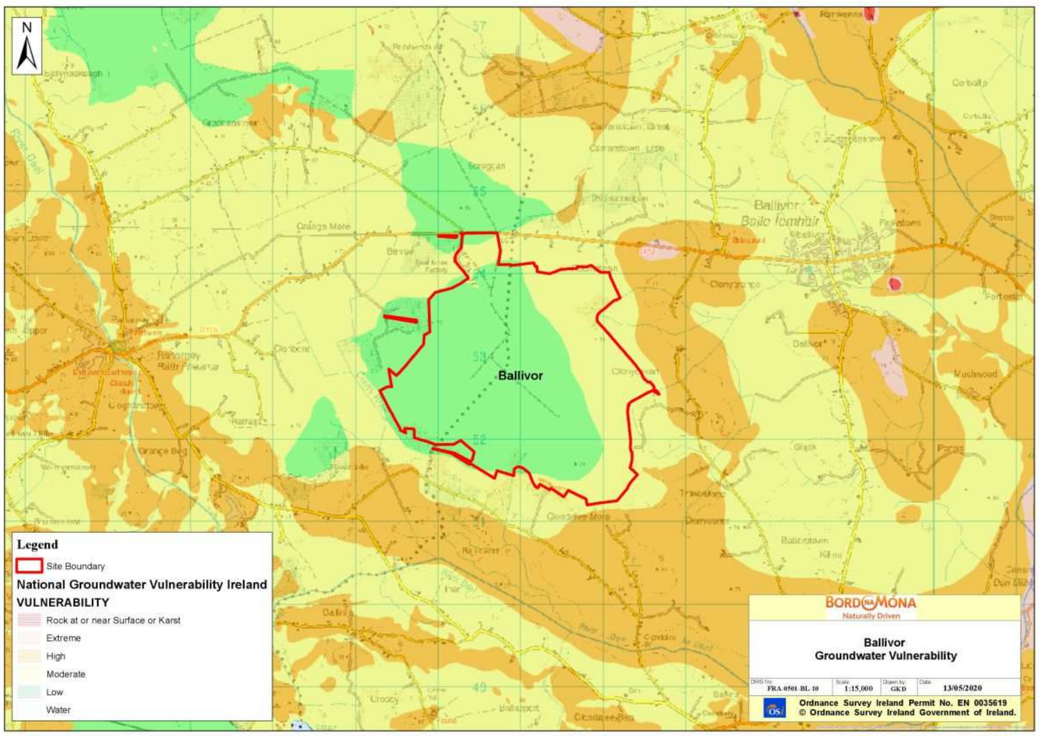

Figure 3.4-6 Ballivor Bog Groundwater Vulnerability

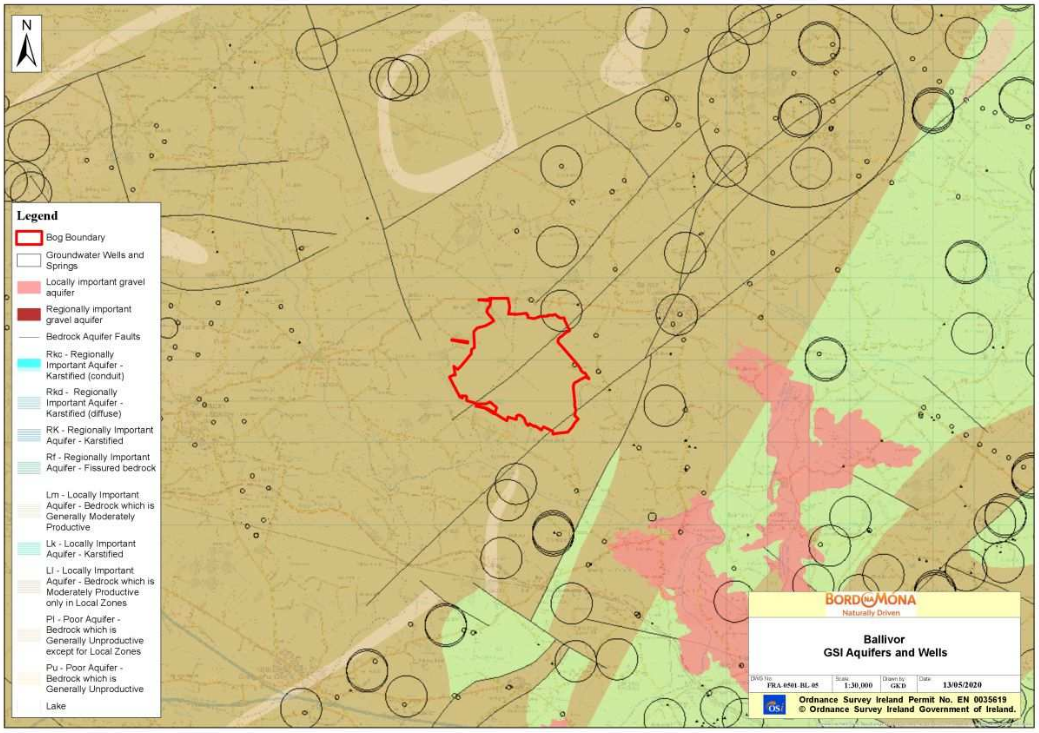

Figure 3.4-7 Ballivor Bog Aquifers, Karst Features, Wells

There is a single aquifer underlaying the Ballivor Bog area. This is known as a *Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll).* Groundwater vulnerability rating for the area is given as Low across the majority of the area and Moderate across a strip of the bog in the east.

There are records of a number of wells around the western and southern perimeter of the site and along the R156 to the north. There is no record of any karst features in the area.

There are no Bord na Móna records or local anecdotal evidence to suggest groundwater flooding has ever occurred at this bog.

3.4.7 **Fluvial Flood Risk**

CFRAM flood mapping is shown in the Figure below.

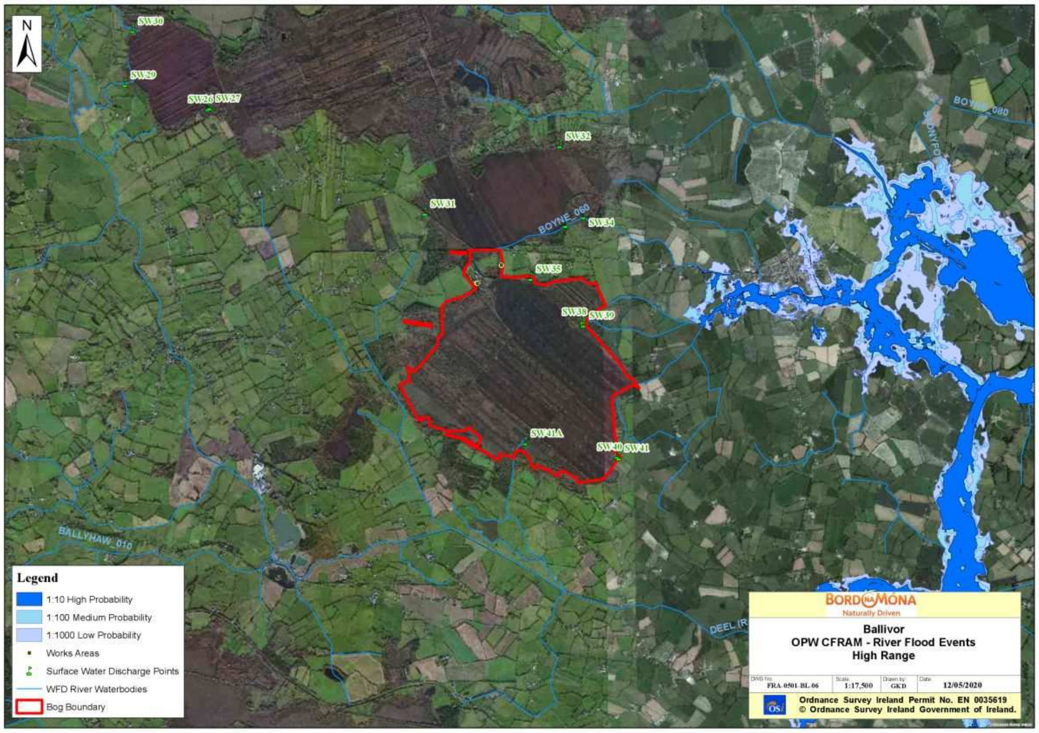

Figure 3.4-8 Ballivor CFRAM Flood Mapping

The rivers and streams in the vicinity of Ballivor bog are described in terms of regional hydrology in section 3.4.43.2.4.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with the 'High-End Future Scenario extents' (generated taking in the potential effects of climate change using an increase in rainfall of 30% and sea level rise of 1,000 mm (40 inches)).

Flooding is identified in the Ballivor watercourse which accepts runoff from all outfalls from this bog, at approximately 1.3 km east of the site. There is no flooding identified further upstream of this location. There is no risk of flooding identified within the Ballivor Bog boundary

There are no Bord na Móna records or local anecdotal evidence to suggest fluvial flooding has ever occurred at this bog. In such an event, outfalls would become submerged if water levels in receiving water were to rise. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events. In the event of flooding in receiving waters, any such flow into the bog would be limited to the capacity of the outfall pipes from the bogs. It is noted that the limited outfall pipe diameter will also restrict run-off rates from the bog to the receiving waters.

3.4.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100 year and 1000 year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices

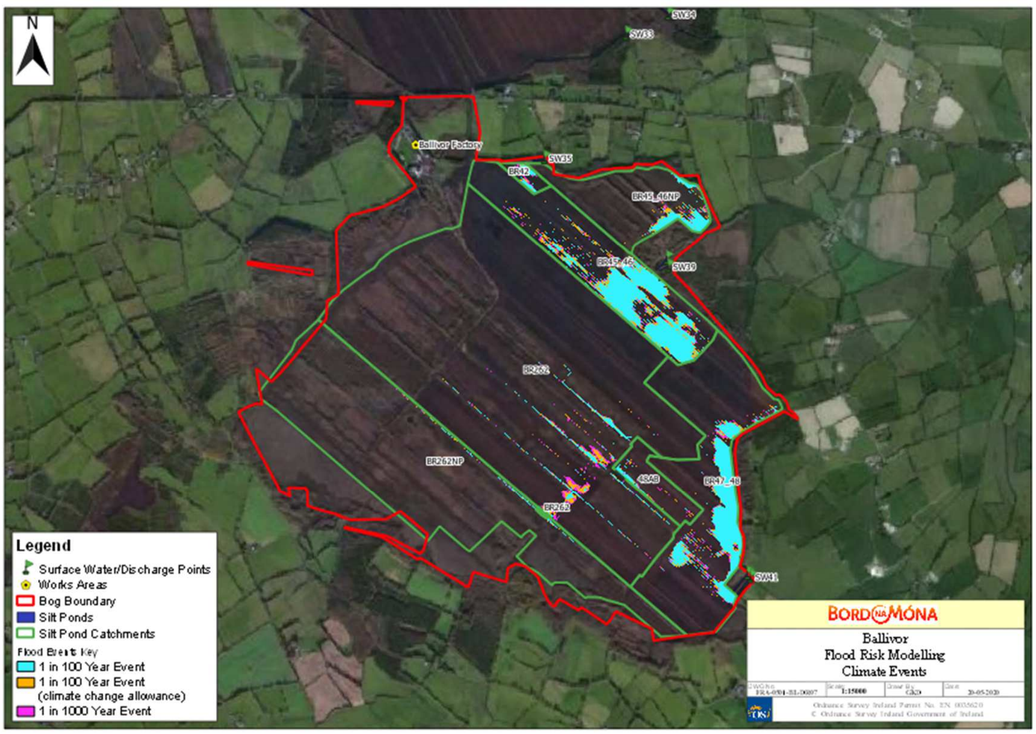

Figure 3.4-9 Ballivor Bog Pluvial Flooding, Rainfall Events

Flooding modelling carried out for Ballivor bog is presented here. The basins used in the model are the extent of the catchments that discharge through the surface water discharge points in the bog. Ballivor Bog is modelled for four basins including BR42, BR45_46&NP, BR262&NP and BR47_48&48AB. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

Flooding is predicted close to the eastern boundary of the site and locally in central parts of the site. Maximum predicted levels for the 1 in 1000year event are 75.45mOD in the northern basin, with maximum flood levels at the southern end of the bog at a lower level of 70.60mOD. Catchments are separated within the bog by topographical features such as ridges in surface levels and locally elevated rail lines and local elevated peat fields.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

There is no flooding predicted in the area of the horticultural factory at the northern end of this bog.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	***BR45_46 and E.Catch***	***BR47_48 and 48AB***	***BR262 and SW.Catch***	***BN42***
mOD	***m^3***	***m^3***	***m^3***	***m^3***
67.75	0	0	0	0
68	0	2	0	0
68.25	0	8	0	0
68.5	0	21	5	0
68.75	0	59	69	0
69	0	179	291	0
69.25	0	506	856	0
69.5	0	1438	1909	0
69.75	0	4551	3657	0
70	0	10660	6394	0
70.25	0	20682	10646	0
70.5	0	36405	18308	0
70.75	0	58850	36175	0
71	0	88654		0
71.25	0	127437		0
71.5	1			0
71.75	8			0
72	28			0
72.25	69			0
72.5	155			0
72.75	357			0
73	950			0

73.25	2712			0
73.5	8538			0
73.75	24281			0
74	52524			0
74.25	94780			0
74.5	154997			1
74.75				36
75				283
75.25				1179
75.5				3447

Table 3.4.1 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Ballivor Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

3.4.9 Climate Change

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 3.4.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100 year event plus 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case the maximum rainfall for the 100 year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000-year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 3.4.7, the High-Emissions Future Scenario (HEFS) has been considered which takes in account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

3.4.10 Conclusions

The Flood Risk Assessment for Ballivor Bog identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area has occurred locally only and is remedied by ongoing maintenance of drains.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.

- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. There is no record of this having occurred previously on this site. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelling carried out indicated that the maximum predicted 1 in 1000 year flood levels will be below the levels in the horticultural peat factory in the northern end of the site and will be limited to the production areas.

This Flood Risk Assessment indicates that the horticultural peat factory area of Ballivor Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low Risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C. This development is also outside of the scope of this application as it is subject of existing planning permissions.

This Flood Risk Assessment indicates that the peat production fields and drains in Ballivor Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 3.4.2 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as

Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Ballivor Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities (all within the horticultural peat factory area) are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal;
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management

Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Ballivor Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

3.5 Kinnegad (Rossan) Bog

3.5.1 Introduction

Kinnegad Bog (also known as Rossan bog) is part of the Bord na Móna Derrygreenagh Bog Group which operates under an Integrated Pollution Control licence (ref P0501-01). The Bog is used primarily to produce milled horticultural peat while some fuel peat is also being harvested and this is generally transported to Lough Ree Power. The total area within Bord na Móna ownership is 352 Ha.

3.5.2 Site Location

The Kinnegad site location is highlighted in red in the Figure below.

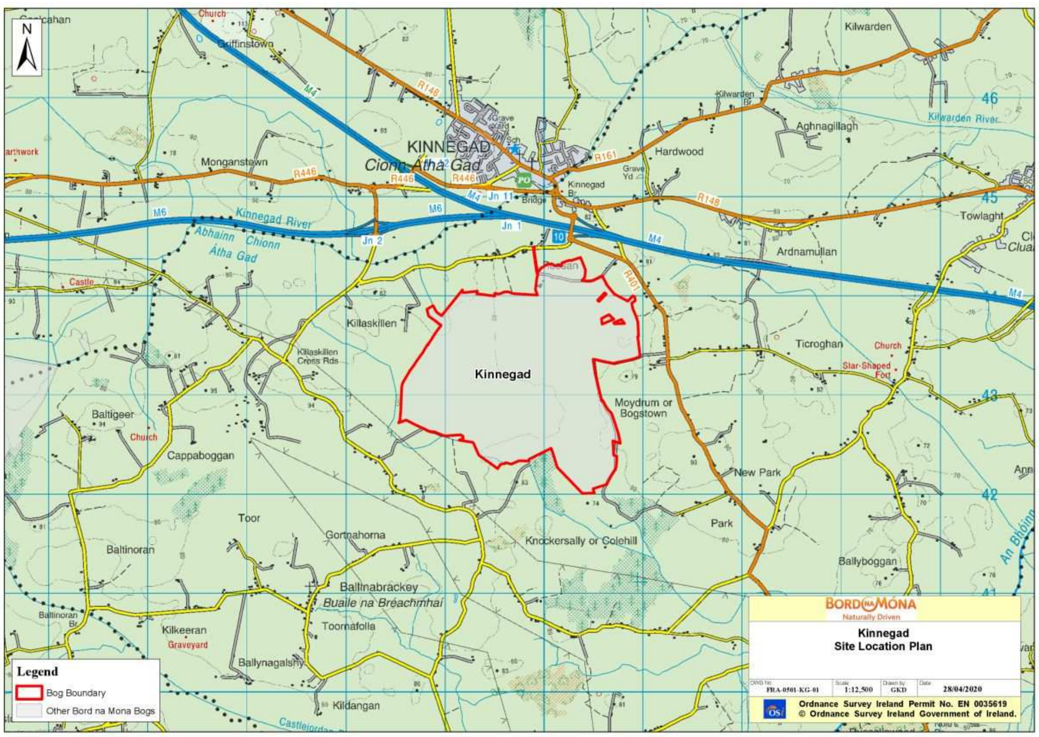

Figure 3.5-1 Kinnegad Site Location

Kinnegad bog is located in County Meath, 1.5 kilometres south of Kinnegad and south of the M4/M6 motorway.

3.5.3 Bog Description

The bog layout is shown in the Figure.

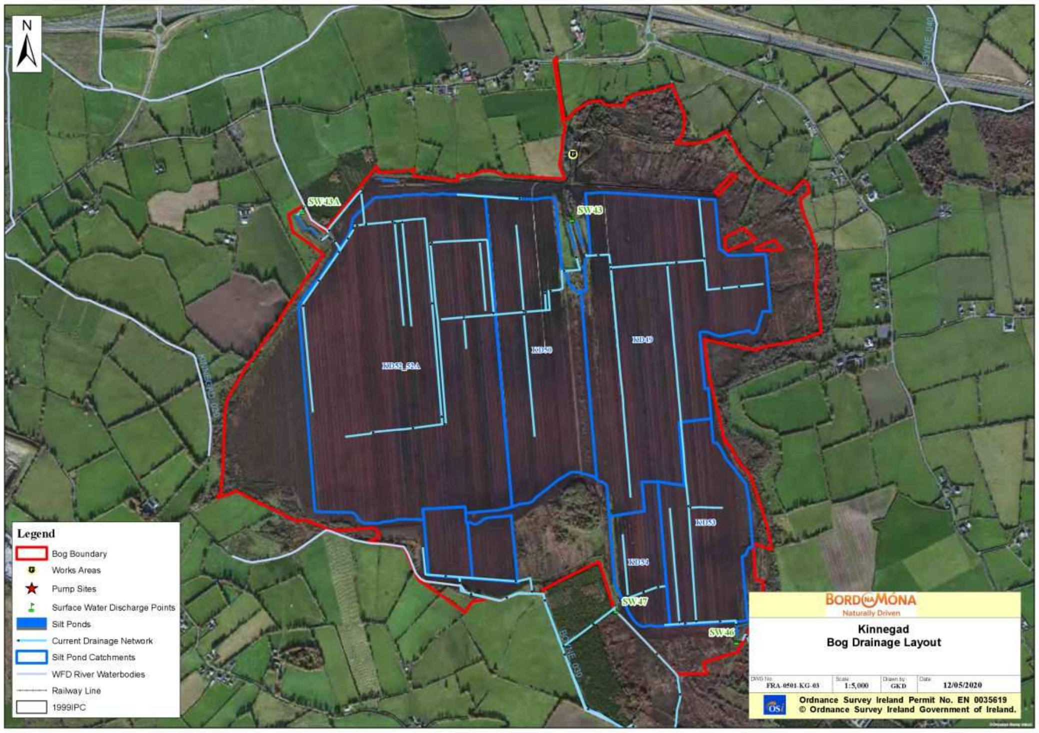

Figure 3.5-2 Kinnegad Layout

Bord na Móna came into possession of Kinnegad bog in 1976, with pre-development drainage works carried out in 1977 before first production in 1982. The Bog is used primarily to produce milled horticultural peat while some fuel peat is also being harvested and this has been generally transported to Lough Ree Power. The total area within Bord na Móna ownership is 352 Ha.

The existing ground levels of the peat production areas range from 83.30mOD in the southern and western parts of the site to 73.5mOD in a low area in the centre of the site. A welfare centre and compound for this site is located at the northern end of the site, with access available directly off a local road to the north of the bog. Ground level in this area is 75.75mOD. Finished floor levels range from 75.97mOD to 76.35mOD. This area serves as an outloading facility where HGVs take delivery of peat.

The majority of Kinnegad Bog is in production with only the edge habitats left undisturbed. These edge habitats range from woodland to remnant sections of raised bog and cutaway bog.

In Kinnegad Bog there are four surface water gravity outfalls located along the northern and southern boundaries of the bog. Outfalls SW 43 and 43A are located in the north, with outfalls SW 46 and 47 located in the south. Water draining through the northern outfalls flows into the Kinnegad River (Kinnegad_020) to the north, whereas water draining from the southern outfalls drains into the Knockersally_or_Colehill watercourse (Boyne_030). Both the Kinnegad River and the Knockersally_or_colehill watercourse discharge into the Boyne.

3.5.4 **Regional Hydrology**

The catchment area and water courses are shown in the figures presented here.

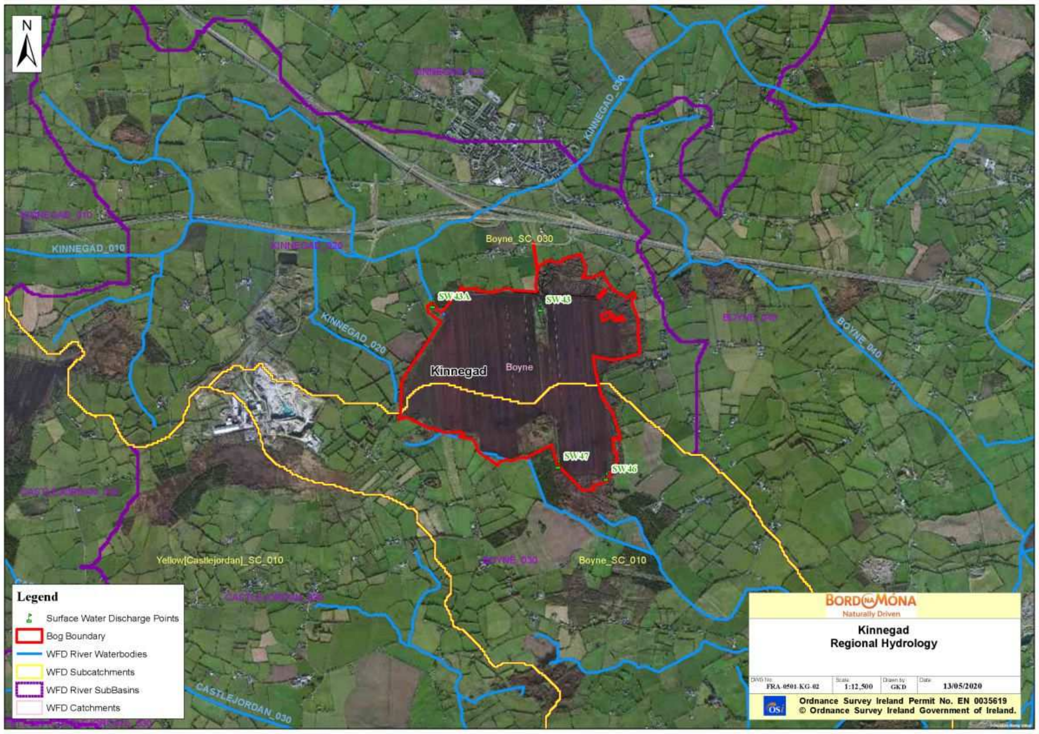

Figure 3.5-3 Kinnegad Bog Regional Hydrology

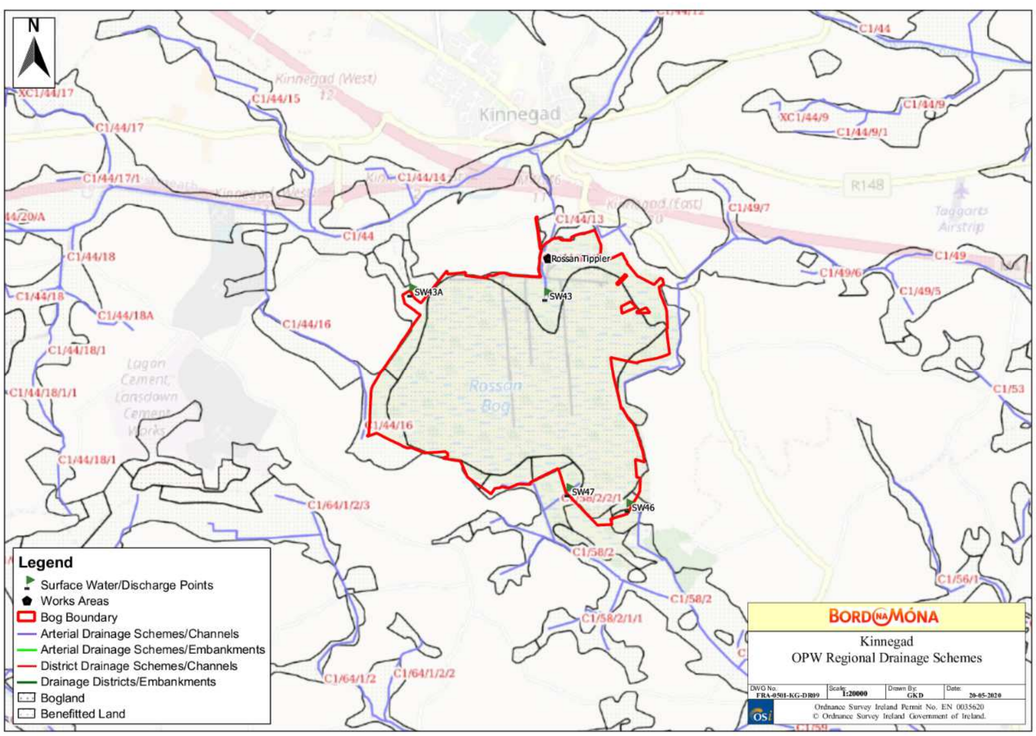

Figure 3.5-4 Kinnegad Bog District Drainage Schemes

Kinnegad Bog is within in the Boyne catchment (Hydrometric Area 07). The Boyne catchment covers an area of 2689 km² and is characterised by an undulating landscape in the south which changes to a more hummocky, drumlin topography (steep-sided, lenticular hills) in the north. The catchment is underlain by metamorphic rocks in the north and limestone bedrock in the centre and south of the catchment. The Boyne catchment comprises 20 sub-catchments with 114 river water bodies, 11 lakes, one transitional and three coastal water bodies, and 25 groundwater bodies.

At the north-western corner of the site, water draining from the SW 43 outfall discharges in a northerly direction into the Kinnegad_020 watercourse, which in turn drains into the Boyne circa 6.5km east of the site. Discharge from SW43A drains directly into a tributary of the Kinnegad_020 watercourse. From the southern boundary, outfalls discharge to the Boyne_030 watercourse, which drains into the Boyne 3.5km southeast of the site. Outfalls SW 43 and SW 43A in the northern end of the site are within WFD Sub-basin Kinnegad_020 and WFD Sub-catchment Boyne_SC_030. The two outfalls in the south (SW 46, SW 47) are within the Boyne_030 and Boyne_SC_010 sub-basin and sub catchment respectively.

The Arterial Drainage and District Drainage schemes near Kinnegad Bog is shown in the Figures below. The benefitted land from these drainage schemes are also highlighted demonstrating the enhanced flood protection, as a result of this scheme, for the lands between Kinnegad Bog and both the Kinnegad River and the River Boyne.

The Standard Annual Average Rainfall (SAAR) in this location is 889mm.

3.5.5 Historical Flooding

A map of historical flooding is shown in the Figure.

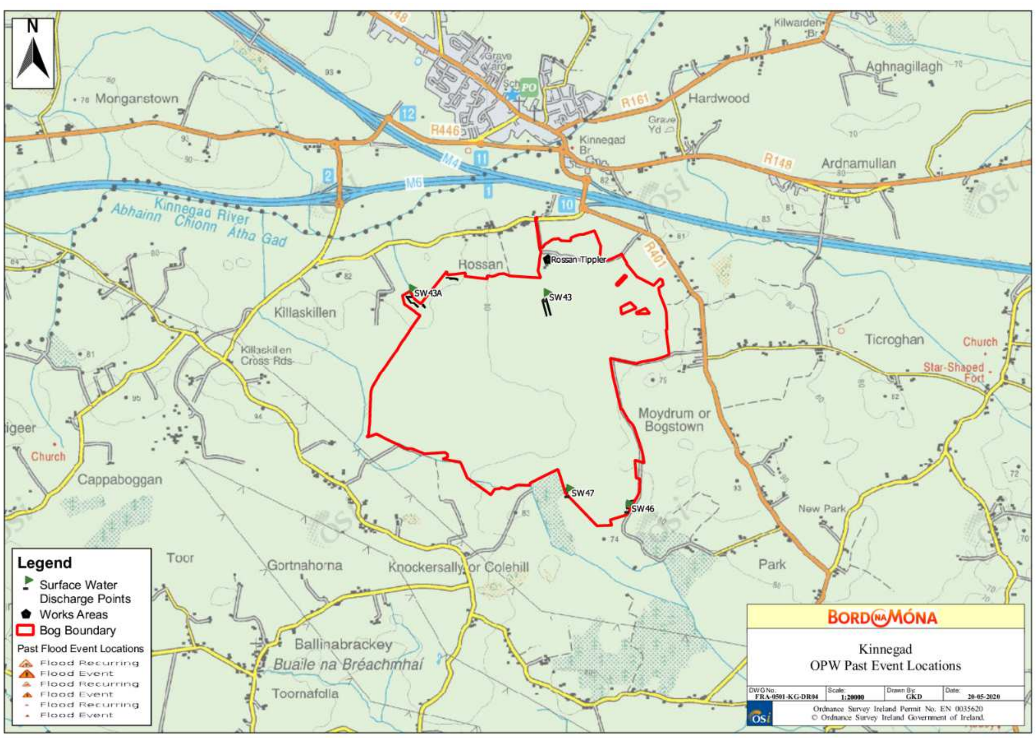

Figure 3.5-5 Kinnegad Historical Flooding

Information from Bord na Móna operatives indicates that a low area in the centre of this bog is prone to local flooding in periods of prolonged rainfall. This flooding is not due to high water levels at outfalls but instead is due to limited capacity in the existing gravity drainage network to discharge water from the bog. It is accepted that local flooding will occur during winter periods through blockages in this internal network however annual drainage maintenance works are carried out to address any such blockages.

Historical flood records are taken from the OPW website, https://www.floodinfo.ie. Records of past flood events in the general area of the bog identifies events to the north and south of the bog. Approx. 2.5km north of the site, there is a record of flooding at Corkhill, Kinnegad Co Westmeath, where two houses experienced flooding in 2008 and 2009. The OPW report states that the "source of the flood waters was run off (and the cause was Infiltration of runoff into combined sewer)". Approx. 5km southwest of the site there is a record of a flood at Ballinabrackey, where a house flooded after heavy rain due to inadequate drainage. This flood was cause by an undersized local road drain.

Historical OSI 25" mapping was also examined for this area. There is no additional record of flooding to be taken from these maps for Kinnegad bog, however there are local areas of water and reeds identified within the area of the bog.

3.5.6 **Groundwater Flood Risk**

A map of aquifers, karst features and known wells is shown in the Figure.

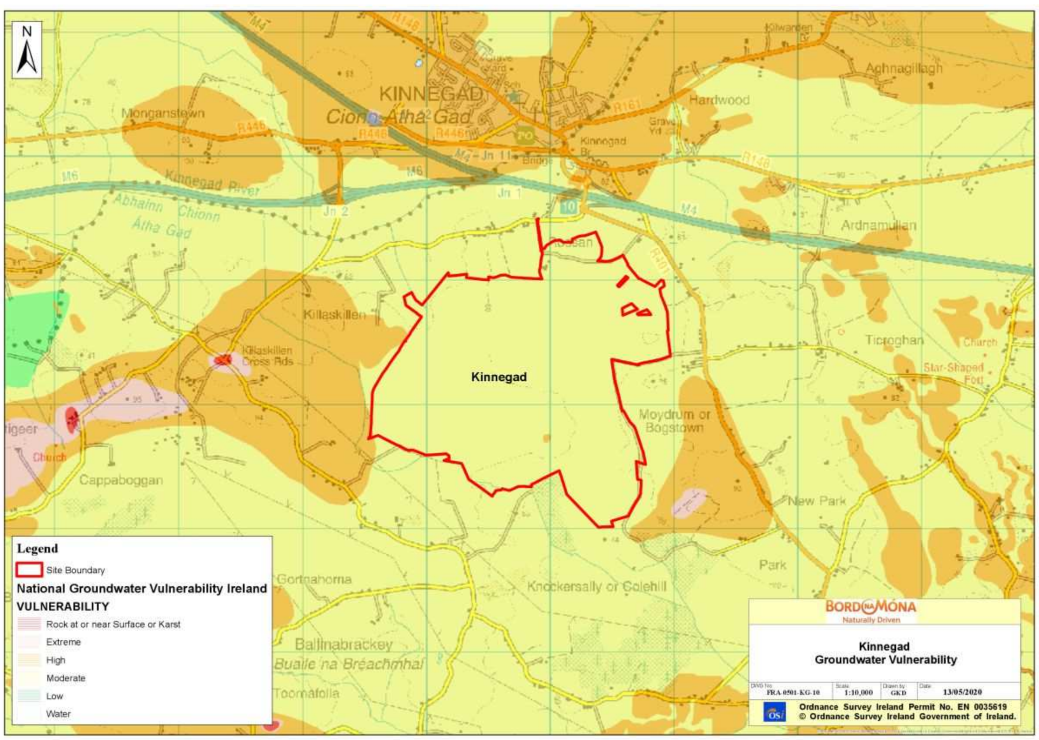

Figure 3.5-6 Kinnegad Bog Groundwater Vulnerability

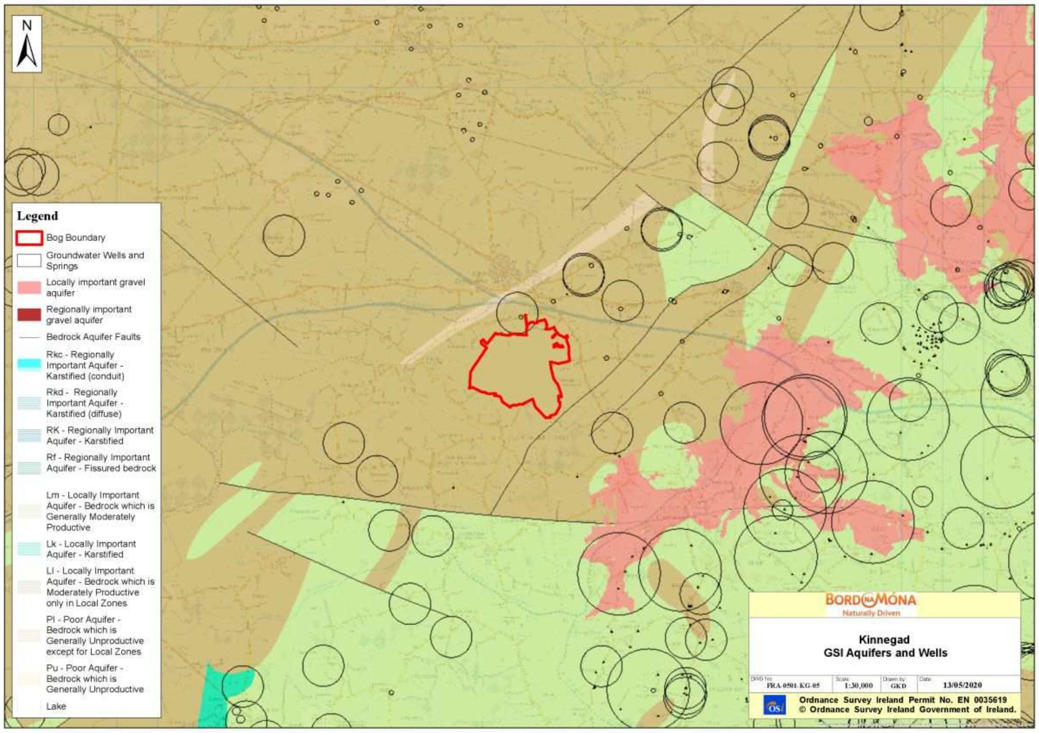

Figure 3.5-7 Kinnegad Bog Aquifers, Karst Features, Wells

The aquifer underlaying Kinnegad bog is described as *Ll - locally important Aquifer bedrock which is moderately productive only in local areas.* A groundwater vulnerability rating for this site is generally moderate, with a local area designated as high at the southern end of the site.

There is no record of any karst landforms within the bog or its surrounds. There are a limited number of recorded abstraction points around the northern and eastern sides of the site but none within the site.

There are no Bord na Móna records or local anecdotal evidence to suggest groundwater flooding has ever occurred at this bog.

3.5.7 **Fluvial Flood Risk**

CFRAM flood mapping is shown in the Figure below.

Figure 3.5-8 Kinnegad CFRAM Flood Mapping

The rivers and streams in the vicinity of Kinnegad Bog are described in terms of regional hydrology in section 3.5.4.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with the 'High-End Future Scenario extents' (generated taking in the potential effects of climate change using an increase in rainfall of 30% and sea level rise of 1,000 mm (40 inches))

Mapping using this conservative scenario identifies the potential for flooding at a distance of circa 3.0 km southeast of the site. There is no mapping to identify flood risk in any of the watercourses upstream of this location, between the site and the River Boyne.

There are no Bord na Móna records or local anecdotal evidence to suggest fluvial flooding has ever occurred at this bog. In such an event, outfalls would become submerged if water levels in receiving water were to rise. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events. In the event of flooding in receiving waters, any such flow into the bog would be limited to the capacity of the outfall pipes from the bogs. The pipe diameters of these outfall pipes are shown in the table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW43	0.45

SW43A	0.45
SW46	0.45
SW47	0.45

Table 3.5.1 Kinnegad Bog Surface Water Outfalls

It is noted that the limited pipe diameter will also restrict run-off rates from the bog to the receiving waters.

3.5.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100 year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices.

Figure 3.5-9 Kinnegad Bog Pluvial Flooding, Rainfall Events

Flooding modelling carried out for Kinnegad bog is presented here. The basins used in the model are the extent of the catchments that discharge through the surface water discharge points in the bog. Kinnegad Bog is modelled for four basins, KD49 & KD50, KD52_52A, KD53 and KD54. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

From the modelling, it can be seen that surface water flooding is predicted in the northern end of the larger catchments which drain via outfalls in the north and northwest. The 1 in 1000-year event was the most onerous in terms of flood levels. The maximum predicted flood levels in these areas are 75.80mOD in catchments KD49 and KD50 and a higher level of 77.43mOD in the western catchment of KD52_52A. Some flooding in the southern catchments has also been predicted. Catchments are separated within the bog by topographical features such as ridges in surface levels and locally elevated rail lines and local elevated peat fields.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

As the compound area in the northern end of the site, at a level of 75.75mOD is lower than the 1 in 1000 year flood level in this area and due to the nature of local topography, this area would be susceptible to flooding. Finished floor levels of buildings in the compound are above this level. The 1 in 100 year flood level for the area was found to be 75.43mOD, which is lower than the compound area. The flood level for the 1 in 100 year plus 30% climate change event, for this catchment, is 75.68mOD which is also below the compound elevation.

As discussed in section 3.5.5**Error! Reference source not found.**, local anecdotal evidence indicates that a low area in the centre of this bog is prone to local flooding in periods of prolonged rainfall. This pluvial flooding is due to limited capacity in the existing gravity drainage network to discharge water from the bog. This is in line with the modelling results.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	***KD50 and KD49***	***KD52_52A***	***KD53***	***KD54 and SW.Catch***
mOD	***m³***	***m³***	***m³***	***m³***
73.00	3	0	0	0
73.25	92	0	4	0
73.50	434	0	25	1
73.75	1329	0	82	6

74.00	3372	0	228	67
74.25	7073	0	576	340
74.50	13125	0	1279	1192
74.75	22562	0	2408	3075
75.00	35184	0	4023	6219
75.25	51084	0	6151	10943
75.50	71350	0	9013	17692
75.75	98752	0	13289	26647
76.00	137220	5	19550	
76.25		302	28255	
76.50		2354		
76.75		9411		
77.00		27680		
77.25		63992		
77.50		118015		

Table 3.5.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Kinnegad Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

3.5.9 Climate Change

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 3.5.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100 year event plus 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case the maximum rainfall for the 100 year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000-year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 3.5.7, the High-Emissions Future Scenario (HEFS) has been considered which takes in account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

3.5.10 Conclusions

The Flood Risk Assessment for Kinnegad Bog identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area has occurred locally only and is remedied by ongoing maintenance of drains.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. There is no record of this having occurred previously on this site. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelling carried out indicated that the estimated 1000 year flood event would cause flooding in the compound area in the northern end of the site but that the 100 year event would not cause flooding to occur.

This Flood Risk Assessment indicates that the compound in the northern end of the site is at risk of flooding from a 1000year event but is not at risk of flooding from a 100-year event and therefore can be considered to be in a Flood Zone B. This Flood zone is appropriate for all types of development except development which is highly vulnerable (including essential infrastructure). This development represents commercial and less vulnerable developmentand is appropriate for Flood Zone B without justification.

This Flood Risk Assessment indicates that the peat production fields and drains in Kinnegad Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 3.5.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
    - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
    - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
    - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
    - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Kinnegad Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;

- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities (all within the horticultural peat factory area) are located in an area that is not at risk of flooding in a 1 in 100-year event but which is at risk of flooding in a 1 in 1000 year event. The impact of flood risk is managed in that there are no potential sources of contaminants including oils and fuels or vulnerable plant outside of the Spring/Summer peat production season;
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change;
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Kinnegad Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

3.6 Ballybeg Bog

3.6.1 Introduction

Ballybeg bog is part of the Bord na Móna Derrygreenagh Bog Group which operates under an Integrated Pollution Control licence (ref P0501-01). The bog is a supply bog for the Edenderry Power Station and is served by a rail link to this power station. The total area of the bog is 837 Ha.

3.6.2 Site Location

The Ballybeg site location is highlighted in red in the Figure below.

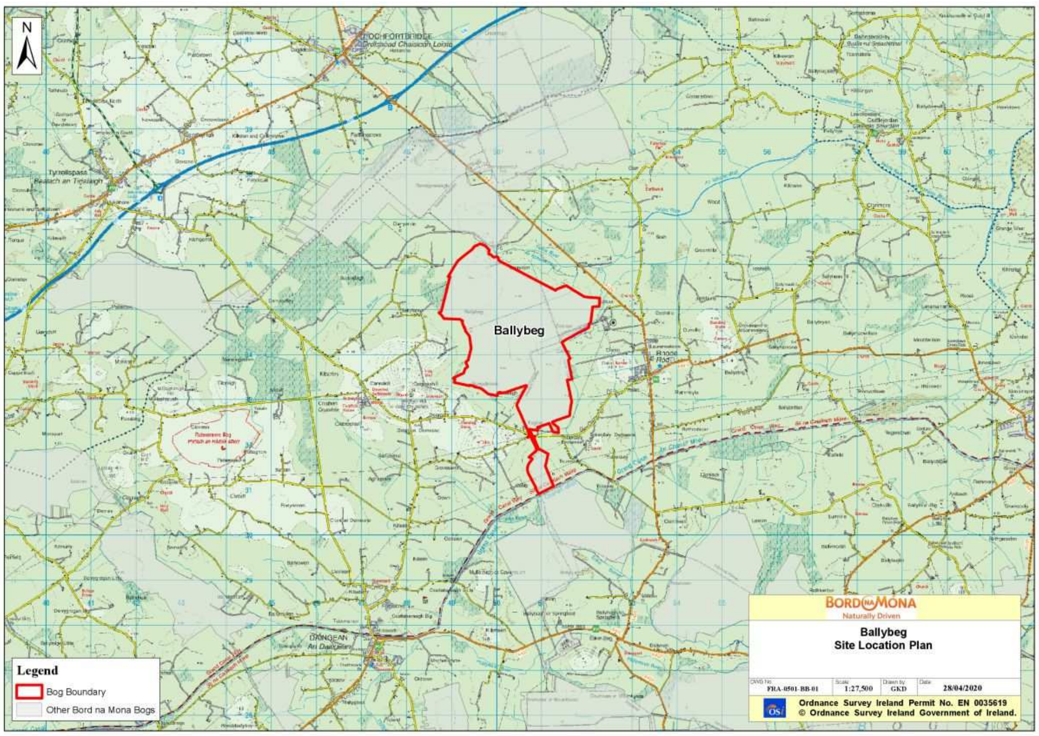

Figure 3.6-1 Ballybeg Site Location

Ballybeg Bog is located in Co Offaly and is approximately 5km south of Rochfortbridge and 2km west of Rhode. The R400 regional road passes the eastern boundary in a north-south direction.

3.6.3 Bog Description

The bog layout is shown in the Figure.

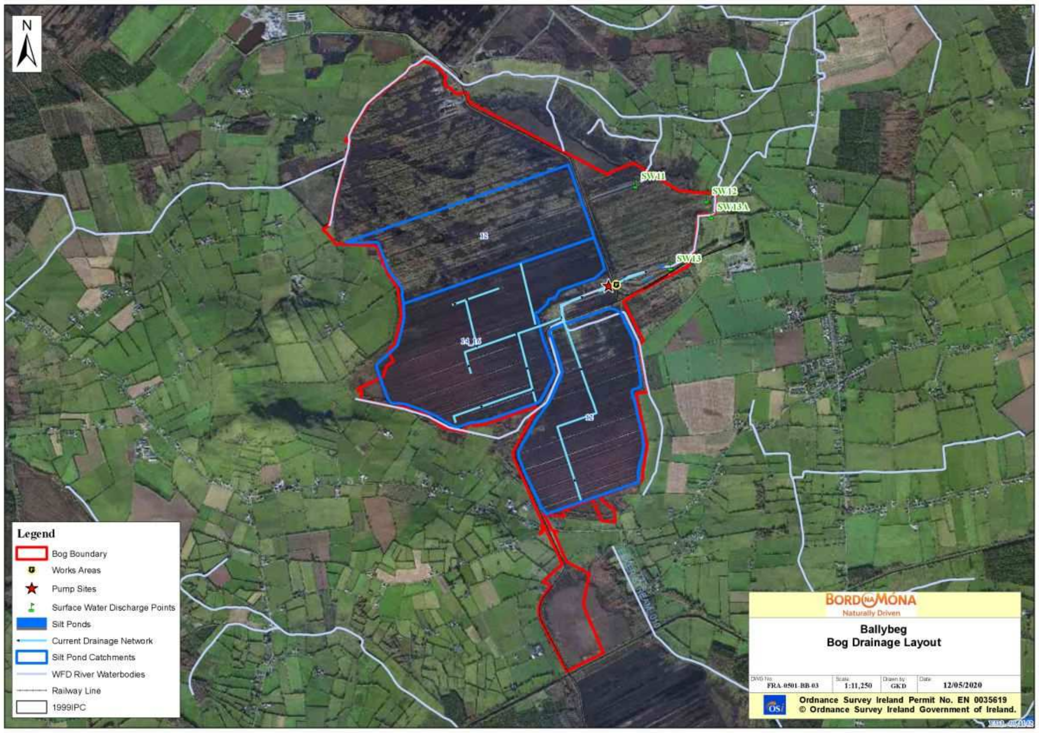

Figure 3.6-2 Ballybeg Layout

Ballybeg bog came under Bord na Móna control in 1950 through compulsory purchase order and pre-development gravity drainage was put in place in 1951. First production took place in 1955. The land use surrounding the bog is comprised of peat harvesting on surrounding bogs, forestry and agriculture.

The southern end of the bog is in active peat production, whilst production fields across the northern part of Ballybeg have ceased production and are revegetating with bog woodland. There are some edge habitats present around the periphery of the bog. These edge habitats are typically remnant sections of raised bog and cutaway bog.

The site is accessed at three locations along the northern, eastern and southern boundaries, with road access back to the R400 regional road. The rail infrastructure passing through Ballybeg links it to bogs north and south and eventually to Edenderry Power Station 17km away. There is a welfare centre present on the eastern side of the bog consisting of a portacabin at a finished floor level of 75.74mOD and unpaved parking area. Levels across the bog typically fall into the centre and eastern side of the site to approx. 73.50mOD from higher areas in the north and south of the bog at circa 79.0mOD. Areas of remnant bog in the north and south are several metres higher than adjacent production fields.

In Ballybeg, there are four outfalls on the eastern side of the site (SW 11, 12, 13 and 13A). Outfalls discharge water to the north of the site into the Yellow River. There is also a pump site in the centre of the bog, upstream of outfall SW13. This pump site houses two submersible 22kW pumps, which operate on a duty and assist basis.

3.6.4 **Regional Hydrology**

The catchment area and water courses are shown in the figures presented here.

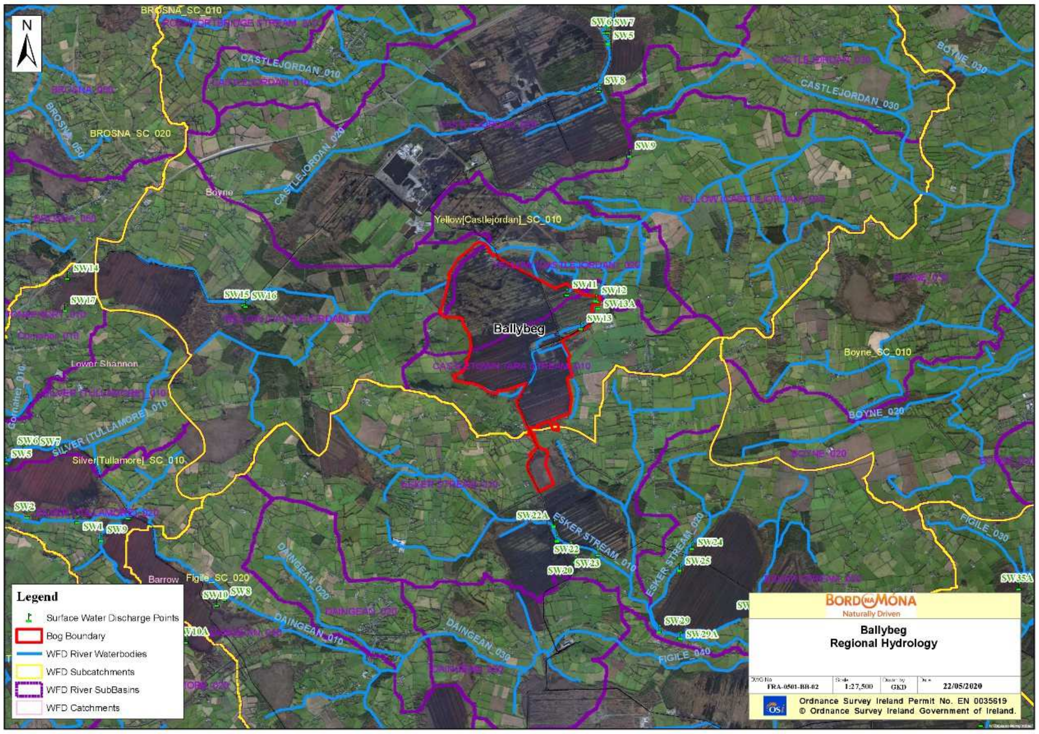

Figure 3.6-3 Ballybeg Bog Regional Hydrology

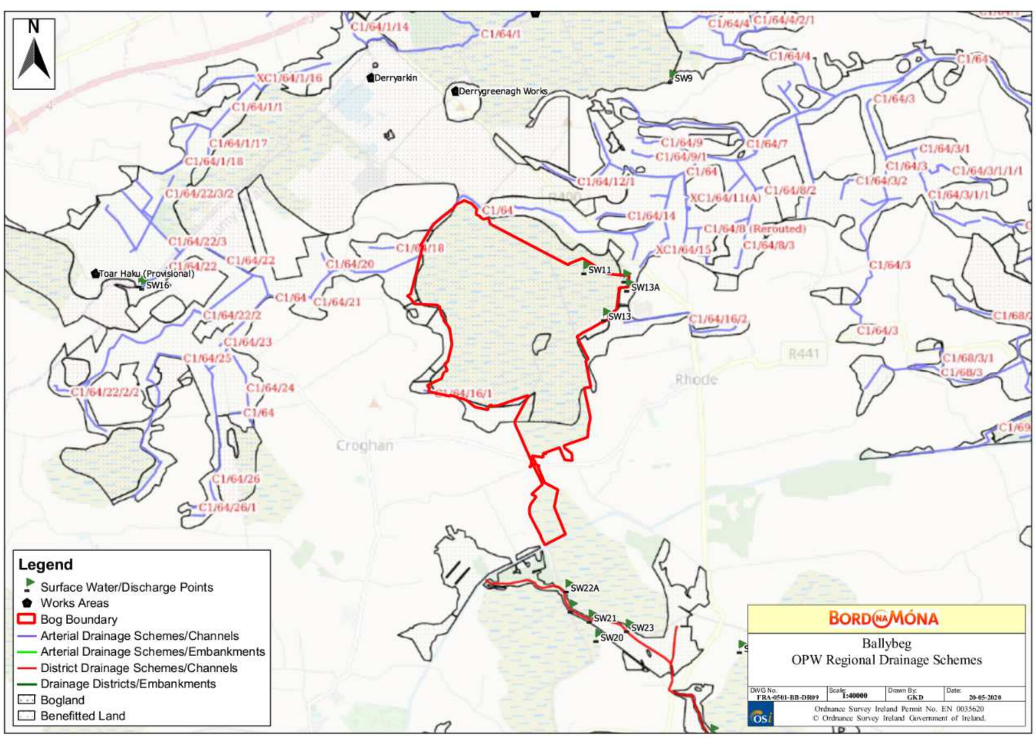

Figure 3.6-4 Ballybeg Bog District Drainage Schemes

Ballybeg Bog is within the Boyne 07 catchment. The Boyne 07 catchment drains a total area of 2,694km^2 and is characterised by an undulating landscape in the south which changes to a more hummocky, drumlin topography (steep-sided, lenticular hills) in the north. The catchment is underlain by metamorphic rocks in the north and limestone bedrock in the centre and south of the catchment. The Boyne catchment comprises 20 sub-catchments with 114 river water bodies, 11 lakes, one transitional and three coastal water bodies, and 25 groundwater bodies.

The outfall SW11 discharges into the Yellow(Castlejordan)_020 watercourse and SW12, SW13 and SW13A discharge into the Castletown Tara Stream_010 both of which flow into the River Boyne approx. 9 km east of the bog. These outfalls all drain into the Yellow (Castlejordan)_SC_010 WFD sub-catchment.

The Arterial Drainage near Ballybeg Bog is shown in the figures below. The benefitted land from the drainage schemes is also highlighted demonstrating the enhanced flood protection, as a result of this scheme, for the lands between the bog and Yellow River to the north.

The Standard Annual Average Rainfall (SAAR) in this location is 916mm.

3.6.5 **Historical Flooding**

A map of historical flooding is shown in the Figure.

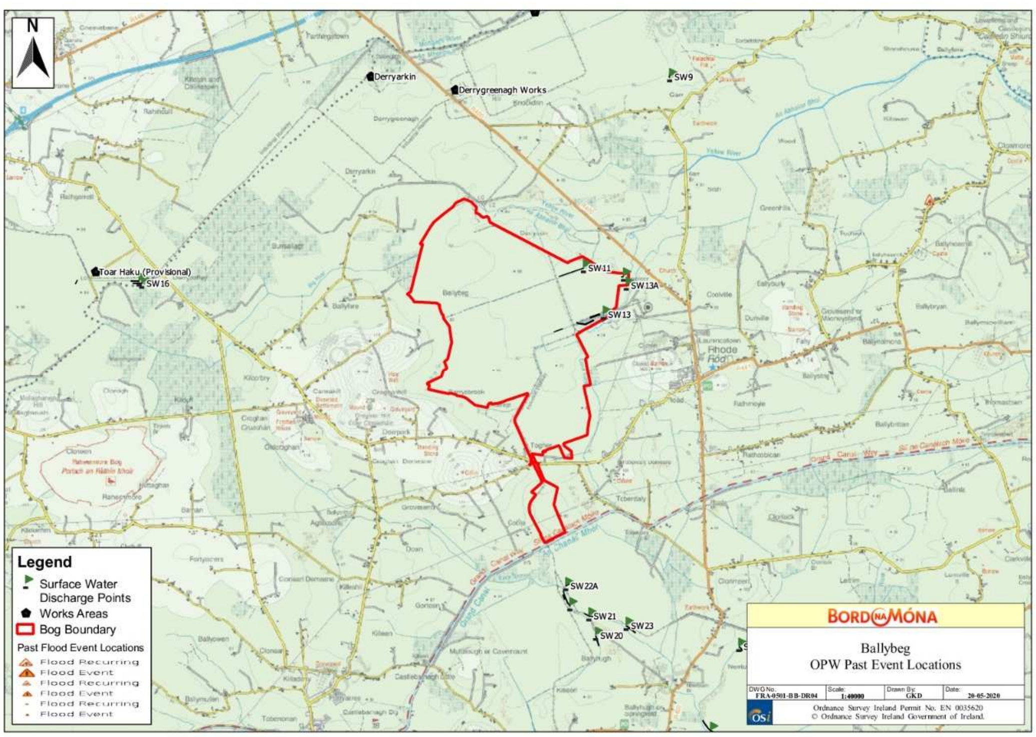

Figure 3.6-5 Ballybeg Bog Historical Flooding

Information from Bord na Móna operatives indicates that this bog has been known to flood in periods where the surface water pumps have either failed or do not have capacity to pump water generated during storm events. It is also accepted that local surface water flooding can occur where blockages to the existing drainage network occur over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production fields on an annual basis as part of the winter works schedule.

Historical flood records are taken from the OPW website, https://www.floodinfo.ie. There is no record of any flooding having occurred in the general area of the bog. The closest recorded event is at Ballyheashill where recurring flooding is noted at 'low-laying lands'. This location is between Rhode and Castlejordan and is approximately 5km from the site boundary.

Historical OSI 25" mapping was also examined for this area. There is no additional record of flooding to be taken from these maps for Ballybeg bog, however there are local areas of water and reeds identified within the area of the bog, particularly in the lower central part of the site.

3.6.6 **Groundwater Flood Risk**

A map of aquifers, karst features and known wells is shown in the Figure.

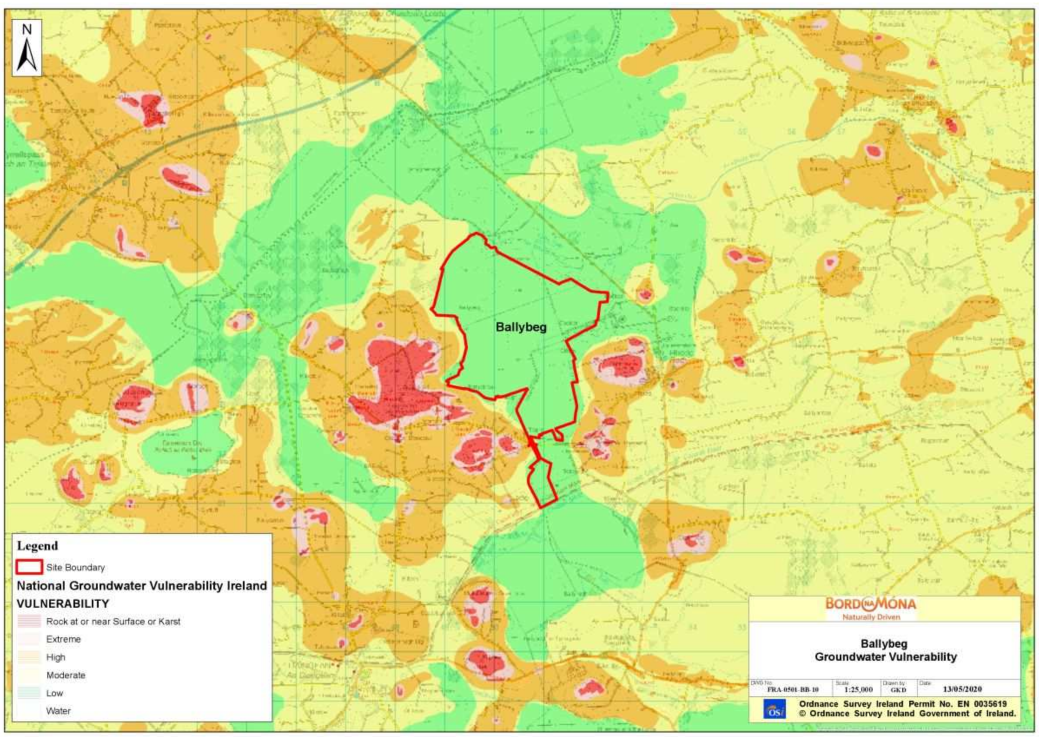

Figure 3.6-6 Ballybeg Bog Groundwater Vulnerability

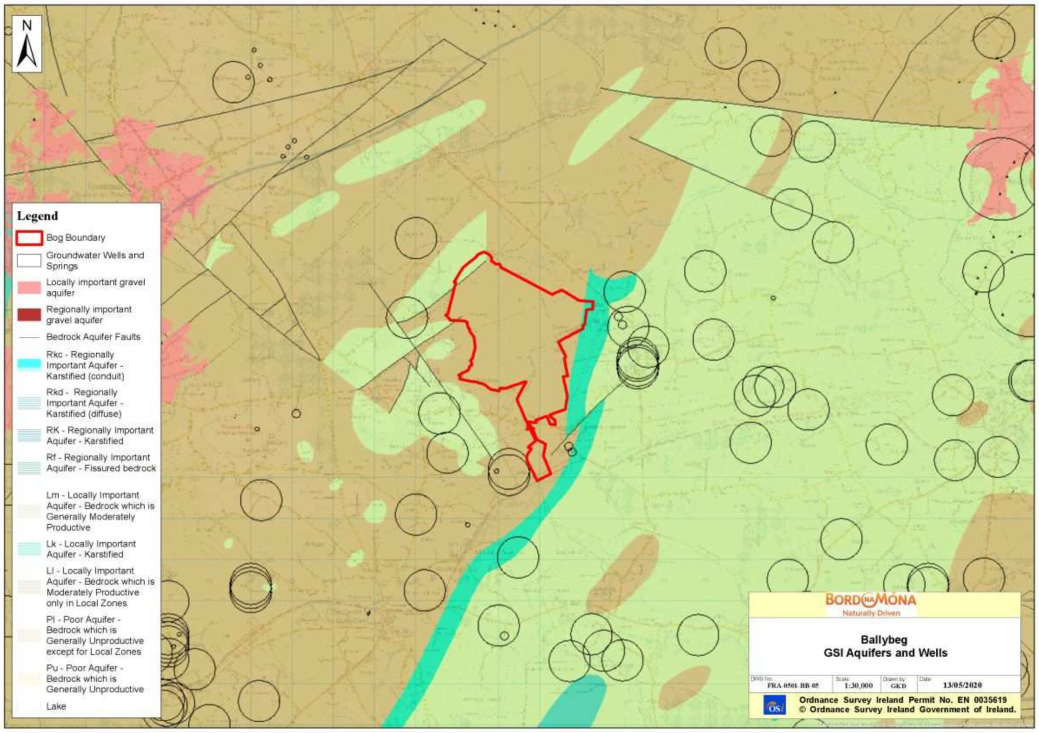

Figure 3.6-7 Ballybeg Bog Aquifers, Karst Features, Wells

There are a number of aquifers underlaying the Ballybeg bog area. The majority of the site is underlain by an aquifer which is known as a *Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll).* A small portion of the eastern side of the bog is underlain by an aquifer which is known as a *Locally Important Important Aquifer – Karstified (Lk).* Finally, there is a small area in the north of the site underlain by an aquifer known as a *Locally Important Aquifer - Bedrock which is Generally Moderately Productive (Lm).* Groundwater vulnerability rating for the area is given as Low across entire bog area.

There are records of a number of wells to the east and west of the bog, likely to be serving residential properties along local roads in these areas. There is no record of any karst features in the area.

There are no Bord na Móna records or local anecdotal evidence to suggest groundwater flooding has ever occurred at this bog.

3.6.7 **Fluvial Flood Risk**

CFRAM flood mapping is shown in the Figure below.

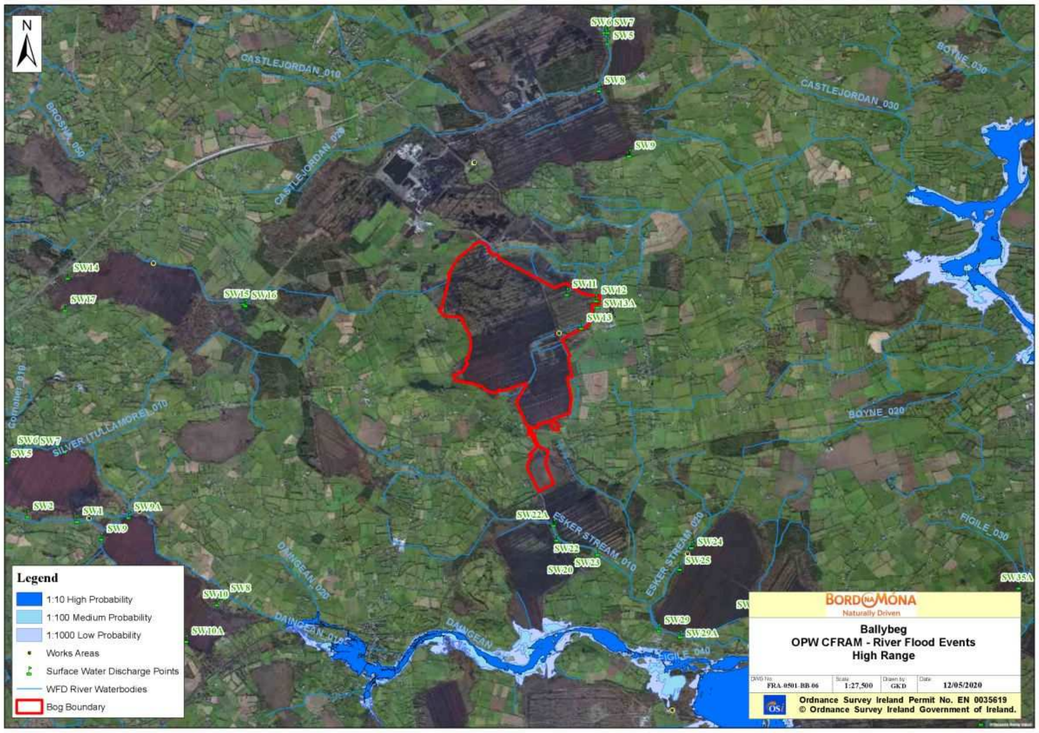

Figure 3.6-8 Ballybeg Bog CFRAM Flood Mapping

The rivers and streams in the vicinity of Ballybeg bog are described in terms of regional hydrology in section 3.6.4.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with the 'High-End Future Scenario extents' (generated taking in the potential effects of climate change using an increase in rainfall of 30% and sea level rise of 1,000 mm (40 inches))

Flooding is identified in the Yellow River, approximately 7.5km downstream of the site. There is no flooding identified further upstream of this location. There is no risk of flooding identified within the Ballybeg Bog boundary.

There are no Bord na Móna records or local anecdotal evidence to suggest fluvial flooding has ever occurred at this bog. In such an event, outfalls would become submerged if water levels in receiving water were to rise. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events. In the event of flooding in receiving waters, any such flow into the bog would be limited to the capacity of the outfall pipes from the bogs. It is noted that the limited pipe diameter at outfalls will also restrict run-off rates from the bog to the receiving waters.

3.6.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100 year and 1000 year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices.

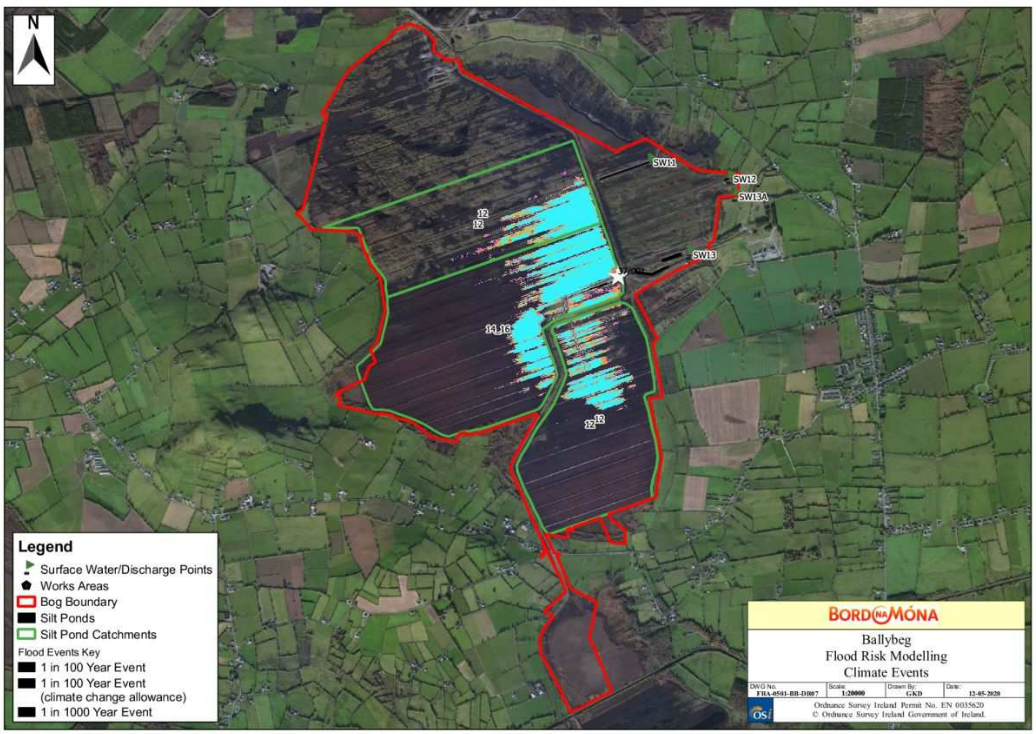

Figure 3.6-9 Ballybeg Bog Pluvial Flooding, Rainfall Events

Flooding modelling carried out for Ballybeg bog is presented here. The basins used in the model are the extent of the catchments that discharge through the surface water discharge points in the bog. Ballybeg Bog is divided into two catchments, 12North and 14_16&12South. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

From the modelling, it can be seen that surface water flooding is predicted towards the eastern side of the production fields. The maximum predicted flood levels in these areas are 75.08mOD in the northern catchment, with a slightly lower level of 74.90mOD to the south. Catchments are separated within the bog by topographical features such as ridges in surface levels and locally elevated rail lines and local elevated peat fields.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

As discussed in section 3.6.5, local anecdotal evidence indicates that pluvial flooding has occurred at Ballybeg bog along the eastern, lower side of the bog during periods of prolonged rainfall or where bog pumps have failed to operate or where they do not have capacity to meet demands of extreme rainfall events. This is broadly in line with the results of the flood modelling carried out.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	***12north***	***14_16 and 12south***
mOD	***m^3***	***m^3***
73	0	13
73.25	0	334
73.5	3	2494
73.75	858	12393
74	6347	37287
74.25	19178	82625
74.5	40888	154405
74.75	72281	259234
75	115781	400214
75.25	172093	

Table 3.6.1 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Ballybeg Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

Ballybeg bog has pumping of surface water from low lying areas. These pumps have been dis-regarded for the flood modelling of the extreme rainfall events set out above as these pumps are not designed for such events. The pump site at Ballybeg has a capacity of 22kW and has an outlet level of 75.36mOD.

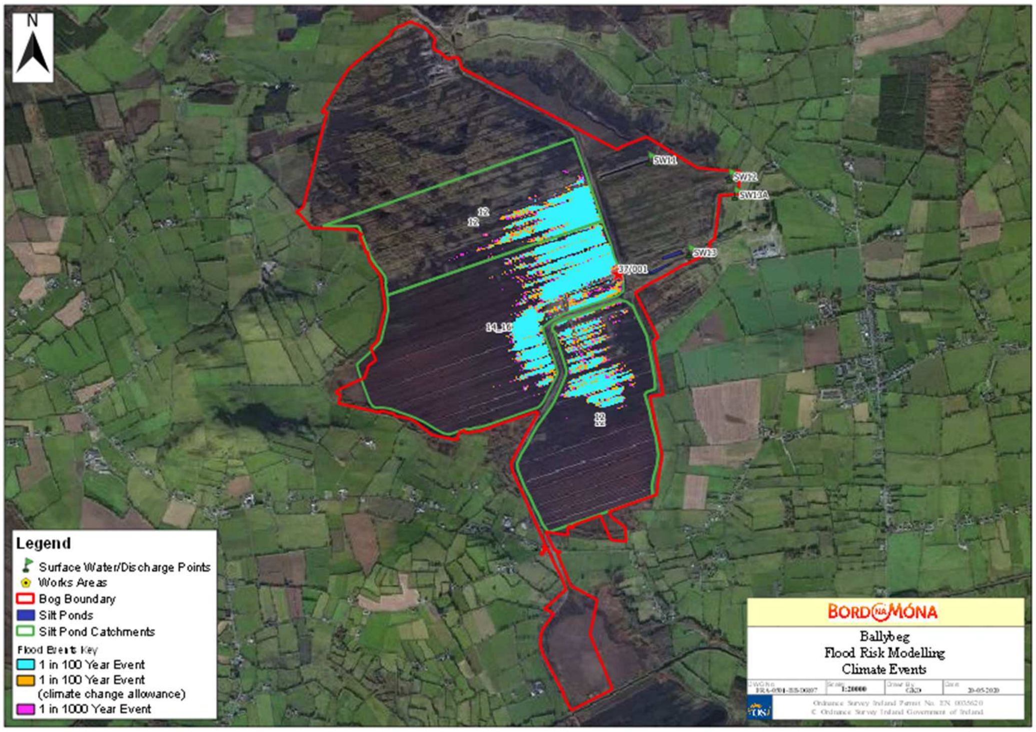

Figure 3.6-10 Ballybeg Bog Pluvial Flooding, Pump Failure

At Ballybeg bog, the pump site is located upstream of the silt ponds and outfall SW13, with a gravity flow from the outfall into receiving waters. In the event that a pump fails, the surface water will pond in low lying areas on the bog to a level where it can discharge by gravity flow. The above figure models the flooding that will occur in the event that these pumps are turned off or breaks down. The expected flood water level in this situation is plotted in red. The flooding caused by the failure of this pump will be retained within the bog peat production area.

Based on the modelling carried out, the works area for Ballybeg bog is not at risk of flooding during the flooding scenario of the 1 in 1000 year event or in the event of flooding due to pump failure.

3.6.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 3.6.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100 year event plus 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case the maximum rainfall for the 100 year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000-year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 3.6.7, the High-Emissions Future Scenario (HEFS) has been considered which takes in account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

3.6.10 Conclusions

The Flood Risk Assessment for Ballybeg Bog identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area has occurred where bog pumps have failed to operate or where pumps have not been able to meet the demands imposed by extreme rainfall events.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. There is no record of this having occurred previously on this site. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. Modelling also indicated that the works area on the eastern side of Ballybeg bog was not at risk of flooding in any of the scenarios modelled.

This Flood Risk Assessment indicates that the works area on the eastern side of Ballybeg bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low Risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C. This development is also outside of the scope of this application as it is subject of existing planning permissions.

This Flood Risk Assessment indicates that the peat production fields and drains in Ballybeg Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 3.6.2 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is only carried out for a few weeks each year during the summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Ballybeg Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the works area and the main access location for the bog are in an area of higher ground that is not at risk of flooding.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change;
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Ballybeg Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

FLOOD RISK ASSESSMENT – CHAPTER 4
Blackwater Bog Group

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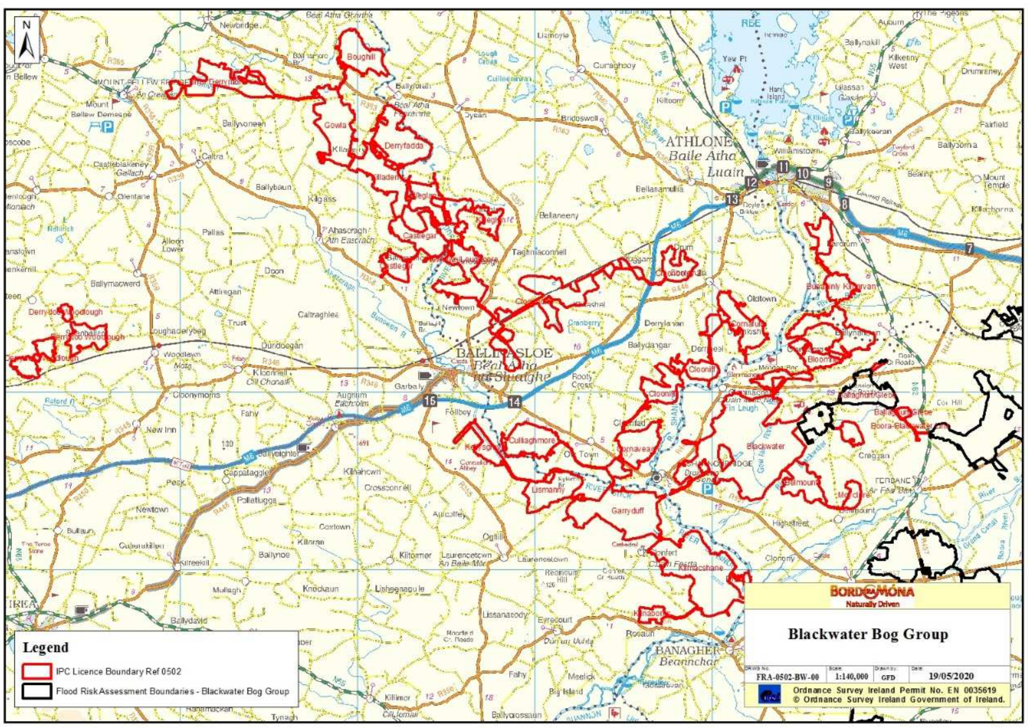
4 FLOOD RISK ASSESSMENTS – BLACKWATER BOG GROUP

4.1 Blackwater Bog Group - IPC License 502

The Blackwater group of bogs are sited in Counties Galway, Offaly, Westmeath and Roscommon. The bog group extends from Attymon in Co. Galway to east of Ferbane in Co. Offaly and from north of Ballyforan Co. Galway to north of Banagher, Co. Offaly in a north south direction. Bord na Móna's licence for the Blackwater Bog Group (Ref. PO502-001) was granted to Bord na Móna Energy Limited on 26 April 2000 and regulates Bord na Móna's activities across 29 bog units. Only one of the bog units in the Blackwater Bog Group, Ballaghurt Bog, is included in the Substitute Consent applications and in this Flood Risk Assessment Report.

Peat extracted from bogs in the Blackwater Bog Group, including Ballaghurt Bog, was primarily used to supply the West Offaly Power station. Once this power station closes in December 2020, all peat produced in Ballaghurt Bog will be used to supply Derrinlough Briquette Factory.



4.2 Ballaghurt Bog

4.2.1 Introduction

Ballaghurt Bog is part of the Bord na Móna Boora Bog Group which operates under an Integrated Pollution Control Licence (ref P0502-01). The Bog is used primarily to produce milled peat which will supply peat for use in the Derrinlough briquette factory. The total area within Bord na Móna ownership is 791 Hectares.

4.2.2 **Site Location**

Ballaghurt Bog is located approximately 5.9km south of Ballynahown in County Offaly. It is connected to Blackwater Bog to the west and Lemanaghan Bog to the south east. The site is within the Lower Shannon 25B catchment, (Hydrometric Area 25).

The Ballaghurt Bog site location is highlighted in red in the Figure below and is 791 Hectares.

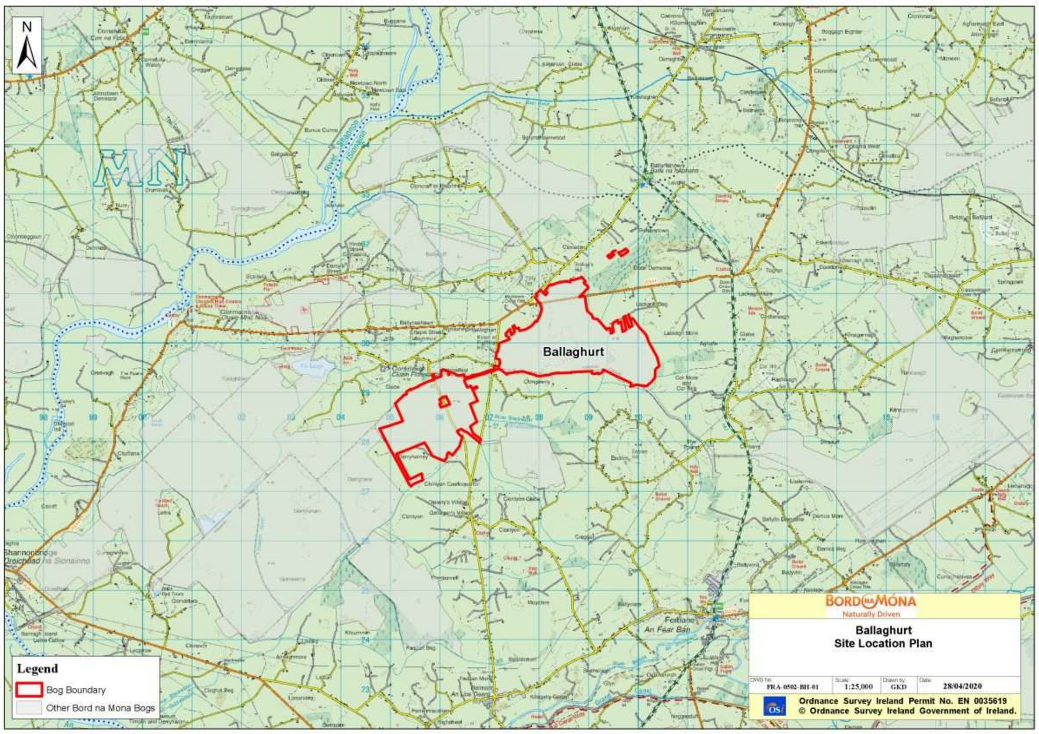


Figure 4.2.1** **Ballaghurt Bog Site Location

4.2.3 **Bog Description**

Ballaghurt Bog consists of two bog areas Ballaghurt 1 (most easterly) and Ballaghurt 2(most westerly) connected via railway link. The western section of Ballaghaurt Bog is also referred to as Derryharney. Ballaghurt Bog is used primarily for the production of milled peat for fuel use. Several sections of remnant raised bog are located along the margins of the site. These remnant areas are small in extent and degraded in condition with some areas in use for the production of domestic turf. A section of the site, close to the works area, contains several former production fields that have re-vegetated with heather. Ballaghurt 1 bog was drained by Bord na Móna in 1975 with peat production commencing in 1980. Ballaghurt 2 bog was drained by Bord na Móna in 1990 with peat production commencing in 1995.

The peat production elevations vary from 49.5mOD to 43.6mOD in the eastern bog area (Ballaghurt 1) and from 44.1mOD to 40.6mOD in the western area of Ballaghurt Bog.

There is a works area where the rail link connects the two bogs. This works area includes welfare facilities, car parking and storage area. The finished floor levels of the buildings in this area range from 49.65mOD to 50.28mOD. The main access point to the bog is off the public road known as Bellmont Road off the R444 into the works area.

There are 10 gravity flow surface water outflows, with associated silt ponds, in Ballaghurt Bog. Details of the existing drainage layout is shown in the Figure below.

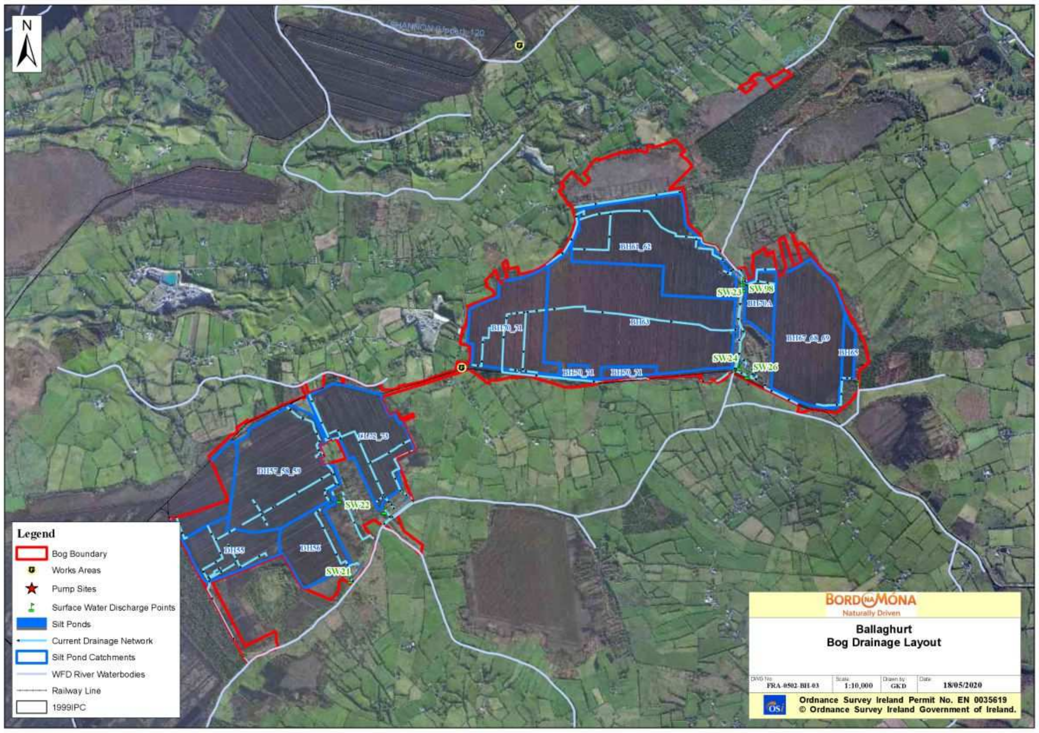


Figure 4.2.2** Ballaghurt Bog Drainage **Layout

4.2.4 **Regional Hydrology**

Ballaghurt Bog is within in the Lower Shannon (Little Brosna) 25B (Hydrometric Area 25). This catchment covers an area of 982km^2 and comprises of 7 sub-catchments with 44 river bodies. There are 12 groundwater bodies and no lakes, transitional or coastal water bodies.

There are 10 gravity flow surface water outflows with associated silt ponds in Ballaghurt Bog. There are no pumps in Ballaghurt Bog and all flow is gravity.

In the eastern bog area, (Ballaghurt 1) there are 6 surface outfalls, 5 are arranged in a north south alignment and the 6TH is on the easterly fringes of the bog. All of these outfalls discharge into the Blackwater(Shannonbridge)_010 water body in the Shannon (Lower)_SC_030 sub catchment.

In the western bog area (Ballaghurt 2) there are 4 surface outfalls, 2 are on the southern edge, 1 is located centrally in the bog and 1 is located on the easterly fringe of the bog. The 2 outfalls on the southern edge and the 1 outfall located centrally all discharge into the Blackwater(Shannonbridge)_020 water body. The outfall located on the easterly fringe of Ballaghurt 2 Bog discharges into the Blackwater(Shannonbridge)_010 sub basin.

The Blackwater (Shannonbridge)_010 flows through Ballaghurt 1 and diverges into two channels south of the bog. Outfalls SW23, SW98, SW24, SW26, and SW24A all discharge into the Blackwater (Shannonbridge)_010 as it flows through Ballaghurt 1 bog. The diverged section of Blackwater (Shannonbridge)_010 and is 5m south of SW26A.

In Ballaghurt 2 the Blackwater (Shannonbridge)_020 flows approximately 10m south of the outfalls SW20, SW21 and SW22 which discharge into this waterbody. There is one outfall in Ballaghurt 2 Bog which discharges into the Blackwater (Shannonbridge)_010 sub basin and it is within 15m proximity. All of the surface water outfalls in Ballaghurt Bog discharge into the Shannon[Lower]_SC_030 sub catchment.

The catchment areas, water courses and District Drainage Schemes are shown in the Figures below.

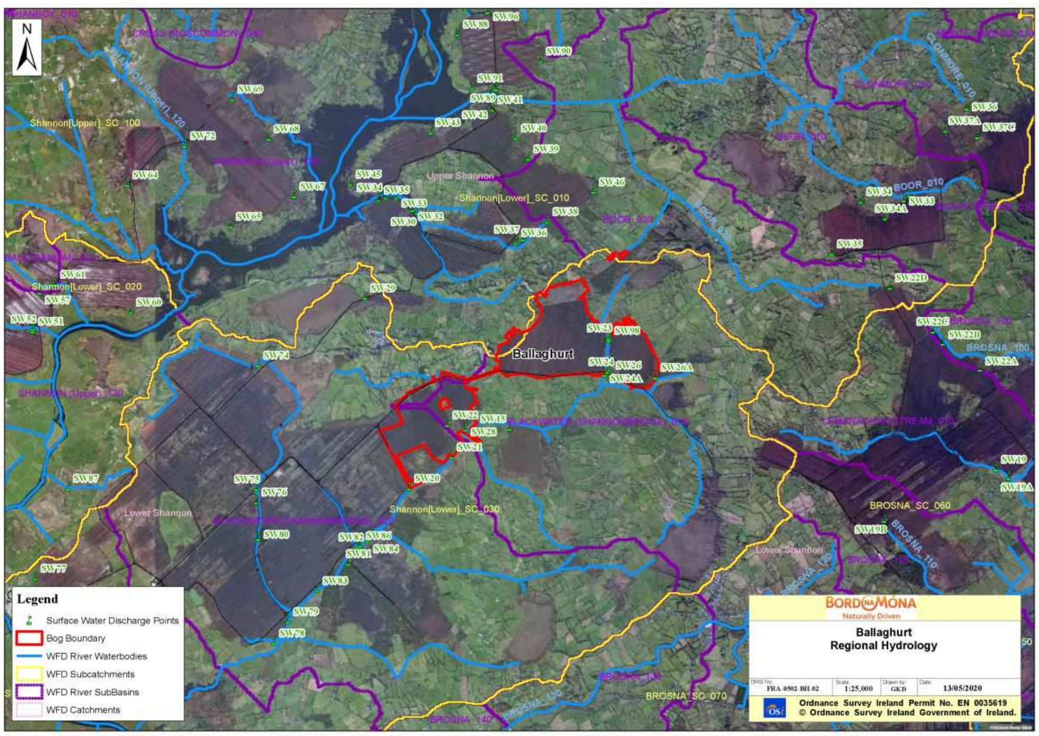


Figure 4.2.3 Ballaghurt Bog Regional Hydrology

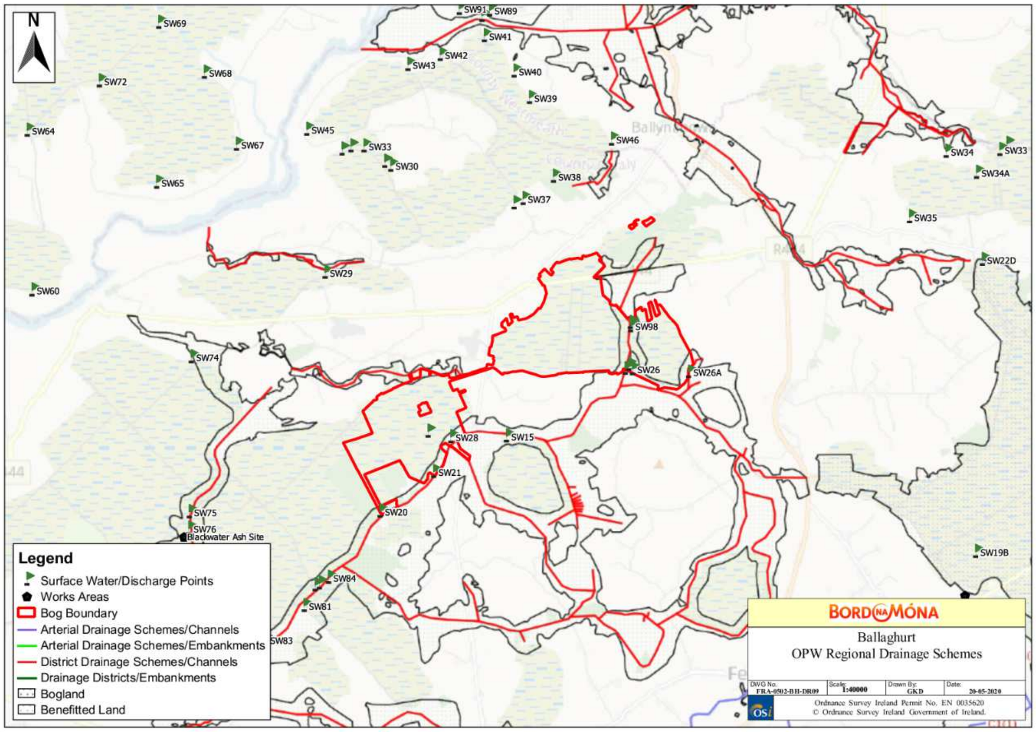


Figure 4.2.4 Ballaghurt Bog District Drainage Schemes

The benefitted land from District Drainage Schemes is also highlighted demonstrating that there are limited benefitting lands associated with this scheme in the area of these bogs.

The groundwater aquifer underlying Ballaghurt Bog is categorised as Ll - *Locally Important Aquifer- Bedrock which is moderately Productive only in Local Zones.* This is discussed further in section 4.2.6.

The Standard Annual Average Rainfall (SAAR) in this location is 898mm.

4.2.5 **Historical Flooding**

The OPW https://www.floodinfo.iewebsite provides some limited information on flood records throughout the country. A map of historical flooding contained for the area, in the vicinity, of Ballaghurt Bog is shown in the Figure below.

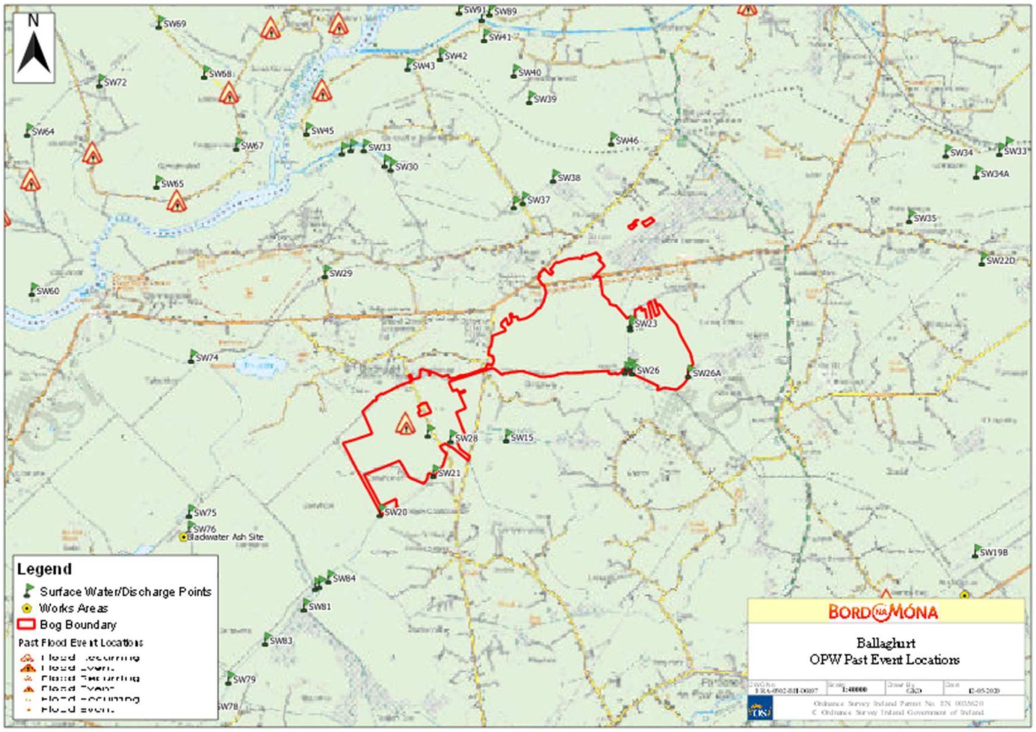


Figure 4.2.5 Ballaghurt Bog Historical Flooding

The OPW Past Flood Events show a record of a flooding event within Ballaghurt Bog.

The flooding event is identified in *The Minutes of Meeting: Offaly County Council – Oral report- Area Engineer- Ferbane, dated 01/11/2005.*

In these minutes the flooding is described as '*Derryharney – Low Lying land and bog floods after heavy rain every year. Road is not liable to flood*.' (Derryharney Bog is the western section of Ballaghurt Bog.)

Information from Bord na Móna operatives familiar with Boora Bog confirmed that surface water flooding has occurred in this bog and that the outfall pipes do on occasion back up into the bog and the silt ponds. Flooding has also occurred in the production area where blockages to the existing drainage network have occurred over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production.

Aerial imagery of the November 2009 and December 2015 flooding events show some flooding in the bog production areas and along the periphery of the bog as shown in the figure below.

Figure 4.2.6 Ballaghurt Bog November 2009 Flood Event

4.2.6 **Groundwater Flood Risk**

The groundwater aquifer underlying Ballaghurt Bog is categorised as Ll - *Locally Important Aquifer- Bedrock which is moderately Productive only in Local Zone.* This aquifer has a low vulnerability code where it underlies the western part of Ballaghurt. Where the aquifer underlies the eastern part of Ballaghurt the vulnerability code is moderate.

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below.

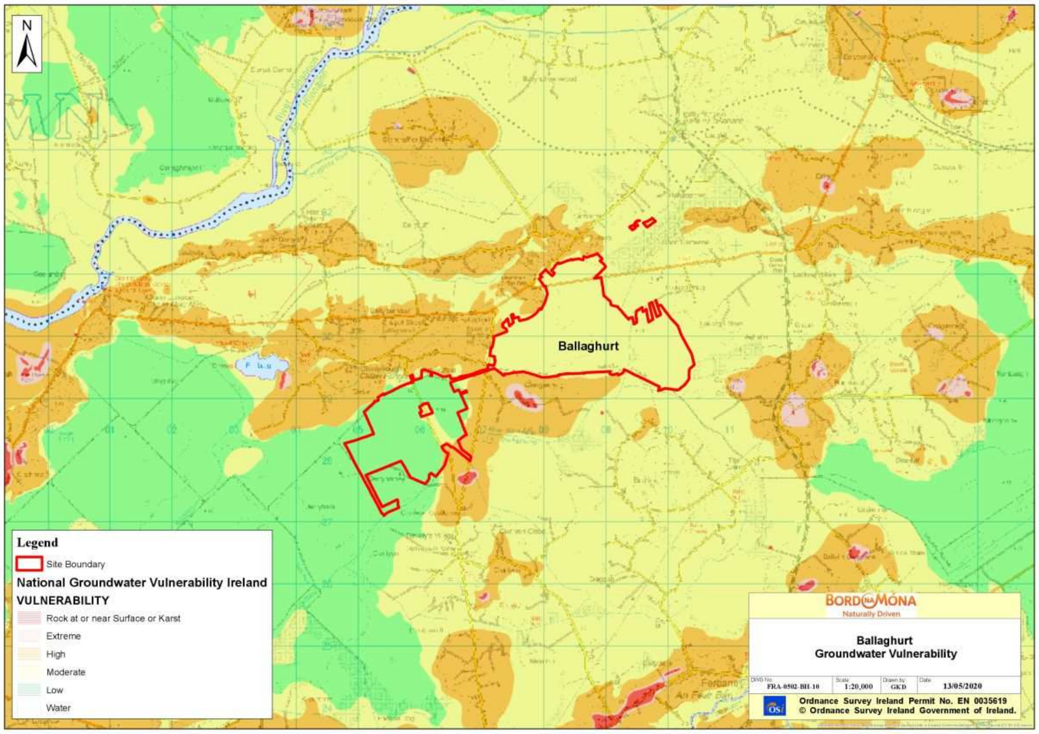


Figure 4.2.7 Ballagahurt Bog Groundwater vulnerability

The GSI https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx website provides information on groundwater throughout the country. The are no wells shown in the vicinity of Ballaghurt Bog.

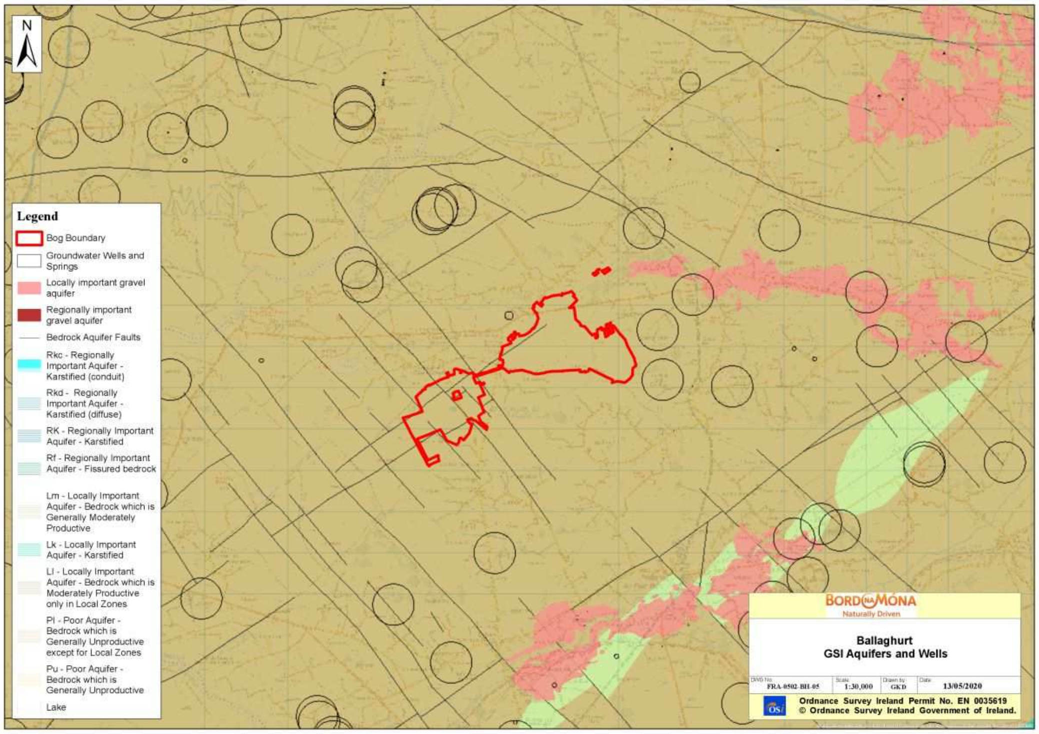


Figure 4.2.8 Ballaghurt Bog Aquifers, Karst Features, Wells

Information from Bord na Móna operatives familiar with Ballaghurt Bog confirmed that groundwater seepage has not been identified as a source of flooding within the bog

4.2.7 **Fluvial Flood Risk**

The rivers and streams in the vicinity of Ballaghurt Bog are described in terms of regional hydrology in section 4.2.4.

The 10 surface water outfalls in Ballaghurt Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameters of these outfalls are shown in the Table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW20	0.600
SW21	0.600
SW22	0.600
SW23	0.600
SW24	0.450
SW24A	0.450
SW26	0.450
SW26A	0.450
SW28	0.600
SW98	0.600

Table 4.2.1 Ballaghurt Bog Surface Water Outfalls

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Ballaghurt Bog. River Flood Events High Range mapping has been examined in the region of this bog. Mapping carried out for the Blackwater (Shannonbridge)_010 river predicts flooding will back up into the into the outfalls of Ballaghurt Bog. This flooding is not extensive and corroborates the information from Bord na Móna operatives familiar with Ballaghurt Bog that the outfalls will become submerged when the water levels of Blackwater (Shannonbridge)_010 river are high. The Blackwater (Shannonbridge)_010 would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

There is no mapping available for the other rivers in the vicinity of the bog.

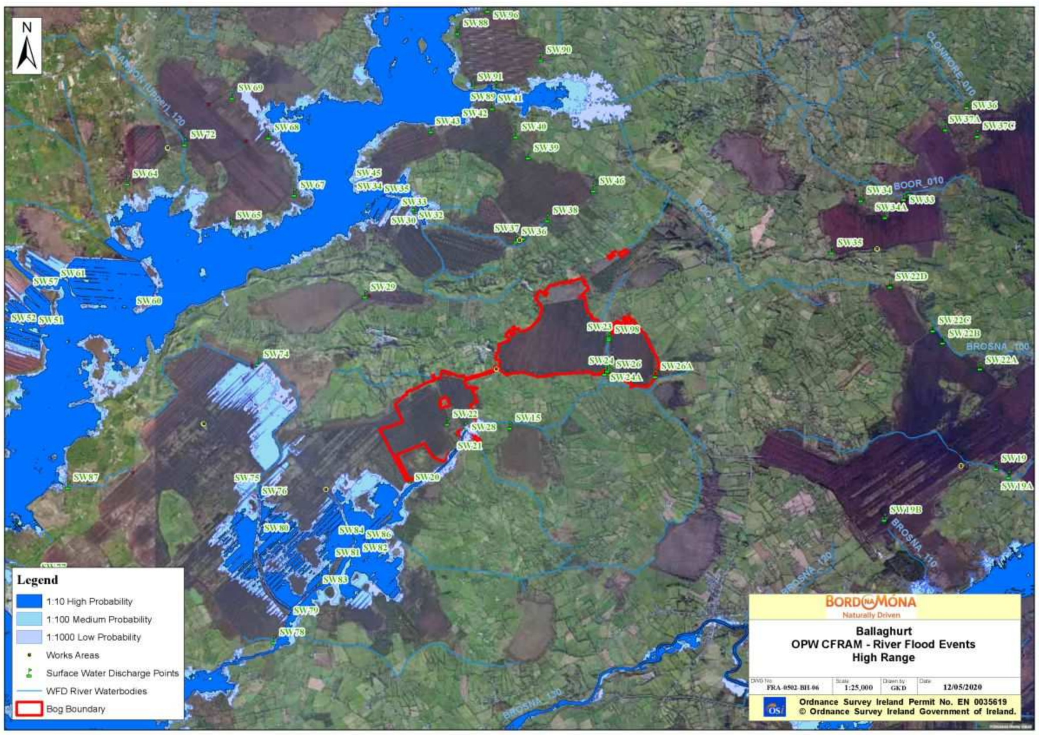


Figure 4.2.9 Ballaghurt Bog Flood Events High Range

4.2.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below.

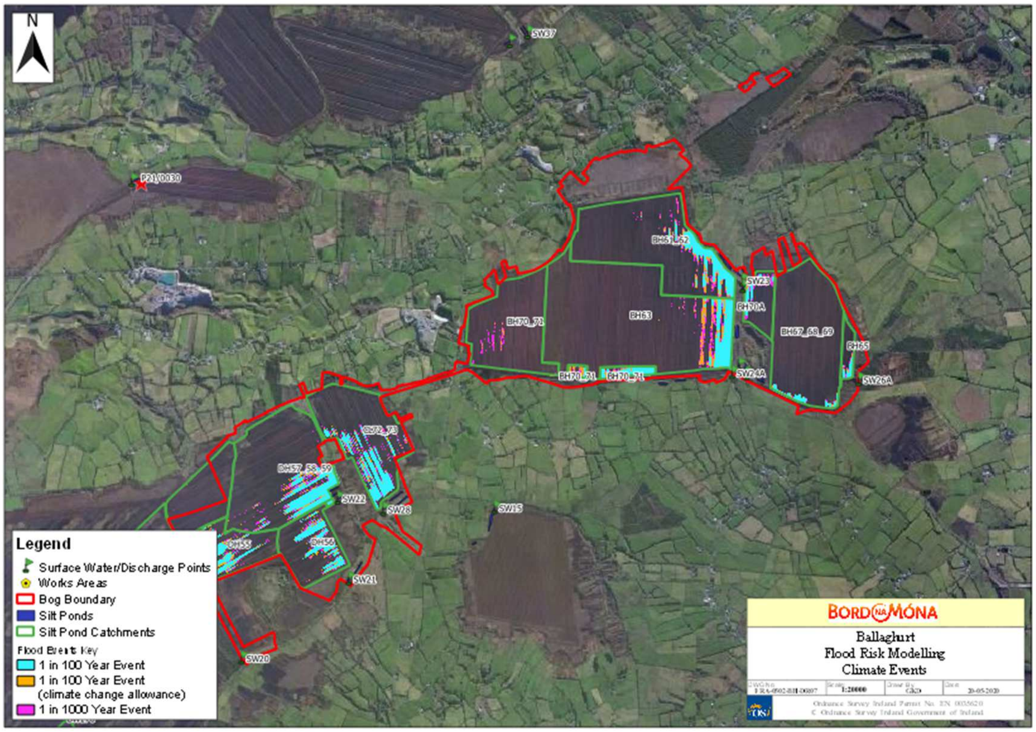


Figure 4.2.10 Ballaghurt Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the Surface water discharge points in the bog. Ballaghurt Bog is modelled for 10 basins, BH61_62, BH63, BH70_71, BH70A, BH67_68_69, BH65, DH55, DH56, DH57_58_59 and CL72_73. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via greenfield runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

The model shows that flood waters are collecting in local areas in the western bogland area and in the central part of the eastern bogland area. The most extensive flooding is shown in the western bogland area. The maximum flood level in this area for the 1000year event is 42.77mOD. The maximum flooding for the same flood event in the eastern bogland area is 47.55mOD, however due to the topography of the bog, this flood level will be retained in this area.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events

The finished floor levels of the buildings range from 49.65mOD to 50.28mOD. The elevation of these buildings is higher than the modelled flood waters in the vicinity of the works area. From this model Ballaghurt Bog works area which includes welfare facilities, car parking and oil storage facilities is not at risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	*BH61_62*	*BH63*	*BH65*	*BH67_68_69*	*BH70_71*	*BH70A*	*CL72_73*	*DH55*	*DH56*	*DH57_58_59*
mOD	***m^3***	***m^3***	***m^3***	***m^3***	***m^3***	***m^3***	***m^3***	***m^3***	***m^3***	***m^3***
41.5	0	0	0	27	0	1	0	0	2	0
41.75	24	11	0	317	0	2	0	0	7	0
42	572	389	0	1272	0	12	0	0		5
42.25	1569	1434	0	3573	0	77	2	0		20
42.5	3616	3047	0	7581	0	281		0		59
42.75	7725	5228	0		0	710		0		262
43	14972	8049	0		0	1362		1		800
43.25	25893	11789	2		0	2364				
43.5	41288	17333	31		0	3921				
43.75	62321	25636	144		0	7462				
44		36316	417		14	13789				
44.25		49644	1245		148					
44.5		65698	2908		520					
44.75		85147	5457		1172					
45		110694			2069					
45.25					3168					
45.5					4539					
45.75					6230					
46					8289					
46.25					10879					
46.5					14235					
46.75					18601					
47					24712					
47.25					32384					
47.5					42720					
47.75					58290					

Table 4.2.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Ballaghurt Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

4.2.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 4.2.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100year event + 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case, the maximum rainfall for the 100year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 4.2.7, the High Emissions Scenario (HEFS) has been considered which takes into account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

4.2.10 **Conclusions**

The Flood Risk Assessment for Ballaghurt Bog identifies the sources of flood risk and their impact. Historical information was also reviewed.

- ***Historical Flooding:*** The 2009 and 2015 aerial imagery show some flooding in Ballaghurt Bog. And there is historical reference to flooding of Derryharney Bog (western section of Ballaghurt Bog) by the local authority. From local knowledge flooding of the peat production area does occur on occasion, however there is no record of flooding of the works area or buildings.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the adjoining water courses if their levels ever rise during flood events. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings area would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Works Area in Ballaghurt Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low Risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Ballaghurt Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 4.2.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Ballaghurt Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Ballaghurt Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

FLOOD RISK ASSESSMENT – CHAPTER 5
Allen Bog Group

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5 FLOOD RISK ASSESSMENTS – ALLEN BOG GROUP

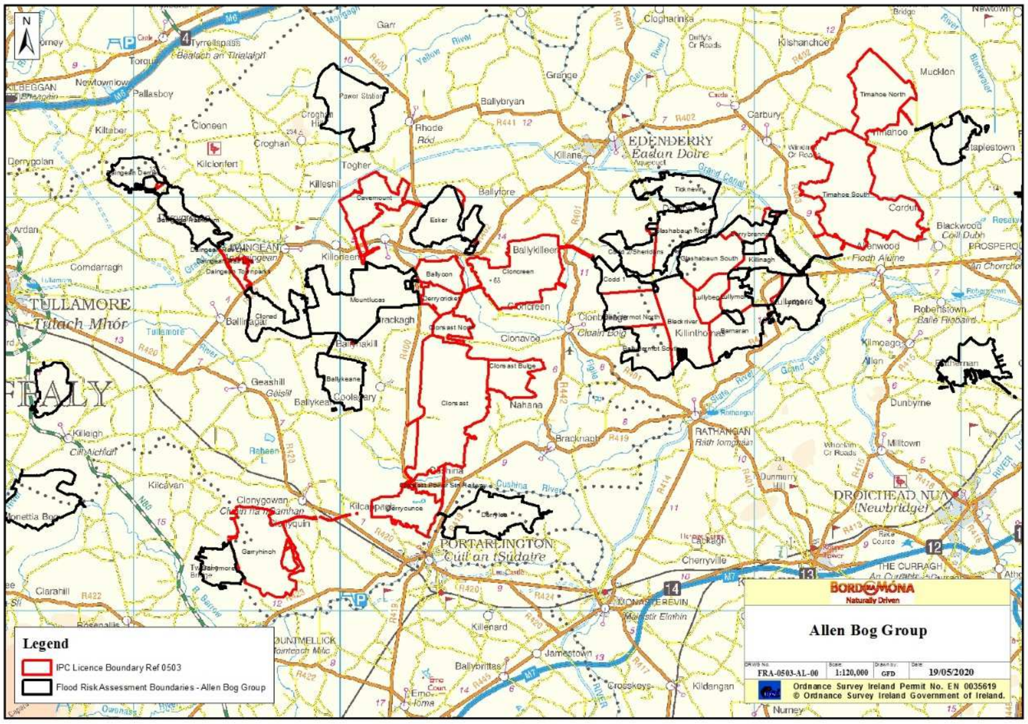
5.1 Allen Bog Group - IPC Licence Ref P0503-01

The Allen group of bogs included in this application are sited between Tullamore, Co. Offaly in the west and Allenwood, Co. Kildare in the East and between Portarlington Co. Laois in the south and Edenderry in the North. Bord na Móna's licence for the Allen Bog Group (Ref. PO503-001) was granted to Bord na Móna Energy Limited on 28th April 2000 and regulates Bord na Móna's activities across 31 bog units. Of these 31 bogs units, 17 are included in the Substitute Consent applications and in this Flood Risk Assessment Report. The 17 Allen bogs included in this report are:

- Daingean (Derries) – Counties Offaly and Westmeath
- Daingean (Rathdrum) – County Offaly
- Clonad – County Offaly
- Ballykean – County Offaly
- Esker – Counties Offaly
- Garrymore – County Laois
- Derrylea – Counties Offaly and Kildare
- Ticknevin – Counties Offaly and Kildare
- Glashabaun North – Counties Offaly and Kildare
- Glashabaun South – Counties Offaly and Kildare
- Codd North – County Offaly
- Codd South – County Offaly
- Ballydermot North – Counties Offaly and Kildare
- Ballydermot South – Counties Offaly and Kildare
- Blackriver – County Kildare
- Barnaran – County Kildare
- Lodge – County Kildare

The River Barrow is the major river catchment for these bogs with all partially or fully located within the Barrow catchment. Daingean (Derries), Daingean (Rathdrum) and Clonad are partially located in the Lower Shannon catchment with a small area of Ticknevin located in the Boyne catchment.

From the records available, it appears that Bord na Móna commenced the development of Ballydermot Bog in 1946 with production commencing in 1950. The most recently developed bog in this bog group is Daingean Rathdrum which was drained in 1996 and commenced production in 2000. Rhode power station which was fuelled by peat from these bogs operated from 1960 to 1998 and this was followed by Edenderry Power Station which opened in 2000. Peat was also supplied to Croghan Briquette Factory which was built in 1958 and operated until its closure in 2000. Peat from the Allen Bog group is currently primarily used for the supply of peat to the Edenderry Power Station.



5.2 Daingean (Derries) Bog

5.2.1 **Introduction**

Daingean (Derries) Bog is part of the Bord na Móna Allen Bog Group which operates under an Integrated Pollution Control Licence (ref P0503-01). The Bog is used primarily to produce milled peat. The total area within Bord na Móna ownership is 285 Hectares.

5.2.2 **Site Location**

Daingean (Derries) Bog is located along the northern margin of Co. Offaly with Co. Westmeath, 8 Km north-west of Daingean Town. The site is within the Lower Shannon 25A catchment, (Hydrometric Area 25).

The Daingean Derries Bog site location is highlighted in red in the Figure below and is is 285 Hectares.

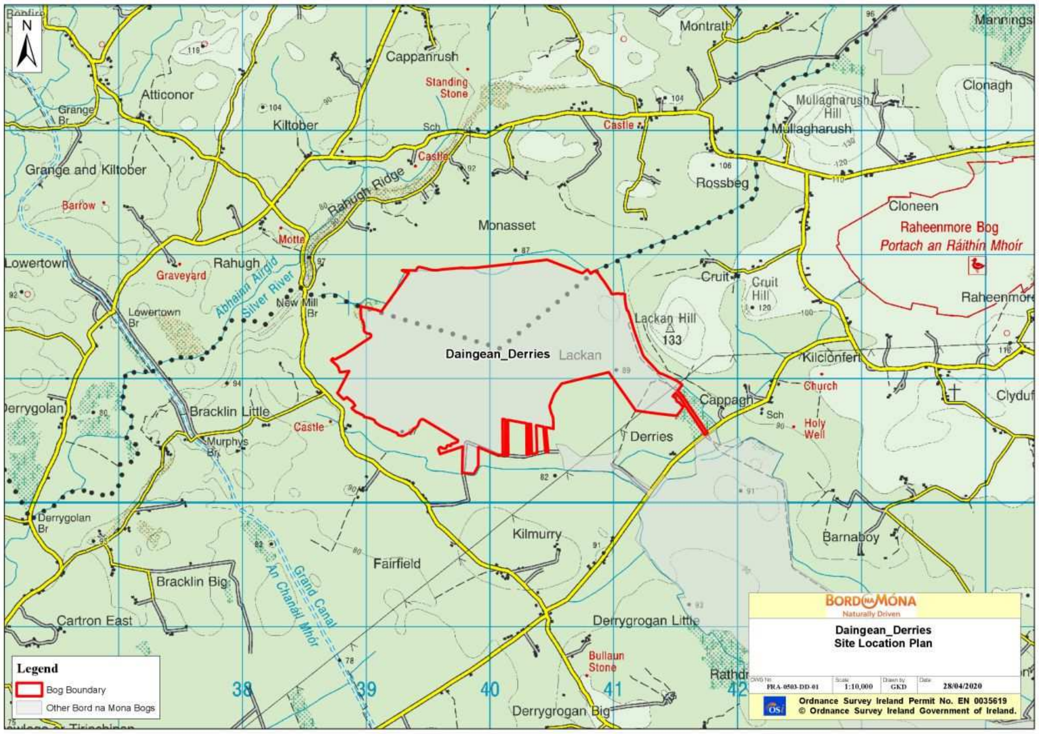


Figure 5.2.1 Daingean Derries Bog Site Location

5.2.3 Bog Description

Daingean (Derries) Bog primarily consists of milled peat production. A railway from the site links Daingean (Derries) Bog with the adjacent Daingean-Rathdrum bog and onto the Derrygreenagh bog complex. The landscape around the bog is largely agricultural and the bog is located close to Lackan Hill, which over-looks the site. Much of the surrounding land is improved grassland. There is some low-lying land towards the south-eastern side where conifer plantation has been developed. Marginal remnant habitats include scrub, some high bog and birch woodland. A large part of the southeast section is privately owned. This bog was drained by Bord na Móna in 1995 with peat production commencing in 1999.

There is a works area in the south west corner of the bog and this contains a storage area. The main access point to the bog is off the local road L1025 into the works area. There are 8 gravity flow surface water outflows, with associated silt ponds, in Daingean (Derries) Bog.

Details of the existing drainage layout is shown in the Figure below.

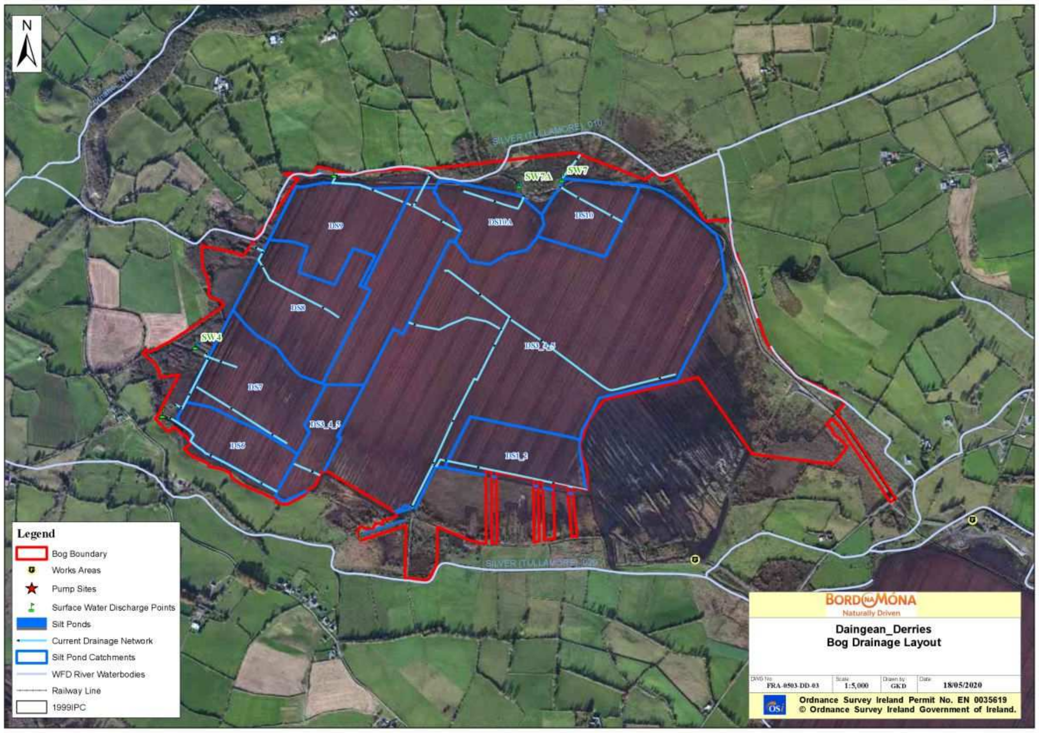


Figure 5.2.2 Daingean (Derries) Bog Drainage Layout

5.2.4 **Regional Hydrology**

Daingean (Derries) Bog is within in the Lower Shannon 25A (Hydrometric Area 25). The Lower Shannon 25A catchment covers an area of 1,248km² and is characterised by relatively flat topography with extensive areas of boglands in the low-lying areas. The Lower Shannon (Brosna) catchment comprises 12 sub catchments with 60 river water bodies, four lakes and 18 groundwater bodies.

There are 8 gravity flow surface water outflows with associated silt ponds in Daingean (Derries) Bog. There are no pumps in Daingean (Derries) Bog and all flow is gravity.
The Silver (Tullamore) _020 is located to the south of the bog and outfalls SW1, SW2, SW3 and SW4 all discharge into this waterbody. The Silver (Tullamore)_010 is located to the north of the bog and outfalls SW5 SW6, SW7 and SW7A all discharge into this waterbody.

The catchment areas, water courses and District Drainage Schemes are shown in the Figures below.

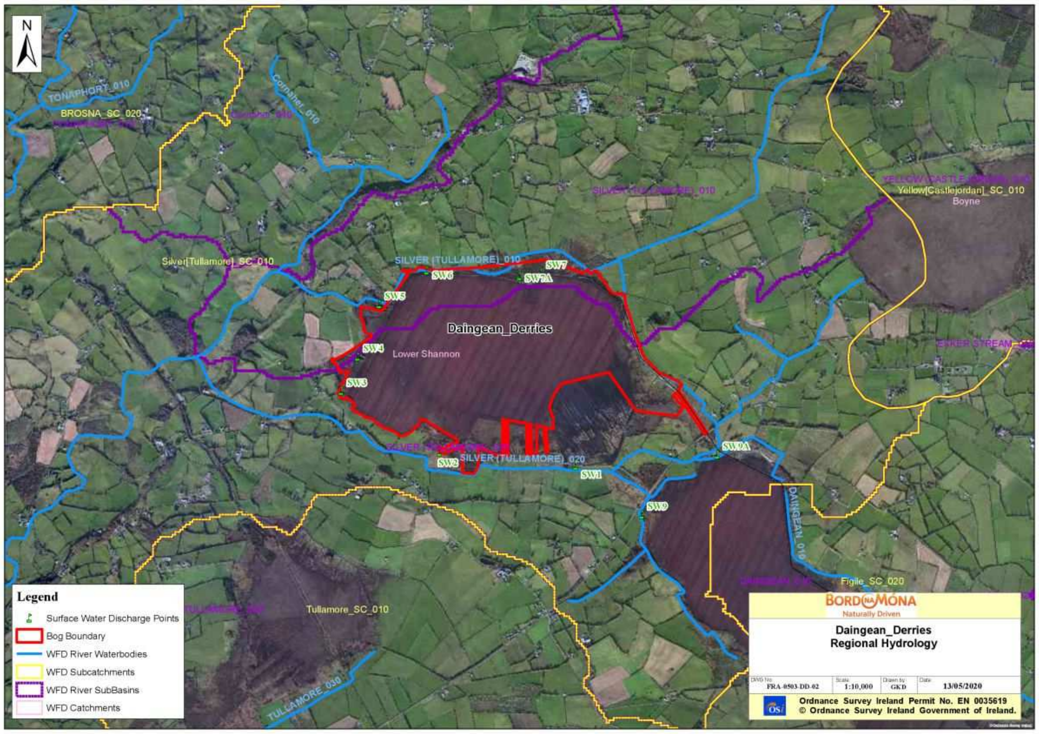


Figure 5.2.3 Daingean (Derries) Bog Regional Hydrology

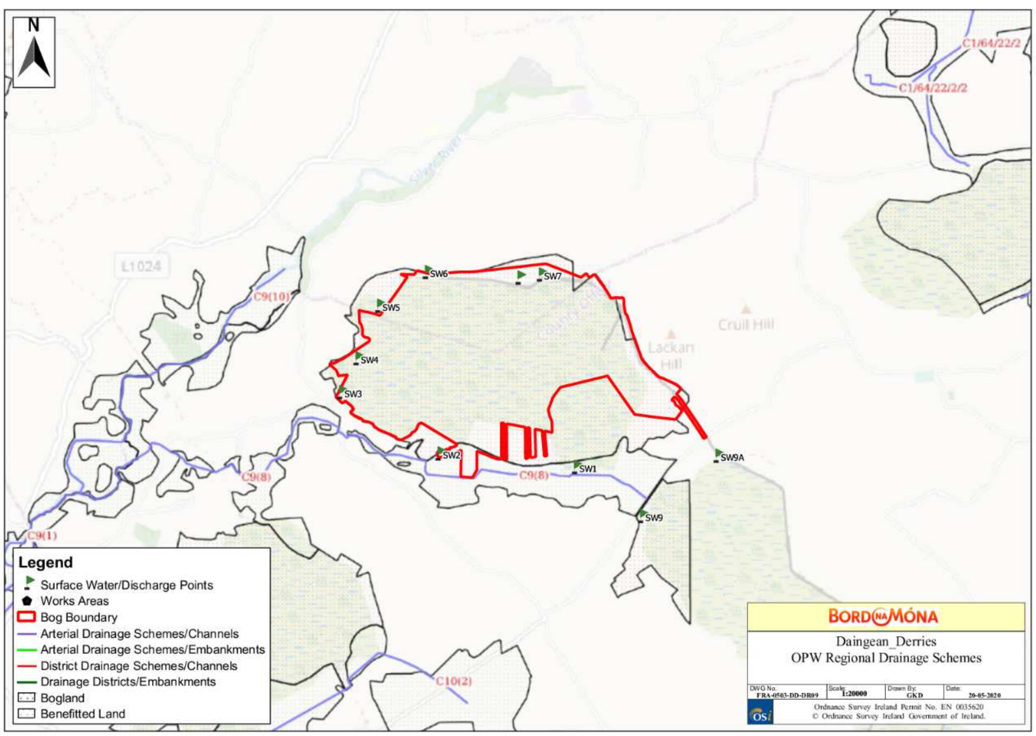


Figure 5.2.4 Daingean (Derries) Bog District Drainage Schemes

The benefitted land from District Drainage Schemes is also highlighted demonstrating that there are limited benefitting lands associated with this scheme in the area of these bogs.

There groundwater aquifer underlying Daingean (Derries) Bog is categorised as follows: Ll – Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones. This is discussed further in section 5.2.6.

The Standard Annual Average Rainfall (SAAR) in this location is 893mm.

5.2.5 Historical Flooding

The OPW https://www.floodinfo.ie website provides some limited information on flood records throughout the country. A map of historical flooding contained for the area, in the vicinity, of Boora Bog is shown in the Figure below.

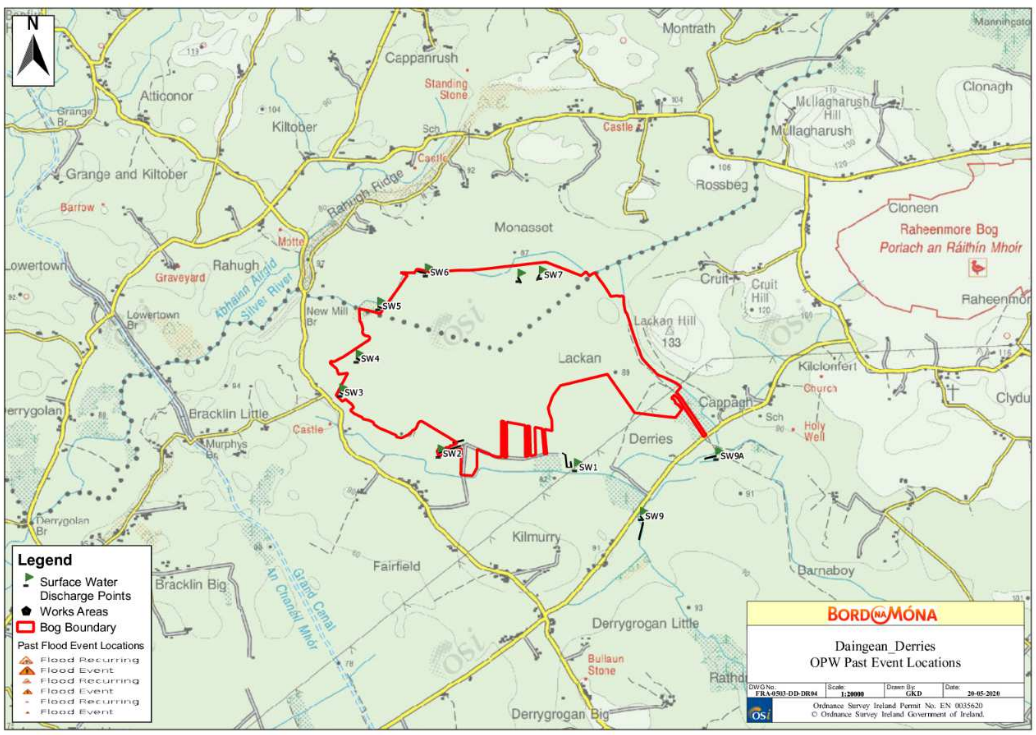


Figure 5.2.5 Daingean (Derries) Bog Historical Flooding

The OPW past flood events database show no records of any flooding events encroaching into Daingean (Derries) Bog.

There is no anecdotal evidence to suggest any historical flooding of the site. Information from Bord na Móna operatives familiar with Daingean (Derries) Bog confirmed that surface water flooding has, on occasion, occurred in the production area where blockages to the existing drainage network have occurred over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production.

5.2.6 **Groundwater Flood Risk**

The groundwater aquifer underlying Daingean (Derries) Bog is categorised as Ll - *Locally Important Aquifer- Bedrock which is moderately Productive only in Local Zones.* This aquifer has moderate vulnerability.

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below.

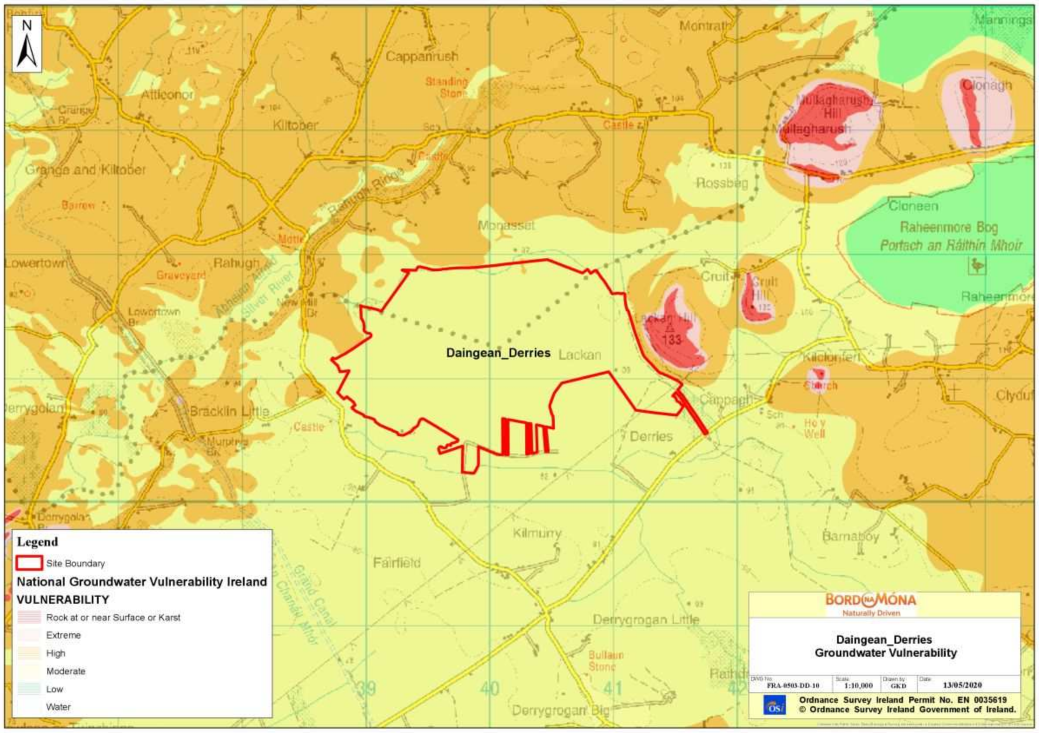


Figure 5.2.6 Daingean (Derries) Bog Groundwater vulnerability

The GSI https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx website provides information on groundwater throughout the country. The borehole shown to the south west of Daingean (Derries) Bog was recorded as having been dug in 1940. According to the GSI website the accuracy for this location is 1Km and Information from Bord na Móna operatives familiar with Daingean (Derries) Bog confirmed that this well is not located within the bog boundary.

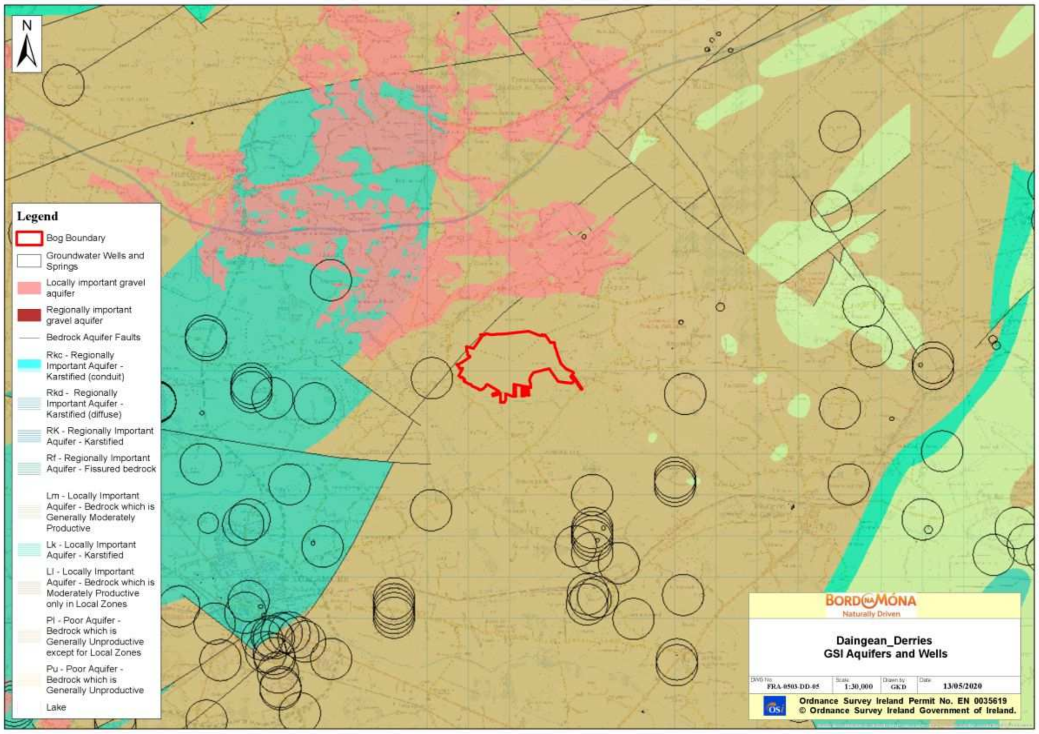


Figure 5.2.7 Daingean (Derries) Bog Aquifers, Karst Features, Wells

Information from Bord na Móna operatives familiar with Daingean (Derries) Bog confirmed that groundwater seepage has not been identified as a source of flooding within the bog

5.2.7 **Fluvial Flood Risk**

The rivers and streams in the vicinity of Daingean (Derries) Bog are are described in terms of regional hydrology in section 5.2.4.

The 8 surface water outfalls in Daingean (Derries) Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameters of these outfalls is shown in the Table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW1	
SW2	0.450
SW3	0.450
SW4	0.450
SW5	0.450
SW6	0.450
SW7	0.450
SW7A	0.450

Table 5.2.1 Daingean (Derries) Bog Surface Water Outfalls

Information from Bord na Móna operatives familiar with Daingean (Derries) Bog confirmed the outfalls will become submerged when the water levels of the rivers into which they are discharging are high. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Daingean (Derries) Bog. River Flood Events High Range mapping has been examined in the region of this bog. Mapping carried out for the Daingean river identifies the potential for flooding at a distance of circa 3.0 km southeast of the site. There is no mapping available for the other rivers in the vicinity of the bog.

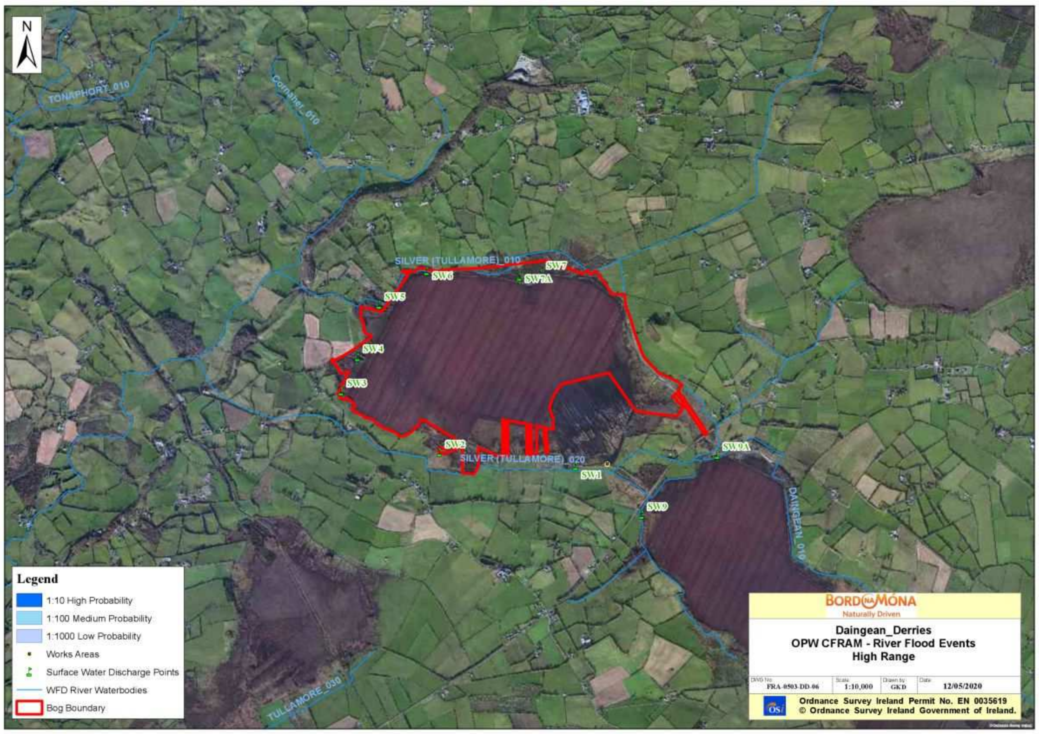


Figure 5.2.8 Daingean (Derries) Bog Flood Events High Range

5.2.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices.

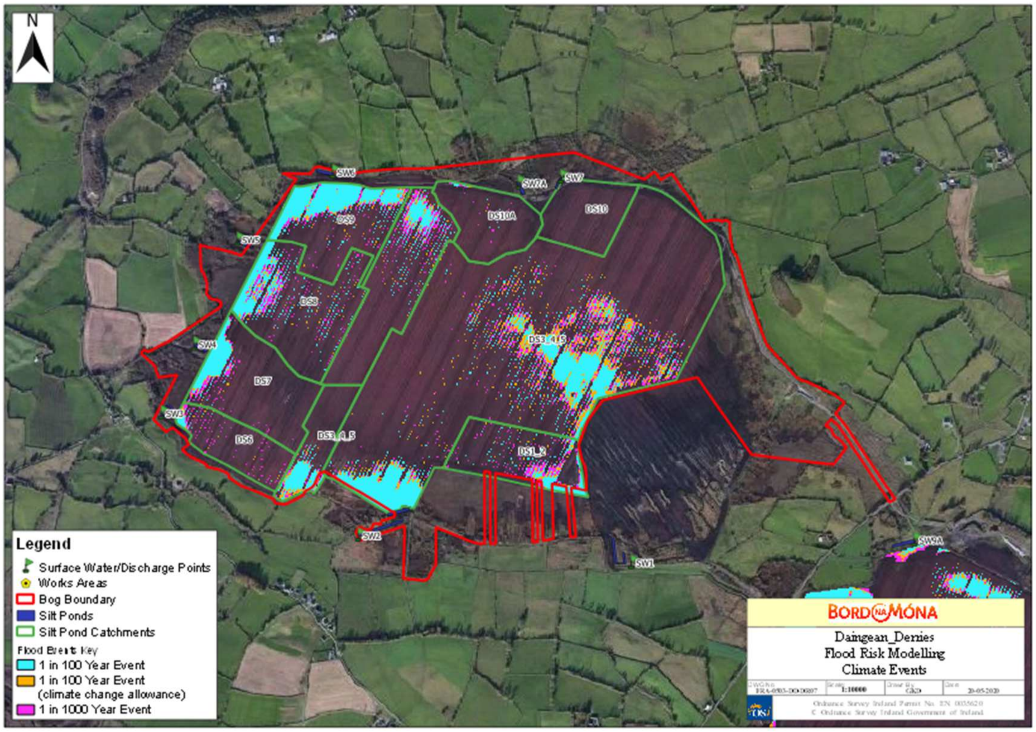


Figure 5.2.9 Daingean (Derries) Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the Surface water discharge points in the bog. Daingean (Derries) Bog is modelled for 5 basins DS1_2, DS3_4_5, DS6 & DS7, DS8, DS9&CentralCatch&DS10A&DS10. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption. The model shows that flood waters are collecting in local areas in the west, south and central parts of the bog. The most extensive flooding is shown in the west section and the maximum flood level in this area for the 1000year event is 85.65mOD.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The finished floor levels of the buildings are higher than 82.19mOD. The elevation of these buildings is higher than the modelled flood waters in the vicinity of the works area.

From this model Daingean (Derries) Bog works area which includes storage facilities is not as risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	***DS1_2***	***DS3_4_5***	***DS6 and DS7***	***DS8***	***DS9 DS10 DS10A CentCatch***
mOD	***m^3***	***m^3***	***m^3***	***m^3***	***m^3***
80.00	*0*	*0*	*0*	*0*	*0*
80.25	*0*	*0*	*0*	*0*	*0*
80.50	*0*	*0*	*0*	*0*	*0*
80.75	*0*	*2*	*0*	*0*	*0*
81.00	*0*	*20*	*0*	*0*	*0*
81.25	*0*	*68*	*0*	*0*	*0*
81.50	*0*	*169*	*1*	*0*	*0*
81.75	*0*	*366*	*9*	*0*	*1*
82.00	*1*	*689*	*67*	*0*	*5*
82.25	*4*	*1209*	*285*	*0*	*25*
82.50	*14*	*2125*	*849*	*0*	*86*
82.75	*48*	*3583*	*1998*	*3*	*226*
83.00	*118*	*5515*	*3775*	*14*	*447*
83.25	*246*	*7850*	*6128*	*44*	*725*
83.50	*439*	*10615*	*9081*	*115*	*1098*
83.75	*716*	*13962*	*12694*	*253*	*1696*
84.00	*1101*	*18224*	*17012*	*488*	*2860*
84.25	*1642*	*24272*	*22166*	*822*	*5156*
84.50	*2576*	*34467*	*28863*	*1289*	*10409*
84.75	*4117*	*55239*		*1932*	*20861*
85.00	*7073*	*97147*		*3029*	*37183*
85.25	*13572*			*5114*	*60543*
85.50				*9488*	
85.75				*18904*	

Table 5.2.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Boora Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

5.2.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 5.2.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100year event + 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case, the maximum rainfall for the 100year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario

resulted in less flooding than the 1000year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 5.2.7, the High Emissions Scenario (HEFS) has been considered which considers the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

5.2.10 **Conclusions**

The Flood Risk Assessment for Daingean (Derries) Bog identifies the sources of flood risk and their impact. Historical information was also reviewed.

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area does occur on occasion.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings area would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Works Area in Daingean (Derries) Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Daingean (Derries) Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 5.2.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Daingean (Derries) Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Daingean (Derries) Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

5.3 Daingean (Rathdrum) Bog

5.3.1 Introduction

Daingean (Rathdrum) Bog is part of the Bord na Móna Allen Bog Group which operates under an Integrated Pollution Control Licence (ref P0503-01). The Bog is used primarily to produce milled horticultural peat and the total area within Bord na Móna ownership is 368 Hectares.

5.3.2 Site Location

Daingean Rathdrum is located 3.5 km west of Daingean in Co. Offaly. The site is within the Lower Shannon 25A catchment, (Hydrometric Area 25).

The Daingean (Rathdrum) Bog site location is highlighted in red in the Figure below and is is 368 Hectares.

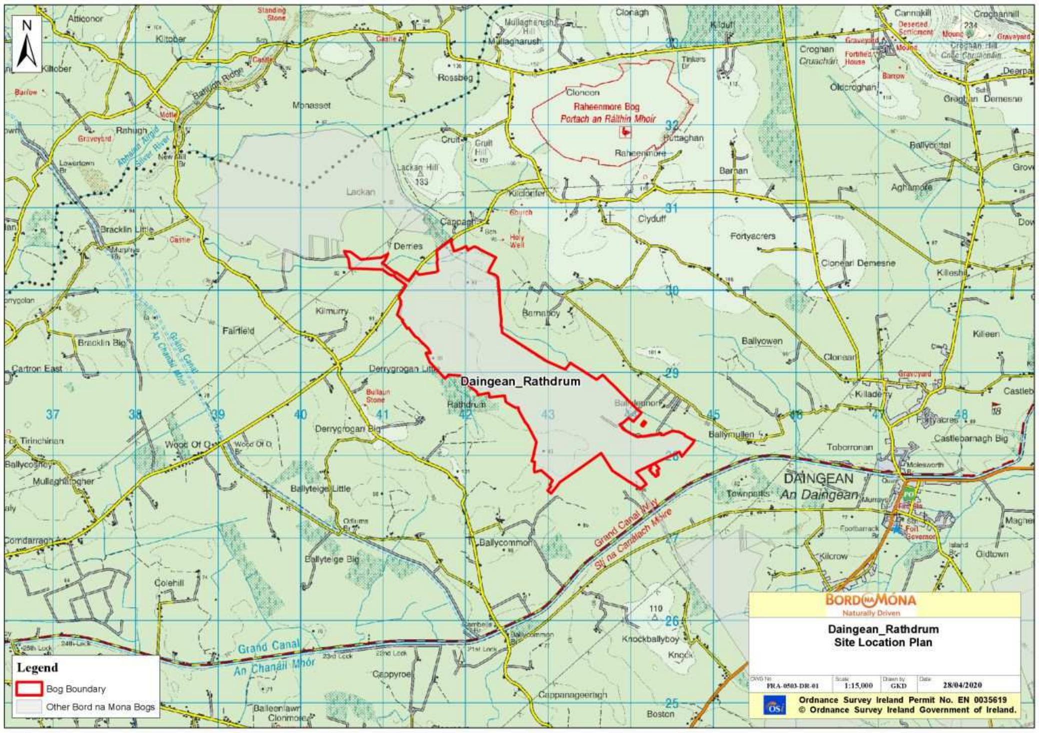


Figure 5.3.1 Daingean (Rathdrum) Bog Site Location

5.3.3 **Bog Description**

Daingean (Rathdrum) Bog primarily consists of milled peat production. Railway lines from the site connect this Bog with the adjacent Daingean (Derries) bog to the north and to Daingean (Townparks) bog to the south. A large part of the southeast section is privately owned. The topography of the main production bog is variable and there are several glacial mounds/ridges present under the peat. A large section of developed high bog in the south-west of the site (32 ha) has not been in production for some years. This area has now re-vegetated with Heather, along with some patches of Bog Cotton and bare peat. This area is now zoned for biodiversity and is being restored with a bog restoration drain-blocking programme. Marginal remnant habitats include scrub, high bog and birch woodland. This bog was drained by Bord na Móna in 1996 with peat production commencing in 2000.

There is a works area which includes welfare facilities, car parking and storage area. The main access point to the bog is off the public road L1025 into the works area

There are 5 gravity flow surface water outflows, with associated silt ponds, in Daingean (Rathdrum) Bog.

Details of the existing drainage layout is shown in the Figure below.

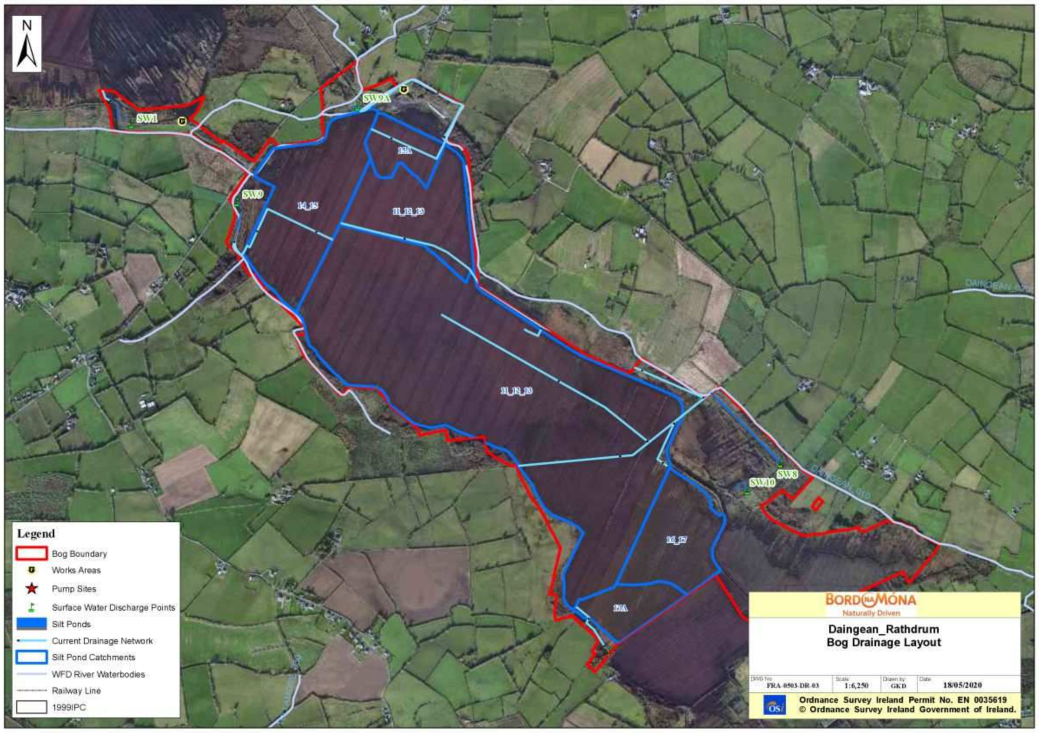


Figure 5.3.2 Daingean (Rathdrum) Bog Drainage Layout

5.3.4 **Regional Hydrology**

Daingean (Rathdrum) Bog is within the Lower Shannon 25A and Barrow 14 catchments (Hydrometric Areas 25 and 14). The Lower Shannon 25A catchment covers an area of 1,248km² and is characterised by relatively flat topography with extensive areas of boglands in the low-lying areas. The Lower Shannon (Brosna) catchment comprises 12 sub catchments with 60 river water bodies, four lakes and 18 groundwater bodies.

The Barrow catchment includes the area drained by the River Barrow draining an area of 3,025km². The surface water and groundwater are closely and complexly linked in this catchment particularly south of Monasterevin. The catchment comprises 20 sub-catchments with 145 river water bodies, 6 transitional water bodies and 29 ground water bodies.

There are 5 gravity flow surface water outfalls with associated silt ponds in Daingean (Rathdrum) Bog. There are no pumps in Daingean (Rathdrum) Bog and all flow is gravity.
The Daingean_010 is located along the eastern boundary of the bog and outfalls SW8, SW10 and SW10A all discharge into this waterbody. The Silver (Tullamore)_020 is located along the northern boundary of the bog and outfalls SW9 and SW9A both discharge directly into this waterbody.

The catchment areas, water courses and District Drainage Schemes are shown in the Figures below.

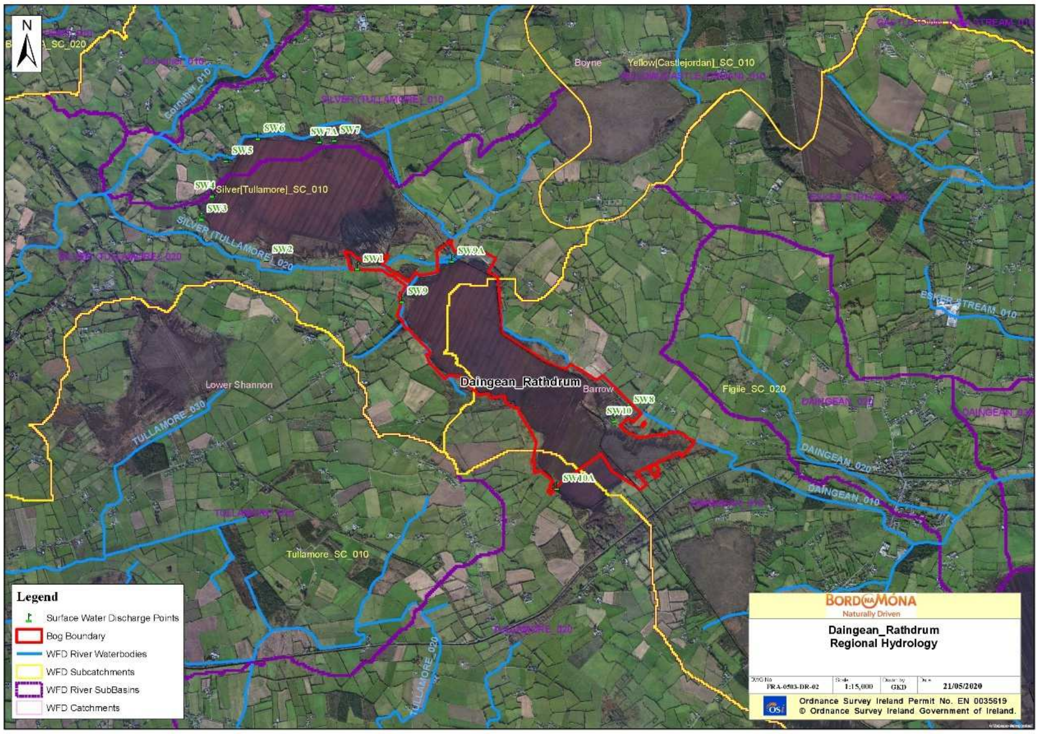


Figure 5.3.3 Daingean (Rathdrum) Bog Regional Hydrology

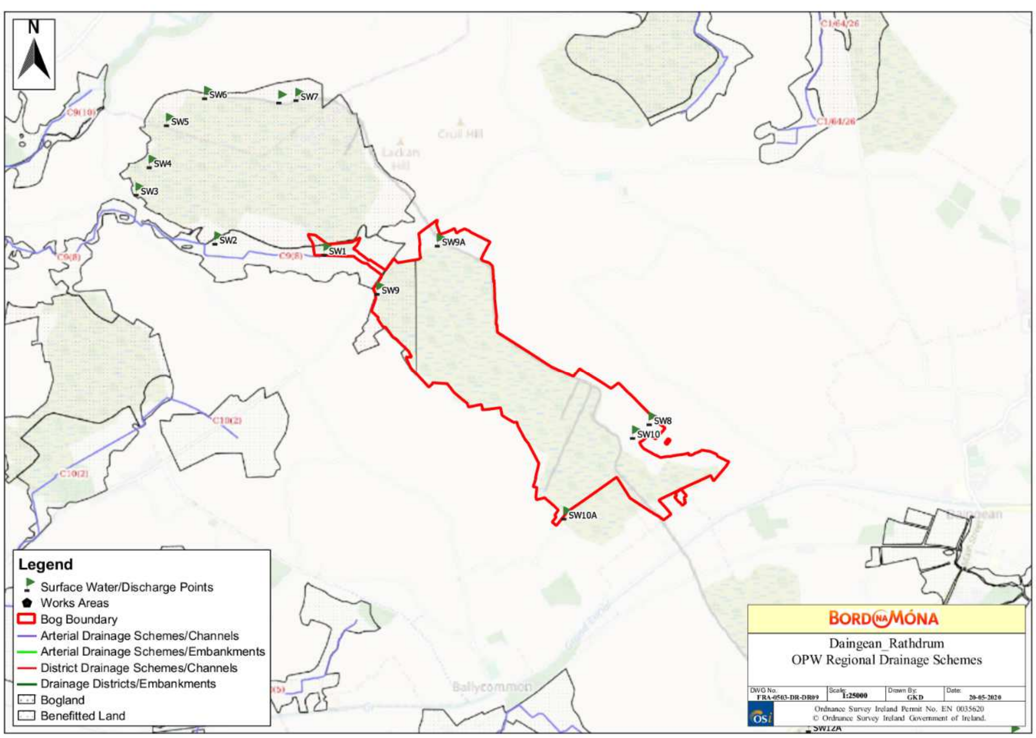


Figure 5.3.4 Daingean (Rathdrum)Bog District Drainage Schemes

The benefitted land from District Drainage Schemes is also highlighted demonstrating that there are limited benefitting lands associated with this scheme in the area of these bogs.

The groundwater aquifer underlying Daingean (Rathdrum) Bog is categorised as Ll - *Locally Important Aquifer- Bedrock which is moderately Productive only in Local Zones.* This is discussed further in section 5.3.6.

The Standard Annual Average Rainfall (SAAR) in this location is 894mm.

5.3.5 **Historical Flooding**

The OPW https://www.floodinfo.ie website provides some limited information on flood records throughout the country. A map of historical flooding contained for the area, in the vicinity, of Daingean (Rathdrum) Bog is shown in the Figure below.

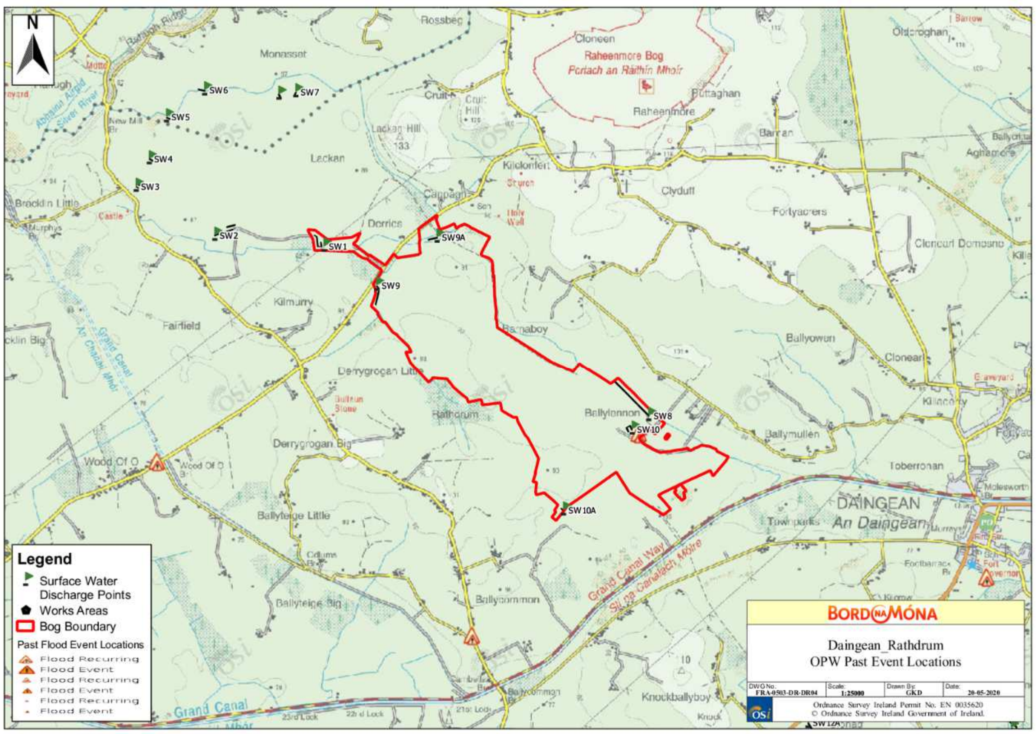


Figure 5.3.5 Daingean (Rathdrum)Bog Historical Flooding

There is a flood event shown in the southeast corner of the bog and in the *Edenderry Area Engineer - Minutes of Meeting identifying areas subject to flooding – Edenderry Area Engineer – Offaly dated 17/10/2005* this flood event is referred to as:

'Ballylennon Recurring- low lying land after heavy rain every year. There is inadequate drainage and the terrain is very flat. Road is liable to flood.'

Information from Bord na Móna operatives familiar with Boora Bog confirmed that surface water flooding has, on occasion, occurred in the production area where blockages to the existing drainage network have occurred over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production.

5.3.6 **Groundwater Flood Risk**

The groundwater aquifer underlying Daingean (Rathdrum) Bog is categorised as Ll - *Locally Important Aquifer- Bedrock which is moderately Productive only in Local Zones.* This aquifer has moderate vulnerability.

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below.

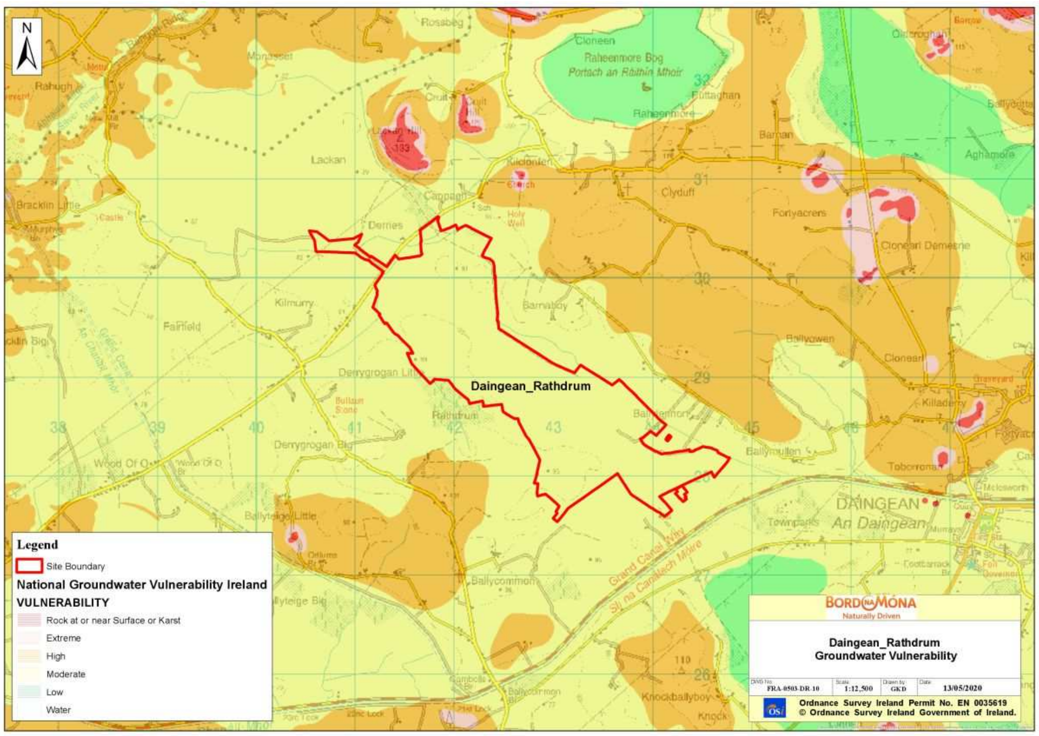


Figure 5.3.6 Daingean (Rathdrum) Bog Groundwater vulnerability

The GSI https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx website provides information on groundwater throughout the country. The well shown to the south west of Daingean (Rathdrum) Bog was recorded as having been dug in 1962 According to the GSI website the accuracy for this location is 1Km and Information from Bord na Móna operatives familiar with Daingean (Rathdrum) Bog confirmed that this well is not located within the bog boundary.

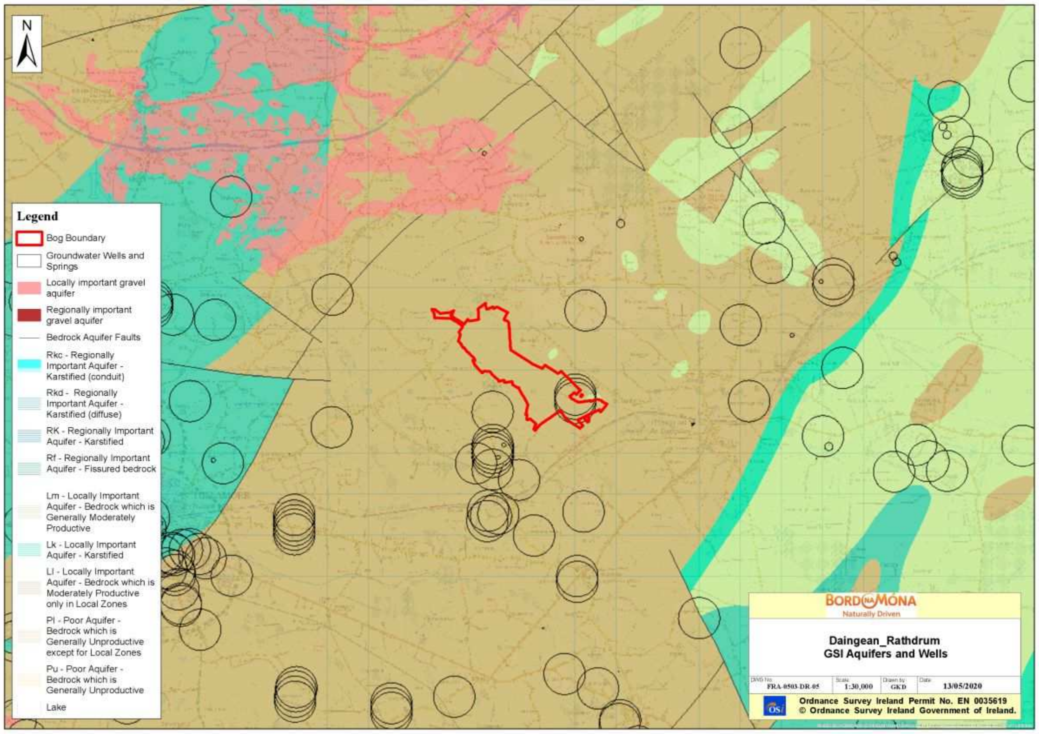


Figure 5.3.7 Daingean (Rathdrum) Bog Aquifers, Karst Features, Wells

Information from Bord na Móna operatives familiar with Daingean (Rathdrum) Bog confirmed that groundwater seepage has not been identified as a source of flooding within the bog.

5.3.7 **Fluvial Flood Risk**

The rivers and streams in the vicinity of Daingean (Rathdrum) Bog are are described in terms of regional hydrology in section 5.3.4.

The 5 surface water outfalls in Daingean (Rathdrum) Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameters of these outfalls are shown in the Table below.

Surface Water Outfall ref:	**Pipe Diameter (m)**
SW8	0.600
SW9	0.450
SW9A	0.450
SW10	0.450
SW10A	0.450

Table 5.3.1 Daingean (Rathdrum) Bog Surface Water Outfalls

Information from Bord na Móna operatives familiar with Daingean (Rathdrum) Bog confirmed the outfalls will become submerged when the water levels of the rivers into which they are discharging are high. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Daingean (Rathdrum) Bog. River Flood Events High Range mapping has been examined in the region of this bog. Mapping carried out for the Daingean river identifies the potential for flooding at a distance of circa 0.5 km southeast of the site. There is no mapping available for the other rivers in the vicinity of the bog.

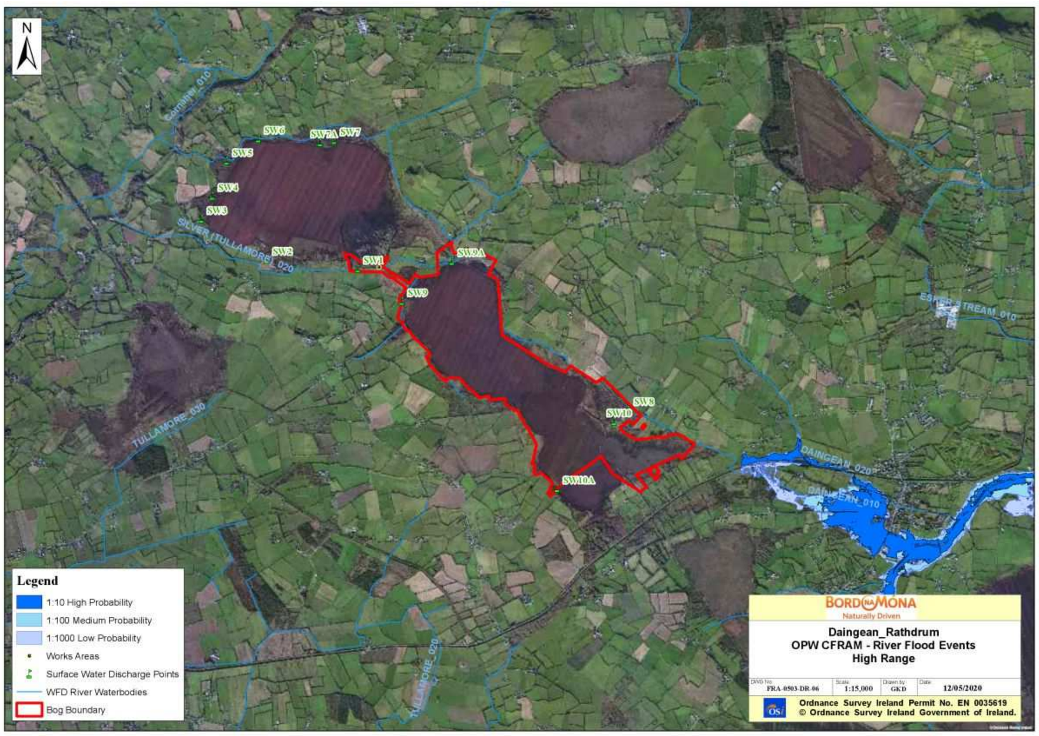


Figure 5.3.8 Daingean (Rathdrum) Bog Flood Events High Range

5.3.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices.

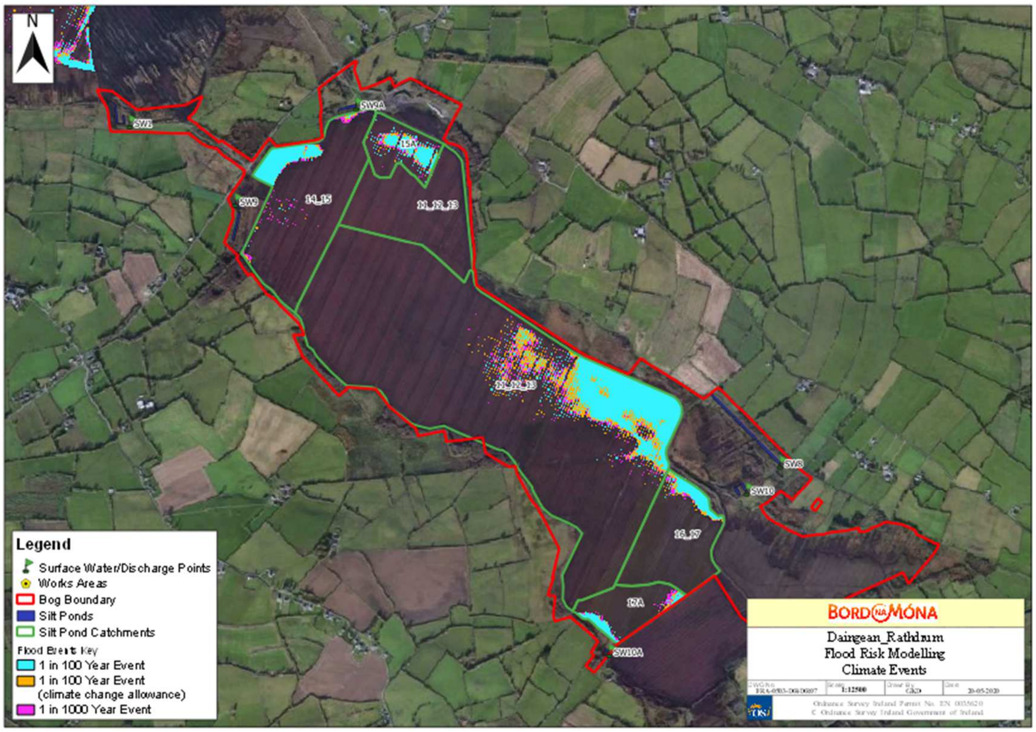


Figure 5.3.9 Daingean (Rathdrum) Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the Surface water discharge points in the bog. Daingean (Rathdrum) Bog is modelled for 4 basins, 14_15, 15A, 16_17 & 11_12_13 and 17A. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption. The model shows that flood waters are collecting in local areas in the south east and north east parts of the bog. The most extensive flooding is shown in the southeast section. The maximum flood level in this area for the 1000year event is 83.05mOD. The flood level to the north east for the same flood event is 86.03mOD and in the south west for the same flood event is 87.1mOD, however due to the topography of the bog, these flood levels will be retained in these areas.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

Ground levels in the area of the works is typically of the order of 85.1mOD. The maximum flood level in the adjacent drainage basin for the 100 year and 1000 year events are 85.9mOD and 86.03mOD respectively. These levels are above the level of the works area, however, due to the nature of local topography, flooding in this basin will not impact the works area.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	**14_15**	**15A**	**16_17 and 11_12_13**	**17A**
mOD	**m^3**	**m^3**	**m^3**	**m^3**
80.00	0	0	294	0
80.25	0	0	747	0
80.50	0	0	1472	0
80.75	0	0	2612	0
81.00	0	0	4705	0
81.25	0	0	8390	0
81.50	0	0	14822	0
81.75	0	0	24607	0
82.00	17	0	38330	0
82.25	135	0	57599	0
82.50	458	0	85056	0
82.75	1277	0	123642	0
83.00	3083	0	175355	0
83.25	6625	0	243607	0
83.50	12274	0		0
83.75	19941	0		0
84.00	29052	0		0
84.25	40134	0		0
84.50		0		0
84.75		0		0
85.00		1		0
85.25		51		0
85.50		399		7
85.75		1966		56
86.00		6842		296
86.25		15226		953
86.50				2249
86.75				4310
87.00				7340

87.25				11537

Table 5.3.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Daingean (Rathdrum) Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

5.3.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 5.3.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100year event + 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case, the maximum rainfall for the 100year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 5.3.7, the High Emissions Scenario (HEFS) has been considered which considers the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

5.3.10 **Conclusions**

The Flood Risk Assessment for Daingean (Rathdrum) Bog identifies the sources of flood risk and their impact. Historical information was also reviewed.

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area does occur on occasion.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short .
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings area would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Works Area in Daingean (Rathdrum) Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Daingean (Rathdrum) Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 5.3.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   (i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;

(ii) *The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*

(iii) *The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*

(iv) *The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Daingean (Rathdrum) Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities are located in an area that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Daingean (Rathdrum) Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

5.4 Clonad Bog

5.4.1 **Introduction**

Clonad Bog is part of the Bord na Móna Allen Bog Group which operates under an Integrated Pollution Control Licence (ref P0503-01). The Bog is used primarily to produce milled horticultural peat and the total area within Bord na Móna ownership is 448 Hectares.

5.4.2 **Site Location**

Clonad Bog is located 3Km south of Daingean town in County Offaly. The site is within the Lower Shannon 25A and Barrow 14 catchments, (Hydrometric Areas 25 and 14).
The Clonad Bog site location is highlighted in red in the Figure below and is 448 Hectares.

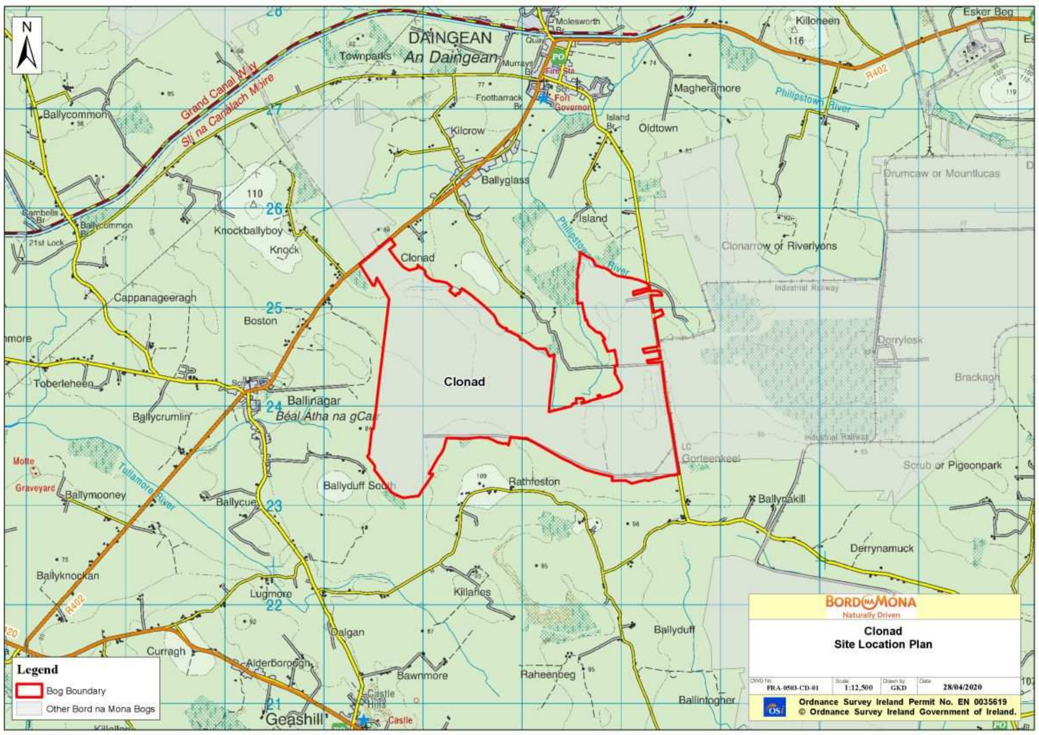


Figure 5.4.1 Clonad Bog Site Location

5.4.3 **Bog Description**

The bog primarily consists of active milled peat production. There is a relatively large lobe of undeveloped raised bog in the NE part of the site. The site also includes areas colonised with birch, cutaway areas and bog remnants. This bog was drained by Bord na Móna in 1956 with peat production commencing in 1962.

There is a works area which includes welfare facilities, car parking and storage area. The main access point to the bog is off a local road off the public road R420 into the works area.

There are 4 gravity flow surface water outflows, with associated silt ponds, in Clonad Bog.

Details of the existing drainage layout is shown in the Figure below.

Figure 5.4.2 Clonad Bog Drainage Layout

5.4.4 **Regional Hydrology**

Clonad Bog is within the Lower Shannon 25A and Barrow 14 catchments (Hydrometric Areas 25 and 14). The Lower Shannon 25A catchment covers an area of 1,248km² and is characterised by relatively flat topography with extensive areas of boglands in the low-lying areas. The Lower Shannon (Brosna) catchment comprises 12 sub catchments with 60 river water bodies, four lakes and 18 groundwater bodies. The Barrow catchment includes the area drained by the River Barrow draining an area of 3,025km^2. The surface water and groundwater are closely and complexly linked in this catchment particularly south of Monasterevin. The catchment comprises 20 sub-catchments with 145 river water bodies, 6 transitional water bodies and 29 ground water bodies.

There are 4 gravity flow surface water outfalls with associated silt ponds in Clonad Bog. There are no pumps in Clonad Bog and all flow is gravity. The Daingean_010 diverges into 3 channels to the North of Clonad Bog and outfall SW12 discharges directly into this waterbody and outfall SW12A is within 650m and SW11A is within 570m. The Tullamore_010 is located to the south of the bog and outfall SW13 is within 870m this waterbody.

The catchment areas, water courses and District Drainage Schemes are shown in the Figures below.

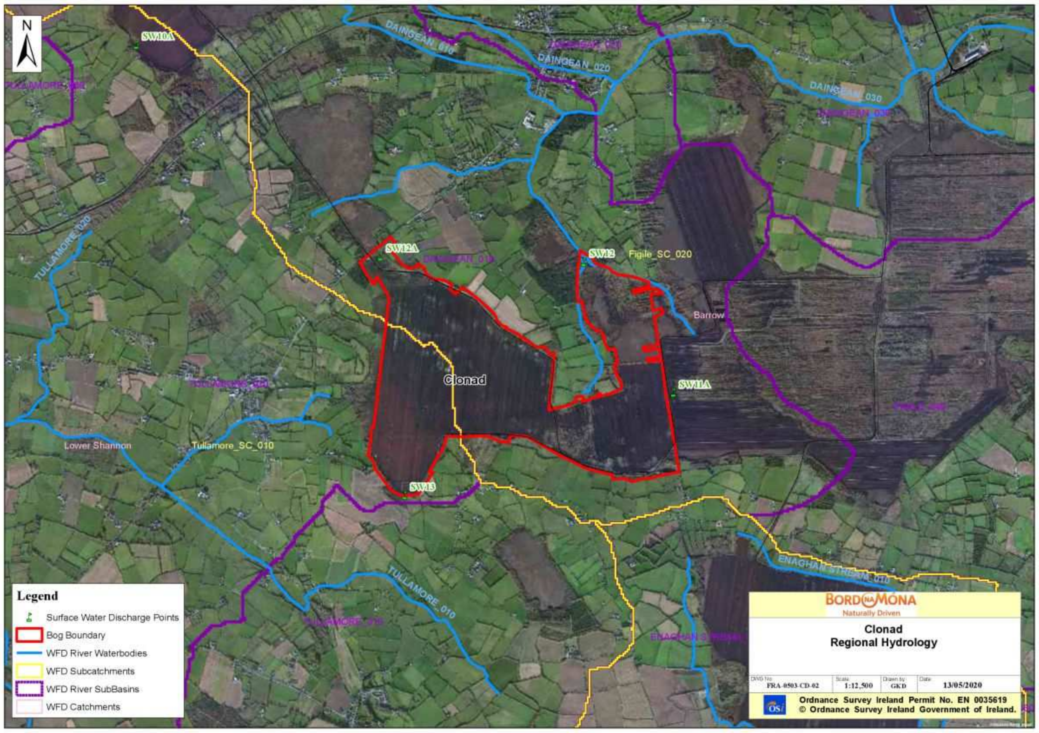


Figure 5.4.3 Clonad Bog Regional Hydrology

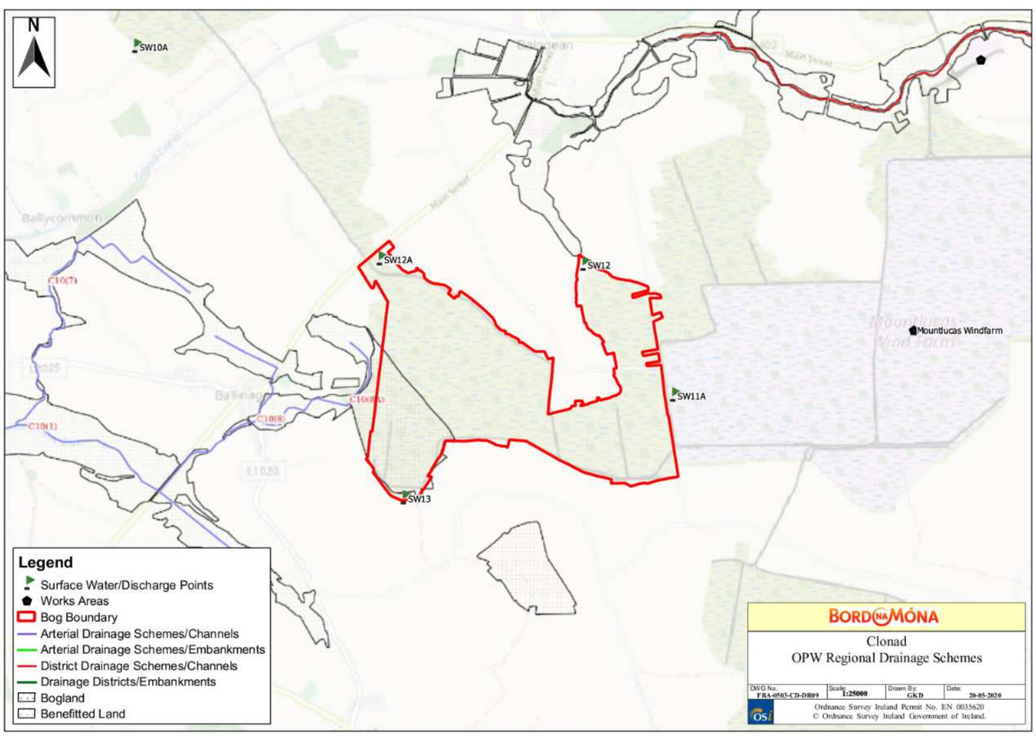


Figure 5.4.4 Clonad Bog District Drainage Schemes

The benefitted land from District Drainage Schemes is also highlighted demonstrating that there are limited benefitting lands associated with this scheme in the area of these bogs.

The Standard Annual Average Rainfall (SAAR) in this location is 873mm.

5.4.5 Historical Flooding

The OPW https://www.floodinfo.ie website provides some limited information on flood records throughout the country. A map of historical flooding contained for the area, in the vicinity, of Clonad Bog is shown in the Figure below.

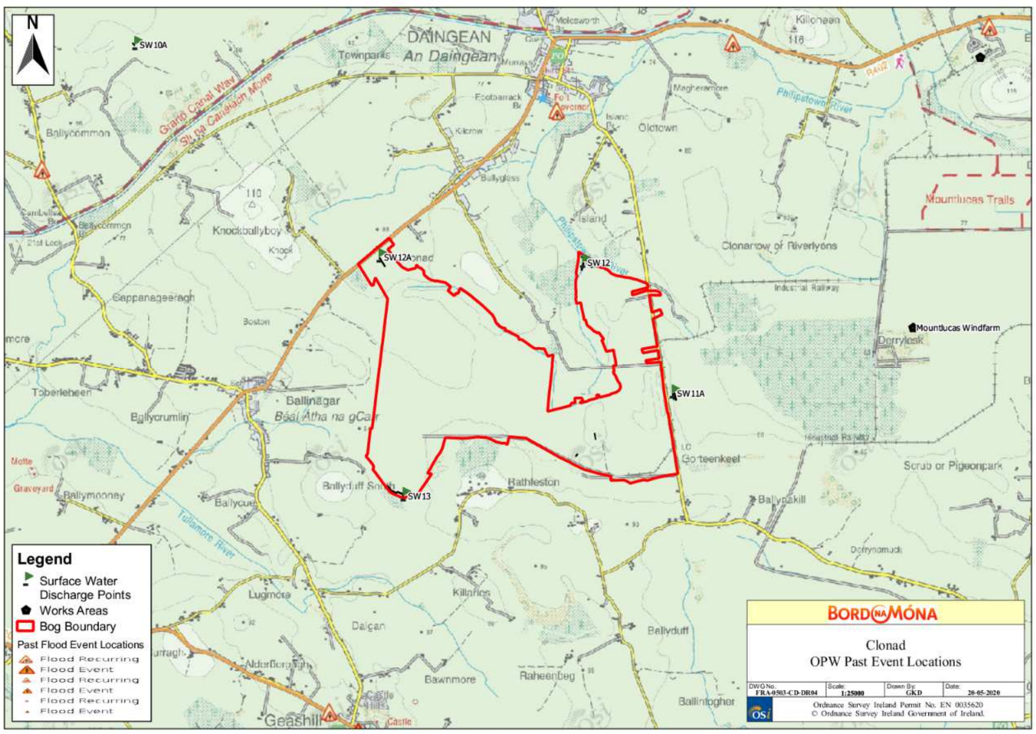


Figure 5.4.5 Clonad Bog Historical Flooding

The OPW past flood events database show no records of any flooding events encroaching into Clonad Bog

There is little anecdotal evidence to suggest any historical flooding of the site. However, information from Bord na Móna operatives familiar with Boora Bog confirmed that surface water flooding has, on occasion, occurred in the production area where blockages to the existing drainage network have occurred over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production.

5.4.6 Groundwater Flood Risk

There are 3 groundwater aquifers underlying Clonad Bog. The westerly section is underlain by an aquifer categorised as Ll - *Locally Important Aquifer- Bedrock which is moderately Productive only in Local Zones.* There is a central area underlain by an aquifer categorised as

Lk -Locally Important Aquifer- Karsified. The easterly section is underlain by an aquifer categorised *as Lm- Locally important Aquifer- Bedrock which is Generally Moderately Productive.* The aquifer *vulnerability is low*

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below

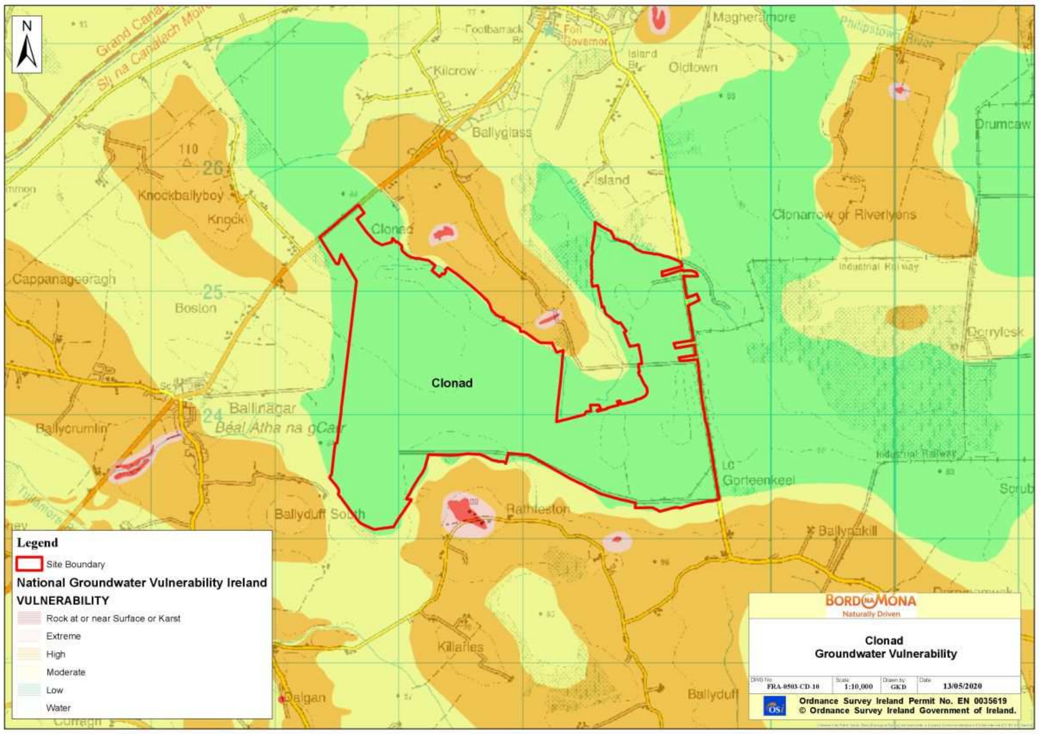


Figure 5.4.6 Clonad Bog Groundwater vulnerability

The GSI https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx website provides information on groundwater throughout the country. The well shown to the south of Clonad Bog was recorded as having been dug in 1963. According to the GSI website the accuracy for this location is 1Km and Information from Bord na Móna operatives familiar with Clonad Bog confirmed that this well is not located within the bog boundary.

A map of aquifers, karst features and known wells is shown in the Figure below.

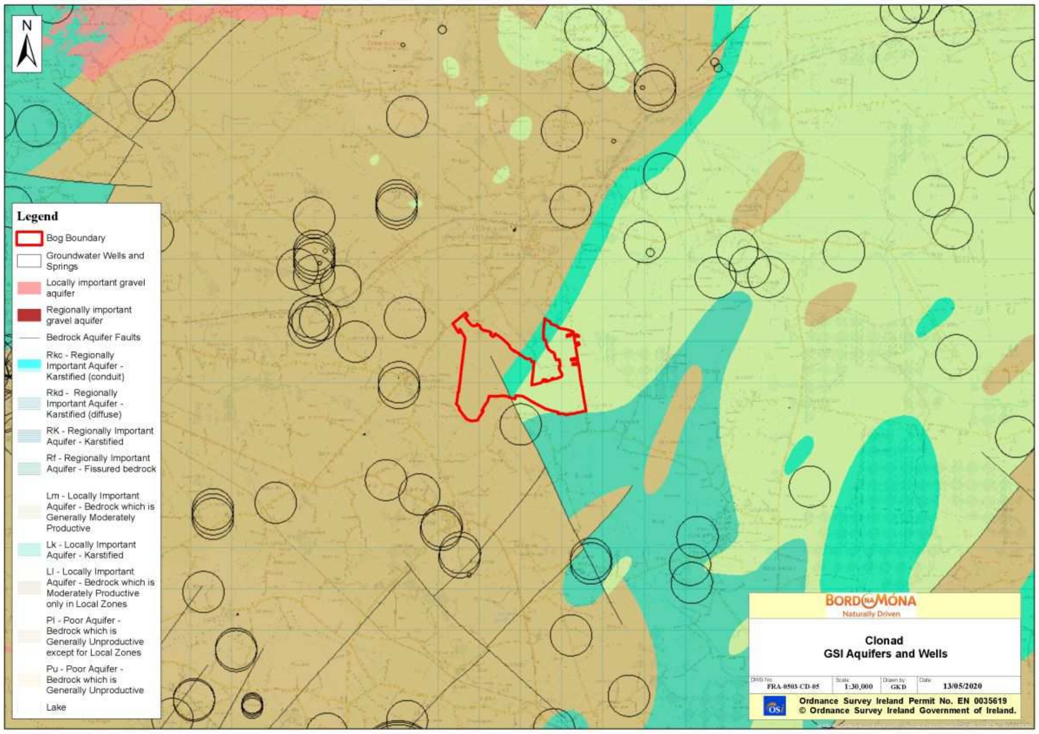


Figure 5.4.7 Clonad Bog Aquifers, Karst Features, Wells

Information from Bord na Móna operatives familiar with Clonad Bog confirmed that groundwater seepage has not been identified as a source of flooding within the bog.

5.4.7 **Fluvial Flood Risk**

The rivers and streams in the vicinity of Clonad Bog are are described in terms of regional hydrology in section 5.4.4.

The 4 surface water outfalls in Clonad Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameters of these outfalls are shown in the Table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW11A	0.450
SW12	0.600
SW12A	0.600
SW13	0.450

Table 5.4.1 Clonad Bog Surface Water Outfalls

Information from Bord na Móna operatives familiar with Clonad Bog confirmed the outfalls will become submerged when the water levels of the rivers into which they are discharging are high. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Daingean (Rathdrum) Bog. River Flood Events High Range mapping has been examined in the region of this bog. Mapping carried out for the Daingean river identifies the potential for flooding at a distance of circa 0.5 km north east of the site. This flooding is not predicted to encroach into the site. There is no mapping available for the other rivers in the vicinity of the bog.

Figure 5.4.8 Clonad Bog Flood Events High Range

5.4.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.
The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices.

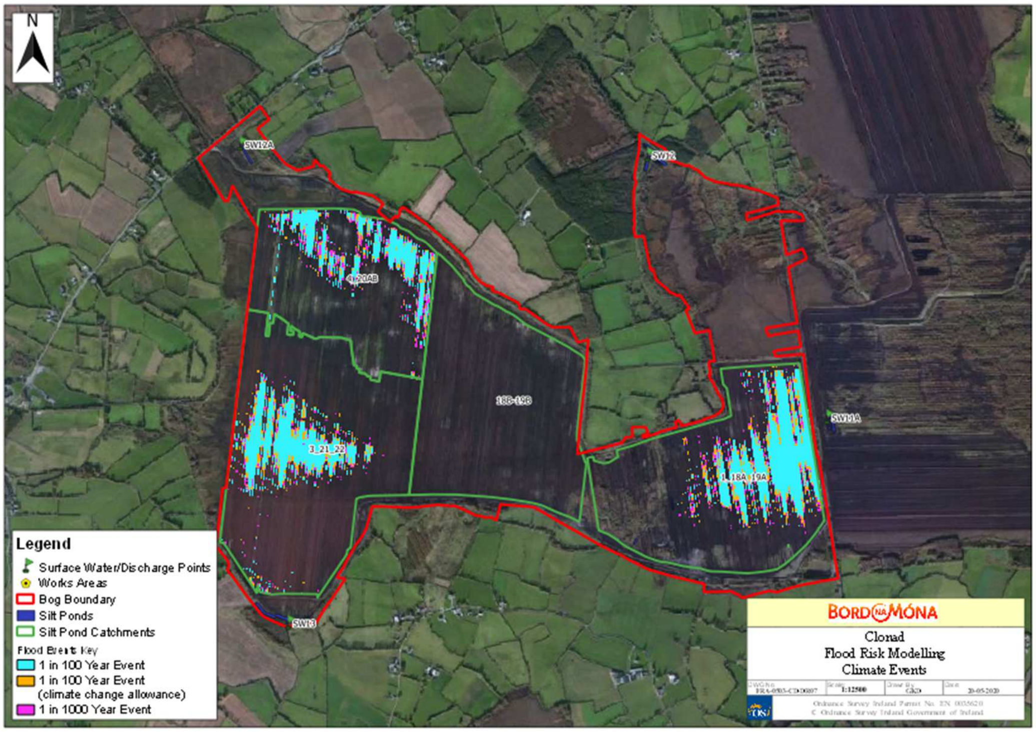


Figure 5.4.9 Clonad Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the Surface water discharge points in the bog. Clonad Bog is modelled for 3 basins, 3_21_22, 4_20AB and 18B-19B & 1_18A_19A. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption. The model shows that flood waters are collecting in local areas in the west and east parts of the bog. The most extensive flooding is shown in the east section, where rainfall generated over this basin is drained. The maximum flood level in this area for the 1000year event is 77.35mOD. The highest flood level is shown in the northwest section of the bog and the maximum flood level in this area for the same event is 85.38mOD, however due to the topography of the bog, this flood level will be retained in this area.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The finished floor levels of the buildings are higher than 84.89mOD. The elevation of these buildings is higher than the modelled flood waters in the vicinity of the works area.

From this model Clonad Bog works area which includes welfare facilities, car parking and oil storage facilities is not as risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	*3_21_22*	*4_20AB*	*18B-19B and 1_18A_19A*
mOD	***m³***	***m³***	***m³***
75.00	*0*	*0*	*0*
75.25	*0*	*0*	*13*
75.50	*0*	*0*	*98*
75.75	*0*	*0*	*466*
76.00	*0*	*0*	*1720*
76.25	*0*	*0*	*5018*
76.50	*0*	*0*	*12342*
76.75	*0*	*0*	*25868*
77.00	*0*	*0*	*48420*
77.25	*0*	*0*	*80977*
77.50	*0*	*0*	*124522*
77.75	*0*	*0*	*179997*
78.00	*0*	*0*	
78.25	*0*	*0*	
78.50	*0*	*0*	
78.75	*0*	*0*	
79.00	*0*	*0*	
79.25	*0*	*0*	
79.50	*0*	*0*	
79.75	*0*	*0*	
80.00	*0*	*0*	
80.25	*21*	*0*	
80.50	*129*	*0*	
80.75	*544*	*0*	
81.00	*1664*	*0*	
81.25	*4138*	*0*	
81.50	*9093*	*0*	
81.75	*18416*	*0*	
82.00	*34964*	*0*	
82.25	*61160*	*0*	
82.50	*98051*	*0*	
82.75		*0*	
83.00		*0*	
83.25		*2*	
83.50		*21*	
83.75		*109*	
84.00		*509*	
84.25		*1791*	
84.50		*5029*	
84.75		*11637*	
85.00		*23830*	
85.25		*44998*	

Table 5.4.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Clonad Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

5.4.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 5.4.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100year* plus 30% climate change allowance (High End Emissions Scenario). In the climate change model run case, the maximum rainfall for the 100year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 5.4.7, the High Emissions Future Scenario (HEFS) has been considered which takes into account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

5.4.10 **Conclusions**

The Flood Risk Assessment for Clonad Bog identifies the sources of flood risk and their impact. Historical information was also reviewed.

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area does occur on occasion.

- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short .
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings area would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Works Area in Clonad Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Clonad Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 5.4.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
    - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
    - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
    - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*

(iv) *The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Belair North Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been taken into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Clonad Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

5.5 Ballykeane Bog

5.5.1 Introduction

Ballykeane Bog is part of the Bord na Móna Allen Bog Group which operates under an Integrated Pollution Control Licence (ref P0503-01). The Bog is used primarily to produce milled horticultural peat and the total area within Bord na Móna ownership is 452 Hectares.

5.5.2 Site Location

Ballykeane is located approximately 4 Km west of Walsh Island in Co. Offaly. The site is within Barrow 14 catchment (Hydrometric Area 14).
The Ballykeane Bog site location is highlighted in red in the Figure below and is 452 Hectares.

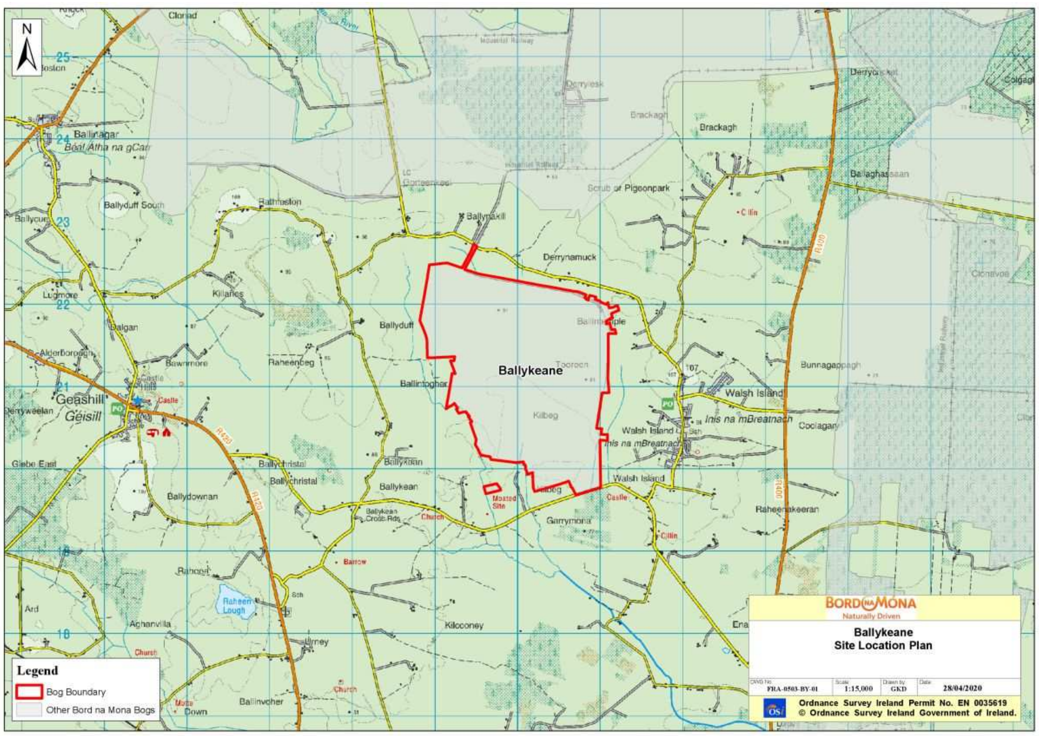


Figure 5.5.1 Ballykeane Bog Site Location

5.5.3 Bog Description

The bog primarily consists of active milled peat production. There is a narrow margin around the production area containing typical marginal habitats such as scrub, bog woodland and remnant raised bog. This bog was drained by Bord na Móna in 1951 with peat production commencing in 1955.

There is a works area which includes welfare facilities, car parking and storage area. The main access point to the bog is off a local road off the public road R420 into the works area.

There are 5 gravity flow surface water gravity outflows, with associated silt ponds, in Ballykeane Bog. There are no pumps in Ballykeane Bog.

Details of the existing drainage layout is shown in the Figure below.

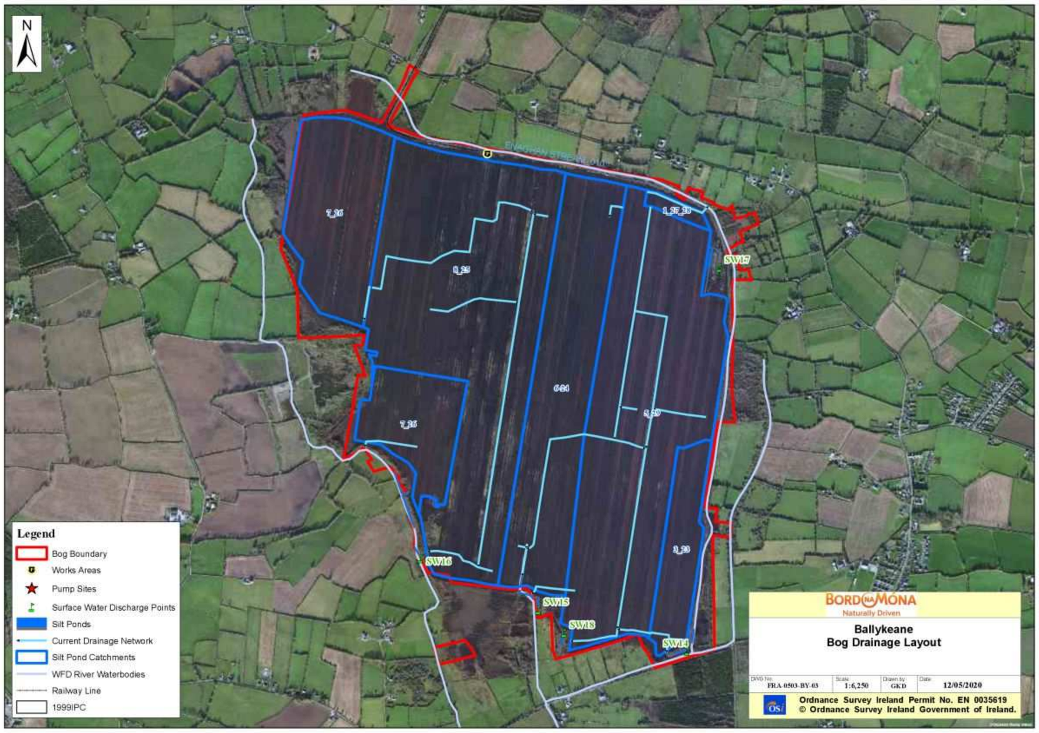


Figure 5.5.2 Ballykeane Bog Drainage Layout

5.5.4 **Regional Hydrology**

Ballykeane Bog is within the Barrow 14 (Hydrometric Area 14). The Barrow catchment includes the area drained by the River Barrow draining an area of 3,025km^2. The surface water and groundwater are closely and complexly linked in this catchment particularly south of Monasterevin. The catchment comprises 20 sub-catchments with 145 river water bodies, 6 transitional water bodies and 29 ground water bodies.

South of Ballykeane Bog the Enaghan Stream _010 diverges into different courses. One course of the Enaghan Stream _010 is located along the western boundary of the site and the other is located along the eastern boundary of the site and there is a third course that aligns centrally with the site. SW15 and SW16 both discharge within 50m of Enaghan Stream _010. SW14 discharges within 80m of Enaghan Stream _010. SW17 and SW18 both discharge within 150m of Enaghan Stream _010.

The catchment areas, water courses and District Drainage Schemes are shown in the Figures below.

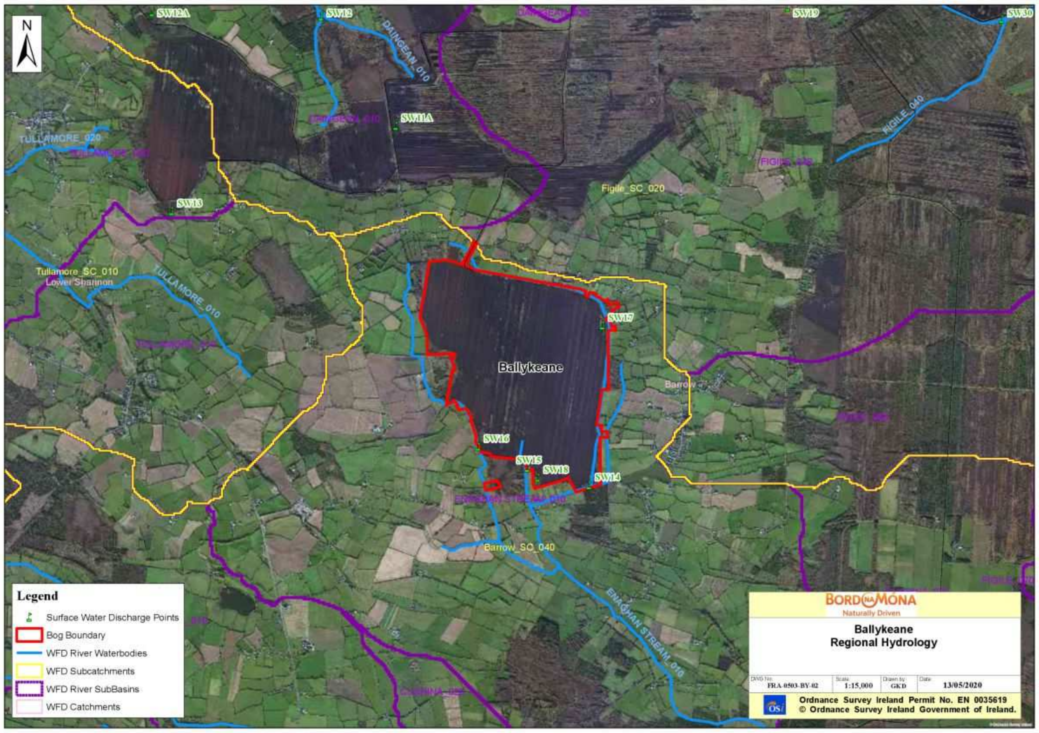


Figure 5.5.3 Ballykeane Bog Regional Hydrology

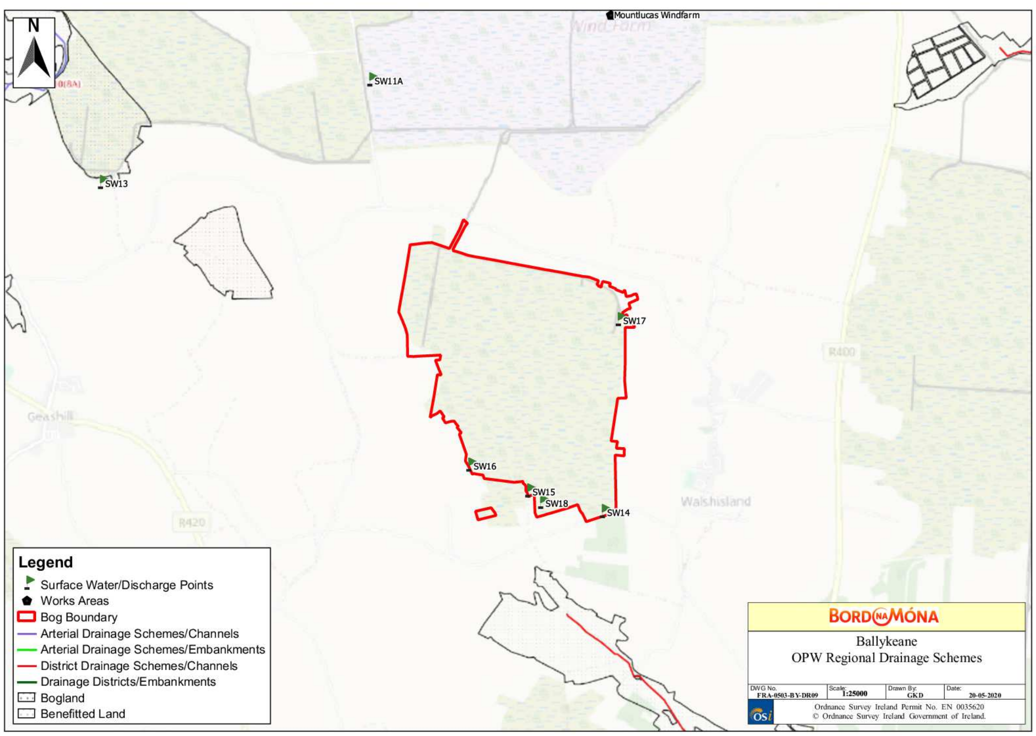


Figure 5.5.4 Ballykeane Bog District Drainage Schemes

The benefitted land from District Drainage Schemes is also highlighted demonstrating that there are limited benefitting lands associated with this scheme in the area of these bogs.

The Standard Annual Average Rainfall (SAAR) in this location is 873mm.

5.5.5 **Historical Flooding**

The OPW https://www.floodinfo.ie website provides some limited information on flood records throughout the country. A map of historical flooding contained for the area, in the vicinity, of Ballykeane Bog is shown in the Figure below.

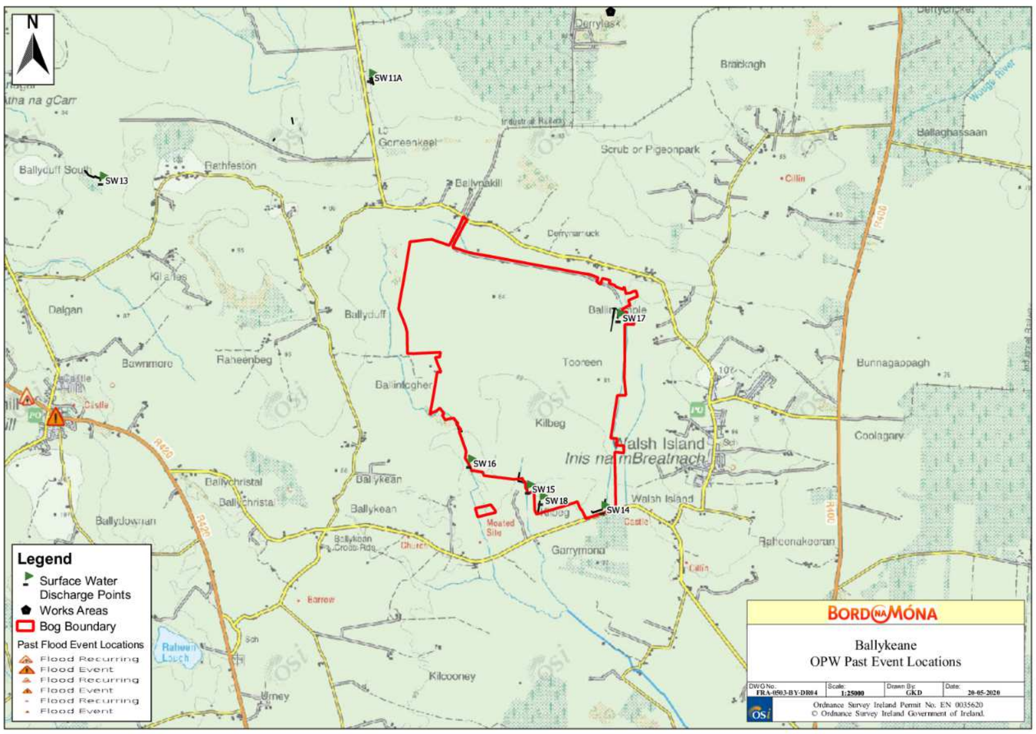


Figure 5.5.5 Ballykeane Bog Historical Flooding

The OPW past flood events database show no records of any flooding events in the vicinity of Ballykeane Bog

There is little anecdotal evidence to suggest any historical flooding of the site, however information from Bord na Móna operatives familiar with Ballykeane Bog confirmed that surface water flooding has, on occasion, occurred in the production area where blockages to the existing drainage network have occurred over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production.

5.5.6 Groundwater Flood Risk

There are two groundwater aquifers underlying Ballykeane Bog. The majority of the bog is underlain by an aquifer categorised as: *Rkd: Regionally Important Aquifer Karstified (diffuse).* There is a narrow central western section and a narrow northeastern section categorised as: *LI: Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones*. The aquifers have moderate vulnerability.

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below.

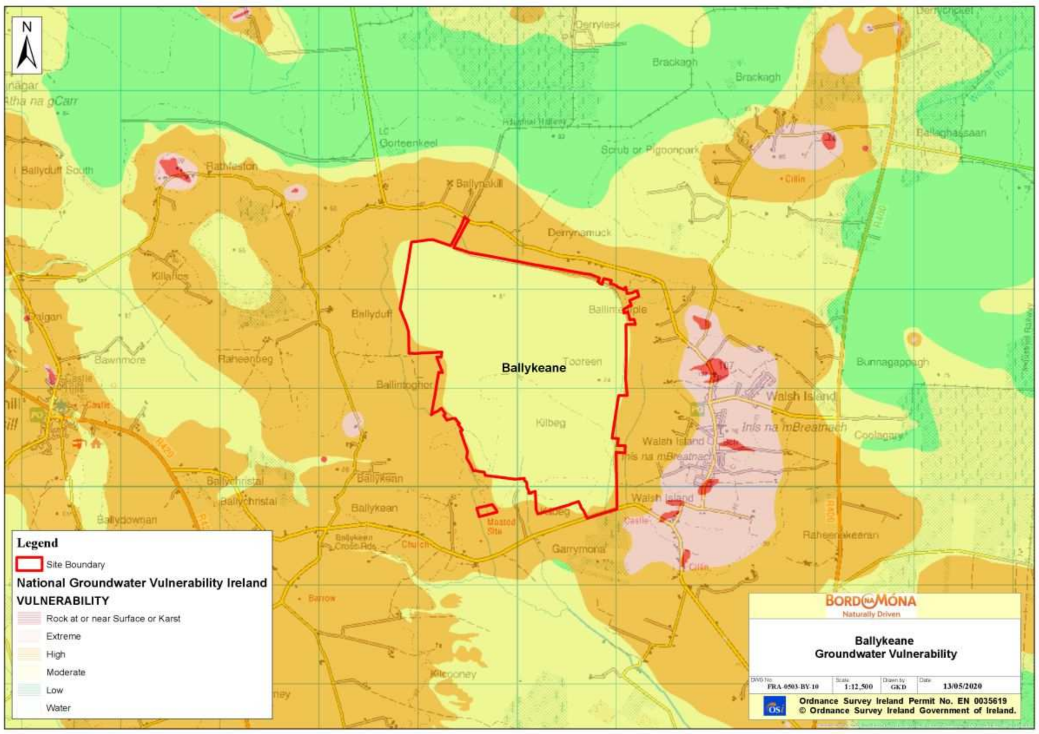


Figure 5.5.6 Ballykeane Bog Groundwater vulnerability

The GSI https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx website provides information on groundwater throughout the country. The two boreholes shown to the south east of Ballykeane Bog were recorded as having been dug in 1963 and 1924. According to the GSI website the accuracy for this location is 1Km and Information from Bord na Móna operatives familiar with Ballykeane Bog confirmed that these wells are not located within the bog boundary.

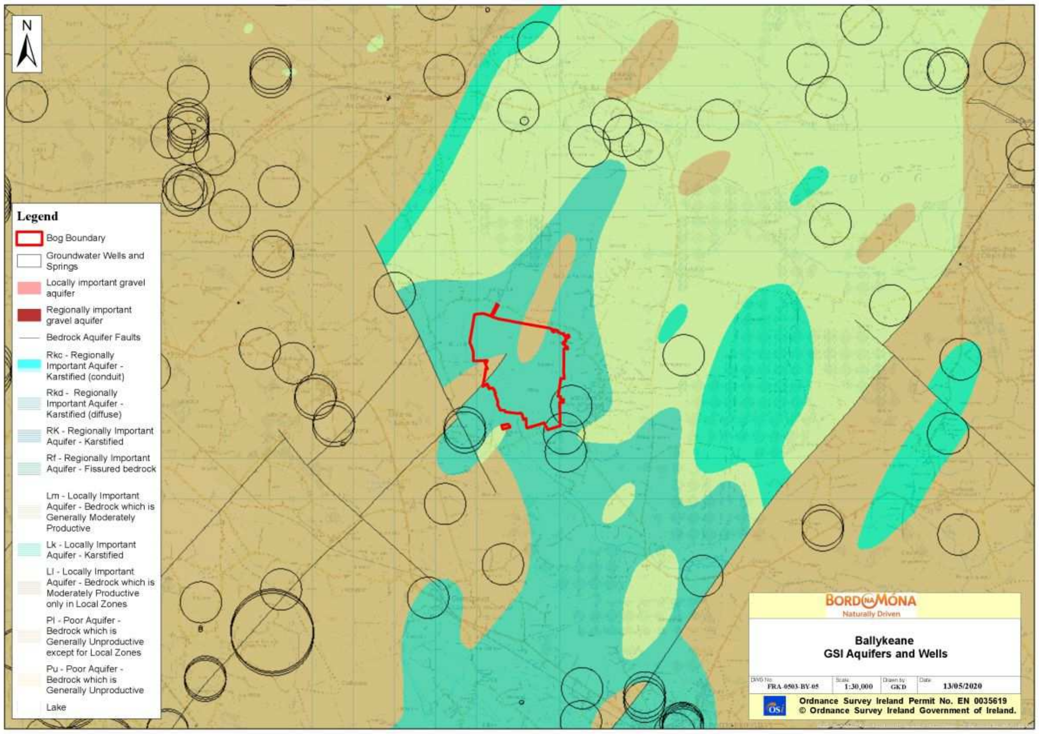


Figure 5.5.7 Ballykeane Bog Aquifers, Karst Features, Wells

Information from Bord na Móna operatives familiar with Ballykeane Bog confirmed that groundwater seepage has not been identified as a source of flooding within the bog

5.5.7 **Fluvial Flood Risk**

The rivers and streams in the vicinity of Ballykeane Bog are are described in terms of regional hydrology in section 5.5.4

The 5 surface water outfalls in Ballykeane Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameters of these outfalls are shown in the Table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW14	0.750
SW15	0.600
SW16	0.450
SW17	0.600
SW18	0.600

Table 5.5.1 Ballykeane Bog Surface Water Outfalls

Information from Bord na Móna operatives familiar with Ballykeane Bog confirmed that outfalls will become submerged when the water levels are high. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Ballykeane Bog. River Flood Events High Range mapping has been examined in the region of this bog. Mapping carried out for the Figile river identifies the potential for flooding at a distance of circa 4.0km north east of the site. This flooding is not predicted to encroach into the site. There is no mapping available for the other rivers in the vicinity of the bog.

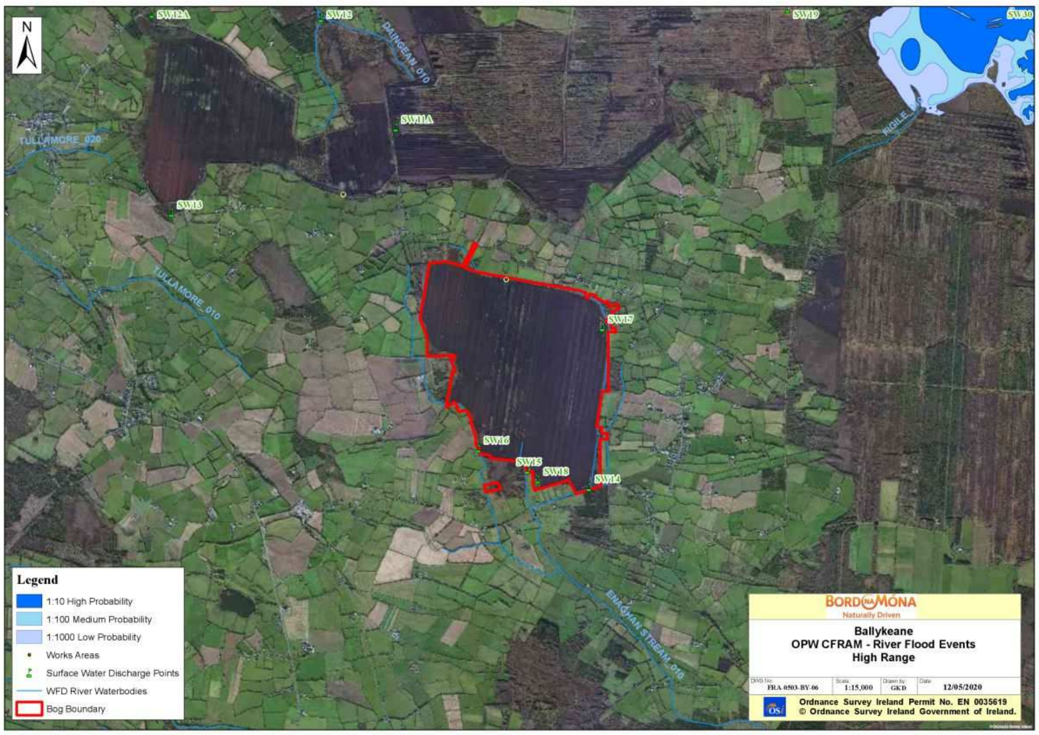


Figure 5.5.8 Ballykeane Bog Flood Events High Range

5.5.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)

- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices.

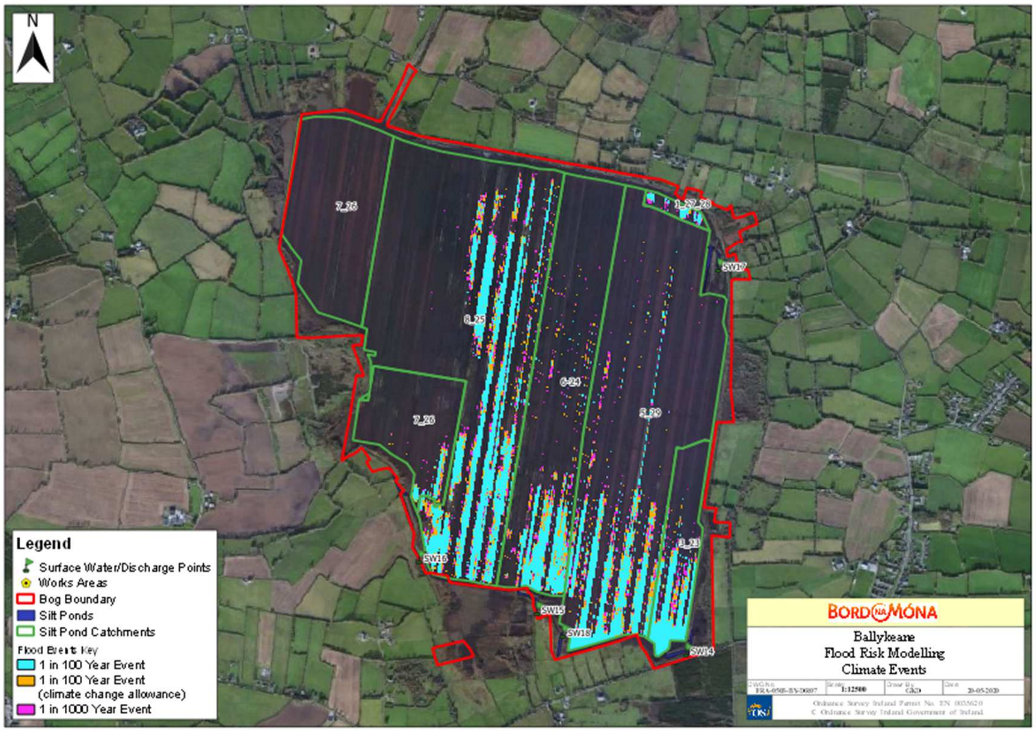


Figure 5.5.9 Ballykeane Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the Surface water discharge points in the bog. Ballykeane Bog is modelled for 3 basins, 6_24&5_29&3_23, 8_25 & 7_26 and 1_27_28. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption. The model shows that flood waters are collecting in local areas in the south and central parts of the bog and a small section in the north east of the bog. The most extensive flooding is shown in the southern section, where rainfall generated over these basins are drained. The maximum flood level in this area for the 1000year event range is 78.23mOD. The maximum flood for the northeast corner for the same flood event is 78.55mOD however due to the topography of the bog, this flood level will be retained in this area.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt

ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The existing ground level of the works area located centrally in the bog is above 82.76mOD and the finished floor levels of the buildings are higher than 83.28mOD. The elevation of these buildings is higher than the modelled flood waters in the vicinity of the works area.

From this model Ballykeane Bog works area which includes welfare facilities, car parking and oil storage facilities is not as risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	***1_27_28***	***6_24 and 5_29 and 3_23***	***8_25 and 7_26***
mOD	***m^3***	***m^3***	***m^3***
75.00	*0*	*153*	*0*
75.25	*0*	*1022*	*0*
75.50	*0*	*3131*	*0*
75.75	*0*	*6544*	*0*
76.00	*0*	*12196*	*3*
76.25	*0*	*21782*	*54*
76.50	*0*	*38839*	*303*
76.75	*0*	*70362*	*1360*
77.00	*0*	*121782*	*5562*
77.25	*0*	*196259*	*16168*
77.50	*0*		*34836*
77.75	*8*		*65768*
78.00	*143*		*114386*
78.25	*657*		*184398*
78.50	*1920*		
78.75	*4196*		

Table 5.5.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Ballykeane Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

5.5.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 5.5.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100year* plus 30% climate change allowance (High End Emissions Scenario). In the climate change model run case, the maximum rainfall for the 100year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario

resulted in less flooding than the 1000year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 5.5.7, the High Emissions Scenario (HEFS) has been considered which considers the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

5.5.10 **Conclusions**

The Flood Risk Assessment for Boora Bog identifies the sources of flood risk and their impact. Historical information was also reviewed.

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area does occur on occasion.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short .
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings area would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Works Area in Ballykeane Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Ballykeane Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 5.5.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Ballykeane Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Ballykeane Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

5.6 Esker Bog

5.6.1 **Introduction**

Esker Bog is part of the Bord na Móna Allen Bog Group which operates under an Integrated Pollution Control licence (ref P0503-01). The Bog is used primarily to produce milled horticultural peat and the total area within Bord na Móna ownership is 590 Hectares.

5.6.2 **Site Location**

Esker Bog is located 4Km south of Rhode in Co. Offaly. The site is within Barrow 14 catchment (Hydrometric Area 14). The Esker Bog site location is highlighted in red in the Figure below and is 590 Hectares.

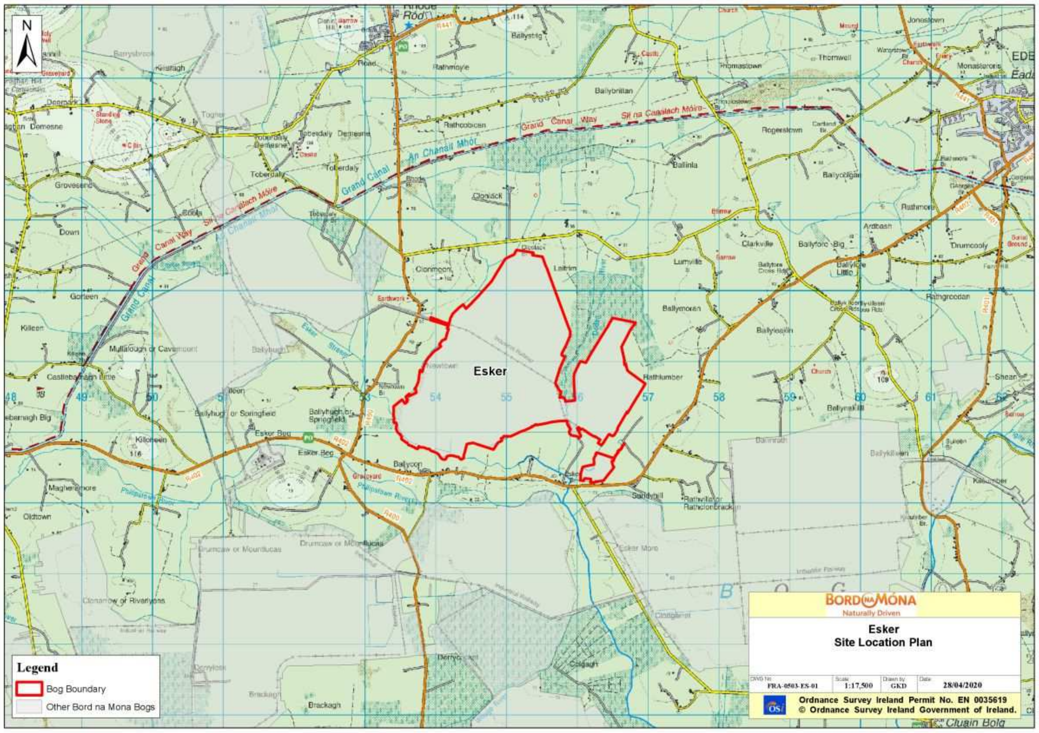


Figure 5.6.1 Esker Bog Site Location

5.6.3 **Bog Description**

The majority of Esker bog is owned by Bord na Mòna with a small section to the north-east being cut as turbary. The bog primarily consists of milled peat production. There are some remnant habitats around the margins of the production bog consisting of scrub and Birch woodland. This bog was drained by Bord na Móna in 1959 with peat production commencing in 1965.

The main access to the site is via the R400 to the Works Area which includes welfare facilities, car parking and storage containers. Access to the bog area is available via machine track and rail line south of the works area. Esker bog is divided into 7 drainage basins that each drain to a separate surface water gravity outfall. There are no pumps in Esker Bog and all flow is gravity.

Details of the existing drainage layout is shown in the Figure below.

Figure 5.6.2 Esker Bog Drainage Layout

5.6.4 Regional Hydrology

Esker Bog is within in the Barrow 14 catchment (Hydrometric Area 14). The Barrow catchment includes the area drained by the River Barrow draining an area of 3,025km^2. The surface water and groundwater are closely and complexly linked in this catchment particularly south of Monasterevin. The catchment comprises 20 sub-catchments with 145 river water bodies, 6 transitional water bodies and 29 ground water bodies.

The 7 surface water outfalls from this bog discharge into the Esker Sream_020 and into the sub-catchment Figile_SC_020. The proximity of the surface water outfall locations to the Esker Sream_020 is detailed below:

Outfall ref:	Waterbody	Distance from Outfall to Waterbody (m)
SW24	Esker Sream_020	Discharges directly into waterbody
SW25	Esker Sream_020	Discharges directly into waterbody
SW26	Esker Sream_020	50
SW27	Esker Sream_020	Discharges directly into waterbody
SW28	Esker Sream_020	Discharges directly into waterbody
SW29	Esker Sream_020	Discharges directly into waterbody
SW29A	Esker Sream_020	Discharges directly into waterbody

Table 5.6.1 Esker Bog Outfalls Distance from Waterbody

The catchment areas, water courses and District Drainage Schemes are shown in the Figures below.

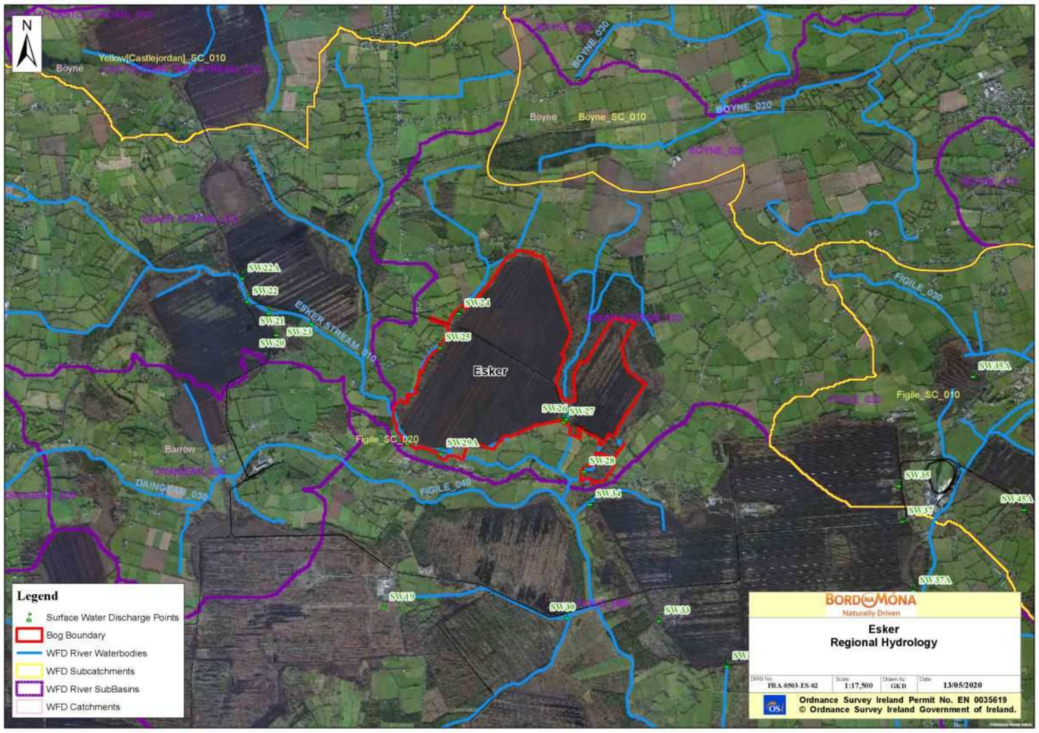


Figure 5.6.3 Esker Bog Regional Hydrology

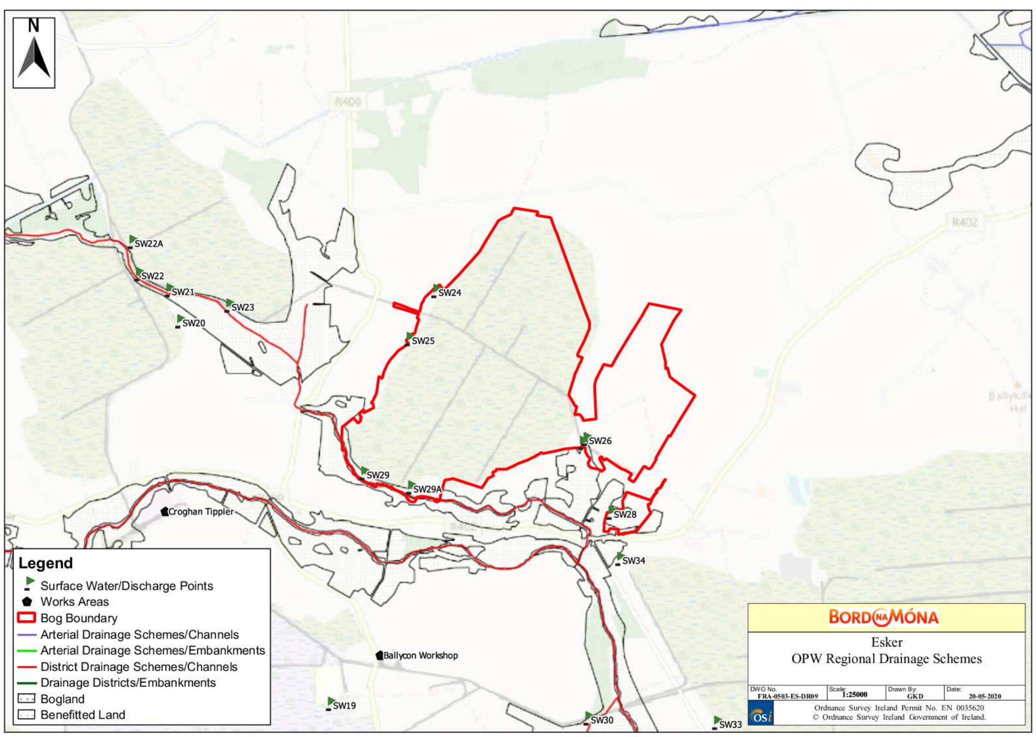


Figure 5.6.4 Esker Bog District Drainage Schemes

The benefitted land from District Drainage Schemes is also highlighted demonstrating that there are limited benefitting lands associated with this scheme in the area of these bogs.

The Standard Annual Average Rainfall (SAAR) in this location is 881mm.

5.6.5 Historical Flooding

The OPW https://www.floodinfo.ie website provides some limited information on flood records throughout the country. A map of historical flooding contained for the area, in the vicinity, of Esker Bog is shown in the Figure below.

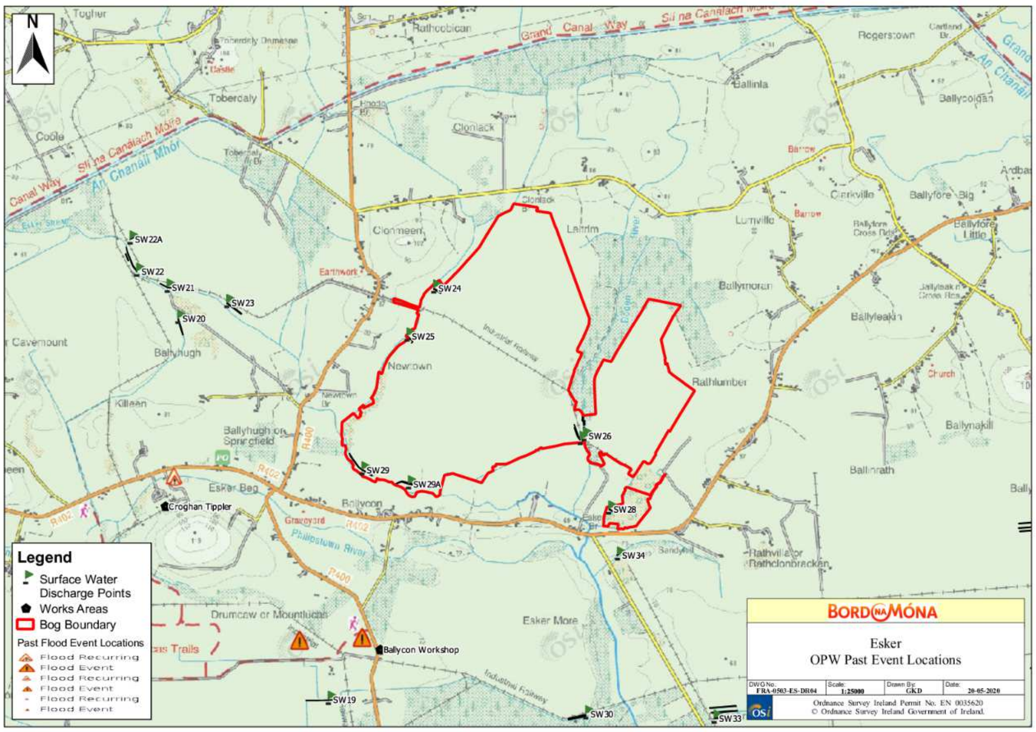


Figure 5.6.5 Esker Bog Historical Flooding

The OPW Past Flood Events show no records of any flooding events encroaching into Esker Bog.

There is little anecdotal evidence to suggest any historical flooding of the site. However information from Bord na Móna operatives familiar with Esker Bog confirmed that surface water flooding has, on occasion, occurred in the production area where blockages to the existing drainage network have occurred over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production.

5.6.6 **Groundwater Flood Risk**

The groundwater aquifer underlying Esker Bog is categorised as *Lm: Locally Important Aquifer- Bedrock which is generally Moderately Productive.* This aquifer has a moderate vulnerability.

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below.

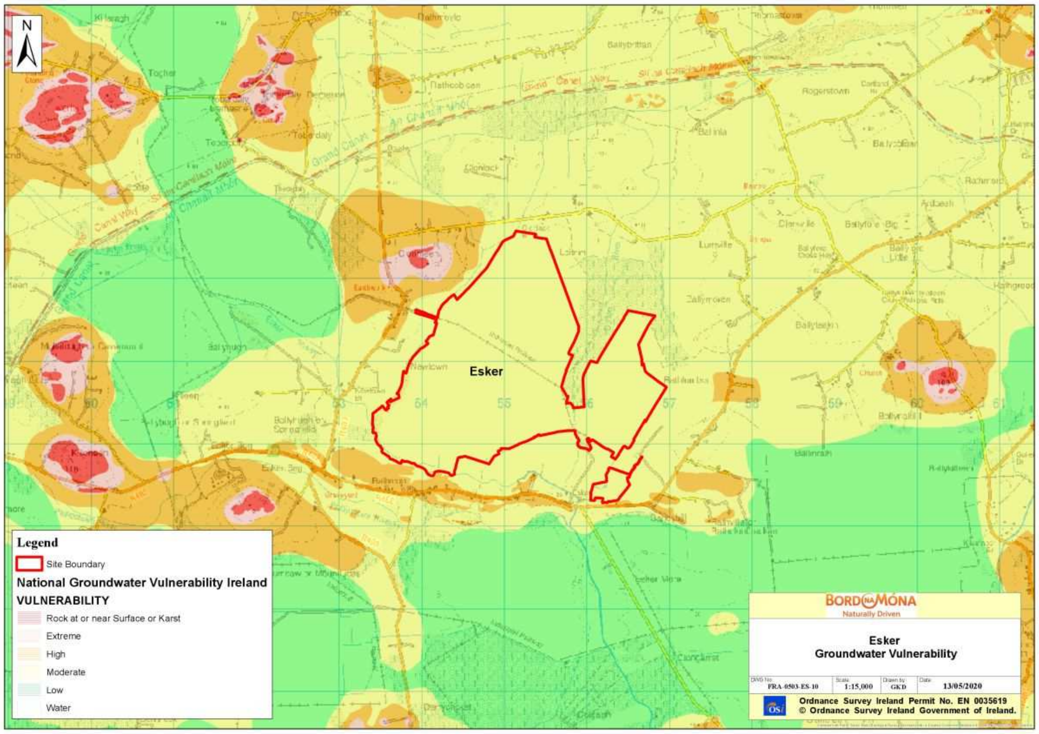


Figure 5.6.6 Esker Bog Groundwater vulnerability

The GSI https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx website provides information on groundwater throughout the country. The well shown to the south east of Esker Bog was recorded as having been dug in 1899. According to the GSI website the accuracy for this location is 1Km and Information from Bord na Móna operatives familiar with Esker Bog confirmed that this well is not located within the bog boundary.

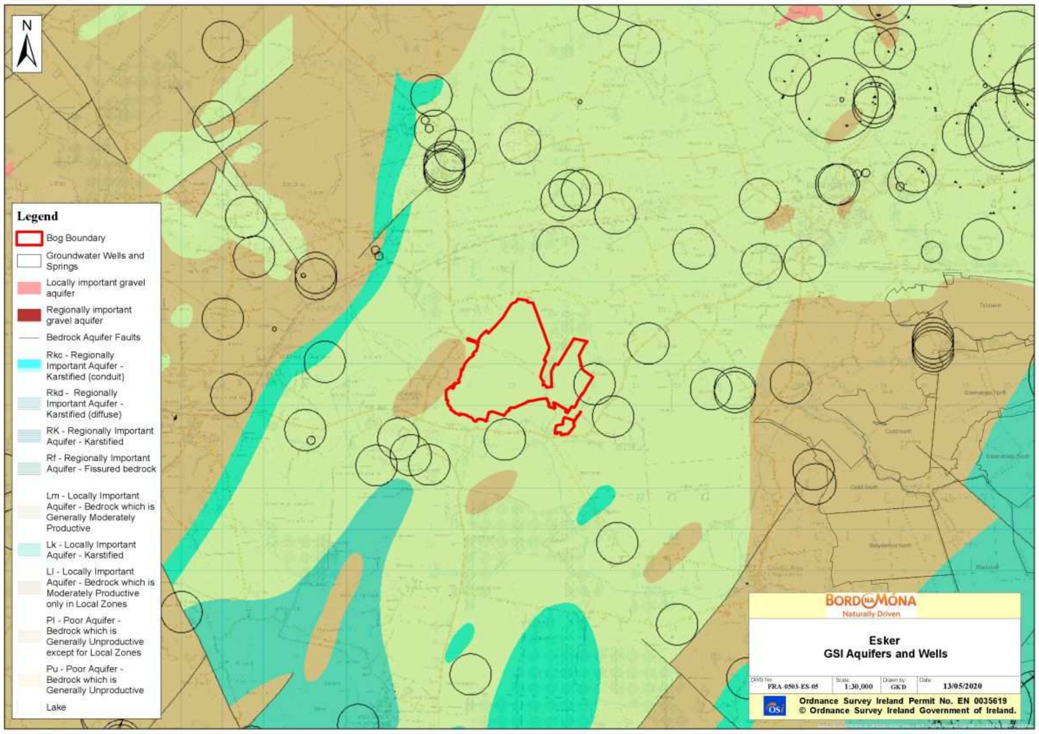


Figure 5.6.7 Esker Bog Aquifers, Karst Features, Wells

Information from Bord na Móna operatives familiar with Esker Bog confirmed that groundwater seepage has not been identified as a source of flooding within the bog

5.6.7 **Fluvial Flood Risk**

The rivers and streams in the vicinity of Esker Bog are are described in terms of regional hydrology in section 5.6.4.

The 7 surface water outfalls in Esker Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameters of these outfalls are shown in the Table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW24	0.600
SW25	0.450
SW26	0.450
SW27	0.600
SW28	0.450
SW29	0.600
SW29A	0.600

Table 5.6.2 Esker Bog Surface Water Outfalls

Information from Bord na Móna operatives familiar with Esker Bog confirmed that outfalls will become submerged when the water levels are high. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Esker Bog. River Flood Events High Range mapping has been examined in the region of this bog. Mapping carried out for the Figile River shows a potential for flooding for a 1 in 1000year event to the south of Esker Bog. This flooding is at a distance of circa 20m from the bog boundary and is not predicted to encroach into Esker bog. There is no mapping available for the other rivers in the vicinity of the bog.

Figure 5.6.8 Esker Bog Flood Events High Range

5.6.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)

- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices.

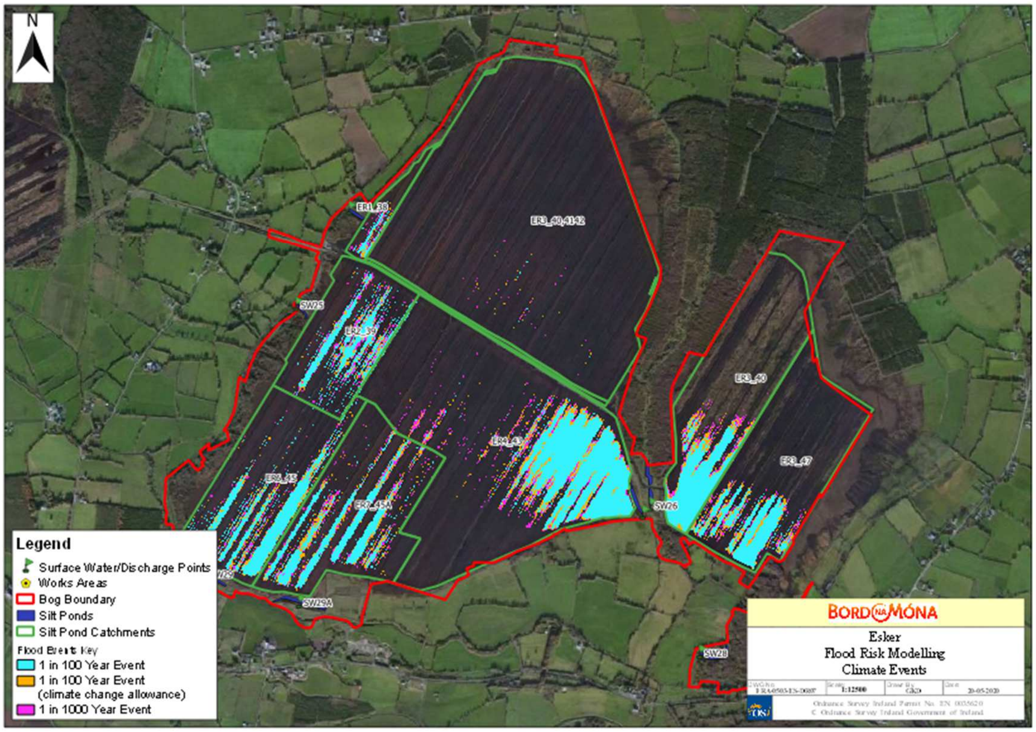


Figure 5.6.9 Esker Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the Surface water discharge points in the bog. Esker Bog is modelled for 6 basins ER1_38, ER2_39, ER4_43 &ER3_40 &ER40_41, 42, ER3_47, ER6_45 and ER7_45A. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption. The model shows that flood waters are collecting in local areas in the south, central and north western parts of the bog. The most extensive flooding is shown in the southern sections. The maximum flood level in this area for the 1000year event is 70.83mOD. The maximum flood level in the northwestern area for the same event is 73.55mOD however due to the topography of the bog, this flood level will be retained in this area.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The finished floor levels of the buildings are higher than 73.92OD. The elevation of these buildings is higher than the modelled flood waters in the vicinity of the works area.

From this model Esker Bog works area which includes welfare facilities, car parking and oil storage facilities is not as risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	**E6_45**	**ER 3_47**	**ER1_38**	**ER2_39**	**ER4_43 and ER3_40 and ER3_404142**	**ER7_45A**
mOD	**m³**	**m³**	**m³**	**m³**	**m³**	**m³**
67.00	0	0	0	0	11	0
67.25	0	4	0	0	24	0
67.50	0	27	0	0	42	0
67.75	0	198	0	0	71	0
68.00	0	1109	0	0	142	0
68.25	0	3555	0	0	384	0
68.50	0	7736	0	0	1255	0
68.75	0	14412	0	0	4299	0
69.00	0	25622	0	0	11979	2
69.25	0	42945	0	0	26729	28
69.50	0	67039	0	0	50984	152
69.75	2		0	0	86489	649
70.00	24		0	0	135235	2542
70.25	161		0	0	198524	7996
70.50	633		0	0	276836	19637
70.75	2337		0	0	373414	40299
71.00	8136		0	5		74239
71.25	20267		0	100		
71.50	41513		0	568		
71.75			0	2188		
72.00			1	6582		
72.25			17	16934		
72.50			97	37289		
72.75			370			
73.00			1087			
73.25			2325			
73.50			4515			
73.75			8293			

Table 5.6.3 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Esker Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

5.6.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 5.6.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100year* plus 30% climate change allowance (High End Emissions Scenario). In the climate change model run case, the maximum rainfall for the 100year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 5.6.7, the High Emissions Future Scenario (HEFS) has been considered which considers the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

5.6.10 **Conclusions**

The Flood Risk Assessment for Esker Bog identifies the sources of flood risk and their impact. Historical information was also reviewed.

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area does occur on occasion.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short .
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings area would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Works Area in Esker Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Esker Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 5.6.4 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Esker Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Esker Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

5.7 Garrymore Bog

5.7.1 **Introduction**

Garrymore Bog is part of the Bord na Móna Allen Bog Group which operates under an Integrated Pollution Control Licence (ref P0503-01). The Bog is used primarily to produce horticultural peat and sod moss and the total area within Bord na Móna ownership is 308 Hectares.

5.7.2 **Site Location**

Garrymore is located approximately 4 km north of Mountmellick in Co. Laois. The site is within Barrow 14 catchment (Hydrometric Area 14). The Garrymore Bog site location is highlighted in red in the Figure below and is 308 Hectares.

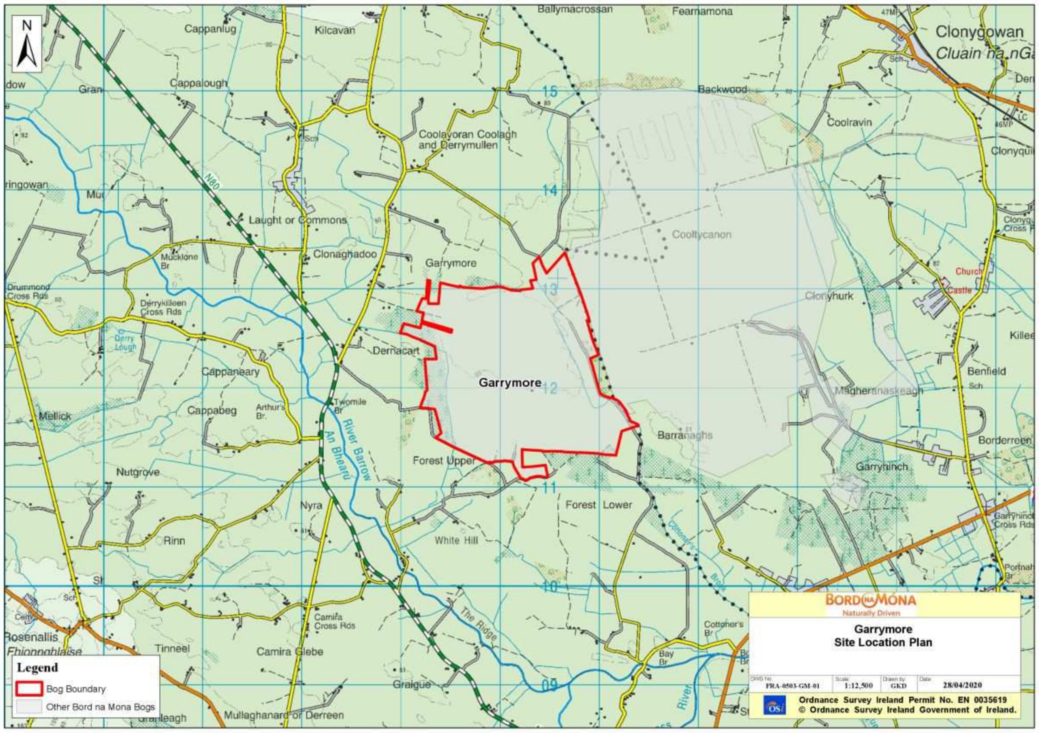


Figure 5.7.1 Garrymore Bog Site Location

5.7.3 **Bog Description**

The bog primarily consists of milled peat production. There is a private development in the southern end of the production bog which is also in milled peat production. The margins of the bog have some marginal remnant high bog, as well as some abandoned cutover bog. This bog was drained by Bord na Móna in 1992 with peat production commencing in 1999.

The elevation of the peat production area ranges from 78.4mOD in the north-western corner to 74.68mOD in the south-eastern corner.

The main access to the site is via the N80 to the Works Area which includes welfare facilities, car parking and storage containers. The finished floor levels of these buildings is 74.3mOD. Garrymore bog is divided into 4 drainage basins that each drain to a separate surface water gravity outfall.

Details of the existing drainage layout is shown in the Figure below.

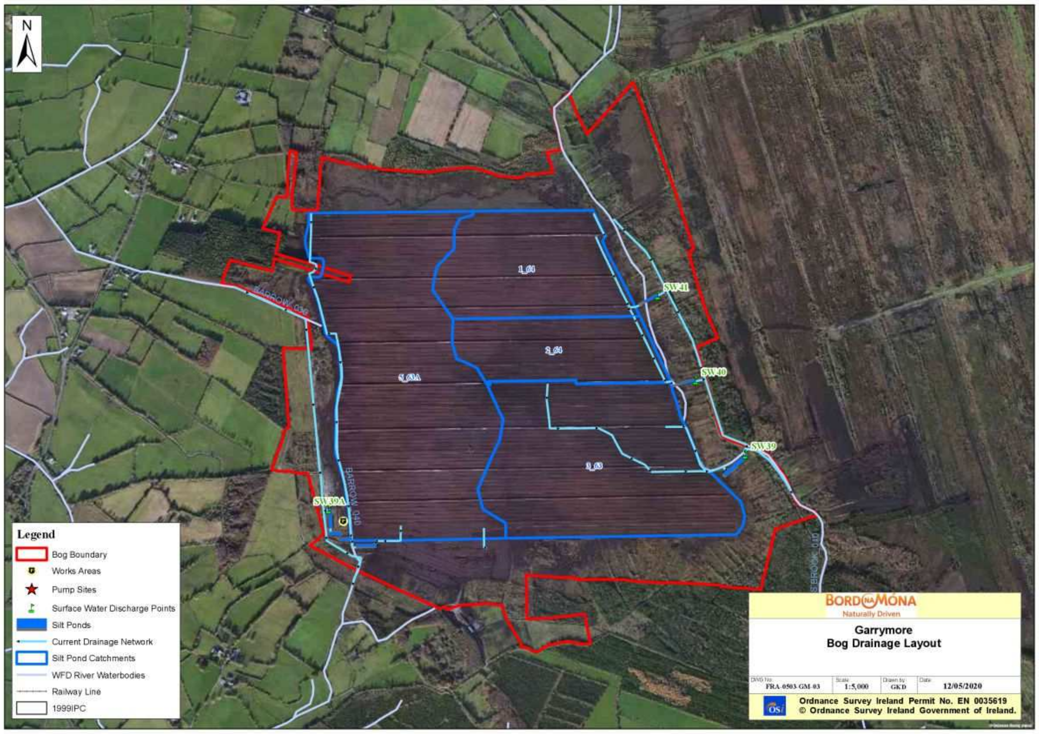


Figure 5.7.2 Garrymore Bog Drainage Layout

5.7.4 **Regional Hydrology**

Garrymore Bog is within in the Barrow 14 catchment (Hydrometric Area 14). The Barrow catchment includes the area drained by the River Barrow draining an area of 3,025km^2. The surface water and groundwater are closely and complexly linked in this catchment particularly south of Monasterevin. The catchment comprises 20 sub-catchments with 145 river water bodies, 6 transitional water bodies and 29 ground water bodies.

There are 4 gravity flow surface water outfalls with associated silt ponds in Garrymore Bog. There are no pumps in Garrymore Bog and all flow is gravity. SW39, SW40 and SW41 all discharge directly into Cottoners Brook_010. SW40 is within 80m and SW41 is within 50m of this waterbody and in the sub-catchment Barrow_SC_030. SW39A is within 90m of the Barrow_040 into which it discharges and this is in the Barrow_SC_010 sub basin.

The catchment areas, water courses and District Drainage Schemes are shown in the Figures below.

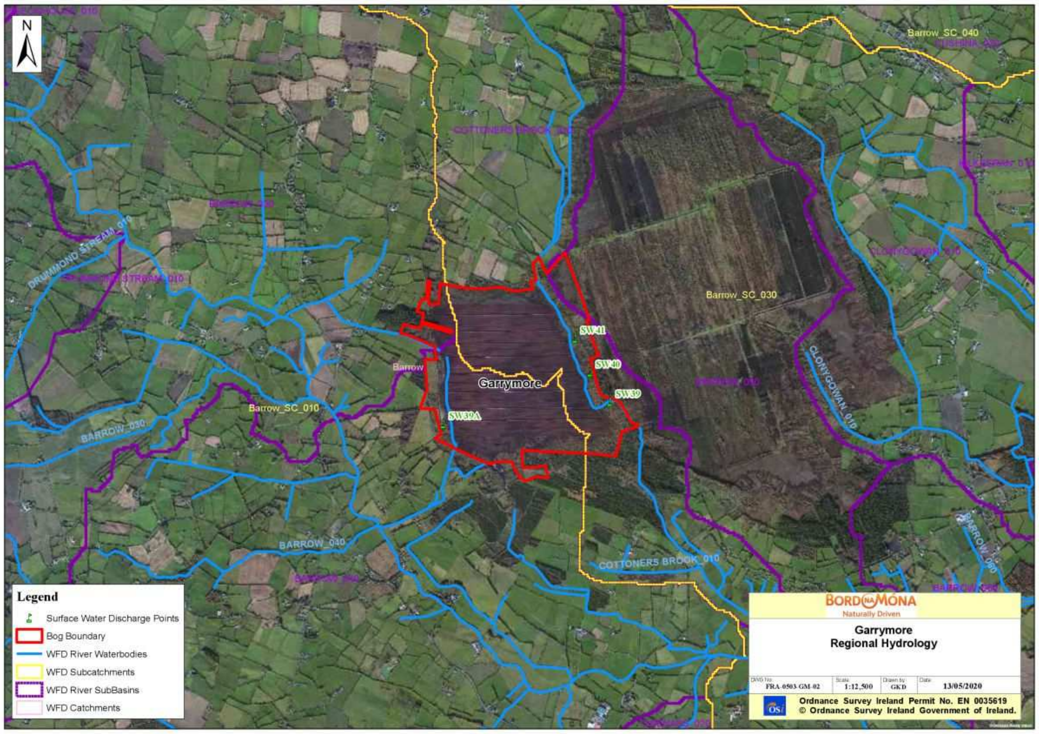


Figure 5.7.3 Garrymore Bog Regional Hydrology

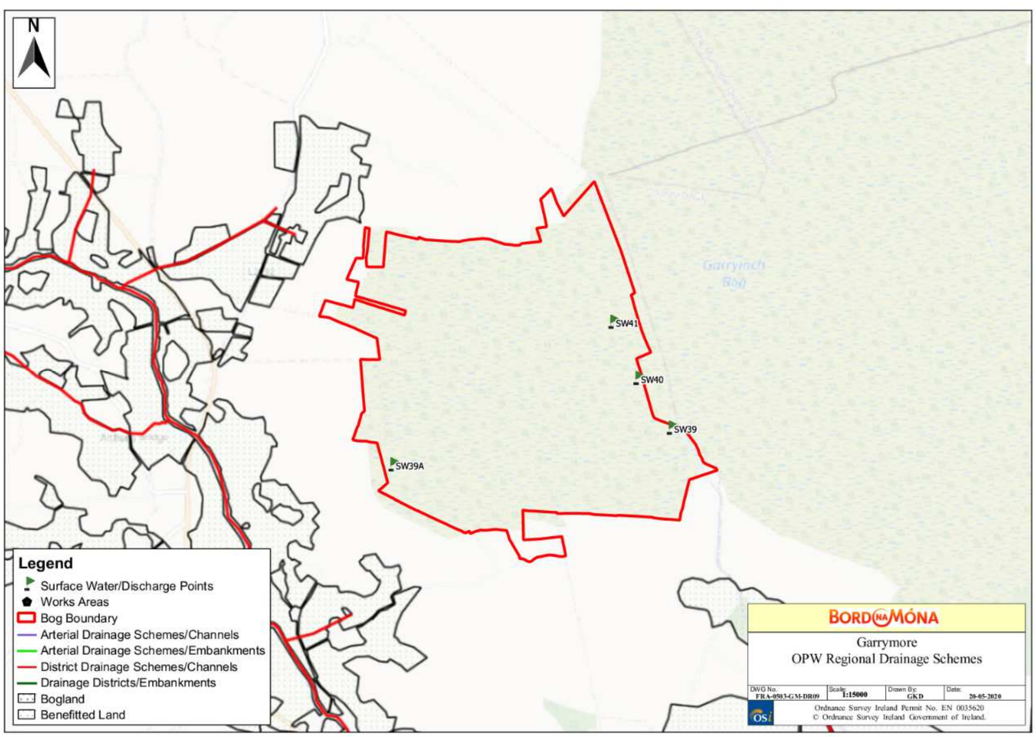


Figure 5.7.4 Garrymore Bog District Drainage Schemes

The benefitted land from District Drainage Schemes is also highlighted demonstrating that there are limited benefitting lands associated with this scheme in the area of these bogs.

The Standard Annual Average Rainfall (SAAR) in this location is 869mm.

5.7.5 **Historical Flooding**

The OPW https://www.floodinfo.ie website provides some limited information on flood records throughout the country. A map of historical flooding contained for the area, in the vicinity, of Garrymore Bog is shown in the Figure below.

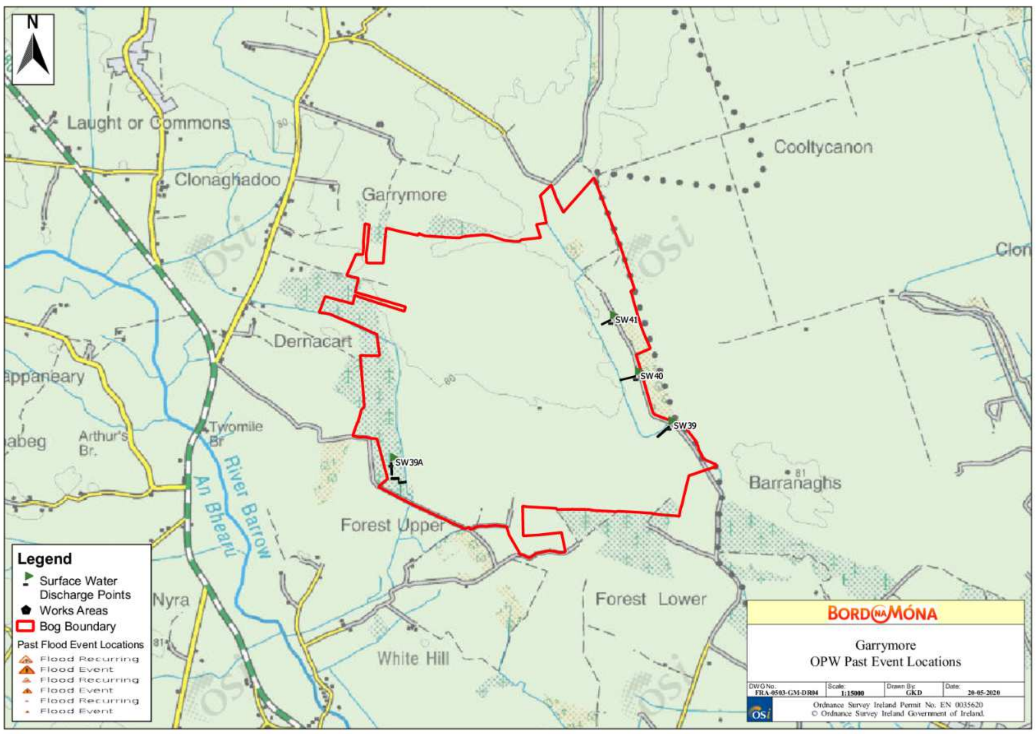


Figure 5.7.5 Garrymore Bog Historical Flooding

The OPW past flood events database show no records of any flooding events encroaching into Garrymore Bog.

There is little anecdotal evidence to suggest any historical flooding of the site. However, Information from Bord na Móna operatives familiar with Garrymore Bog, confirmed that surface water flooding has, on occasion, occurred in the production area when blockages to the existing drainage network have occurred over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production.

5.7.6 **Groundwater Flood Risk**

The groundwater aquifer underlying Garrymore Bog is categorised as *Lm: Locally Important Aquifer- Bedrock which is generally Moderately Productive only in local zones.* This aquifer has a vulnerability that is low over most of bog to moderate on western edge

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below.

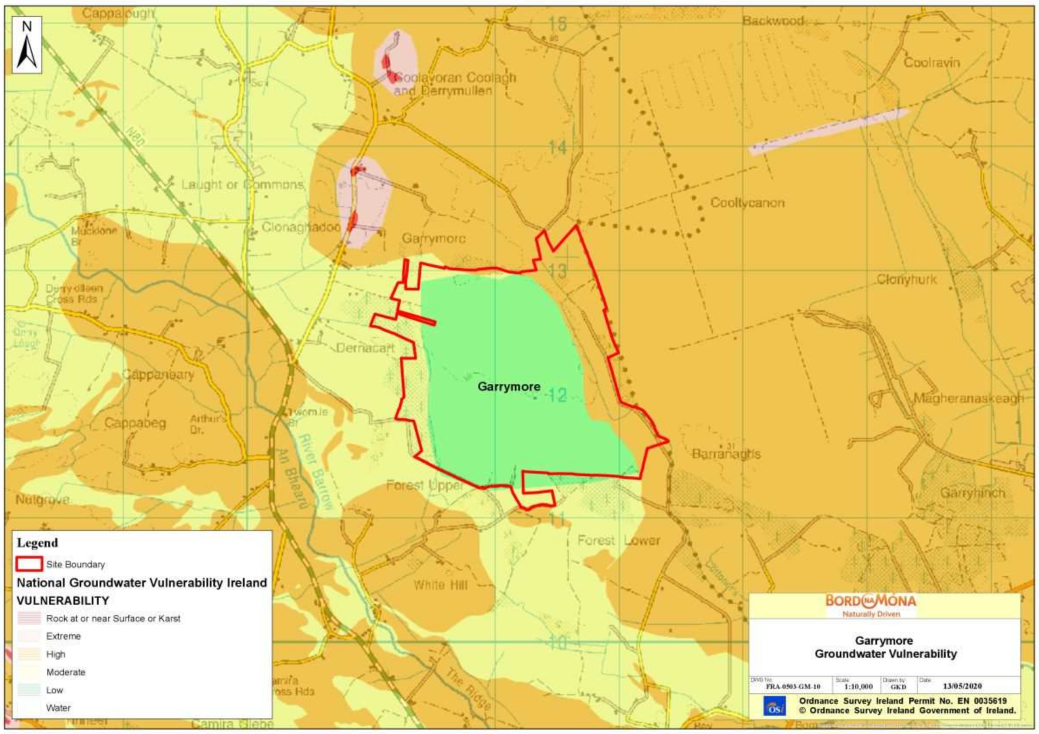


Figure 5.7.6 Garrymore Bog Groundwater vulnerability

The GSI https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx website provides information on groundwater throughout the country. The wells shown to the south west and south east of Garrymore Bog were recorded as having been dug in the early 1970's. According to the GSI website the accuracy for these locations is 2Km and Information from Bord na Móna operatives familiar with Garrymore Bog confirmed that these well is not located within the bog boundary.

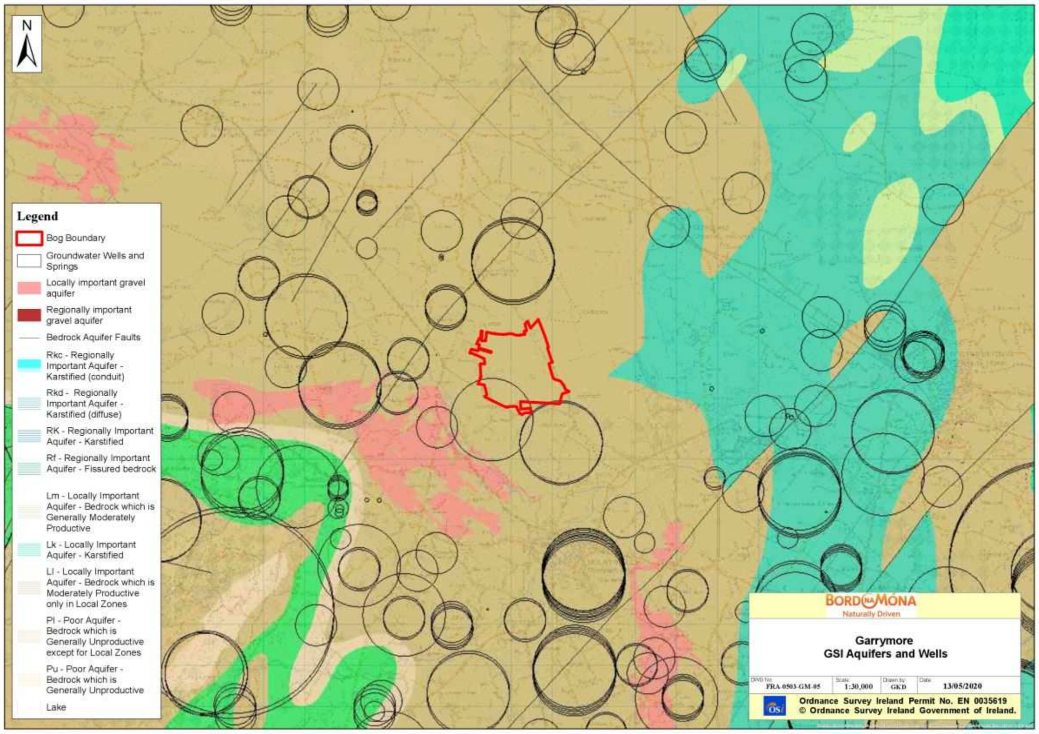


Figure 5.7.7 Garrymore Bog Aquifers, Karst Features, Wells

Information from Bord na Móna operatives familiar with Garrymore Bog confirmed that groundwater seepage has not been identified as a source of flooding within the bog.

5.7.7 **Fluvial Flood Risk**

The rivers and streams in the vicinity of Garrymore Bog are described in terms of regional hydrology in section 5.7.4

The 4 surface water outfalls in Garrymore Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameters of these outfalls are shown in the Table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW39	0.600
SW39A	0.450
SW40	0.450
SW41	0.450

Table 5.7.1 Garrymore Bog Surface Water Outfalls

Information from Bord na Móna operatives familiar with Garrymore Bog confirmed that outfalls will become submerged when the water levels are high. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Garrymore Bog. River Flood Events High Range mapping has been examined in the region of this bog. Mapping carried out for the Barrow River does not predict flooding in the vicinity of the bog. The closest predicted flooding, which is for flooding for a 1 in 1000year event, is over 0.7km to the south of Garrymore Bog. There is no mapping available for the other rivers in the vicinity of the bog.

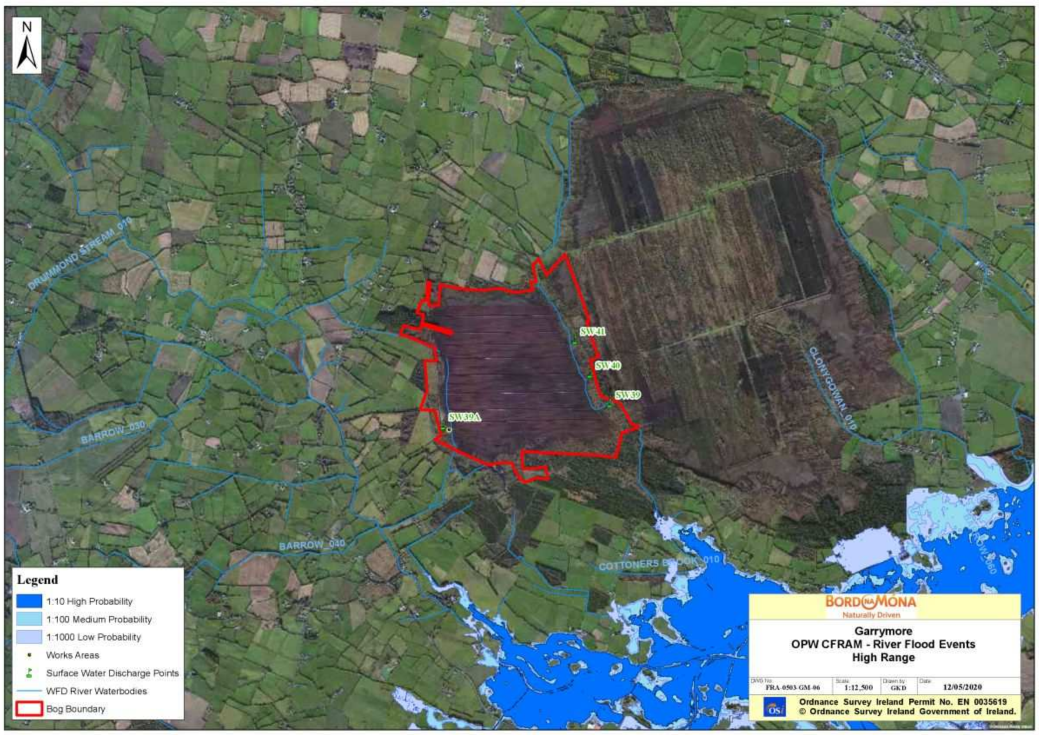


Figure 5.7.8 Garrymore Bog Flood Events High Range

5.7.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event

- 1 in 100yr rainfall event (+30% climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices.

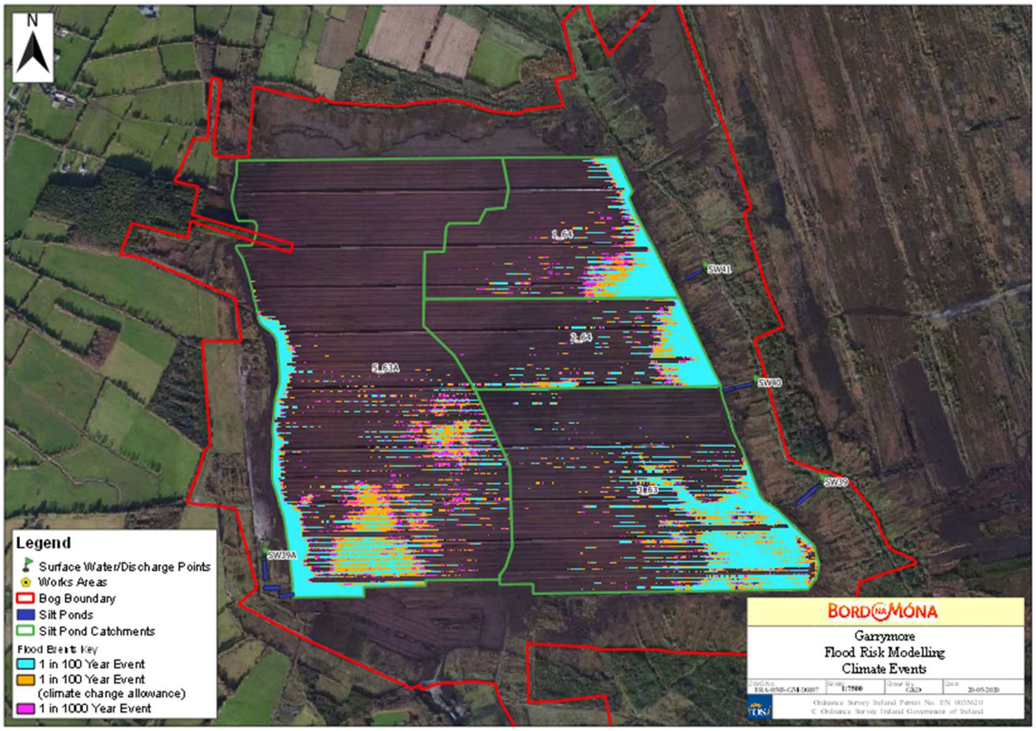


Figure 5.7.9 Garrymore Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the Surface water discharge points in the bog. Garrymore Bog is modelled for 4 basins, 3_63, 2_64, 1_64 and 5_63A. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption. The model shows that flood waters are collecting in local areas in the western and eastern parts of the bog. The most extensive flooding is shown in the eastern section. The maximum flood level in this area for the 1000year event is 77.73mOD. The maximum flood level in the western section of the bog for the same flood event is 76.30mOD.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt

ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The lowest finished floor levels of any building in the Works area is at 74.31mOD and the maximum flood level in the area adjacent to the works area for the 1000year event is 76.3mOD. The existing ground level between the works area and the flooded area within the peat production fields is at a level of 76.48mOD. This higher surrounding ground level will retain the extent of flooding and prevent flooding to the adjacent works area.

From this model Garrymore Bog works area which includes welfare facilities and oil storage facilities is not as risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	**1_64**	**2_64**	**3_63**	**5_63A**
mOD	**m^3**	**m^3**	**m^3**	**m^3**
72.00	0	0	0	0
72.25	0	0	0	0
72.50	0	0	0	2
72.75	0	0	3	12
73.00	0	0	30	39
73.25	0	0	86	111
73.50	0	0	187	305
73.75	0	0	348	820
74.00	0	0	568	2028
74.25	0	0	882	4039
74.50	0	1	1567	6771
74.75	0	2	3149	10144
75.00	6	6	6725	14188
75.25	27	21	15106	19099
75.50	61	87	35275	25287
75.75	115	421	70438	33783
76.00	201	1484		46753
76.25	332	3682		71828
76.50	705	7844		
76.75	1580	15254		
77.00	3307			
77.25	6665			
77.50	13098			
77.75	23911			
78.00				

Table 5.7.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Garrymore Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

5.7.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 5.7.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100year event* plus 30% climate change allowance (High End Emissions Scenario) In the climate change model run case, the maximum rainfall for the 100year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 5.7.7, the High Emissions Future Scenario (HEFS) has been considered which takes into account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

5.7.10 **Conclusions**

The Flood Risk Assessment for Garrymore Bog identifies the sources of flood risk and their impact. Historical information was also reviewed.

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area does occur on occasion.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings area would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Works Area in Garrymore Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Garrymore Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 5.7.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number weeks each year during the Spring/Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Garrymore Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities are not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Garrymore Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

5.8 Derrylea Bog

5.8.1 **Introduction**

Derrylea Bog is part of the Bord na Móna Allen Bog Group which operates under an Integrated Pollution Control Licence (ref P0503-01). The Bog is used primarily to produce milled horticultural peat and the total area within Bord na Móna ownership is 665Hectares.

5.8.2 **Site Location**

Derrylea Bog is a located to the north of Portarlington on the borders of Co. Kildare and Co. Offaly. The site is within Barrow 14 catchment (Hydrometric Area 14). The Derrylea Bog site location is highlighted in red in the Figure below and is 665Hectares.

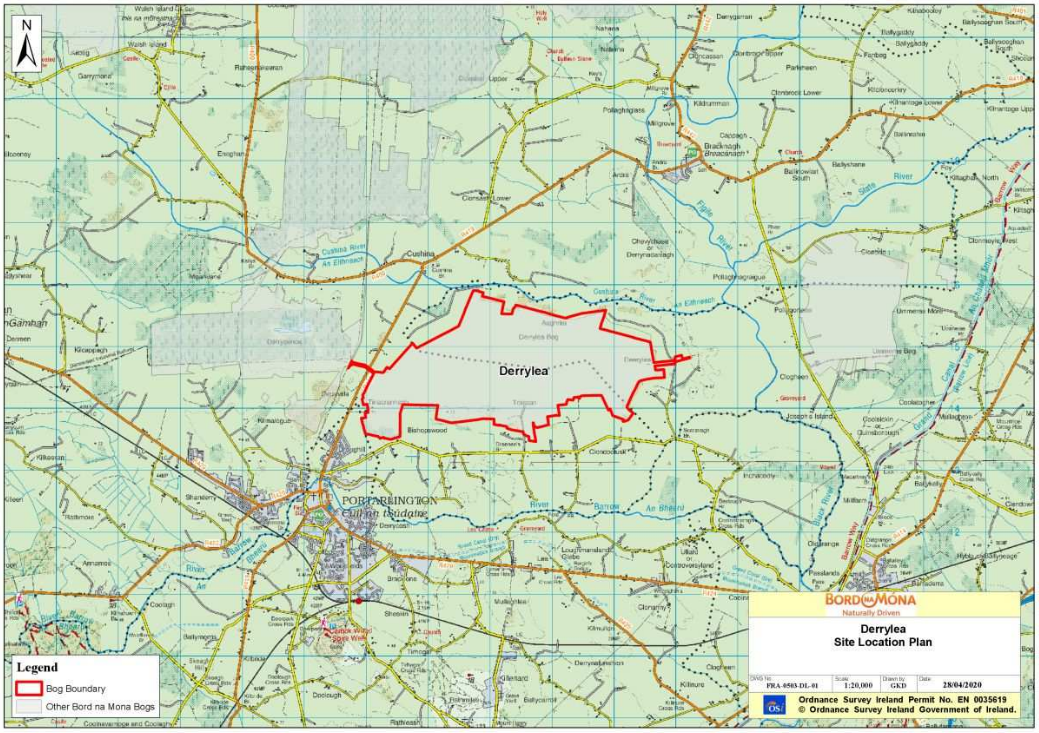


Figure 5.8.1 Derrylea Bog Site Location

5.8.3 **Bog Description**

The bog primarily consists of milled peat production. Some of the bog has intact raised bog and Birch woodland habitats. This bog was drained by Bord na Móna in 1968 with peat production commencing in 1972.

The main access to the site is via the R419 to the Works Area which includes welfare facilities, car parking and storage containers. Derrylea Bog is divided into 2 drainage basins that each drain to a separate surface water gravity outfall. The finished floor level of the buildings range from 67.9mOD to 68.3mOD.

Details of the existing drainage layout is shown in the Figure below.

Figure 5.8.2 Derrylea Bog Drainage Layout

5.8.4 **Regional Hydrology**

Derrylea) Bog is within the Barrow 14 catchment (Hydrometric Areas 14). This catchment includes the area drained by the River Barrow draining an area of 3,025km2. The catchment comprises 20 sub-catchments with 145 river water bodies, 6 transitional water bodies and 29 ground water bodies.

There are 2 gravity flow surface water outfalls with associated silt ponds in Derrylea Bog and both of these outfalls discharge into the Figile_080 and into the Barrow_SC_040. SW43 outfall is within 950m of the Figile_080 and SW43A is within 1.1km of the same waterbody.

The catchment areas, water courses and District Drainage Schemes are shown in the Figures below.

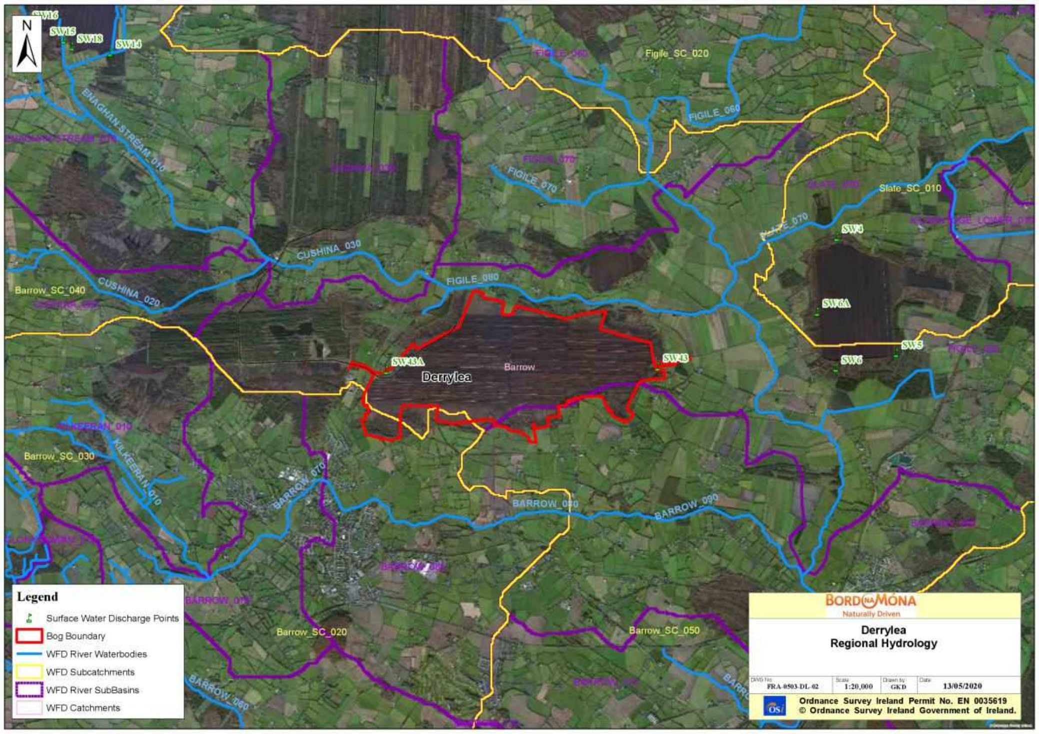


Figure 5.8.3 Derrylea Bog Regional Hydrology

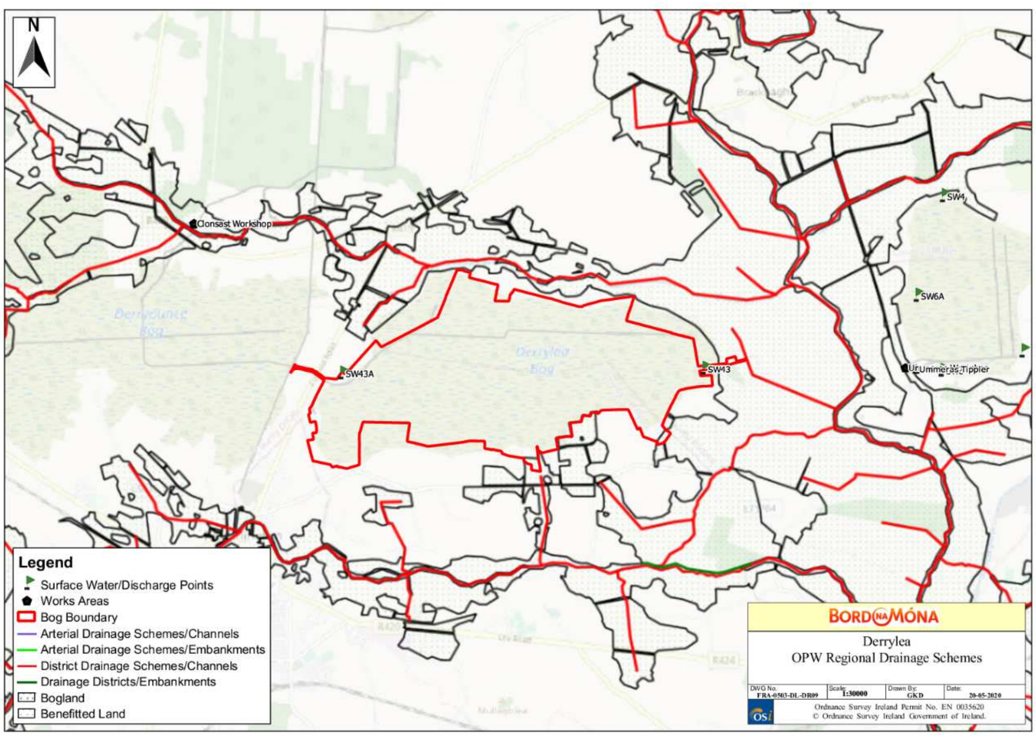


Figure 5.8.4 Derrylea Bog District Drainage Schemes

The benefitted land from District Drainage Schemes is also highlighted demonstrating that there are limited benefitting lands associated with this scheme in the area of these bogs.

The Standard Annual Average Rainfall (SAAR) in this location is 827mm.

5.8.5 **Historical Flooding**

The OPW https://www.floodinfo.ie website provides some limited information on flood records throughout the country. A map of historical flooding contained for the area, in the vicinity, of Derrylea Bog is shown in the Figure below.

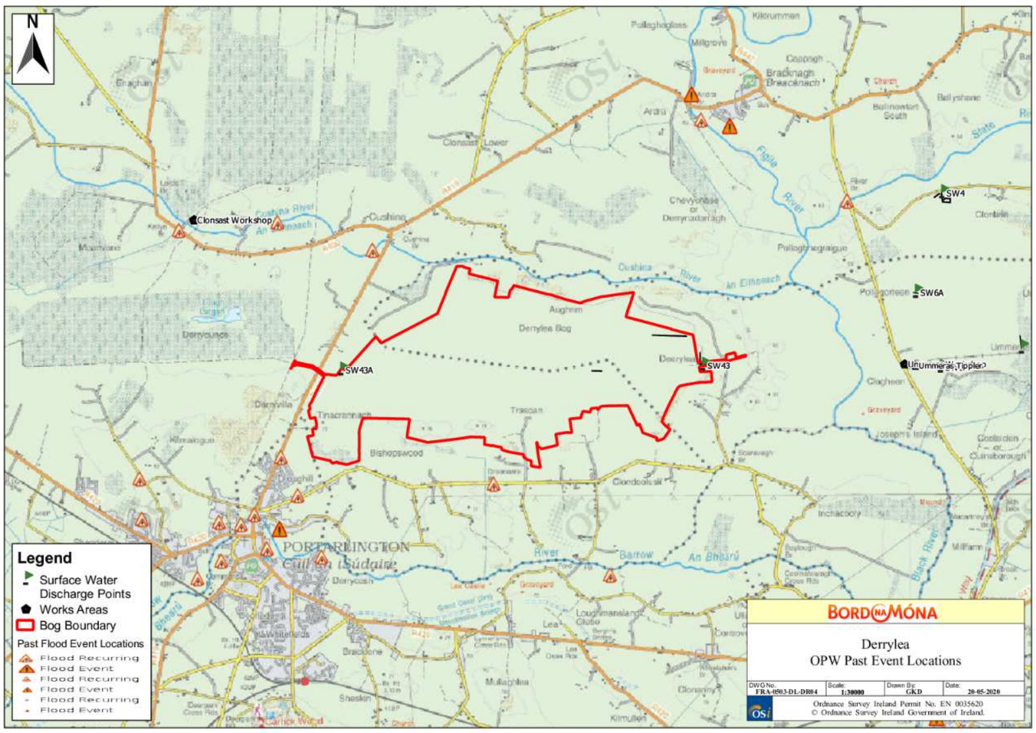


Figure 5.8.5 Derrylea Bog Historical Flooding

The OPW past flood events database show no records of any flooding events encroaching into Derrylea Bog.

There is little anecdotal evidence to suggest any historical flooding of the site. However, information from Bord na Móna operatives familiar with Derrylea Bog, confirmed that surface water flooding has, on occasion, occurred in the production area where blockages to the existing drainage network have occurred over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production

5.8.6 Groundwater Flood Risk

The groundwater aquifer underlying Derrylea Bog is categorised as *Ll: Locally Important Aquifer- Bedrock which is Moderately Productive only in local zones.* This aquifer has a low vulnerability code.

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below.

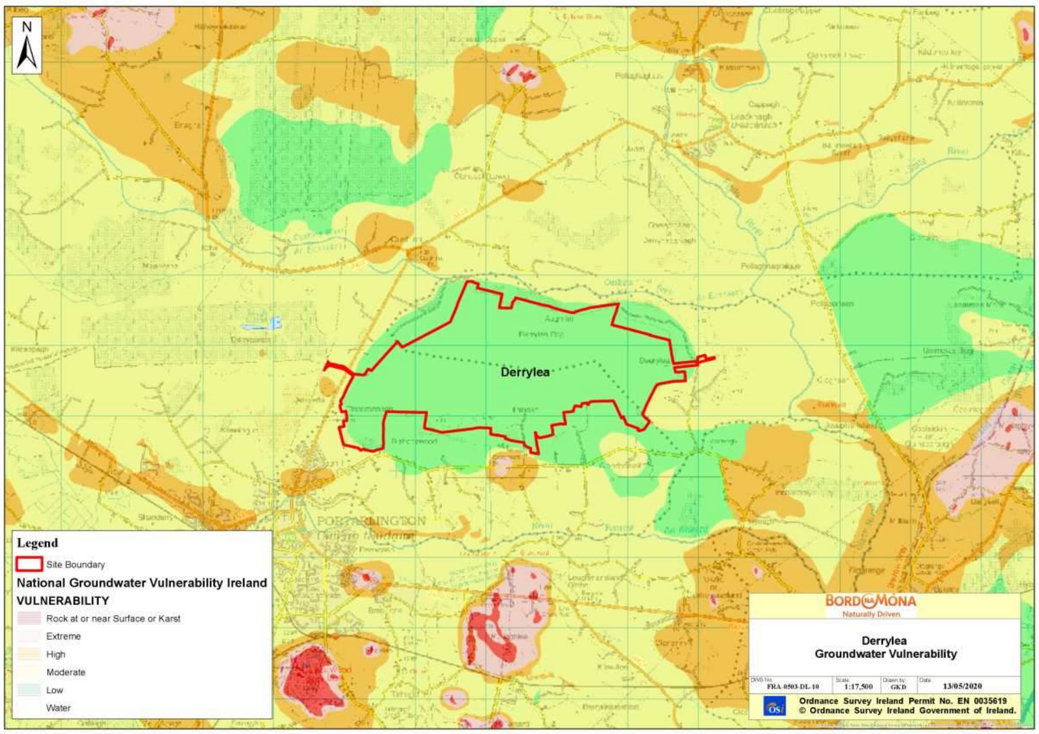


Figure 5.8.6 Derrylea Bog Groundwater vulnerability

The GSI https://www.gsi.ie/en-ie/data-and-maps/Pages/Groundwater.aspx website provides information on groundwater throughout the country. The borehole shown to the south of Derrylea Bog was recorded as having been dug in 1940. According to the GSI website the accuracy for this location is 1Km and Information from Bord na Móna operatives familiar with Derrylea Bog confirmed that this borehole is not located within the bog boundary.

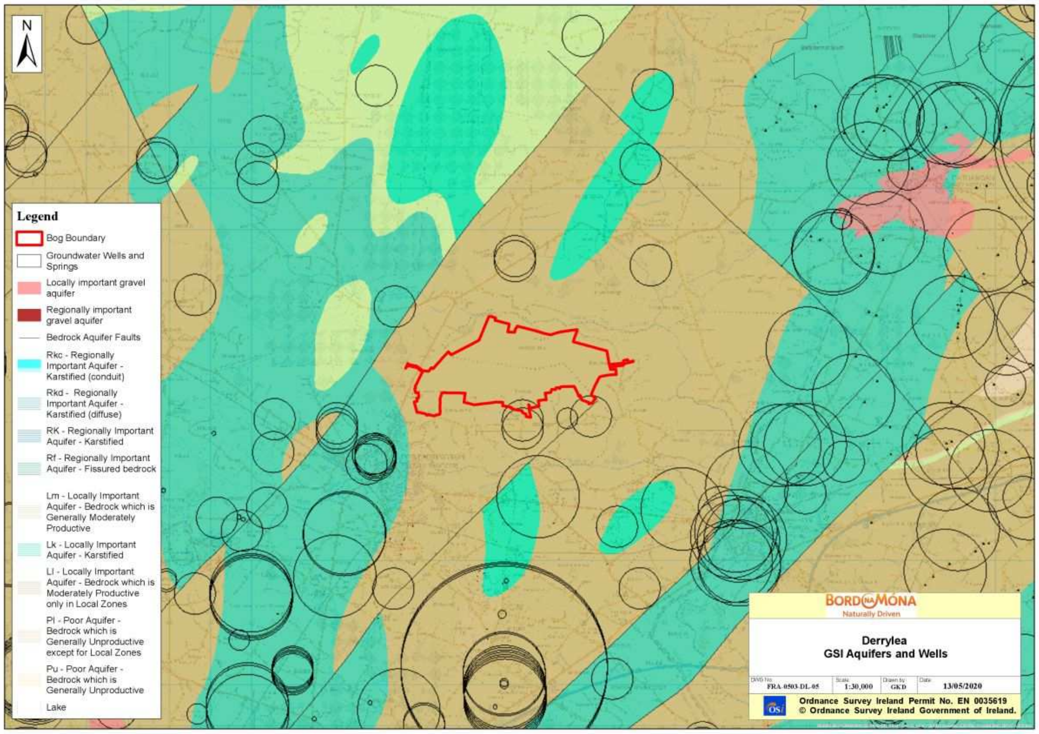


Figure 5.8.7 Derrylea Bog Aquifers, Karst Features, Wells

Information from Bord na Móna operatives familiar with Derrylea Bog confirmed that groundwater seepage has not been identified as a source of flooding within the bog

5.8.7 **Fluvial Flood Risk**

The rivers and streams in the vicinity of Derrylea Bog are described in terms of regional hydrology in section 5.8.4.

The 2 surface water outfalls in Derrylea Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameters of these outfalls are shown in the Table below.

Surface Water Outfall ref:	**Pipe Diameter (m)**
SW43	0.450
SW43A	0.600

Table 5.8.1 Derrylea Bog Surface Water Outfalls

Information from Bord na Móna operatives familiar with Derrylea Bog confirmed that outfalls will become submerged when the water levels are high. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Derrylea Bog. River Flood Events High Range mapping has been examined in the region of this bog. Mapping carried out for the Barrow River predicts localised flooding along the southern and eastern boundary of the bog. The predicted flooding to the southern boundary encroaches into areas which have revegetated. The predicted flooding to the eastern boundary occurs in a 1 in 100year event and is predicted to be confined to a localised area circa 400m in length. There is no mapping available for the other rivers in the vicinity of the bog.

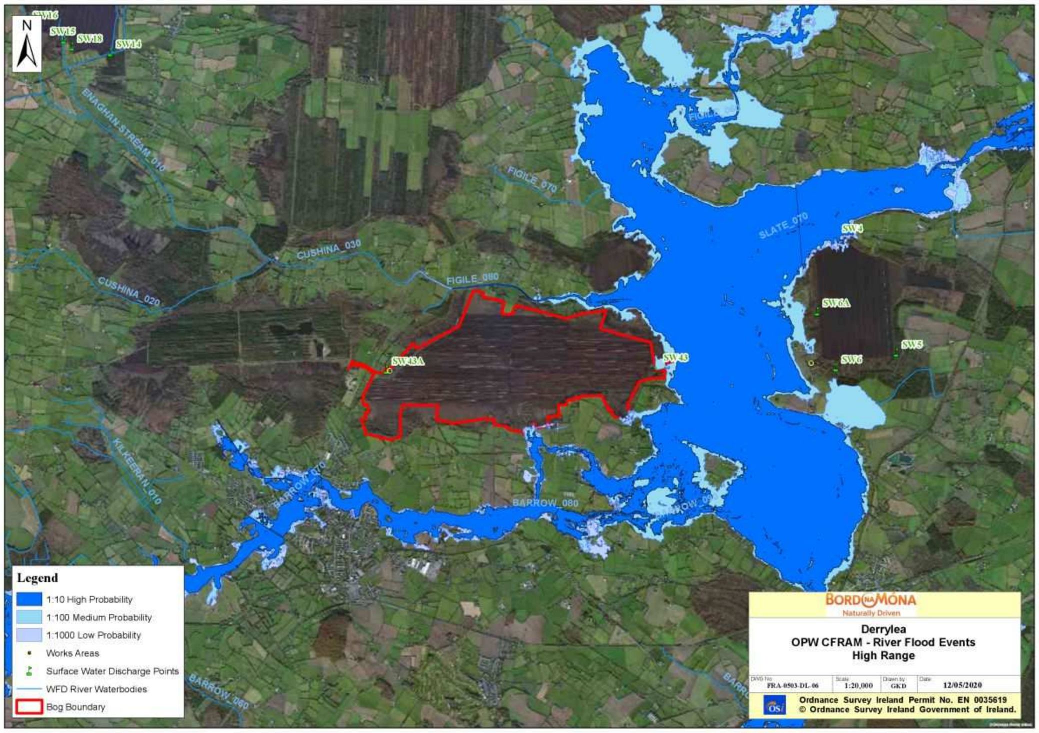


Figure 5.8.8 Derrylea Bog Flood Mapping

5.8.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices.

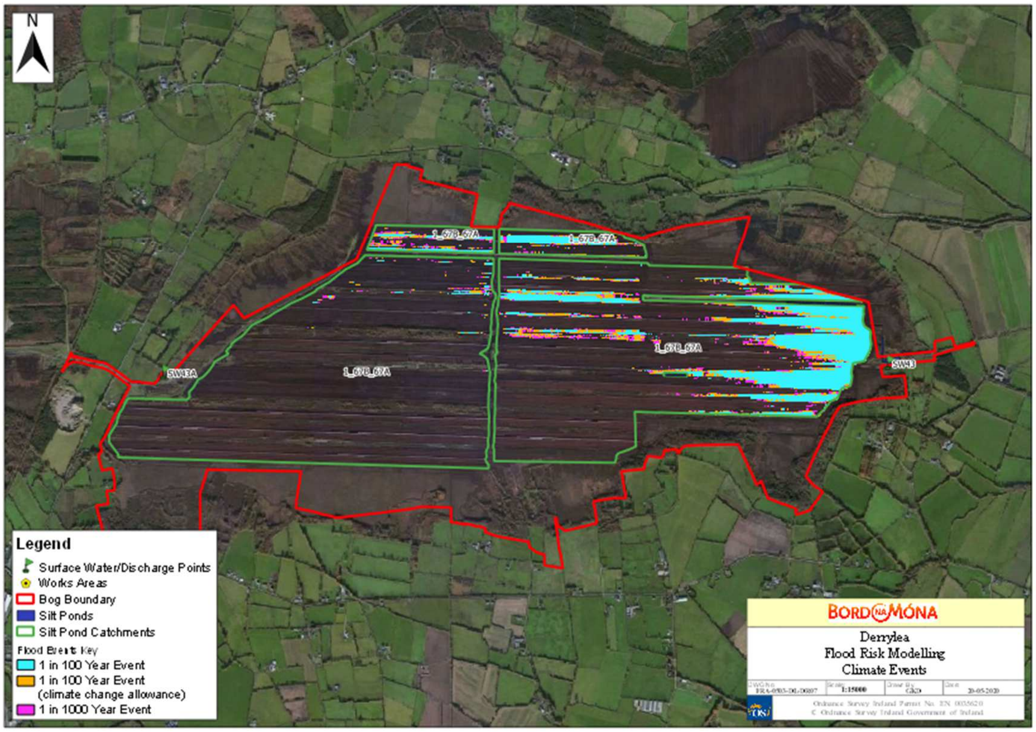


Figure 5.8.9 Derrylea Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the Surface water discharge points in the bog. Derrylea Bog is modelled for 1 basin 1_67A_67B. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption. The model shows that flood waters are collecting in local areas in the northern, central and eastern parts of the bog. The most extensive flooding is shown in the eastern section, where rainfall generated over this basin is drained. The maximum flood level in this area for the 1000year event is 64.92mOD.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The finished floor levels of the buildings range from 67.9mOD to 68.3mOD. The elevation of these buildings is higher than the modelled flood waters in the vicinity of the works area.

From this model Derrylea Bog works area which includes a workshop, welfare facilities and oil storage facilities is not as risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	**1_67A_67B**
mOD	**m^3**
61.00	0
61.25	2
61.50	14
61.75	68
62.00	279
62.25	930
62.50	2389
62.75	5528
63.00	11477
63.25	21812
63.50	37466
63.75	60381
64.00	93010
64.25	139906
64.50	209537
64.75	312849
65.00	459881

Table 5.8.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Derrylea Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

5.8.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 5.9.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100year event* plus 30% climate change allowance (High End Emissions Scenario). In the climate change model run case, the maximum rainfall for the 100year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 5.9.7, the High Emissions Future Scenario (HEFS) has been considered which takes into account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

5.8.10 **Conclusions**

The Flood Risk Assessment for Derrylea Bog identifies the sources of flood risk and their impact. Historical information was also reviewed.

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area does occur on occasion.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings area would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Works Area in Derrylea Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Derrylea Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 5.8.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number weeks each year during the Spring / Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Derrylea Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning

procedures further ensure minimal risk to people, property, the economy and the environment;

- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been taken into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Derrylea Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

5.9 Ticknevin/Glashabaun North/Codd North

5.9.1 **Introduction**

Ticknevin, Glashabaun North and Codd North bogs are part of the Bord na Móna Derrygreenagh Bog Group which operates under an Integrated Pollution Control License (ref P0501-01). Each of these three bogs are supply bogs for the nearby Edenderry Power Station. Codd North bog also supplies horticultural sod moss peat. The total area of the bogs is 1277 Ha, with 459 Ha in Ticknevin, 506 Ha in Glashabaun North and 312 Ha in Codd North.

5.9.2 **Site Location**

The location of these bog is highlighted in red in the Figure below.

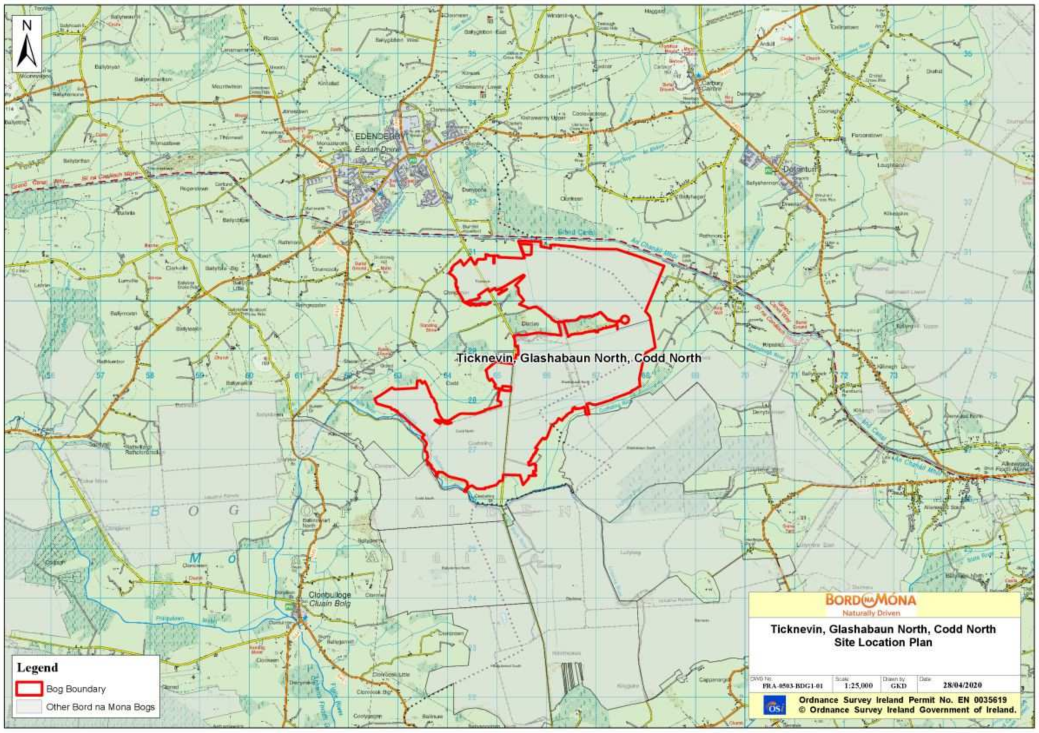


Figure 5.9.1 Ticknevin/Glashabaun North/Codd North Site Location

Bogs including Ticknevin, Glashabaun North and Codd North are located between Co. Offaly and Co. Kildare. The town of Edenderry is located circa 2km to the north. The L3001 Edenderry to Rathangan road runs through the centre of these bogs from north to south. Edenderry Power Station is located immediately to the west and the Grand Canal is located immediately to the north.

5.9.3 **Bog Description**

The bog layout is shown in the Figure.

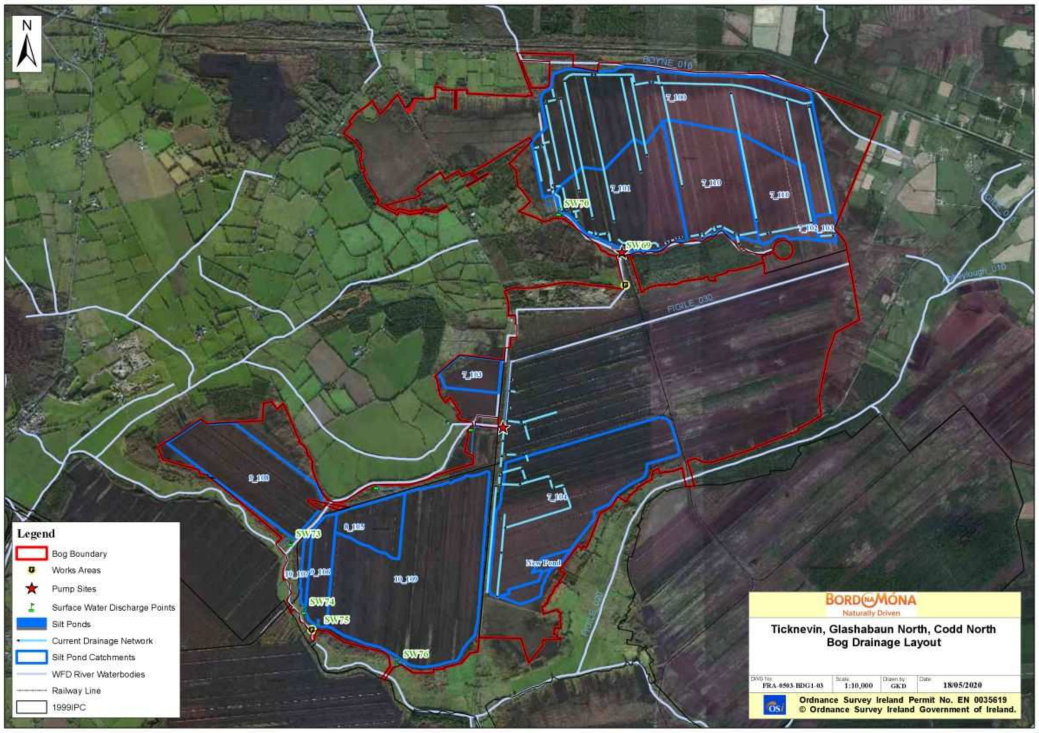


Figure 5.9.2 Ticknevin/Glashabaun North/Codd North Layout

From the records available it appears that Ticknevin, Glashabaun North and Codd North were first drained in 1976, 1983 and 1946 respectively with peat production beginning within a couple of years in the case of Glashabaun North and Codd North but not until 2000 in the case of Ticknevin. These bogs have been used in recent years to supply milled fuel peat and horticultural sod moss.

The land use surrounding the bog is comprised of peat harvesting on surrounding bogs, forestry and agriculture. Edenderry Power Station is located to the west of the bogs, along with a gravel pit along the R401.

There is active peat production in the majority of Ticknevin in the north and Codd North to the west, whereas there is only limited amount of production footprint in Glashabaun North bog in the south. Areas not in active production are either cutover or cutaway and in a state of re-vegetation. There are some edge habitats present around the periphery of the bog. These edge habitats are typically remnant sections of raised bog and cutaway bog.

The site is accessed from the R401 at a number of locations, with access to bogs on both sides of this road. A main entrance is present as the R401 passes through Ticknevin bog, which gives access to this bog and to a works compound situated in a strip of land between Ticknevin bog and Glashabaun North bog. This works includes basic welfare facilities for operatives as well as parking and is at a general ground level of 75.60mOD. Finished floor levels range from 75.679mOD to 77.108mOD. Rail infrastructure links these three bogs to each other and to Edenderry Power to the west. Levels over the three bogs vary generally from higher areas in Ticknevin in the north to low areas in Glashabaun North and Codd North. Ticknevin bog is relatively flat with water draining to the southern end of the site at approx. 72.50mOD. Both Glashabaun North and Codd North bogs fall from east to west by approximately 5m to low levels of approx. 69.0mOD.

In Ticknevin, surface water is drained through three surface water outfalls (SW68, 69 and 70) at the southern end of the bog which discharge into the Figile_030 watercourse which flows to the south and west of the bog. Glashabaun bog is served by one outfall on the western side of the bog, adjacent to the R401 (SW 71), which also discharges into the Figile_030 watercourse which drains to the west. Codd North bog is served by five outfalls (SW 72, 73, 74, 75 and 76 which discharge into the same watercourse.

There is a pump site at the southern end of Ticknevin bog (two pumps, total power 72kW, duty and assist operation) and a further pump site located immediately east of the R401 in Glashabaun North bog (two pumps, total power 42kW, duty and assist operation)

Photo 5.9.1 - Pump Site, Ticknevin

Photo 5.9.2 - Pump Site, Glashabaun North

5.9.4 **Regional Hydrology**

The catchment area and water courses are shown in the figures presented here.

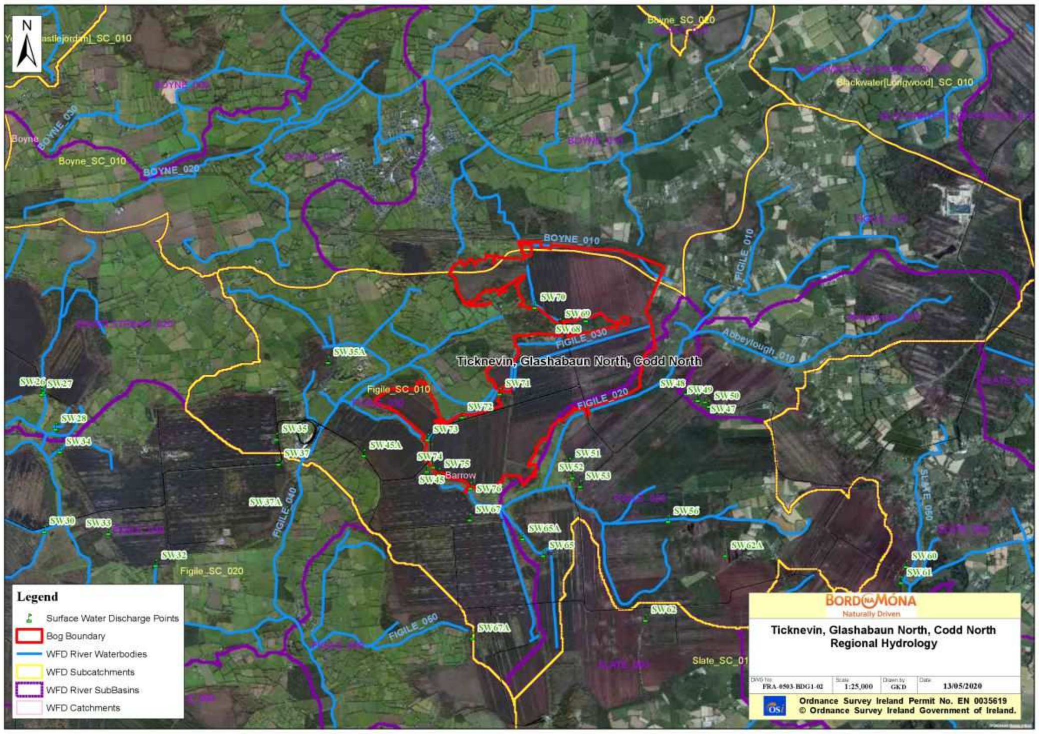


Figure 5.9.3 Ticknevin/Glashabaun North/Codd North Regional Hydrology

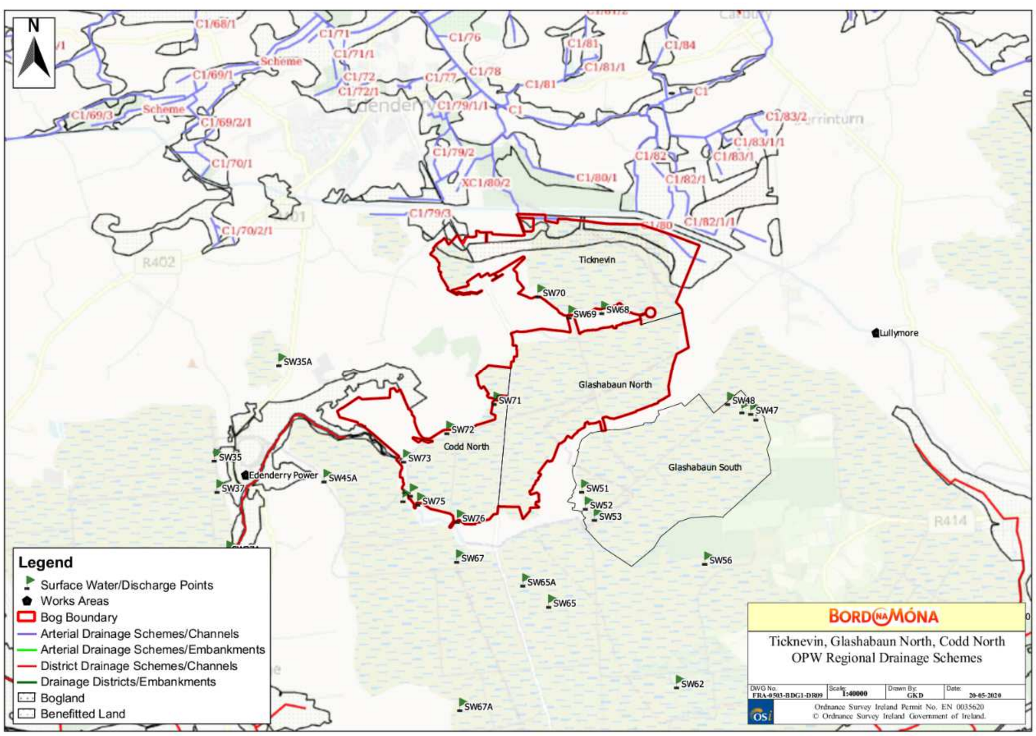


Figure 5.9.4 Ticknevin/Glashabaun North/Codd North District Drainage Schemes

All three of these bogs are within the Barrow 14 catchment. The Barrow 14 catchment drains a total area of 3,015km^2. The Barrow catchment is underlain in its flat northern area by limestones of varying purity which continue down the western side of the catchment and sustain good groundwater resources in places. On the eastern side of the catchment, granites dominate, culminating in the summits of the Blackstairs Mountains.

All outfalls discharge into the tributaries of the Figile River, classified by the Water Framework Directive as the Figile_030. The Figile River itself flows to the south and into the River Barrow at Monasterevin, circa 17km south of Codd North. All outfalls in these bogs are within the Figile_030 WFD Sub-basin and the Figile_SC_010 WFD Sub-catchment.

The Arterial Drainage and District Drainage schemes near Ticknevin bog, Glashabaun North bog and Codd North bog is shown in figures presented here. The benefitted land from the Drainage District Schemes is also highlighted demonstrating that there is limited benefitting lands associated with this scheme in the area of these bogs.

The Standard Annual Average Rainfall (SAAR) in this location is 869 to 880mm.

5.9.5 Historical Flooding

A map of historical flooding is shown in the Figure.

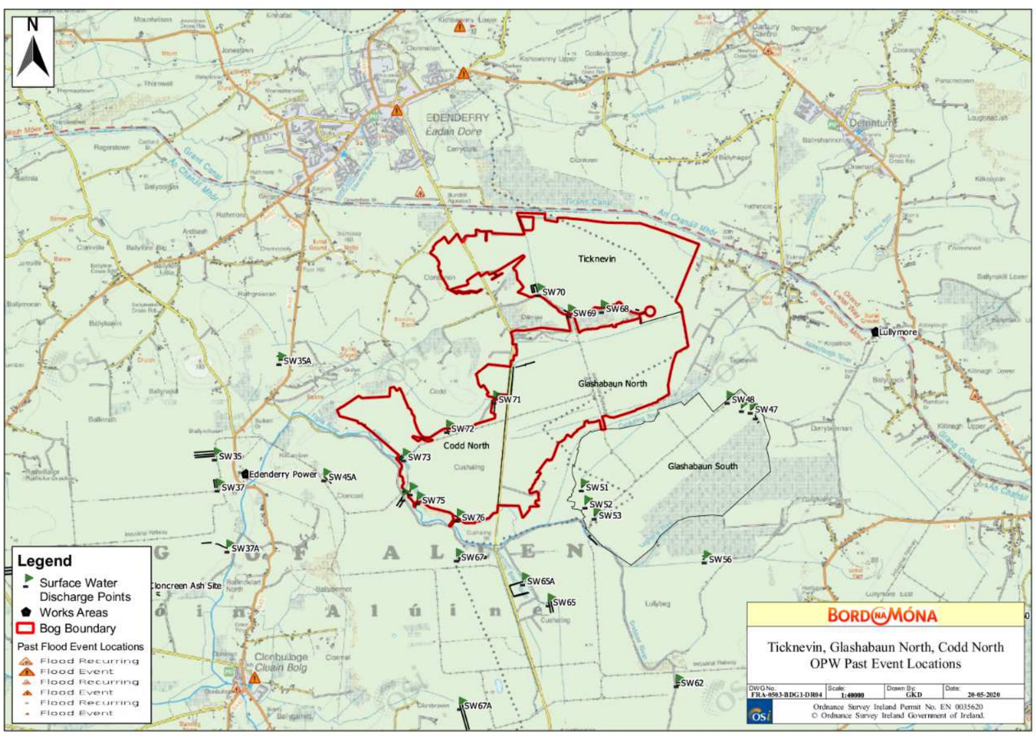


Figure 5.9.5 Ticknevin/Glashabaun North/Codd North Historical Flooding

Ticknevin bog and Glashabaun North bogs are known to flood based on local knowledge, with flooding experienced in Codd North to a lesser extent. The source of this flooding is where pumps fail to operate and surface water generated over the catchments floods the low-laying areas around the pump sites. Also, it is accepted that local surface water flooding can occur where blockages to the existing drainage network occur over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production fields on an annual basis as part of the winter works schedule. From local knowledge and available records, the works area at the southern end of Ticknevin bog has not experienced any surface water flooding within the footprint of this area.

Historical flood records are taken from the OPW website, https://www.floodinfo.ie. There are records of surface water flooding at Edenderry to the north and Clonbullogue circa 4km southwest of these bogs. The closest record of flooding was recorded in 2005 at Edenderry, the Blundell Aquaduct on the R401, which is noted to be low-laying lands. This location is close to the site, circa 600m from the northern boundary of Ticknevin bog.

Historical OSI 25" mapping was also examined for this area. There is no additional record of flooding to be taken from these maps for these bogs.

5.9.6 Groundwater Flood Risk

A map of aquifers, karst features and known wells is shown in the Figure.

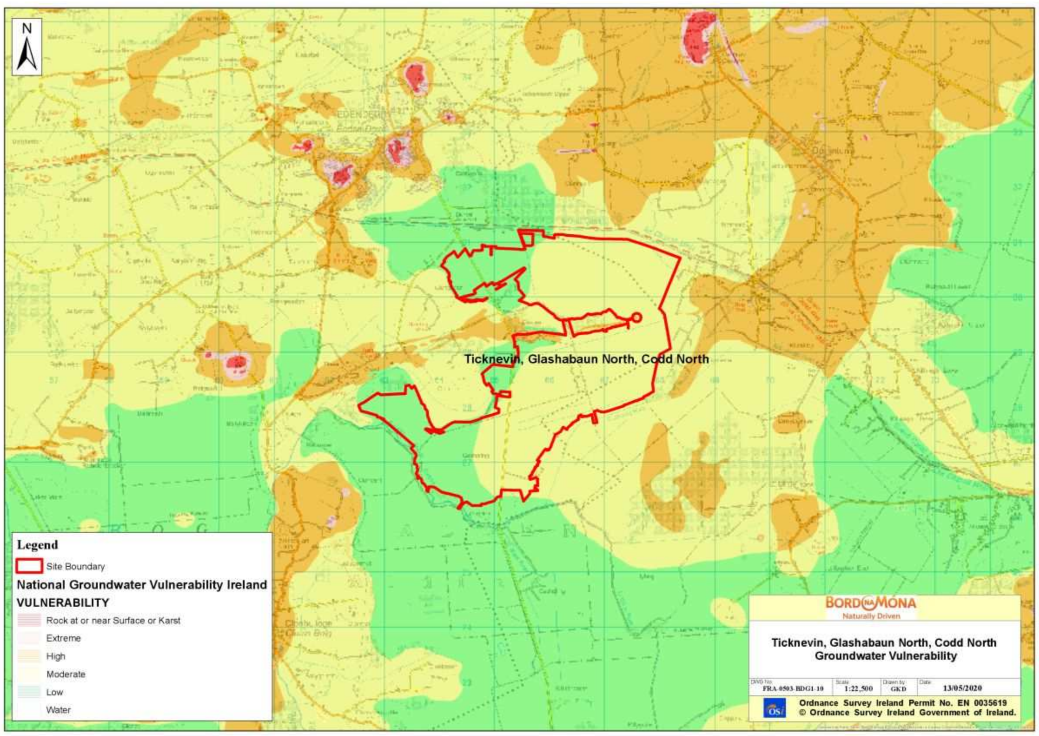


Figure 5.9.6 Ticknevin/Glashabaun North/Codd North Groundwater Vulnerability

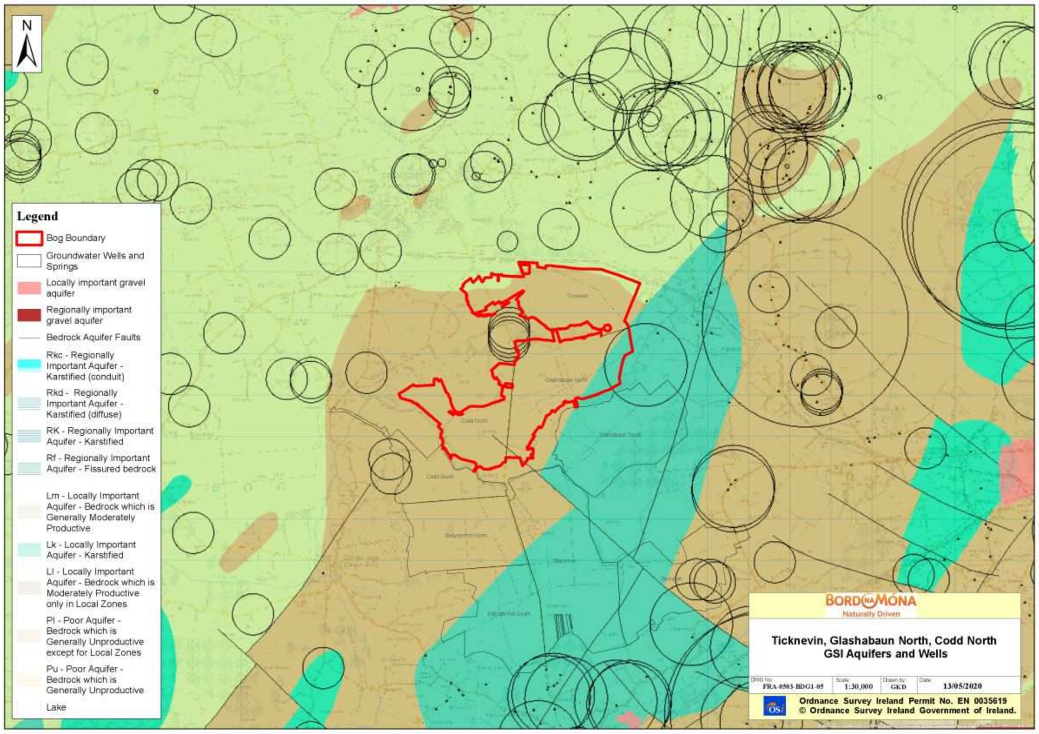


Figure 5.9.7 Ticknevin/Glashabaun North/Codd North Aquifers, Karst Features, Wells

The majority of the area is underlain by an aquifer which is known as a *Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll).* A small portion of Glashabaun North is underlain by an aquifer which is known as a *Regionally Important Aquifer - Karstified (diffuse) (Rkd).*

Groundwater vulnerability rating for western parts of Ticknevin and the majority of Codd North is given as Low with all other areas given as Moderate.

There are records of a number of boreholes along the R401 between Ticknevin and Glashabaun North associated with the Offaly Board of Health and dated 1940. There is also a record of a borehole immediately west of Glashabaun North. There is no record of any karst features in the area.

There are no Bord na Móna records or local anecdotal evidence to suggest groundwater flooding has ever occurred at this bog.

5.9.7 **Fluvial Flood Risk**

CFRAM flood mapping is shown in the Figure below.

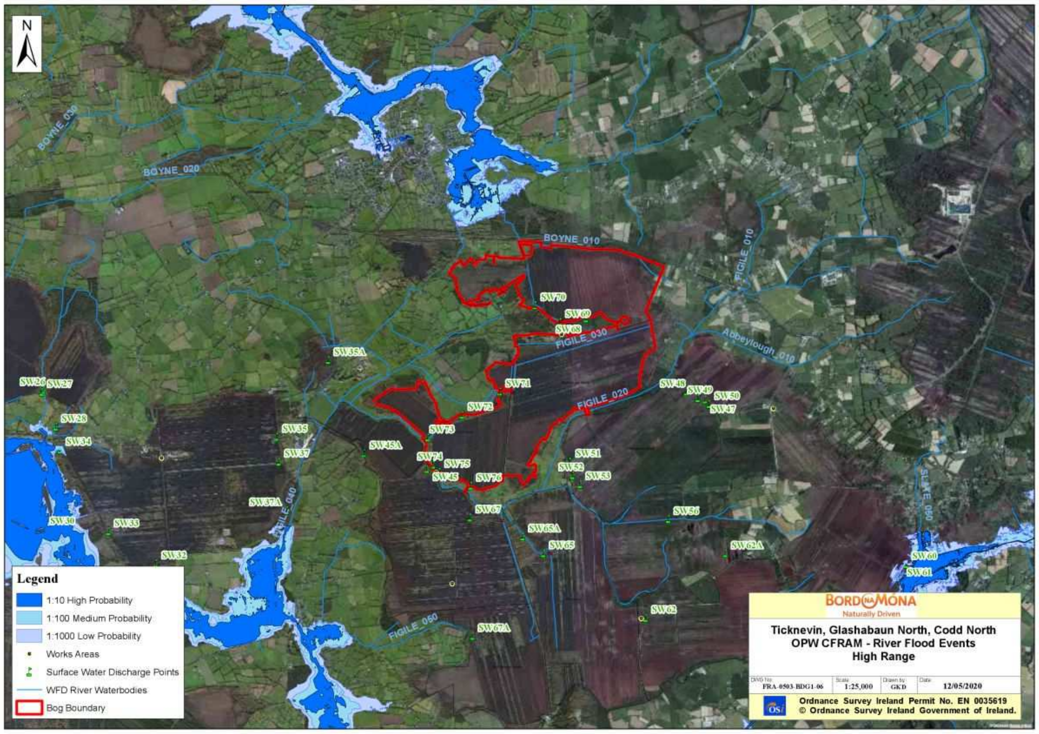


Figure 5.9.8 Ticknevin/Glashabaun North/Codd North CFRAM Flood Mapping

The rivers and streams in the vicinity of this group of bogs are described in terms of regional hydrology in section 5.9.4.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with the 'High-End Future Scenario extents' (generated taking in the potential effects of climate change using an increase in rainfall of 30% and sea level rise of 1,000 mm (40 inches))

Flooding is identified in the Figile River, approximately 3 km downstream of the site. There is no flooding identified further upstream of this location. There is no risk of flooding identified within any of these bogs.

There are no Bord na Móna records or local anecdotal evidence to suggest fluvial flooding has ever occurred at this bog. In such an event, outfalls would become submerged if water levels in receiving water were to rise. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

Any such flow into the bog would be limited to the capacity of the outfall pipe. Pipe sizes at outfalls are given in the table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW68	0.600
SW69	0.600

SW70	0.600
SW71	0.600
SW72	0.600
SW73	0.600
SW74	0.600
SW75	0.600
SW76	0.600

Table 5.9.1 - Ticknevin/Glashabaun North/Codd North Surface Water Outfalls

It is noted that the limited pipe diameter will also restrict run-off rates from the bog to the receiving waters.

5.9.8 Pluvial Flood Risk

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100 year and 1000 year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices.

Figure 5.9.9 Ticknevin/Glashabaun North/Codd North Pluvial Flooding, Rainfall Events

Flooding modelling carried out for this group of bogs is presented here. The basins used in the model are the extent of the catchments that discharge through the surface water discharge points in the bog. Ticknevin, Glashabuan North and Codd North Bogs are modelled for the following basins:

Ticknevin Bog: Three basins - 7_110&7_102_103, 7_101, 7_100;
Glashabaun North: One basin – GBN-20_04
Codd North: 8_105, 9_108, 9_106&10_107, 10_109

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

From the modelling, it can be seen that surface water flooding is predicted in the northern and southern parts of Ticknevin bog, with a maximum predicted flood level of 73.05mOD in the south and 74.78mOD in the north. In Glashabaun North, flooding is predicted on the western side of the site, with a maximum predicted flood level of 68.88mOD. Codd North is predicted to flood in the western and southern end of the bog to a maximum level of 70.88mOD. Flood predictions for these bogs are broadly in line with local experience.

Catchments are separated within the bog by topographical features such as ridges in surface levels and locally elevated rail lines and local elevated peat fields.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Ticknevin				**Glashabaun Nth**		**Codd Nth**				
Level	**7_100**	**7_101**	**7_110 & 7_102_103**	**Level**	**GBN-20_04**	**Level**	**8_105**	**9_108**	**10_107 and 9_106**	**10_109**
mOD	***m³***	***m³***	***m³***	***mOD***	***m³***	***mOD***	***m³***	***m³***	***m³***	***m³***
70	0	0	0	65	0	66.00	0	0	0	0
70.25	0	0	0	65.25	0	66.25	0	0	0	0
70.5	0	0	0	65.5	0	66.50	0	0	9	0
70.75	1	9	0	65.75	1	66.75	0	0	28	2
71	23	60	0	66	29	67.00	0	1	77	34
71.25	202	249	0	66.25	148	67.25	0	12	288	188
71.5	1553	852	0	66.5	511	67.50	0	83	832	1022
71.75	8390	2570	1	66.75	1599	67.75	0	360	1919	3736
72	25116	6041	8	67	4403	68.00	0	1225	3980	10152
72.25	51757	12267	43	67.25	11111	68.25	0	3992	7626	22000
72.5	88571	22641	151	67.5	25682	68.50	0	10282	13236	39732
72.75	137427	39842	442	67.75	54605	68.75	0	21044	20993	63284
73	200996	66978	1321	68	103209	69.00	0	38013		93651
73.25		104318	3754	68.25	173756	69.25	0	63685		132089
73.5			9013	68.5	268415	69.50	2			180865
73.75			17423	68.75	387580	69.75	14			
74			29067	69	531829	70.00	50			

Table 5.9.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within these bogs and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

Ticknevin and Glashabaun North Bog both have pumps for pumping of surface water from low lying areas. These pumps have been dis-regarded for the flood modelling of the extreme rainfall events set out above as these pumps are not designed for such events. The pump site in Ticknevin has a 72kw capacity with an outfall level of 71.89 mOD and the pump in Glashabaun North is a 42KW pump with an outfall level of 69.58mOD.

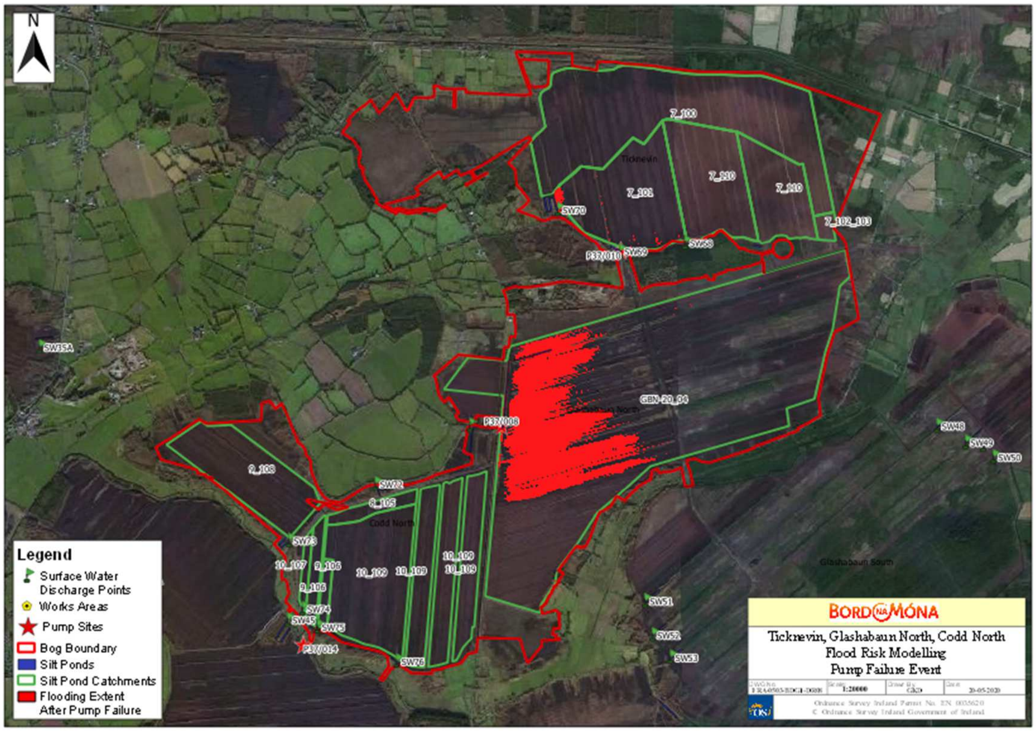


Figure 5.9.10 Ticknevin/Glashabaun North/Codd North Pluvial Flooding, Pump Failure

The pump in Ticknevin is located downstream of the silt ponds and discharges into Figile_030 watercourse. In the event that this pump fails, the surface water will pond in low lying areas on the bog to a level where it can discharge by gravity flow. The above figure models the flooding that will occur in the event that this pump is turned off or breaks down. The expected flood water level in this situation is plotted in red. The flooding caused by the failure of this pump will be retained within the bog peat production area. As the pump is located downstream of the silt pond, the water level will back up into the silt pond, however as the bank of the silt pond is higher than the outfall the silt pond will not over-top.

The existing compound located between Ticknevin bog and Glashabaun North bog and accessed from the R401 is at a ground level of 75.50mOD, which is above the maximum 1 in 1000 year flood level predicted for the southern end of Ticknevin (73.05mOD). It is also above the maximum flood level predicted in the event of pump failure (71.89mOD).

5.9.9 Climate Change

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 5.9.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100 year event (+ 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case the maximum rainfall for the 100 year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000-year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 5.9.7, the High-Emissions Future Scenario (HEFS) has been considered which takes in account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

5.9.10 Conclusions

The Flood Risk Assessment for these bogs identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area has occurred in Ticknevin and Glashabaun North where existing surface water pumps have failed to operate, as well as more locally where drains have become blocked internally.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. There is no record of this having occurred previously on this site. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelling also demonstrated that under worst case flooding conditions, the works compound at the southern end of Ticknevin bog is not at risk of pluvial flooding.

This Flood Risk Assessment indicates that the works area at the southern end of Ticknevin bog is not at risk of flooding from a 1000year event and therefore can be considered to be in a Low Risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in each of these bogs can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 5.9.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
    - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
    - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
    - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
    - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for these bogs, it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the works compound at the southern end of Ticknevin bog is located in an area of higher ground that is not at risk of flooding in a 1 in 1000year event and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in these bogs is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

5.10 Glashabaun South/Blackriver/Barnaran

5.10.1 **Introduction**

Glashabaun South, Blackriver and Barnaran bogs are part of the Bord na Móna Derrygreenagh Bog Group which operates under an Integrated Pollution Control licence (ref P0501-01). Each of these three bogs are supply bogs for the nearby Edenderry Power Station. Glashabaun South bog also supplies horticultural sod moss peat. The total area of the bogs is 1819 Ha, with 561 Ha in Glashabaun South, 766 Ha in Blackriver and 492 Ha in Barnaran.

5.10.2 **Site Location**

The Glashabaun South/Blackriver/Barnaran site location is highlighted in red in the Figure below.

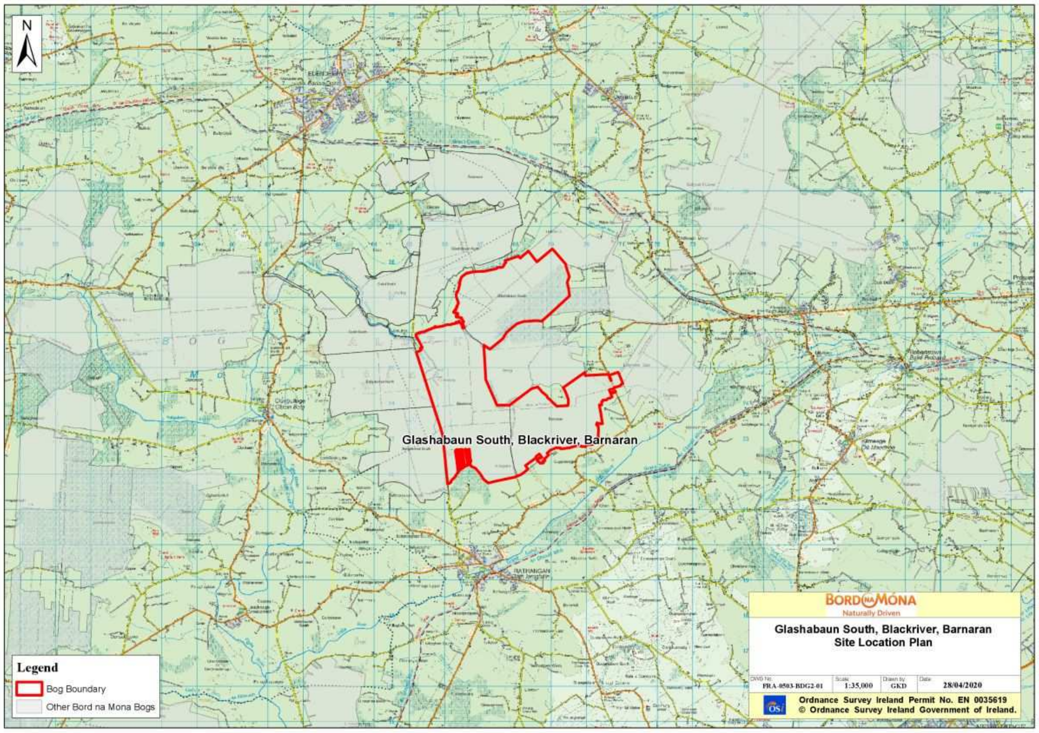


Figure 5.10.1 Glashabaun South/Blackriver/Barnaran Site Location

Bogs including Glashabaun South, Blackriver and Barnaran are located primarily in Co. Kildare. The town of Edenderry is located circa 6km to the north, whilst Rathangan is located circa 2.5km to the south. The L3001 Edenderry to Rathangan road borders the western side of these bogs. Edenderry Power Station is located approximately 4km west of the L3001. Lullymore Heritage and Discovery Park is located within a mineral island, surrounded by Bord na Móna bogs, immediately northeast of Barnaran bog.

5.10.3 **Bog Description**

The bog layout is shown in the Figure.

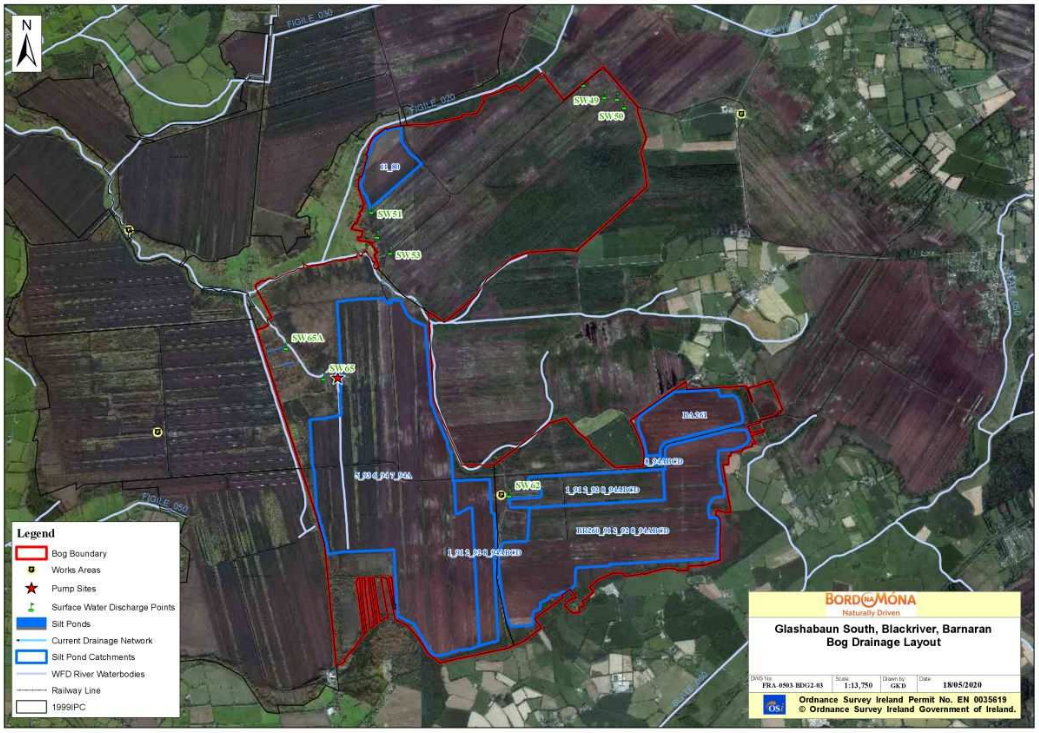


Figure 5.10.2 Glashabaun South/Blackriver/Barnaran Layout

From the records available, it appears that Blackriver and Glashabaun South were first drained for development in 1946 and had commenced peat production in 1951, whereas Barnaran bog was not developed until 1951, with first production a number of years later in 1955.

The land use surrounding the bog is comprised of peat harvesting on surrounding bogs, forestry and agriculture. There is active peat production only in local parts of this overall group of bogs, including in a small area in the north of Glashabaun South and in the southern end of Blackriver and Barnaran bogs. Areas not in active production are either cutover or cutaway and in a state of re-vegetation. There is also a significant area of Coillte forestry towards the southern end of Glashabaun South. There are some edge habitats present around the periphery of the bog. These edge habitats are typically remnant sections of raised bog and cutaway bog.

Blackriver and Barnaran bogs are both accessed from the south, via a local access road directly off the R414. This local access road also provides access to a welfare centre (basic welfare facilities and car parking) which serves these two bog areas. Finished floor levels range from 71.026mOD to 71.651mOD. There are also a number of access points into Blackriver bog directly off the L3001 to gain access to silt ponds. Glashabaun South can be accessed via a local access road off the L3001. This road is actually a continuation of the road which provides access to the aforementioned welfare centre. This is an unpaved gravel track for the most part. Rail infrastructure links these three bogs to each other and to Edenderry Power to the west.

Levels over the three bogs vary generally from higher areas in east and a low area in the centre of Blackriver. Levels in the east parts of Barnaran and Glashabaun South are of the order of 74m OD, while lower levels in the centre of Blackriver are approximately 66m OD. The welfare centre at Blackriver is at a level of circa 71.2mOD.

In Glashabaun South, surface water is discharged via seven outfalls (SW 47, 48, 49, 50, 51, 52 and 53), with SW 47, 48, 49 and 50 in the northeast all of which discharge into the Figile_020 watercourse. Blackriver bog is drained via two outfalls (SW 65 and 65A) which discharge into the Lullybeg 14 watercourse which flows north into the Figile River (Figile_020).

Barnaran Bog drains into outfall SW 62 at the northwestern corner of this bog, which drains also discharges into the Figile_020 watercourse. An additional discharge point SW62A at the north east of the site also discharges into the Figile_020 watercourse.

There is a pump site in Blackriver bog, upstream of outfalls SW 65 and 65A. This pump site includes two submersible pumps with a total capacity of 49kW, which operate on a duty and assist basis.

5.10.4 **Regional Hydrology**

The catchment area and water courses are shown in figures presented here.

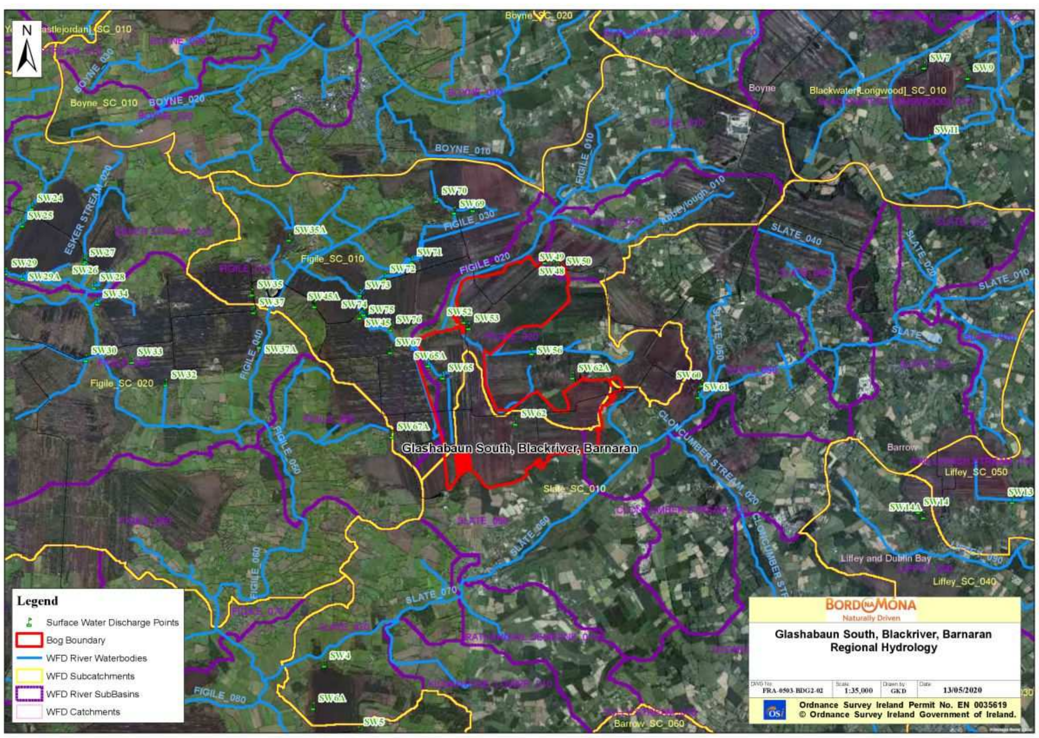


Figure 5.10.3 Glashabaun South/Blackriver/Barnaran Regional Hydrology

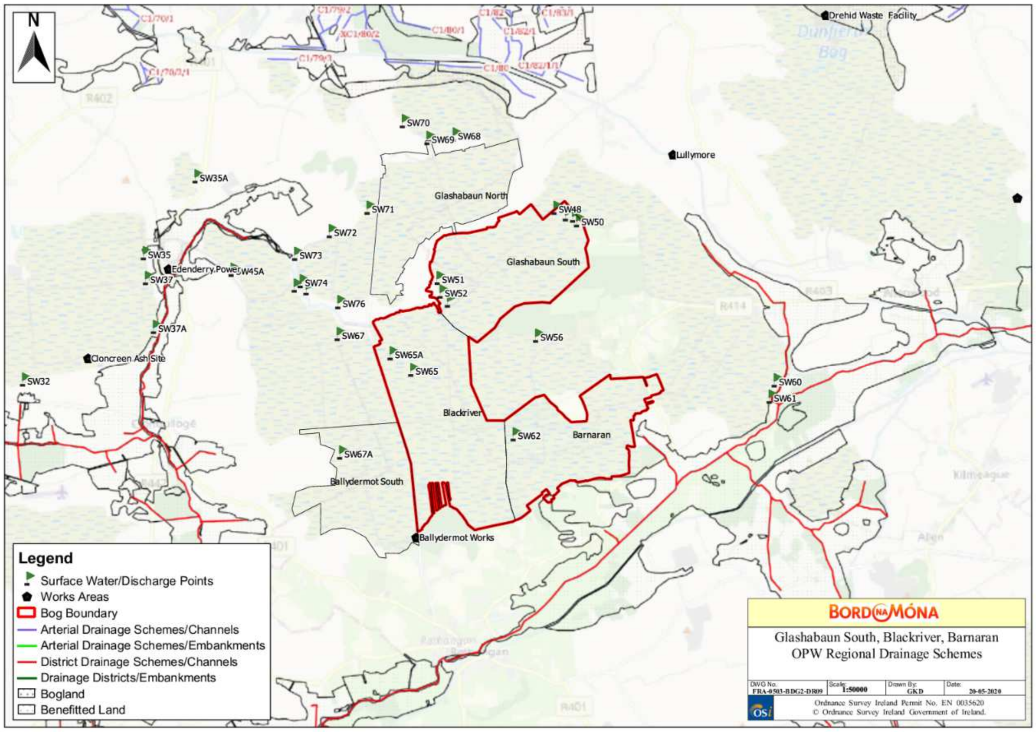


Figure 5.10.4 Glashabaun South/Blackriver/Barnaran District Drainage Schemes

All three of these bogs are within the Barrow 14 catchment. The Barrow 14 catchment drains a total area of 3,015km^2. The Barrow catchment is underlain in its flat northern area by limestones of varying purity which continue down the western side of the catchment and sustain good groundwater resources in places. On the eastern side of the catchment, granites dominate, culminating in the summits of the Blackstairs Mountains.

Surface water discharges from these group of bogs flows northwards from each bog into small watercourses, all classified as WFD Figile_020, then into the Figile River, which flows in a westward direction towards Edenderry Power. The Figile River itself flows to the south and into the River Barrow at Monasterevin, circa 17km south of Codd North. Although not serving to drain any part of these bogs, the Slate River is in close proximity to Barnaran bog, and is circa 1km to the south.

In Glashabaun South, all outfalls are all within the WFD Figile_SC_10 sub-catchment, with the northern outfalls within WFD Abbeylough_10 sub-basin and the southern outfalls within the WFD Figile_020 sub-basin. Both Blackriver outfalls as well as Barnaran outfall SW62A are within the Figile_20 sub-basin and Figile_SC_10 sub-catchment. Outfall SW62 from Barnaran is within the Slate_060 sub-basin and the Slate_SC_010 sub-catchment, however, due to the internal drainage network, this outfall discharges to the north towards the Figile_020 waterbody, rather than to the south as the WFD sub-basin/sub-catchment reference suggests.

The Arterial Drainage and District Drainage schemes near Glashabaun South, Blackriver and Barnaran bogs are shown in figures presented here. The benefitted land is also highlighted demonstrating that there is limited benefitting lands associated with this scheme in the area of these bogs.

The Standard Annual Average Rainfall (SAAR) in this location is 862 to 877mm.

5.10.5 **Historical Flooding**

A map of historical flooding is shown in the Figure.

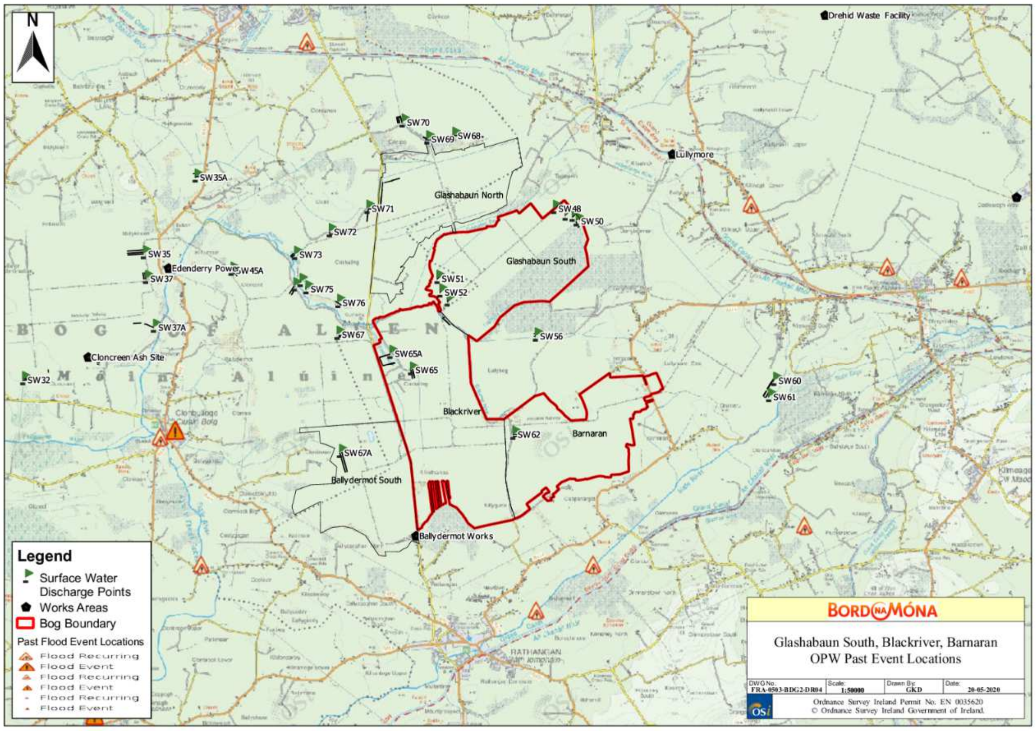


Figure 5.10.5 Glashabaun South/Blackriver/Barnaran Historical Flooding

Information from Bord na Móna operatives suggests that flooding has occurred at both Glashabaun South and Blackriver bogs in periods of prolonged rainfall whereby waters in receiving rivers have been raised above the level of outfalls. Blackriver bog is dependent on a pump site in the north of the bog to prevent surface water flooding in normal operating conditions and it is accepted that local flooding will occur here if pumps fail to operate. Barnaran bog is not known locally to have flooded in the past. Also, it is accepted that local surface water flooding can occur where blockages to the existing drainage network occur over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production fields on an annual basis as part of the winter works schedule.

Historical flood records are taken from the OPW website, https://www.floodinfo.ie. There are records of surface water flooding at Edenderry to the north and Clonbullogue circa 5km west of these bogs. There are also records of flooding along the Slate River outside of Rathangan, circa 2.2km south of Barnaran bog. The closest record of flooding was recorded in 2005 at the Slate River, which is an area noted to flood regularly as it is in the flood plain of this river.

Historical OSI 25” mapping was also examined for this area. There is no additional record of flooding to be taken from these maps for these bogs. Local areas of water are evident in Barnaran bog.

5.10.6 **Groundwater Flood Risk**

A map of aquifers, karst features and known wells is shown in the Figure.

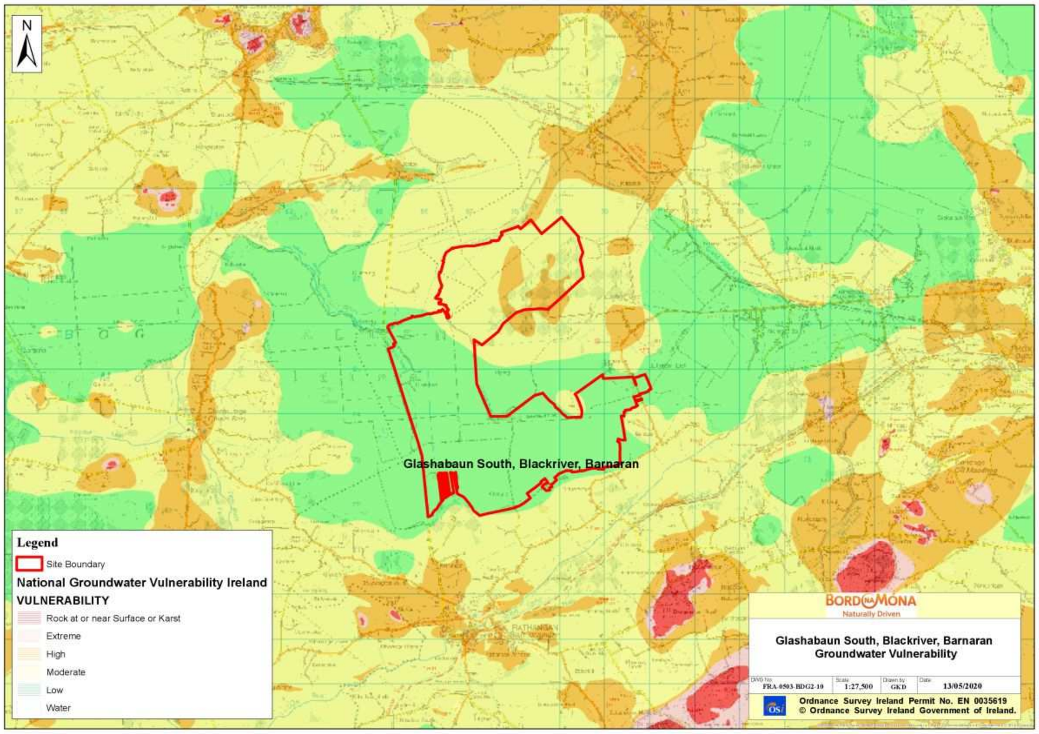


Figure 5.10.6 Glashabaun South/Blackriver/Barnaran Groundwater Vulnerability

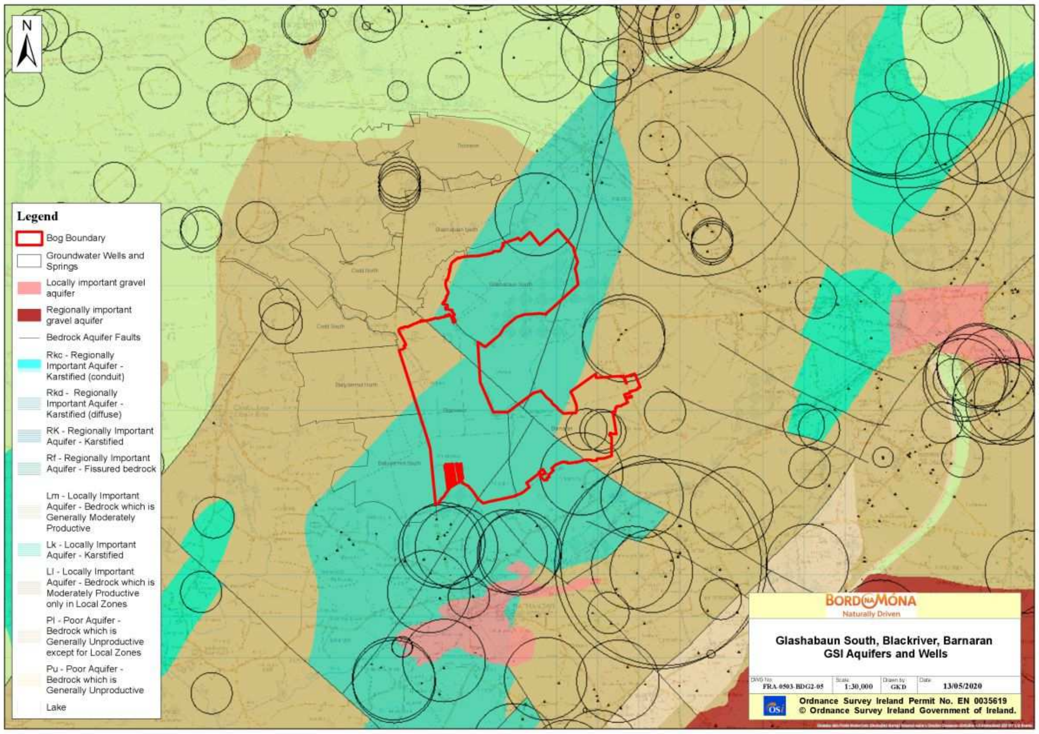


Figure 5.10.7 Glashabaun South/Blackriver/Barnaran Aquifers, Karst Features, Wells

The majority of the area is underlain by an aquifer which is known as a *Regionally Important Aquifer - Karstified (diffuse) (Rkd)*. In the east and west of the bogs, there are also areas which are underlain by an aquifer known as a *Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll)*. There are areas of Low, Moderate and High given to these bogs in terms of groundwater vulnerability. Both Blackriver and Barnaran are given a Low rating, with Glashabaun North split into Moderate and High areas.

There are records of a number of boreholes to the south and west of the bogs. A number of boreholes appear to be shown on the south-eastern corner of Barnaran bog although local knowledge and aerial photography suggests these areas are in active peat production. There is no record of any karst features in the area.

There are no Bord na Móna records or local anecdotal evidence to suggest groundwater flooding has occurred at this bog.

5.10.7 **Fluvial Flood Risk**

CFRAM flood mapping is shown in the Figure below.

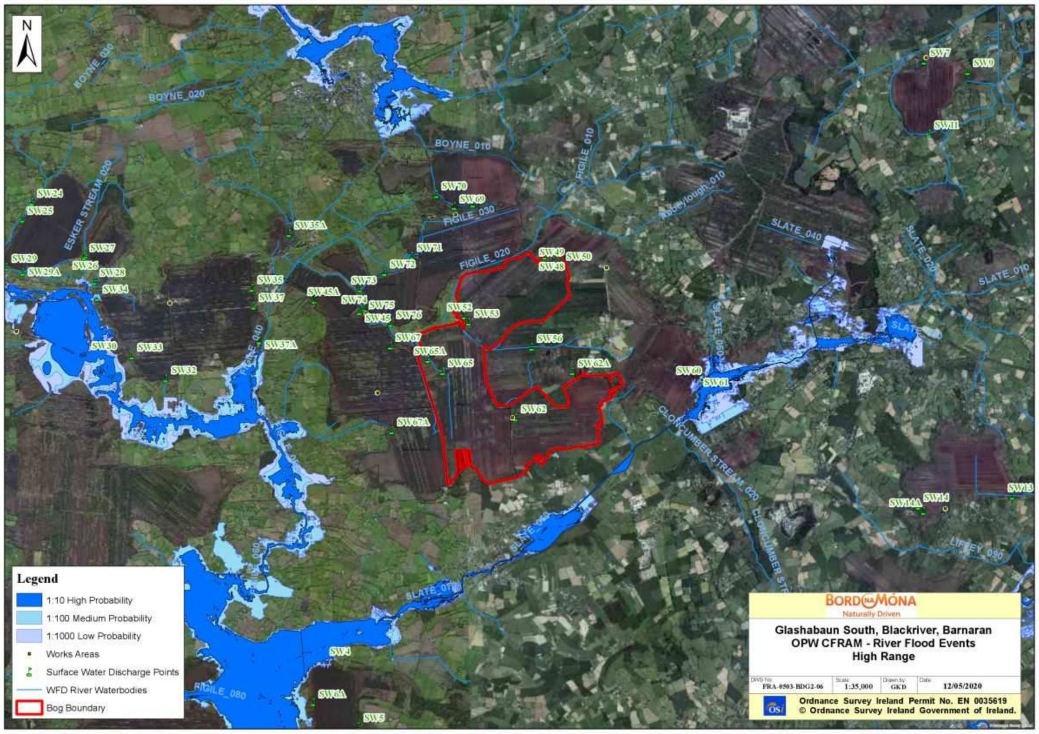


Figure 5.10.8 Glashabaun South/Blackriver/Barnaran CFRAM Flood Mapping

The rivers and streams in the vicinity of this group of bogs are described in terms of regional hydrology in section 5.10.4.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with the 'High-End Future Scenario extents' (generated taking in the potential effects of climate change using an increase in rainfall of 30% and sea level rise of 1,000 mm (40 inches))

Flooding is identified in the Figile River, approximately 4 km west and downstream of the site. There is no flooding identified further upstream of this location. Flooding is also identified along the Slate River, south of Barnaran, within 1km of the site boundary. There is no risk of flooding identified within any of these bogs.

Information from Bord na Móna operatives indicates that levels in receiving waters have risen above the outfall levels and caused water to back-up into the outfalls from the bog. In such an event, outfalls would become submerged if water levels in receiving water were to rise. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events. Any such flow into the bog would be limited to the capacity of the outfall pipe.

Surface Water Outfall ref:	Pipe Diameter (m)
SW47	0.60
SW48	0.60

SW49	0.60
SW50	0.60
SW51	0.60
SW52	0.60
SW53	0.60
SW62	0.60
SW62A	0.45
SW65	0.45
SW65A	0.45

Table 5.10.1 Glashabaun South/Blackriver/Barnaran Surface Water Outfalls

It is noted that the limited pipe diameter will also restrict run-off rates from the bog to the receiving waters.

5.10.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100 year and 1000 year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices.

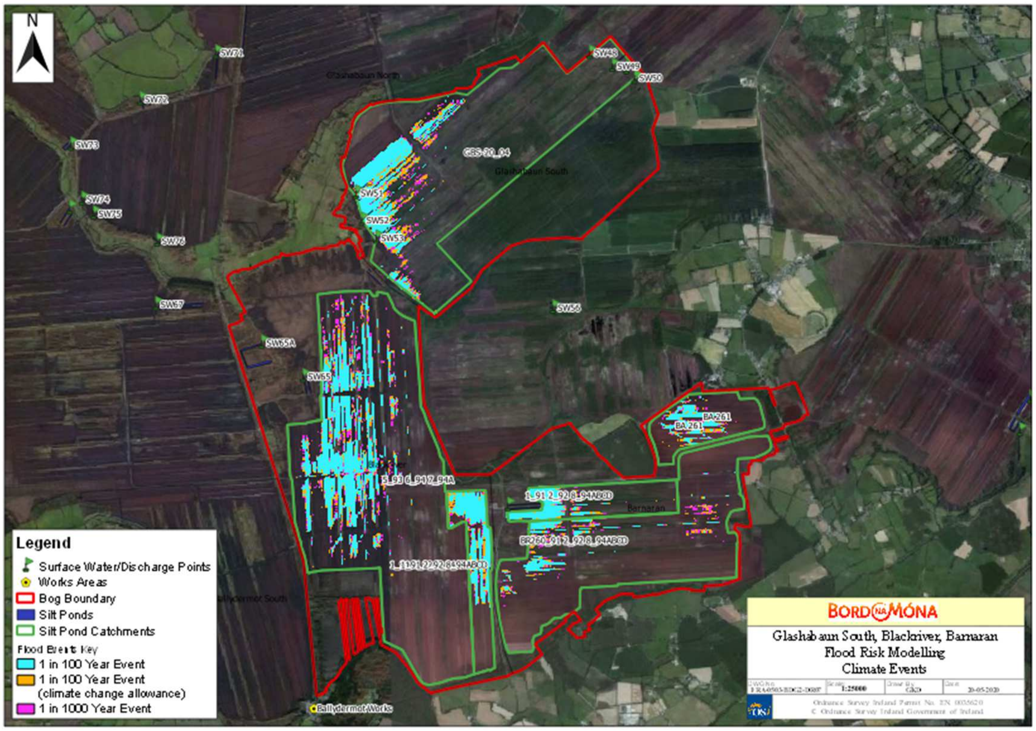


Figure 5.10.9 Glashabaun South/Blackriver/Barnaran Pluvial Flooding, Rainfall Events

Flooding modelling carried out for this group of bogs is presented here. The basins used in the model are the extent of the catchments that discharge through the surface water discharge points in the bog. Glashabaun South, Blackriver and Barnaran Bogs are modelled for the following basins:

Glashabaun South: One basin – GB-20_04;
Blackriver: One basin – 5_93&6_94&7_94A
Barnaran: Two basins BA261 and 1_91/2_92/8_94ABCD/BR260

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

Modelling has predicted flooded areas in southern parts of Glashabaun South bog, central and eastern parts of Blackriver bog and northern parts of Barnaran bog. This is in line with expectations for this grouping of bogs, where falls tend towards the overall centre of the grouping from high areas in the east. Under the 1 in 1000 year scenario, maximum predicted flood levels were 70.58mOD for Glashabaun South, 67.25mOD for Blackriver and 74.45mOD for Barnaran bog.

Catchments are separated within the bog by topographical features such as ridges in surface levels and locally elevated rail lines and local elevated peat fields.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Glashabaun South		**Blackriver**		**Barnaran**		
Level	***GBS-20_04***	**Level**	**5_93 6_94 7_94**	**Level**	**1_91 2_92 8_94ABCD**	**BA261**
mOD	***m^3***	***mOD***	***m^3***	***mOD***	***m^3***	***m^3***
67	0	64	0	69	0	0
67.25	7	64.25	16	69.25	0	0
67.5	76	64.5	238	69.5	42	0
67.75	308	64.75	873	69.75	317	0
68	766	65	1965	70	2843	0
68.25	1671	65.25	3692	70.25	11342	0
68.5	3384	65.5	6420	70.5	29796	0
68.75	6881	65.75	11367	70.75	63584	0
69	16242	66	21906	71	118471	0
69.25	36015	66.25	44444	71.25	199515	0
69.5	66300	66.5	90387	71.5	307730	0
69.75	108333	66.75	173623	71.75	452385	0
70	164838	67	306761	72		0
70.25	241293	67.25	504454	72.25		0
70.5	343902			72.5		0
70.75	477202			72.75		34
				73		214
				73.25		847
				73.5		2797
				73.75		7513
				74		16714
				74.25		32965
				74.5		59253
				74.75		97930

Table 5.10.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within these bogs and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

Blackriver bog has pumping of surface water from low lying areas. These pumps have been dis-regarded for the flood modelling of the extreme rainfall events set out above as these pumps are not designed for such events. The pump site has a 49kw capacity with an outfall level of 67.17 mOD.

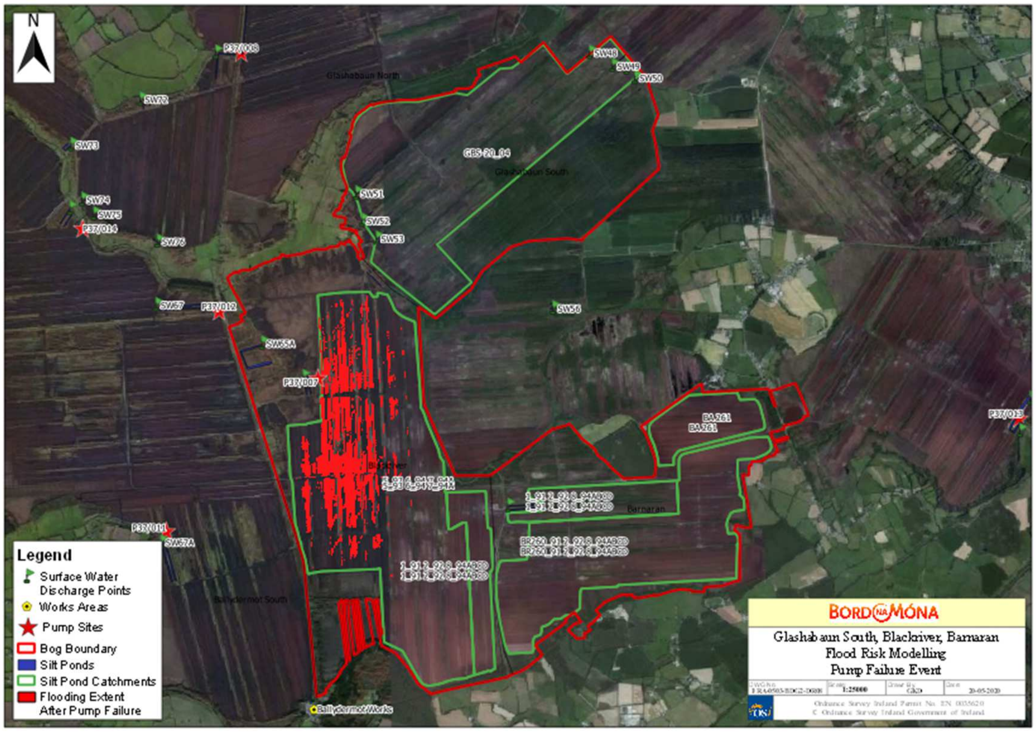


Figure 5.10.10 Glashabaun South/Blackriver/Barnaran Pluvial Flooding, Pump Failure

The pump in Blackriver is located upstream of the silt ponds and outfalls SW65 and SW65A which discharge into the Lullybeg 14 watercourse by gravity flow. In the event that this pump fails, the surface water will pond in low lying areas on the bog to a level where it can discharge by gravity flow. The above figure models the flooding that will occur in the event that this pump is turned off or breaks down. The expected flood water level in this situation is plotted in red. The flooding caused by the failure of this pump will be retained within the bog peat production area.

The maximum predicted flood level for Barnaran bog in the western basin for this bog, in the area of the welfare centre is 71.6mOD for a 1 in 1000 year event. For a 1 in 100 year event, the flood level is 71.3mOD. Both of these scenarios lead to water levels that are higher than finished floor levels around the welfare centre. This, coupled with the local topography, means that this centre is at risk of flooding under these circumstances.

5.10.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 5.10.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100 year event (+ 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case the maximum rainfall for the 100 year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000-year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 5.10.7, the High-Emissions Future Scenario (HEFS) has been considered which takes in account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

5.10.10 **Conclusions**

The Flood Risk Assessment for these bogs identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area has occurred in Blackriver where existing surface water pumps have failed to operate, as well as more locally where drains have become blocked internally.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. There is no record of this having occurred previously on this site. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. Modelling has predicted that flooding will occur at the welfare centre area located on the western side of Barnaran bog at a frequency of less than 1 in 100 years.

This Flood Risk Assessment indicates that the welfare centre at the southern end of Blackriver bog can be classified as Zone A as this area of the bog has a high probability of flooding. This development represents commercial and less vulnerable development and so will require justification in order to be located in flood zone A.

This Flood Risk Assessment indicates that the peat production fields and drains in each of these bogs can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 5.10.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test. A justification test is applied in the case of the welfare centre at Blackriver bog.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for these bogs, it is considered that peat production and the welfare centre area satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The existing welfare centre which would be classed as “less vulnerable development to flooding” is located within the predicted flood zone A on the Bog Site. This is acceptable given that it is an existing development without a history of flooding, it does not impact on flooding as a result of its presence in Flood zone A (through obstruction of flood pathway, loss of flood storage or obstruction of an access to a flood defence) and its flood risk is managed in that it is only in use during the peat production season of spring and summer which are outside of the critical flood period. The impact of flood risk is also managed in that there are no potential sources of contaminants including oils and fuels or vulnerable plant outside of the Spring/Summer peat production season.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in these bogs is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

5.11 Codd South/Ballydermot North/Ballydermot South

5.11.1 Introduction

Codd South, Ballydermot North and Ballydermot South bogs are part of the Bord na Móna Derrygreenagh Bog Group which operates under an Integrated Pollution Control licence (ref

P0501-01). Each of these three bogs are supply bogs for the nearby Edenderry Power Station as well as being supply bogs for horticulture sod moss peat. The total area of the bogs is 1142 Ha, with 256 Ha in Codd South, 452 Ha in Ballydermot North and 434 Ha in Ballydermot South.

5.11.2 **Site Location**

The Codd South/Ballydermot North/Ballydermot South site location is highlighted in red in the Figure below.

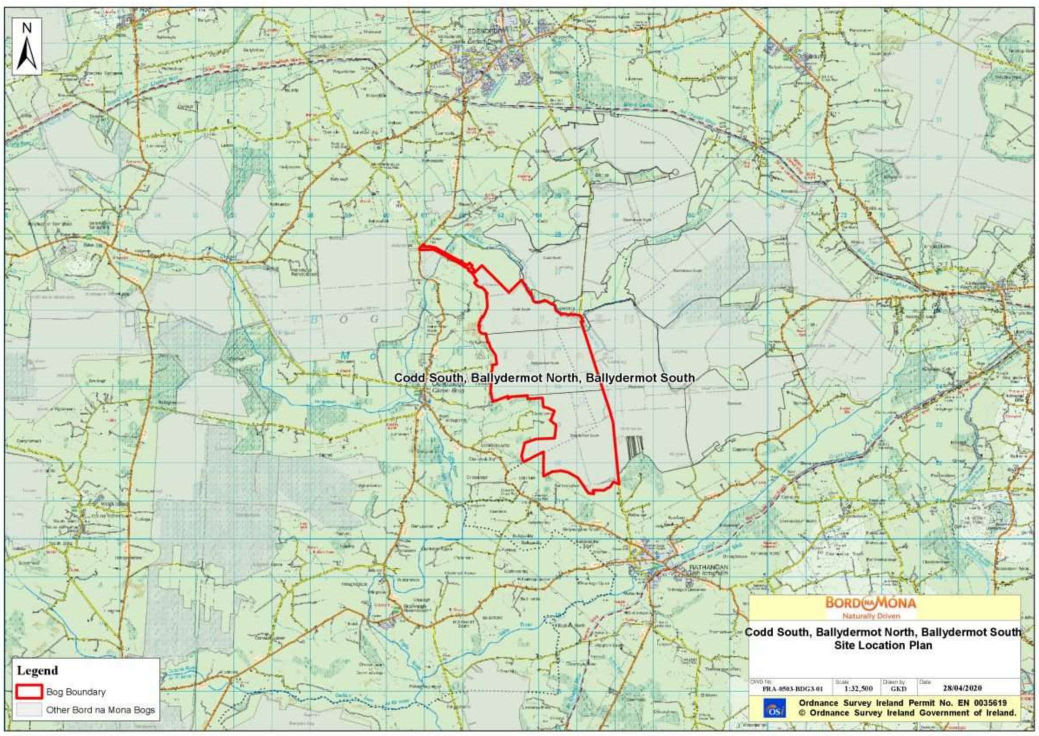


Figure 5.11.1 Codd South/Ballydermot North/Ballydermot South Site Location

Bogs including Codd South, Ballydermot North and Ballydermot South are located between counties Offaly and Kildare. The L3001 Edenderry to Rathangan road borders the eastern side of these bogs. Edenderry Power Station is located immediately west of Codd South.

5.11.3 **Bog Description**

The bog layout is shown in the Figure.

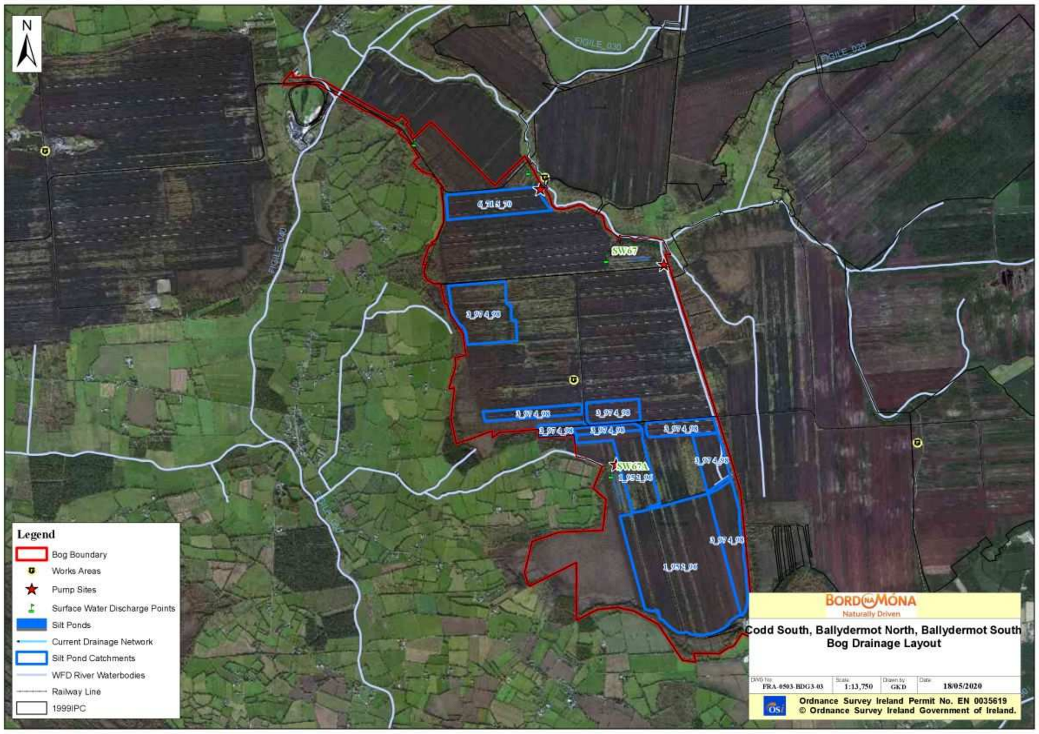


Figure 5.11.2 Codd South/Ballydermot North/Ballydermot South Layout

From the records available, it appears Ballydermot North and Ballydermot South were first drained for development in 1946 and had commenced peat production in 1950. Codd South bog was not developed until 1983, with first production a number of years later in 1989.

The land use surrounding the bog is comprised of peat harvesting on surrounding bogs, forestry and agriculture. There is active peat production only in local parts of this overall group of bogs, including in western areas within Codd South and Ballydermot North and across the southern half of Ballydermot South. Areas not in active production are either cutover or cutaway and in a state of re-vegetation. There are some edge habitats present around the periphery of the bog. These edge habitats are typically remnant sections of raised bog and cutaway bog.

These three bogs are accessed locally by way of a number of tracks off the L3001, however the primary access point for the group is at the southern end, at the main Ballydermot Works site compound. There is also an unpaved track connecting Codd South to the area to the rear of the Edenderry Power Station. Rail infrastructure links these three bogs to each other and to Edenderry Power to the west. Levels over the three bogs vary generally from higher areas in north, west and south and a low area in the centre of the eastern boundary of the site. Levels in the west are of the order of 72.0mOD falling to 62.0mOD in low areas. Areas of remnant bog in the west are at elevations in excess of 75.0mOD.

The level of the works compound at the southern end of Ballydermot South is typically 73.30mOD, with finished floor levels ranging from 73.50mOD to 73.85mOD. This works compound includes welfare facilities, a workshop, offices, car park, yard areas and a security compound for mobile plant. There is also a small welfare centre located in the centre of Ballydermot North bog, accessed off the L3001, with finished floor levels ranging from 75.756mOD to 76.137mOD.

This group of bogs is served by four separate outfalls, with three in Codd South (SW 45, 45A and 67), and one in Ballydermot South (SW 67A). Water discharged from the first three outfalls flow northwards into the Figile River (Figile_030) north of the bogs. Outfall 67A discharges into the Ballygarrett 14 (Figile_050) watercourse which drains into the Figile River to the west of Ballydermot South, immediately south of Clonbullogue.

There are three pump sites serving these three bogs, two in the north which serve Codd South and Ballydermot North and the third in the southwest, serving Ballydermot South. In Codd North, the pump site includes two screw-type pumps with a total combined power of 30kW. In Ballydermot North, the pump site consists of three no. submersible pumps which have a total combined power of 71kW. The southern pump site at Ballydermot South consists of two submersible pumps with a total combined power of 37kW. These pump sites operate on a duty and assist basis.

5.11.4 **Regional Hydrology**

The catchment area and water courses are shown in figures presented here.

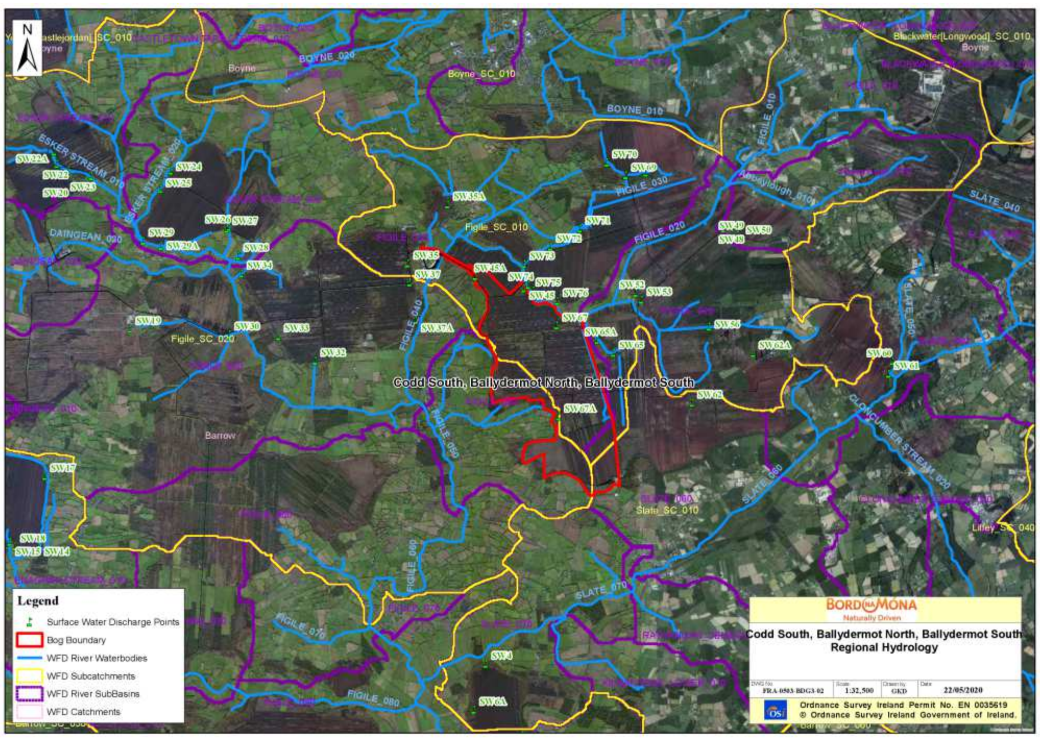


Figure 5.11.3 Codd South/Ballydermot North/Ballydermot South Regional Hydrology

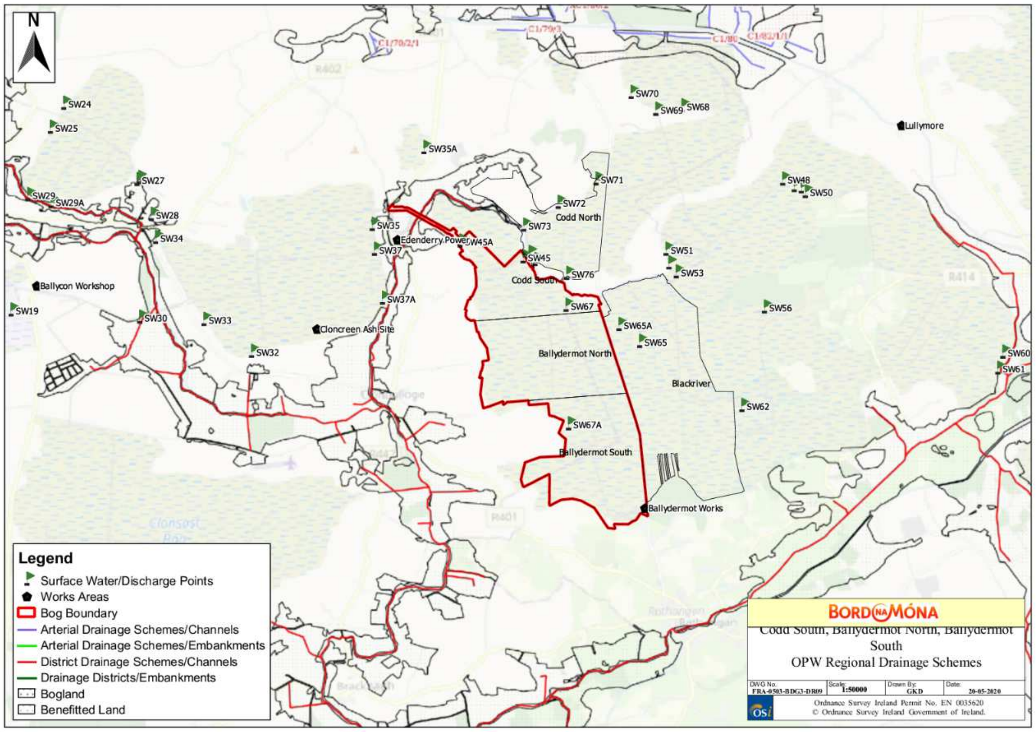


Figure 5.11.4 Codd South/Ballydermot North/Ballydermot South District Drainage Schemes

All three of these bogs are within the Barrow 14 catchment. The Barrow 14 catchment drains a total area of 3,015km^2. The Barrow catchment is underlain in its flat northern area by limestones of varying purity which continue down the western side of the catchment and sustain good groundwater resources in places. On the eastern side of the catchment, granites dominate, culminating in the summits of the Blackstairs Mountains.

Surface water discharged from the three outfalls in the north flows into the Figile River (Figile_030). In the case of SW 45 and 67 there is a direct discharge into the Figile River, whereas in the case of SW 45A the connection to the Figile is via an unnamed channel. Discharge from SW 67A in Ballydermot South enters the Ballygarrett watercourse (Figile_050) and flows westward before entering the River Figile immediately south of Clonbullogue village to the west. The Figile River itself flows in a north south direction to the west of these bogs and into the River Barrow at Monasterevin, circa 12km south of Ballydermot South. Although not serving to drain any part of these bogs, the Slate River is in close proximity to Ballydermot South and flows through Rathangan, circa 2.5km south of the bog. Outfalls SW45, SW45A and SW67 lie within the WFD Sub-basin Figile_030 and sub-catchment Figile_SC_010. Outfall 67A lies within WFD Sub-basin Figile_050 and sub-catchment Figile_SC_020.

The Arterial Drainage and District Drainage schemes near Codd South, Ballydermot North and Ballydermot South bogs is shown in figures presented here. The benefitted land is also highlighted demonstrating that there is some limited benefitting lands associated with this scheme in the area of these bogs.

The Standard Annual Average Rainfall (SAAR) in this location is 862 to 869mm.

5.11.5 **Historical Flooding**

A map of historical flooding is shown in the Figure.

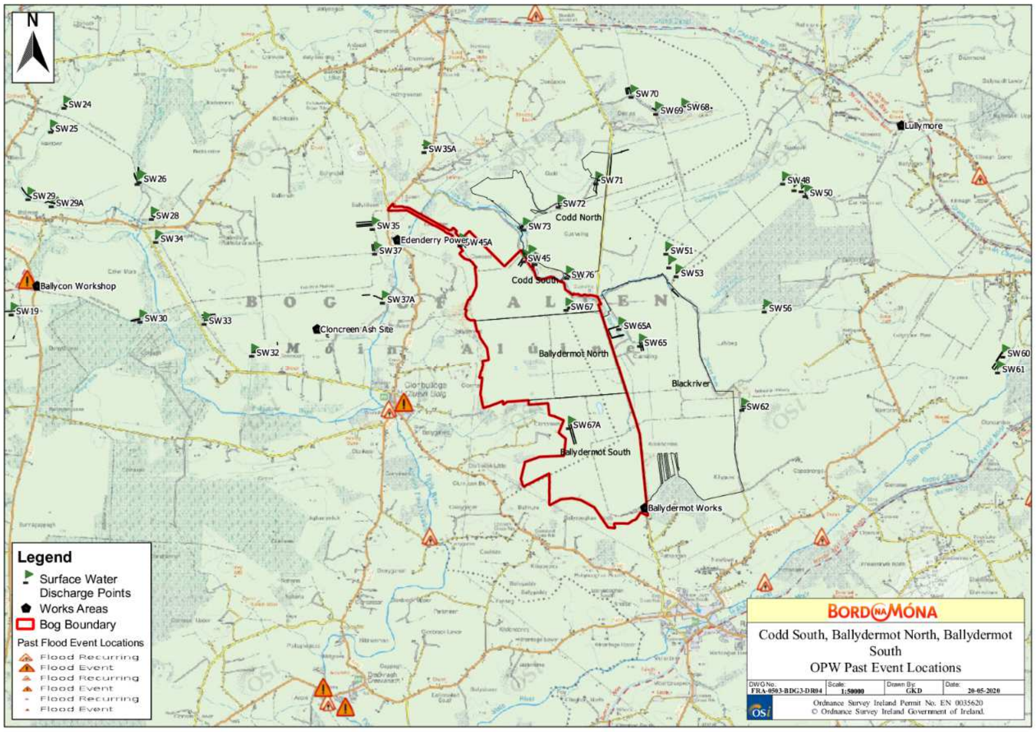


Figure 5.11.5 Codd South/Ballydermot North/Ballydermot South Historical Flooding

Information from Bord na Móna operatives suggests that flooding has occurred at both Codd South and Ballydermot North bogs in periods of prolonged rainfall whereby waters in receiving rivers have been raised above the level of the outfalls. There are no reports of this sort of regular flooding at the outfall on the western side of Ballydermot South bog. Given the presence of pumps at three locations, it is accepted that there is a risk of surface water flooding in these areas if pumps fail to operate, even under normal weather conditions. There are reports of significant flooding in the lower areas on the eastern side of Ballydermot North and Ballydermot South when pumps have failed to operate. There is no local knowledge or records of flooding having ever occurred at the works area at the southern end of Ballydermot South. Also, it is accepted that local surface water flooding can occur where blockages to the existing drainage network occur over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production fields on an annual basis as part of the winter works schedule.

Historical flood records are taken from the OPW website, https://www.floodinfo.ie. There are records of surface water flooding at Edenderry to the north and Clonbullogue to the west of these bogs. There are also records of flooding along the Slate River outside of Rathangan, circa 3km southeast of Ballydermot South bog. The closest record of flooding was recorded in 2008 at Clonbullogue, circa 1.5km west of these bogs where the Figile River rose above the level of its banks and flooded surrounding lands.

Historical OSI 25" mapping was also examined for this area. There is no additional record of flooding to be taken from these maps for these bogs.

5.11.6 **Groundwater Flood Risk**

A map of aquifers, karst features and known wells is shown in the Figure.

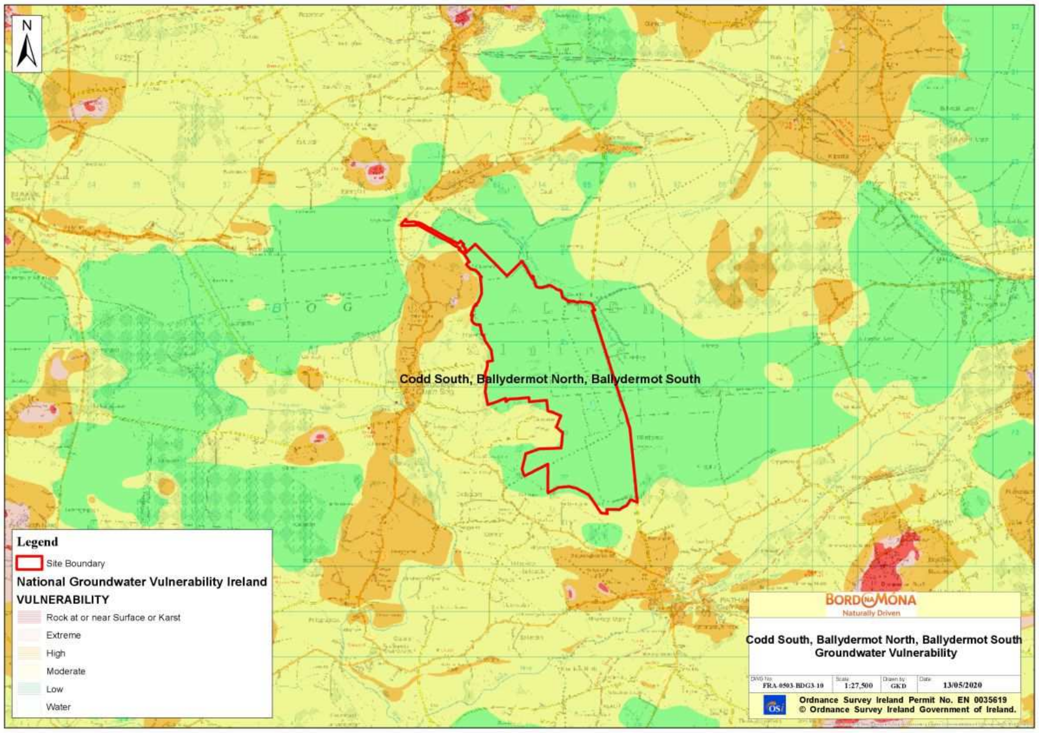


Figure 5.11.6 Codd South/Ballydermot North/Ballydermot South Groundwater Vulnerability

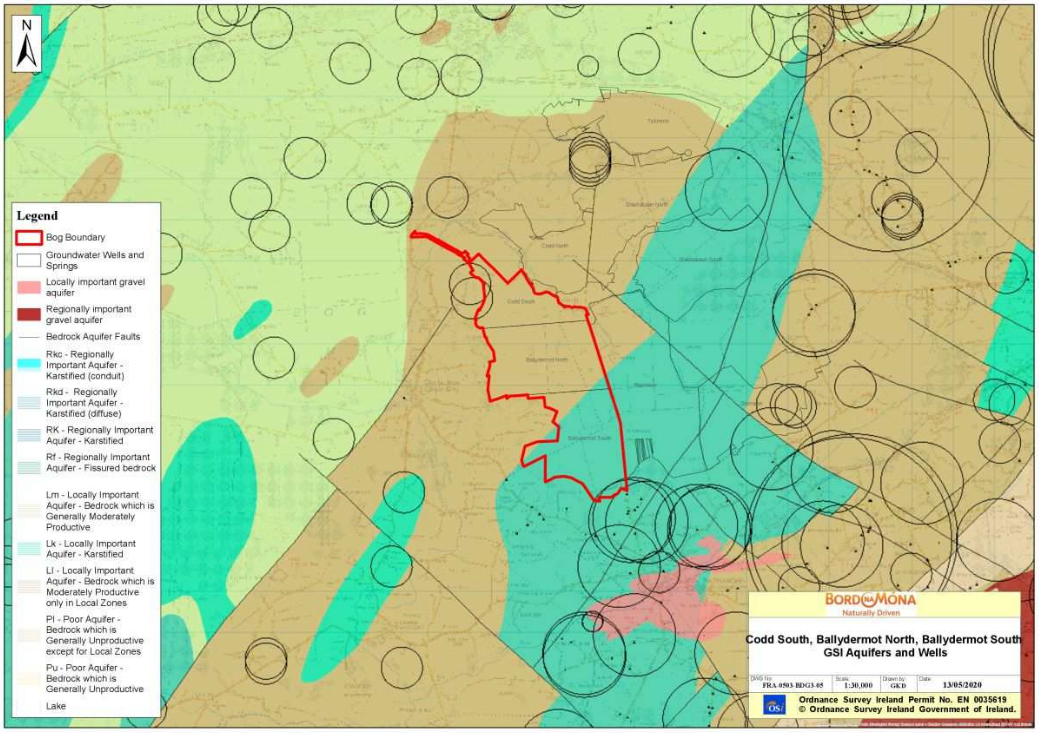


Figure 5.11.7 Codd South/Ballydermot North/Ballydermot South Aquifers, Karst Features, Wells

The majority of the area is underlain by an aquifer which is known as a *Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll)*. In the south, there is an area underlain by an aquifer known as *Regionally Important Aquifer - Karstified (diffuse) (Rkd)*. A Low rating is given to these areas in terms of groundwater vulnerability.

There are records of a number of boreholes to the south and west of the bogs. There is no record of any karst features in the area.

There are no Bord na Móna records or local anecdotal evidence to suggest groundwater flooding has ever occurred at this bog.

5.11.7 **Fluvial Flood Risk**

CFRAM flood mapping is shown in the Figure below.

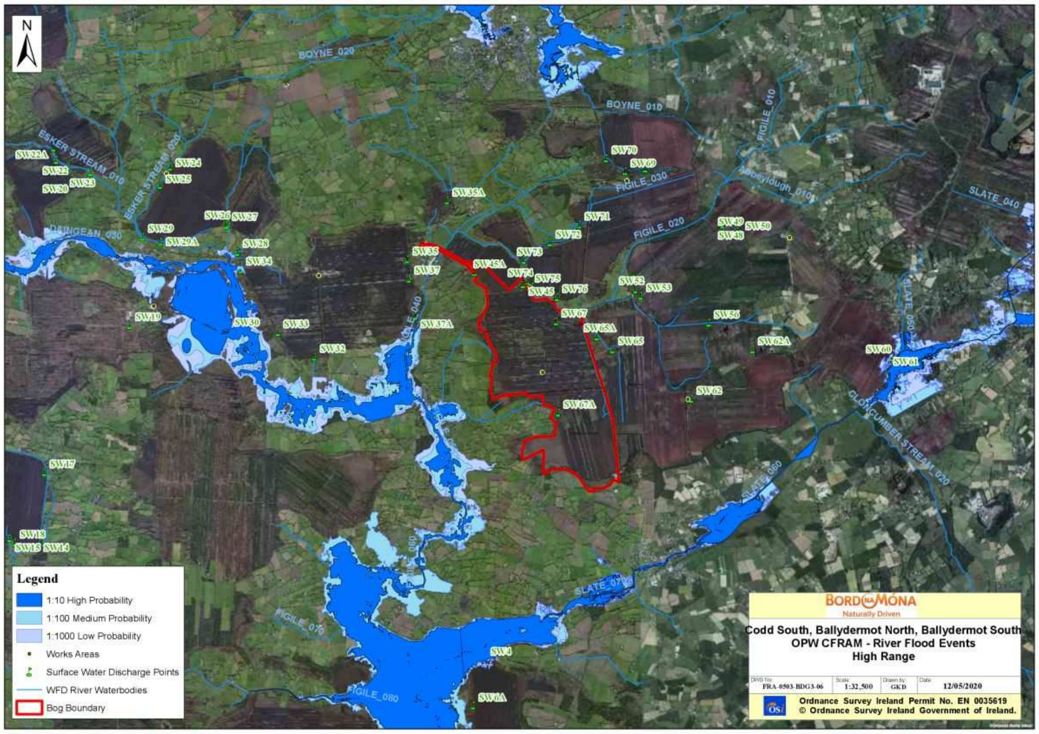


Figure 5.11.8 Codd South/Ballydermot North/Ballydermot South CFRAM Flood Mapping

The rivers and streams in the vicinity of this group of bogs are described in terms of regional hydrology in section 5.11.4.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with the 'High-End Future Scenario extents' (generated taking in the potential effects of climate change using an increase in rainfall of 30% and sea level rise of 1,000 mm (40 inches))

Flooding is identified in the Figile River, approximately 900m west of Ballydermot North bog in the region of Clonbullogue village. There is no flooding identified further upstream of this location. Flooding is also identified along the Slate River, south of Ballydermot South, within 1.7km of the site boundary. There is no risk of flooding identified within any of these bogs.

Information from Bord na Móna operatives indicates that levels in receiving waters have risen above the outfall levels and caused water to back-up into the outfalls from the bog. In such an event, outfalls would become submerged if water levels in receiving water were to rise. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events. Any such flow into the bog would be limited to the capacity of the outfall pipe. It is noted that the limited pipe diameter will also restrict run-off rates from the bog to the receiving waters.

5.11.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100 year and 1000 year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices.

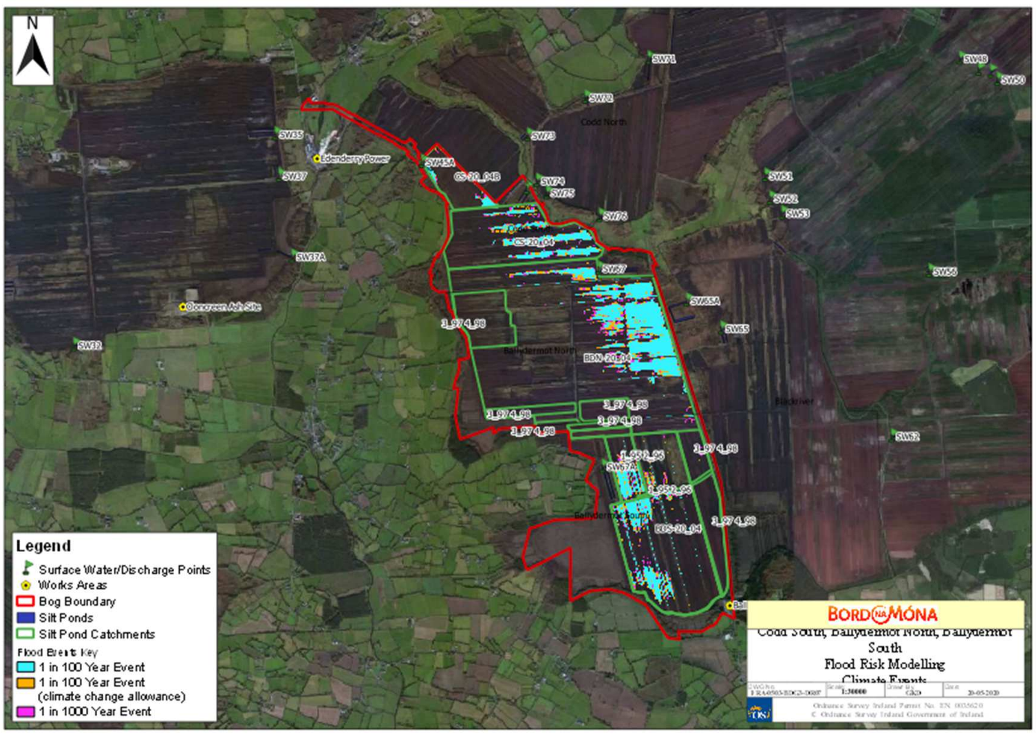


Figure 5.11.9 Codd South/Ballydermot North/Ballydermot South Pluvial Flooding, Rainfall Events

Flooding modelling carried out for this group of bogs is presented here. The basins used in the model are the extent of the catchments that discharge through the surface water discharge points in the bog. Codd South, Ballydermot North and Ballydermot South are modelled for the following basins:

Codd South: Two basins – CS-20_04, CS-20_04B;
Ballydermot North and South: Two basins – BDN-20_04 and BDS-20_04

Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

Flooding is identified for this grouping of bogs mainly on the eastern side of Ballydermot North and Codd South but also to a lesser extent on the western side of Ballydermot South bog. This is broadly in line with local experience in the case of Ballydermot North, where low-laying areas adjacent to the L3001 Edenderry-Rathangan road. Flood levels predicted in the case of the 1 in 1000 year event for Ballydermot South was 68.13mOD, with a level of 67.78mOD in Ballydermot North.

Catchments are separated within the bog by topographical features such as ridges in surface levels and locally elevated rail lines and local elevated peat fields.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events
A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Codd South			**Ballydermot North**		**Ballydermot South**	
Level	**CS-20_04**	**CS-20_04B**	**Level**	**BDN-20_04**	**Level**	**BDS-20_04**
mOD	***m^3***	***m^3***	***mOD***	***m^3***	***mOD***	***m^3***
66	18	0	65	282	65	0
66.25	177	0	65.25	1012	65.25	0
66.5	709	0	65.5	2249	65.5	13
66.75	2200	0	65.75	4475	65.75	279
67	6153	0	66	8943	66	1041
67.25	16114	0	66.25	18875	66.25	2422
67.5	38211	0	66.5	41552	66.5	5111
67.75	76947	0	66.75	85002	66.75	10146
68	134581	0	67	153266	67	19215
68.25		0	67.25	252665	67.25	36325
68.5		0	67.5	389557	67.5	66859
68.75		3	67.75	564805	67.75	112706
69		8	68	776018	68	178238
69.25		26			68.25	270102
69.5		86				
69.75		294				

70		883				
70.25		2038				
70.5		4314				
70.75		8900				

Table 5.11.1 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within these bogs and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

Each of these bogs have pumping of surface water from low lying areas. These pumps have been dis-regarded for the flood modelling of the extreme rainfall events set out above as these pumps are not designed for such events. Pump sites in Codd South, Ballydermot North and Ballydermot South have capacities of 30kW, 71kW and 37kW respectively as well as outlet levels of 66.85mOD, 67.27mOD and 67.55mOD.

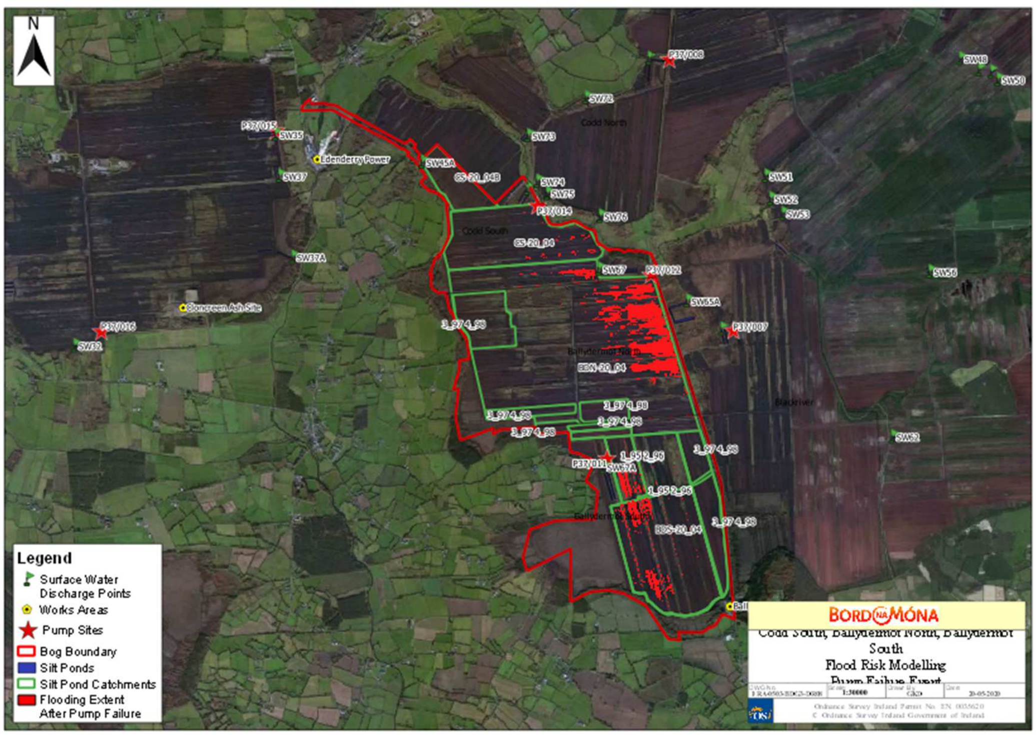


Figure 5.11.10 Codd South/Ballydermot North/Ballydermot South Pluvial Flooding, Pump Failure

In each of these locations, pump sites are located upstream of the silt ponds and respective outfalls, with a gravity flow from the outfall into receiving waters. In the event that a pump fails, the surface water will pond in low lying areas on the bog to a level where it can discharge by gravity flow. The above figure models the flooding that will occur in the event that these pumps are turned off or breaks down. The expected flood water level in this situation is plotted in red. The flooding caused by the failure of this pump will be retained within the bog peat production area.

Flooding is not identified in the general area of either Ballydermot Works at the southeast corner of Ballydermot South bog or at the welfare centre in the centre of Ballydermot North bog. This is in line with local experience. Levels in the area of the Ballydermot Works are of the order of 73.30mOD, significantly above both the maximum predicted 1 in 1000year flood level of 68.13mOD or the maximum predicted flood level in the event of pump failure of 67.55mOD for Ballydermot South.

5.11.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 5.11.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100 year event (+ 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case the maximum rainfall for the 100 year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000-year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 5.11.7, the High-Emissions Future Scenario (HEFS) has been considered which takes in account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

5.11.10 **Conclusions**

The Flood Risk Assessment for these bogs identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area has occurred in Codd South and Ballydermot North, where water in receiving water courses is high or where existing surface water pumps have failed to operate. Flooding has been noted locally in all of these bogs where drains have become blocked internally.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelling has shown that neither Ballydermot

Works (Ballydermot South bog) nor the welfare centre in Ballydermot North bog are at risk of flooding under any scenario modelled.

This Flood Risk Assessment indicates that none of the buildings or compounds present in these bogs are at risk of flooding from a 1000year event and therefore can be considered to be in a Low Risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in each of these bogs can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 5.11.2 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*

(i) *The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*

(ii) *The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*

(iii) *The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*

(iv) *The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for these bogs, it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the works compound is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in these bogs is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

5.12 Lodge Bog

5.12.1 **Introduction**

Lodge bog is part of the Bord na Móna Derrygreenagh Bog Group which operates under an Integrated Pollution Control licence (ref P0501-01). Lodge bog is a supply bog for Edenderry Power and has a total site area of 430 Ha.

5.12.2 **Site Location**

The Lodge site location is highlighted in red in the Figure below.

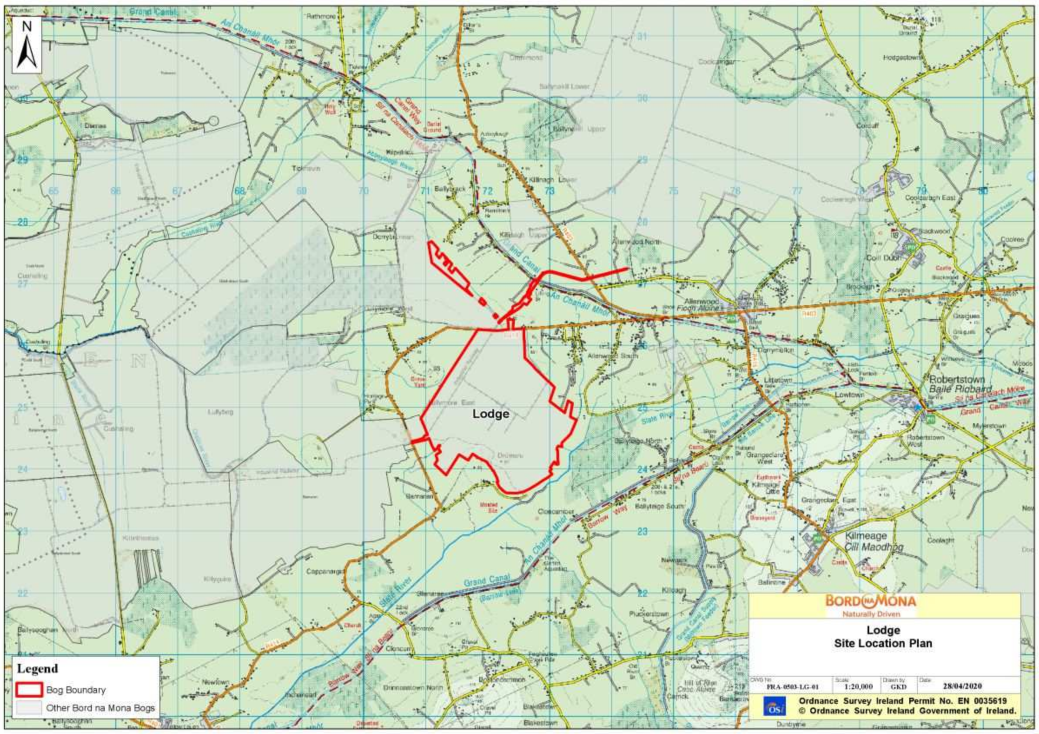


Figure 5.12.1 Lodge Bog Site Location

Lodge bog is located in County Kildare and is bound to the north and the west by the R414 regional road. Allenwood is located circa 3km to the east of this bog and Lullymore Discovery Centre is located immediately to the north.

5.12.3 **Bog Description**

The bog layout is shown in the Figure.

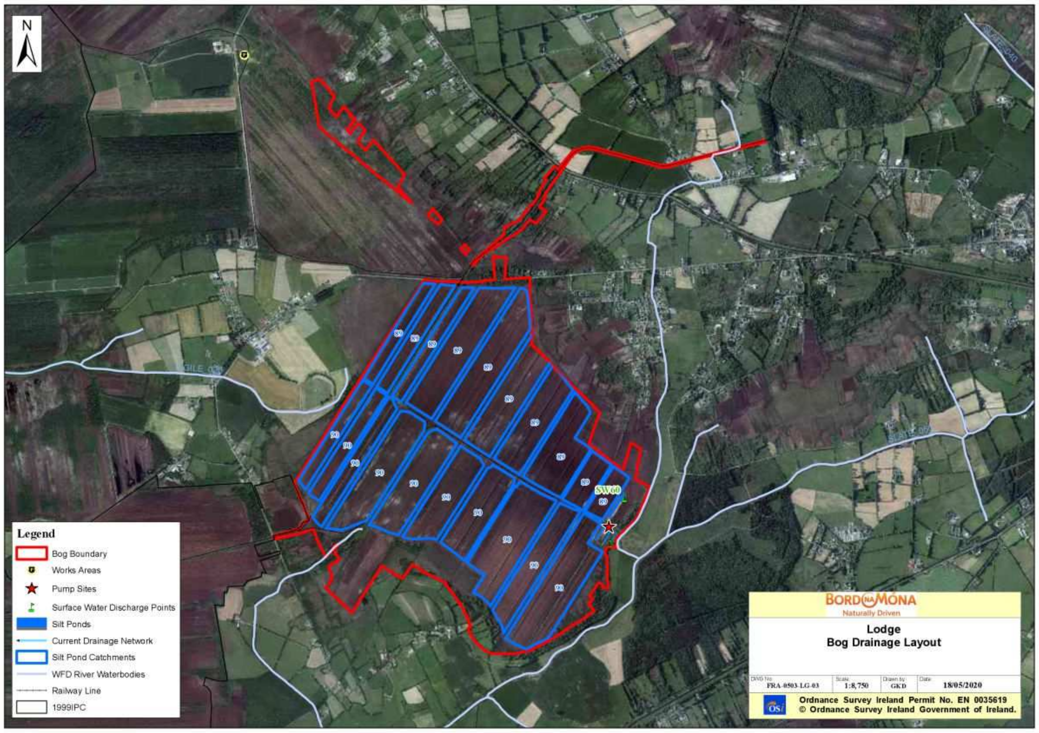


Figure 5.12.2 Lodge Bog Layout

From the records available, it appears that Bord na Móna commenced pre-development drainage of Lodge bog in 1951 and commenced production in 1955. In recent times Lodge Bog has been used as a supply bog for the Edenderry Power station.

The land use surrounding the bog is comprised of peat harvesting on surrounding bogs, forestry, agriculture and eco-tourism at Lullymore Discovery Centre. There is active peat production only on the south-eastern portion of this bog. Areas not in active production are either cutover or cutaway and in a state of re-vegetation. There are some edge habitats present around the periphery of the bog. These edge habitats are typically remnant sections of raised bog and cutaway bog.

There is no dedicated welfare or works compound at Lodge bog and the area is accessed from the R414 on the western side of the bog. Rail infrastructure access is also provided at this location, with a rail line linking Lodge to surrounding bogs and to Edenderry Power to the west. This bog is relatively flat, with low points of the order of 72.5m OD in central and southern parts of the bog from high levels of the order of 75.5mOD in the north and west. A rail line splits the site approximately in half and runs in a southeast to northwest direction.

This bog is served by two outfalls (SW 60 and 61) which are located at the southern end of the bog and which direct surface water into an outfall directly into the Slate River to the south. There is also a pump site at this location. The pump site includes two submersible pumps with a combined power of 54kW, which operate on a duty and assist basis.

5.12.4 **Regional Hydrology**

The catchment area and water courses are shown in figures presented here.

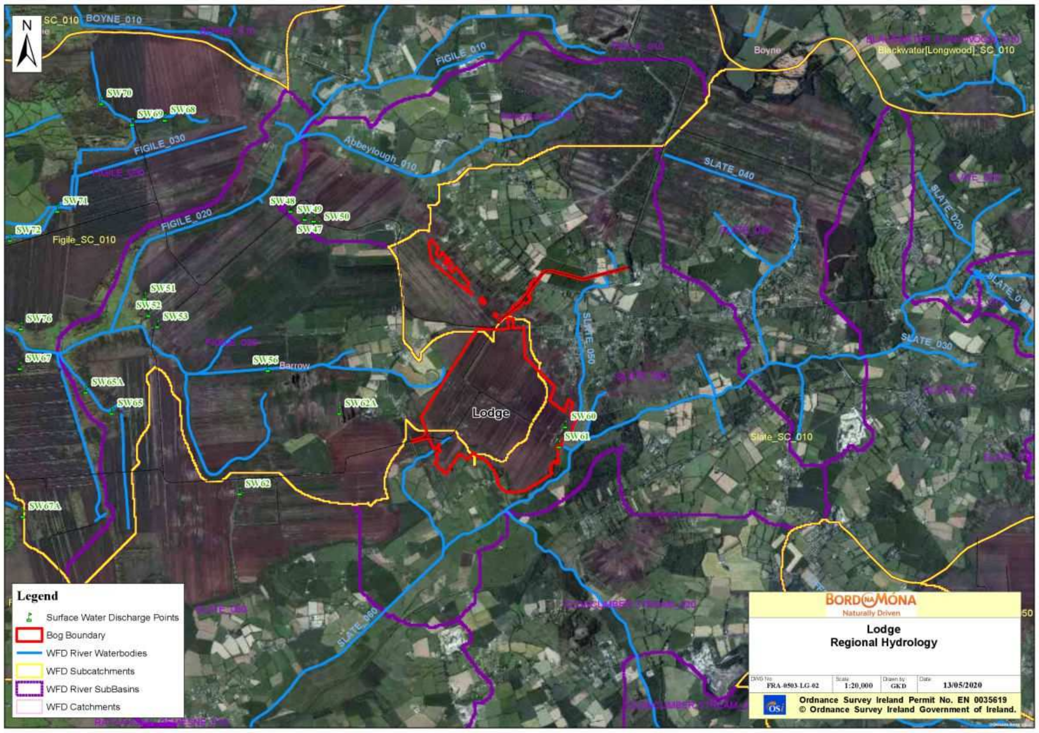


Figure 5.12.3 Lodge Bog Regional Hydrology

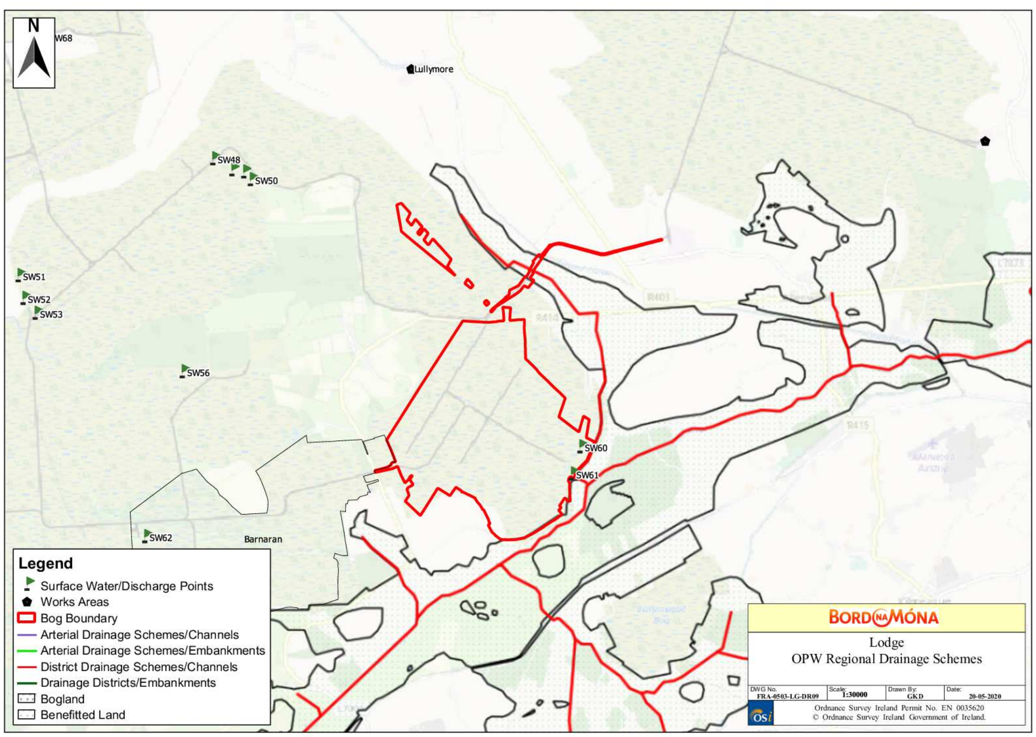


Figure 5.12.4 Lodge Bog District Drainage Schemes

Lodge bog is within the Barrow 14 catchment. The Barrow 14 catchment drains a total area of 3,015km^2. The Barrow catchment is underlain in its flat northern area by limestones of varying purity which continue down the western side of the catchment and sustain good groundwater resources in places. On the eastern side of the catchment, granites dominate, culminating in the summits of the Blackstairs Mountains.

Surface water discharged from the southern outfall is discharged directly into the Slate River (Slate_050) which generally flows from east to west, flowing through Rathangan before merging with the Figile River to the south of Bracknagh village. The Figile River itself flows to the south and into the River Barrow at Monasterevin, circa 15km southwest of Lodge bog. Both outfalls to this bog lie with the Slate_050 WFD Sub-basin and the Slate_SC_010 sub-catchment.

The Arterial Drainage and District Drainage schemes near Lodge bog is shown in figures presented here. The benefitted land is also highlighted demonstrating that there is some limited benefitting lands associated with this scheme in the area of this bog.

The Standard Annual Average Rainfall (SAAR) in this location is 870mm.

5.12.5 **Historical Flooding**

A map of historical flooding is shown in the Figure.

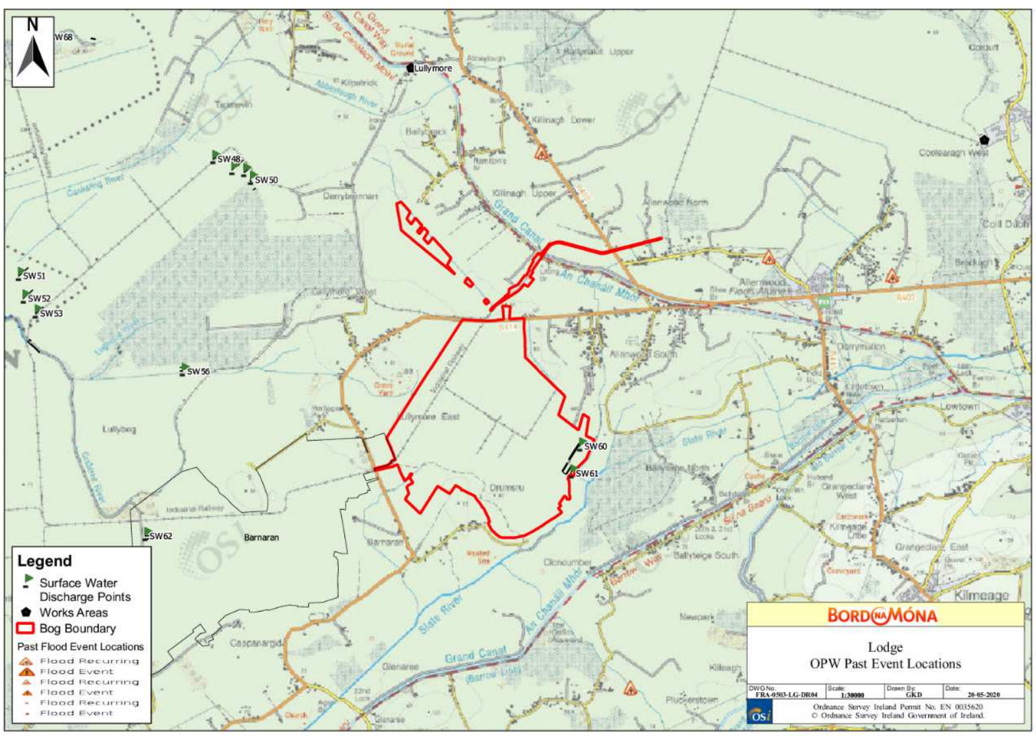


Figure 5.12.5 Lodge Bog Historical Flooding

Information from Bord na Móna operatives suggests that flooding has occurred at Lodge bog in periods of prolonged rainfall whereby waters in the Slate River have been raised above the level of the outfalls and above the levels of the perimeter of the bog, spilling into the bog itself. In these events, surface water generated over the bog catchment would not be able to drain away and would also collect in this lower part of the bog, increasing flood volumes. Given the presence of a pump site at the outfall location, it is accepted that there is a risk of surface water flooding in these areas if pumps fail to operate, even under normal weather conditions. Finally, it is accepted that local surface water flooding can occur where blockages to the existing drainage network occur over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production fields on an annual basis as part of the winter works schedule.

Historical flood records are taken from the OPW website, https://www.floodinfo.ie. There are records of surface water flooding at a number of locations around Allenwood, to the east of the bog. The closest of these is circa 2.5 km east of the bog boundary. Minutes from a local authority meeting from 2005 note that the area is low lying and floods after heavy rain, with no property affected.

Historical OSI 25" mapping was also examined for this area. There is no additional record of flooding to be taken from these maps for Lodge bog.

5.12.6 **Groundwater Flood Risk**

A map of aquifers, karst features and known wells is shown in the Figure.

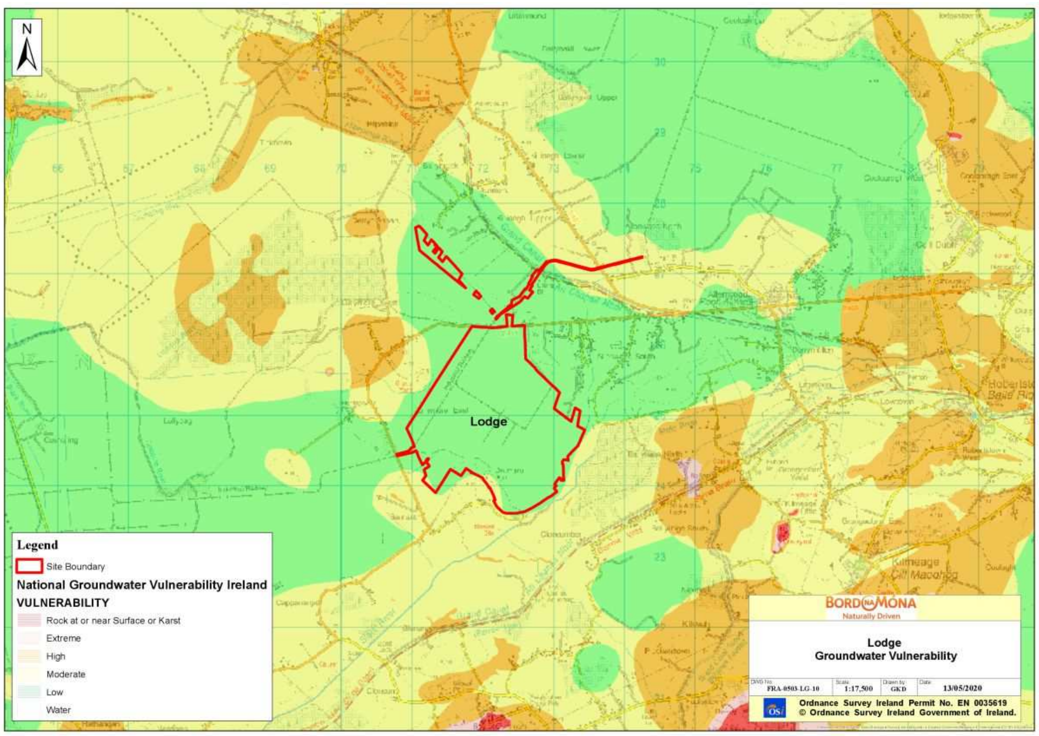


Figure 5.12.6 Lodge Bog Groundwater Vulnerability

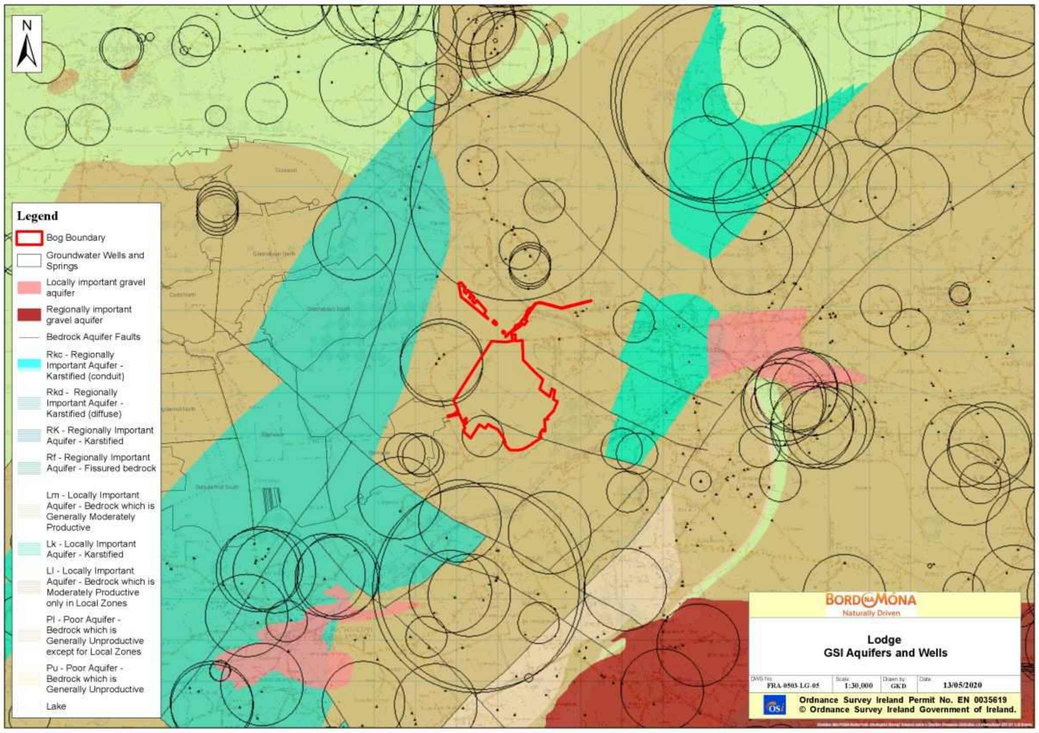


Figure 5.12.7 Lodge Bog Aquifers, Karst Features, Wells

Lodge bog is underlain by an aquifer which is known as a *Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll)*. A Low rating is given to these areas in terms of groundwater vulnerability.

There are records of a number of boreholes to the south and west of the bogs. There is no record of any karst features in the area.

There are no Bord na Móna records or local anecdotal evidence to suggest groundwater flooding has ever occurred at this bog.

5.12.7 **Fluvial Flood Risk**

CFRAM flood mapping is shown in the Figure below.

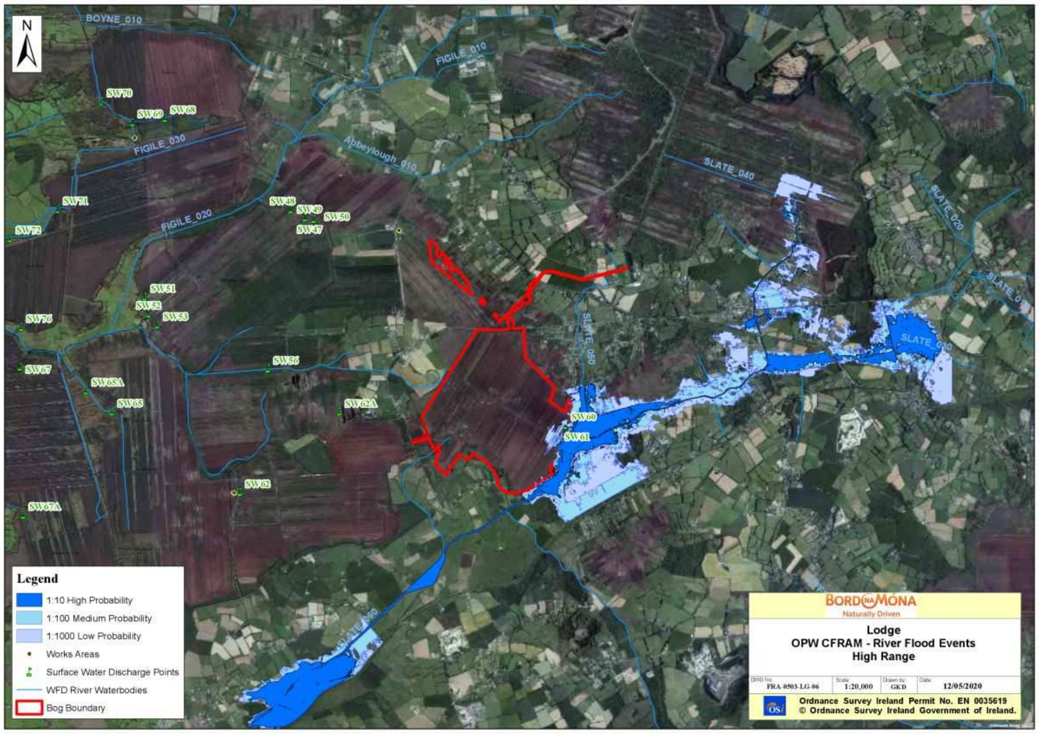


Figure 5.12.8 Lodge Bog CFRAM Flood Mapping

The rivers and streams in the vicinity of Lodge bog are described in terms of regional hydrology in section 5.12.4.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with the ‘High-End Future Scenario extents’ (generated taking in the potential effects of climate change using an increase in rainfall of 30% and sea level rise of 1,000 mm (40 inches))

Flooding is identified in the Slate River, immediately south of Lodge bog and this flooding is indicated to extend into the southern end of the bog. Flooding is also evident upstream and downstream of the bog as the Slate River passes through Allenwood in the east and Rathangan to the southwest.

Information from Bord na Móna operatives indicates that levels in the Slate River have previously risen above the level of the outfalls to the extent that southern parts of the bog area have experienced flooding. In such an event, outfalls would become submerged if water levels in receiving water were to rise. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events. Any such flow into the bog would be limited to the capacity of the outfall pipe. The outfall pipes sizes are given below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW60	0.600
SW61	0.600

Table 5.12.1 Lodge Surface Water Outfalls

It is noted that the limited pipe diameter will also restrict run-off rates from the bog to the receiving waters.

5.12.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100 year and 1000 year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices..

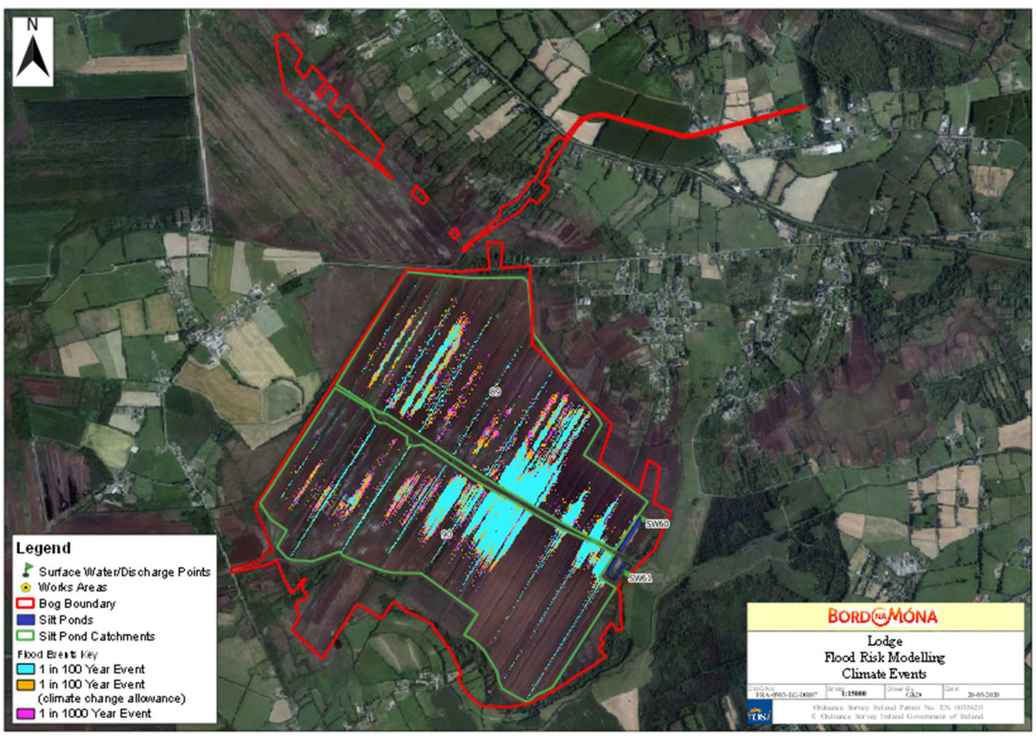


Figure 5.12.9 Lodge Bog Pluvial Flooding, Rainfall Events

Flooding modelling carried out for Lodge bog is presented here. The basins used in the model are the extent of the catchments that discharge through the surface water discharge points in the bog. Lodge Bog is modelled for two basins, Ref 89 and 90. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

The maximum predicted flood level for the bog in the case of the 1 in 1000 year rainfall event is 73.98mOD in the northern basin. The extent of flooding identified is mainly in the low lying central and southeastern parts of the site.

Catchments are separated within the bog by topographical features such as ridges in surface levels and locally elevated rail lines and local elevated peat fields.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.
A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	***89***	***90***
mOD	***m^3***	***m^3***
71.00	0	10
71.25	6	119
71.50	142	549
71.75	576	1407
72.00	1302	2767
72.25	2715	5031
72.50	5536	9660
72.75	10742	20404
73.00	20582	41154
73.25	35844	73562
73.50	58349	121044
73.75	97589	190506
74.00	165976	

Table 5.12.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within these bogs and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

Lodge bog has pumping of surface water from low lying areas. These pumps have been disregarded for the flood modelling of the extreme rainfall events set out above as these pumps are not designed for such events. The pump site at Lodge bog has an outlet level of 72.652mOD and a power output of 54kW.

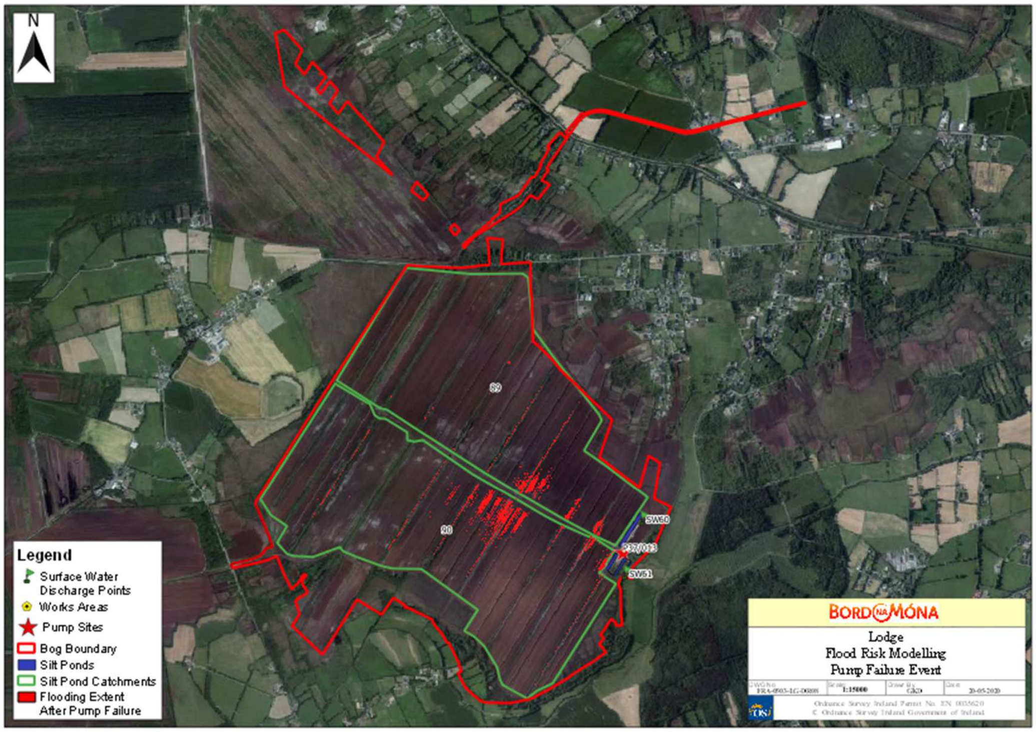


Figure 5.12.10 Lodge Bog Pluvial Flooding, Pump Failure

In Lodge bog, the pump site is located upstream of the silt ponds and respective outfalls, with a gravity flow from the outfall into receiving waters. In the event that a pump fails, the surface water will pond in low lying areas on the bog to a level where it can discharge by gravity flow. The above figure models the flooding that will occur in the event that these pumps are turned off or breaks down. The expected flood water level in this situation is plotted in red. The flooding caused by the failure of this pump will be retained within the bog peat production area.

There is no building or works area on this site which could have been impacted by flooding. The main access point to the bog along the western boundary is not at risk of flooding based on this modelling.

5.12.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 5.12.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100 year event + 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case the maximum rainfall for the 100 year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000-year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 5.12.7, the High-Emissions Future Scenario (HEFS) has been considered which takes in account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

5.12.10 **Conclusions**

The Flood Risk Assessment for these bogs identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area has occurred in Lodge where water levels in receiving waters have risen to above the level of the outfall pipes and potentially created an inflow into the bog.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. OPW CFRAM mapping for the 1 in 1000year event associated with the High-End Future Scenario identifies areas within the southern end of Lodge bog which are at risk of flooding. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. There is no building or works area in Lodge Bog.

This Flood Risk Assessment indicates that the peat production fields and drains in Lodge bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 5.12.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Lodge bog, it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then

discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;

- The flood modelling carried out in this assessment shows that the main access point to the bog is located in an area of higher ground that is not at risk of flooding in a 1 in 1000year event and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Lodge bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

FLOOD RISK ASSESSMENT – CHAPTER 6
Mountdillon Bog Group

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6 FLOOD RISK ASSESSMENTS – MOUNTDILLON BOG GROUP

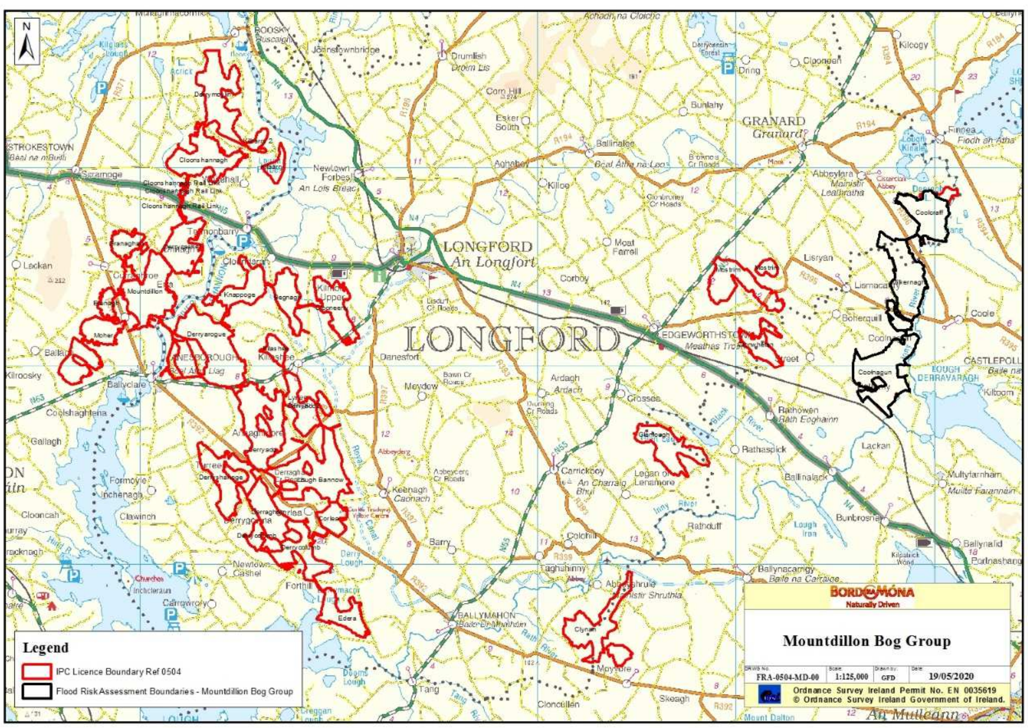
6.1 Mountdillion Bog Group - IPC License 504

The Mountdillon group of bogs are sited between Scramoge, Co. Roscommon in the West, and Coole, Co. Longford in the east and Rooskey, Co. Roscommon to the north and Tang, Co. Westmeath to the south. The Mountdillon bogs included in this application are located to the east of the area adjacent to Coole, Co. Longford. Bord na Móna's licence for the Mountdillon Bog Group (Ref. PO504-001) was granted to Bord na Móna Energy Limited on 09th May 2000 and regulates Bord na Móna's activities across 31 bog units. Of these 31 bogs units, 3 are included in the Substitute Consent applications and in this Flood Risk Assessment Report. The 3 Mountdillon bogs included in this report are:

- Cuil na Gun – County Westmeath
- Milkernagh – County Westmeath and Longford
- Coolcraff – County Longford

These bogs are located in the Upper Shannon catchment 26F.

From the records available, it appears that Bord na Móna commenced the development of Coolnagun and Milkernagh Bogs in 1947 with the commencement of peat extraction in 1953. Coolcraff was developed in the early 1980's. Peat from these bogs have been used as fuel peat for Lough Ree Power Station and for the supply of horticultural peat.



6.2 Cuil na Gun

6.2.1 **Introduction**

Coolnagun Bog is part of the Bord na Móna Mountdillon Bog Group which operates under an Integrated Pollution Control licence (ref P0504-01). This bog supplies horticultural peat and horticultural sod moss and has a permanent rail line that connects it to Milkernagh bog immediately to the north. The total area of the bog is 670 Ha.

6.2.2 **Site Location**

The Cuil na Gun site location is highlighted in red in the Figure below.

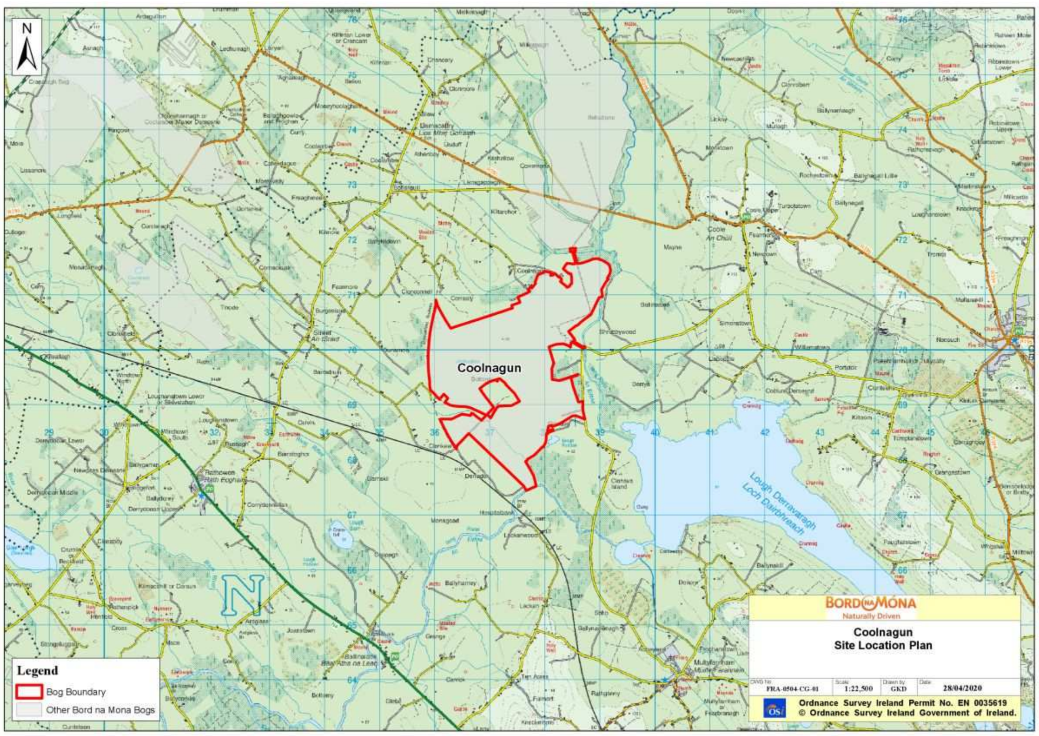


Figure 6.2.1 Cuil na Gun Bog Site Location

Cuil na Gun bog is located in County Westmeath and is approximately 3 km southwest of Coole and 8km west of Castlepollard. This bog is one of a cluster of six Bord na Mona bogs in the Coole area of Co. Longford and Co. Westmeath known as the Cuil na Gun bogs.

6.2.3 **Bog Description**

The bog layout is shown in the Figure.

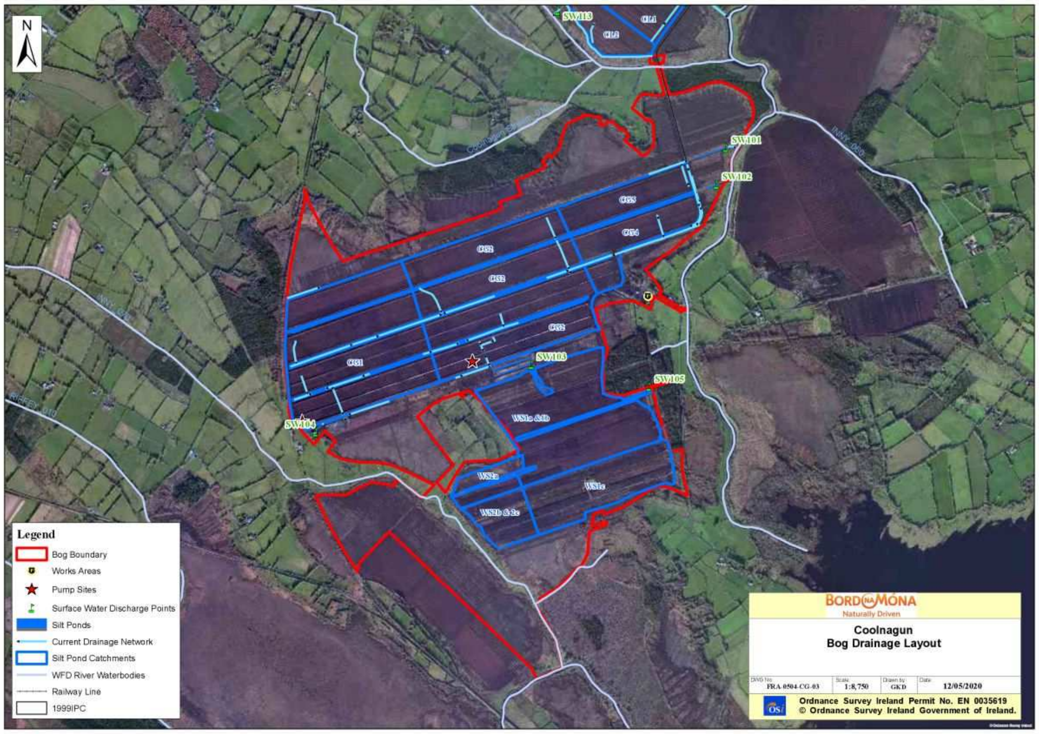


Figure 6.2.2 Cuil na Gun Bog Layout

From the records available, it appears that Bord na Móna commenced the development of the Cuil na Gun bogs in the late 1940's. Pre-development gravity drainage was commenced in 1947 and first production took place in 1953. The bog was initially developed for turf extraction before later being developed for milled peat extraction. The land use surrounding the bog is comprised of peat harvesting on surrounding bogs and agriculture. There is also forestry present to the north of the site.

The majority of the bog is in active peat production. There are some edge habitats present around the periphery of the bog. These edge habitats are typically remnant sections of raised bog and cutaway bog.

Cuil na Gun bog is served by a works compound which is located on the eastern side of the site and accessed from the village of Coole via the L1826 local road. This compound includes welfare facilities, workshop, offices, canteen, parking areas and yard areas. Levels in the area of the works compound are approximately 62.85mOD. Finished floor levels range from 62.472mOD to 63.167mOD. Levels over the northern end of the production area vary from approximately 62mOD to 64.50mOD, with the southern end of the production area at higher levels of around 67.2mOD. Areas of remnant bog in the north and west are several metres higher than adjacent production fields.

In Cuil na Gun, there are five outfalls from the bog, with associated silt ponds, which discharge along the eastern and western boundaries of the site (SW101, 102, 103, 104 and 105). There are two pump sites in the bog, one in the centre of the bog (30kW) and a second on the western boundary (14kW). These pumps are both submersible pumps.

6.2.4 **Regional Hydrology**

The catchment area and water courses are shown in the figures below.

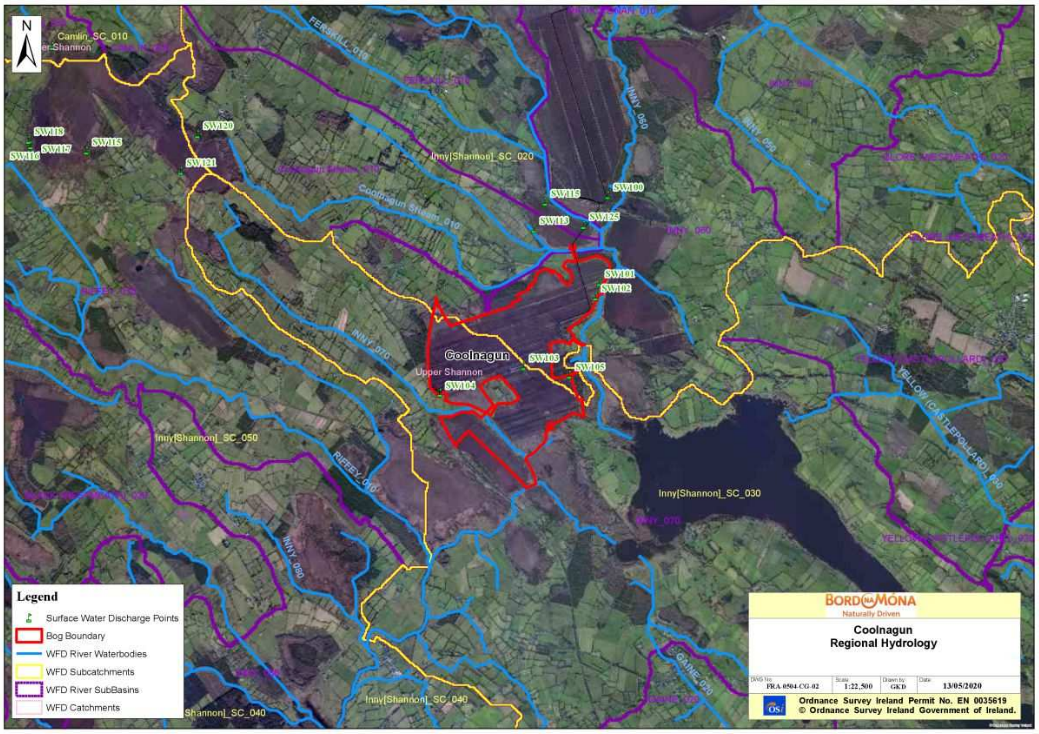


Figure 6.2.3 Cuil na Gun Bog Regional Hydrology

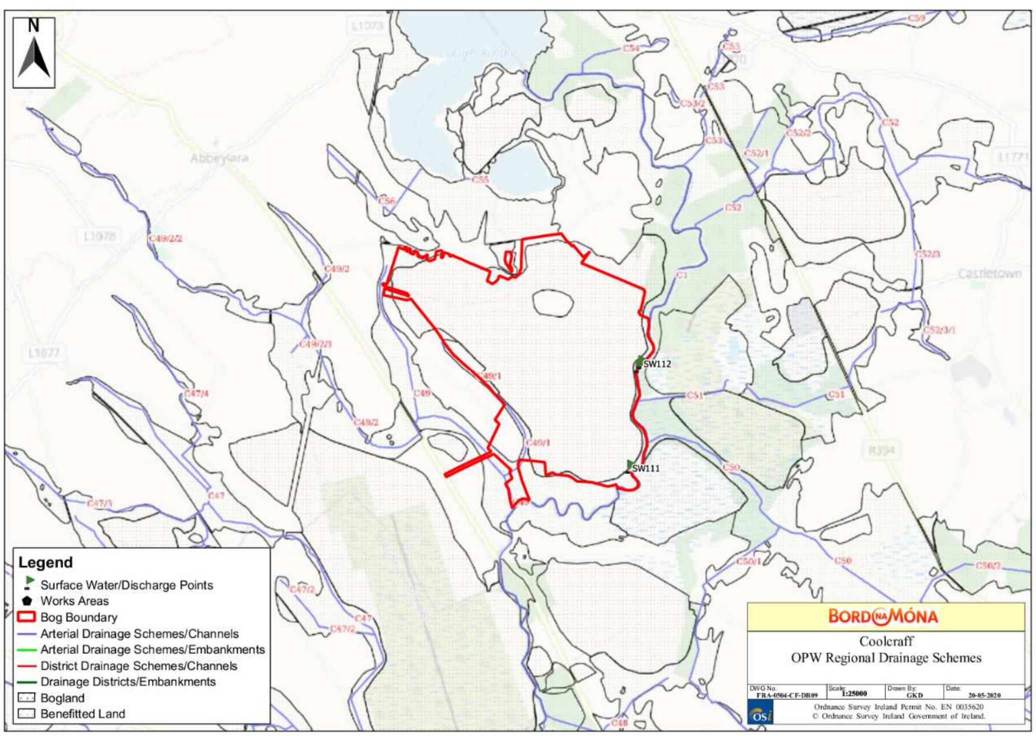


Figure 6.2.4 Cuil na Gun Bog District Drainage Schemes

Cuil na Gun Bog is within Upper Shannon (26F) catchment. The Upper Shannon catchment drains a total area of 1,229km² and is characterised by a southwestern region of flat, boggy land, an eastern region containing swarms of isolated relatively steep-sided hills and a northern section composed of more undulating topography entering the southern part of the drumlin belt. The catchment is generally underlain by impure limestones, although some karst has been identified in the lakes on the Meath-Westmeath border, with the northern part of the catchment underlain by metamorphic and volcanic rocks. An arterial drainage scheme was completed on the River Inny by the OPW between 1959 and 1963. The Upper Shannon (Inny) catchment comprises ten sub-catchments with 41 river water bodies, six lakes, and eight groundwater bodies.

Three outfalls from this bog are located along the western boundary, with discharge points into the immediately adjacent River Inny (Inny_060) which itself discharges into the River Shannon at Loch Ree, north of Athlone. The outfall in the centre of the bog also discharges to this river. The fourth outfall also drains into the River Inny along the southern boundary of the bog via the Inny_070 watercourse. Outfalls SW101, SW102, SW103 and SW105 discharge into WFD Sub-catchment Inny(Shannon)_SC_020. The outfall SW104 is within WFD Sub-basin Inny_070 and is within the sub-catchment Inny(Shannon)_SC_030.

The Arterial Drainage and District Drainage schemes near Cuil na Gun bog is shown in the Figure below. The benefitted land is also highlighted demonstrating the enhanced flood protection, as a result of this scheme, for the lands between the bog and the River Inny.

The Standard Annual Average Rainfall (SAAR) in this location is 962mm.

6.2.5 **Historical Flooding**

A map of historical flooding is shown in the Figure.

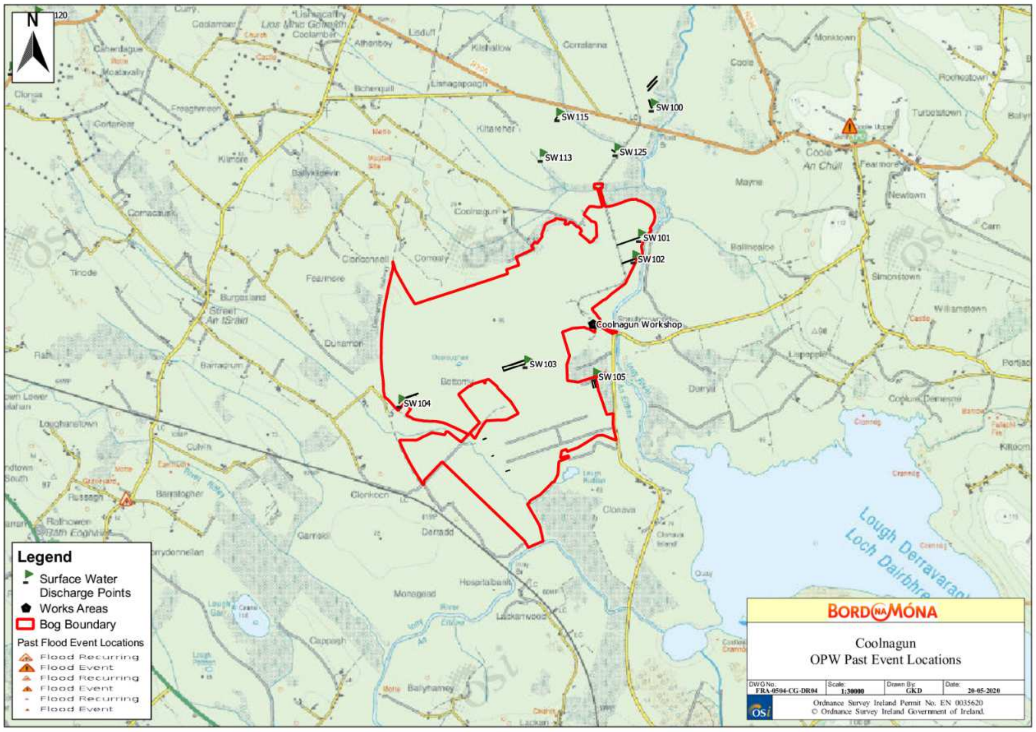


Figure 6.2.5 Cuil na Gun Bog Historical Flooding

Information from Bord na Móna operatives suggests that surface water flooding has occurred on this bog in the past, in the centre of the bog. This is known to occur during winter months should surface water pumps fail to operate. It is also known locally that surface water flooding can occur where blockages to the existing drainage network have occurred over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production fields on an annual basis as part of the winter works schedule. There is no knowledge of flooding where water levels in receiving waters rise above outfall levels or where levels in the River Inny have risen above the levels of its banks.

Historical flood records are taken from the OPW website, https://www.floodinfo.ie. Records of past flood events are given for one location at Coole in 2004. This was where intense rainfall flowing downhill caused some local damage. The local authority report notes that Coole is generally not a high flood risk. South of Street at Barratogher, there is a report of a stream overflowing its banks after heavy rain every year. Both of these locations are approximately 3km from the site boundary.

Satellite imagery from a flood event in 2009 (recorded 30/11/2009) identifies flooding in the area of the River Inny to the east of the site and Loch Derravaragh to the southeast. There is no flooding recorded within the site boundary.

Historical OSI 25" mapping was also examined for this area. There is no additional record of flooding to be taken from these maps for Cuil na Gun bog.

6.2.6 **Groundwater Flood Risk**

A map of aquifers, karst features and known wells is shown in the Figure.

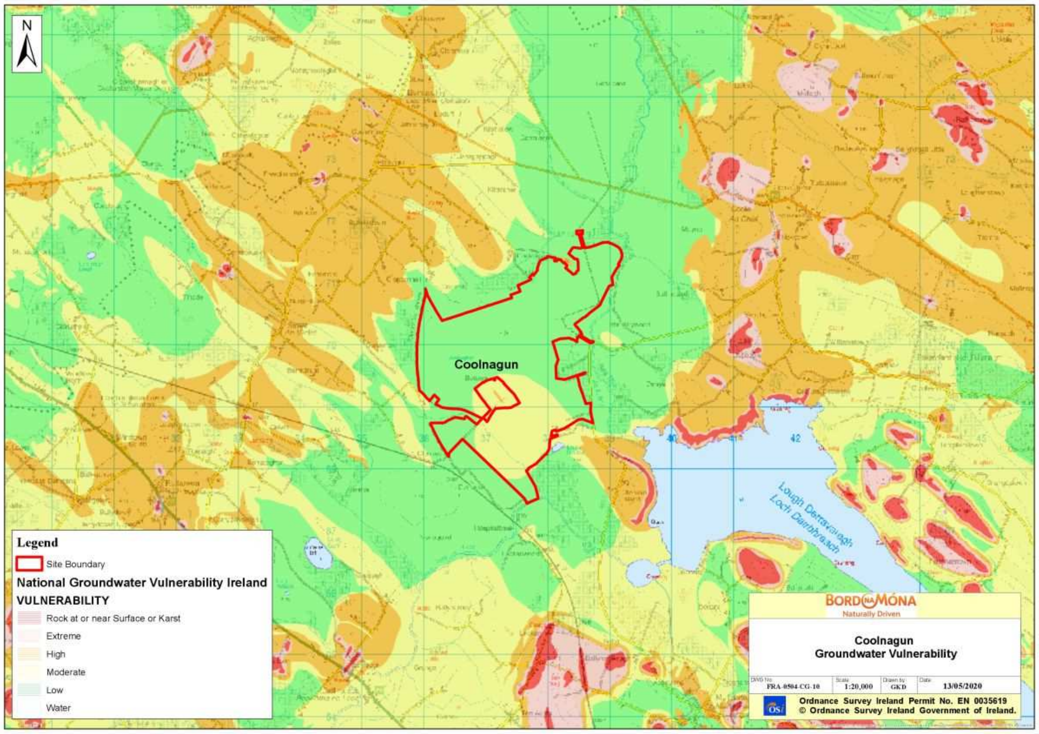


Figure 6.2.6 Cuil na Gun Bog Groundwater Vulnerability

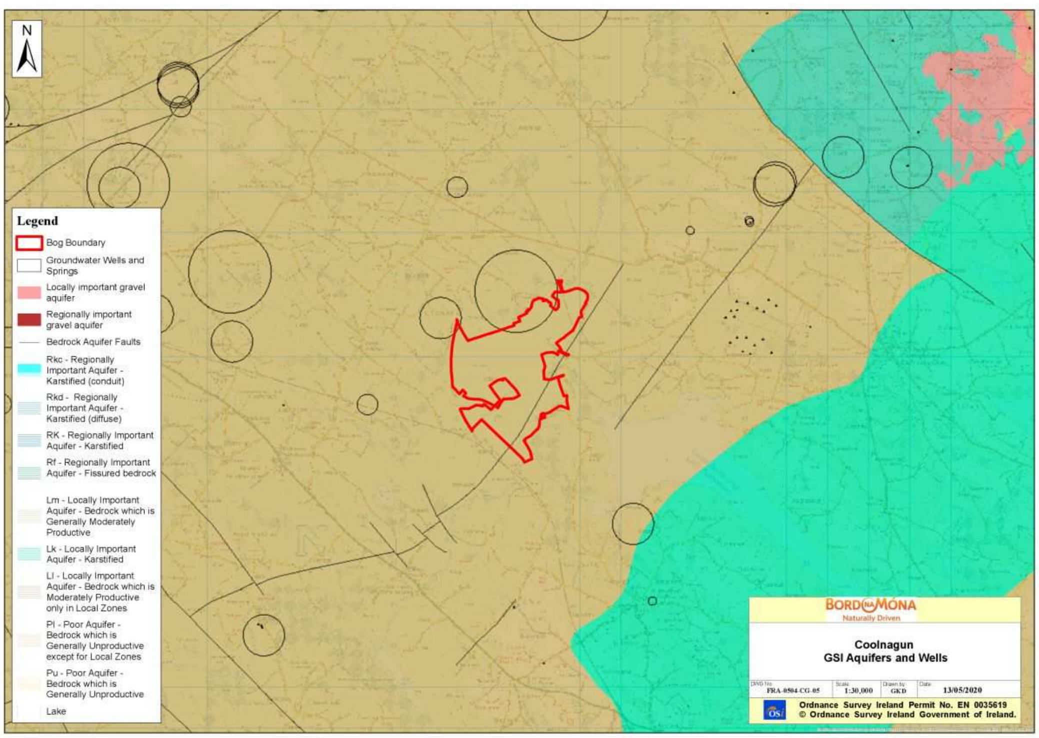


Figure 6.2.7 Cuil na Gun Bog Aquifers, Karst Features, Wells

There is a single aquifer underlaying the Cuil na Gun Bog area. This is known as a *Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll).* Groundwater vulnerability rating for the area is given as Low across the majority of the area and Moderate across a piece of the southern end of the site.

There are records of a number of wells around the northern perimeter of the site. There is no record of any karst features in the area.

Information from Bord na Móna operatives indicates that part of the centre of the site has flooded historically, particularly whenever pumps in this area have failed to operate. The source of this water is expected to be surface water rather than groundwater as local knowledge also suggests that whilst there may be local springs present, these have not had a material impact on bog operations in the past and have gone unnoticed.

6.2.7 **Fluvial Flood Risk**

CFRAM flood mapping is shown in the Figure below.

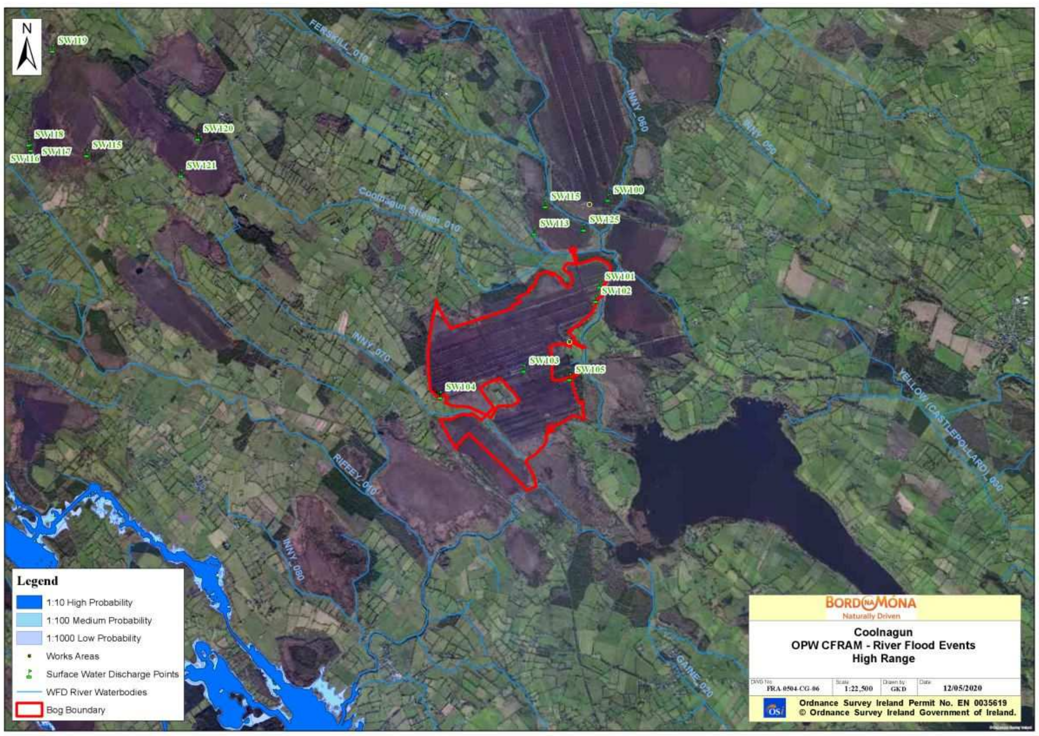


Figure 6.2.8 Cuil na Gun CFRAM Flood Mapping

The rivers and streams in the vicinity of Cuil na Gun bog are described in terms of regional hydrology in section 6.2.4.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with the 'High-End Future Scenario extents' (generated taking in the potential effects of climate change using an increase in rainfall of 30% and sea level rise of 1,000 mm (40 inches))

Flooding is identified in the River Inny immediately south of Ballinalack, approximately 5.5km southwest of the site. There is no flooding identified further upstream of this location. There is no risk of flooding identified within the Cuil na Gun bog boundary

Information from Bord na Móna operatives indicates that levels in the Inny River have risen above the outfall levels and caused water to back-up into the outfalls from the bog. In such an event, outfalls would become submerged if water levels in receiving water were to rise. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events. It is noted that the limited pipe diameters at outfalls will also restrict run-off rates from the bog to the receiving waters.

6.2.8 Pluvial Flood Risk

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100 year and 1000 year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices.

Figure 6.2.9 Cuil na Gun Bog Pluvial Flooding, Rainfall Events

Flooding modelling carried out for Cuil na Gun bog is presented here. The basins used in the model are the extent of the catchments that discharge through the surface water discharge points in the bog. Cuil na Gun Bog is modelled for four basins, CG1, CG2, CG4&CG5, and all WS Catchments. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

From the modelling, it can be seen that surface water flooding is predicted mainly in the lower, northern end of the site, particularly in the centre of the bog. There is also some areas predicted to flood around the periphery of the bog. The 1 in 1000-year event was the most onerous in terms of flood levels. The maximum predicted flood levels in the centre of the site is 62.30mOD, with maximum flood levels in the south of 65.65mOD. Catchments are separated within the bog by topographical features such as ridges in surface levels and locally elevated rail lines and local elevated peat fields.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	***CG1***	***CG2***	***CG4andCG5***	***WS***
mOD	***m^3***	***m^3***	***m^3***	***m^3***
59.00	0	0	0	0
59.25	0	0	0	1
59.50	0	9	0	62
59.75	0	119	0	1194
60.00	6	633	1	4600
60.25	41	2815	8	10928
60.50	230	10879	97	21387
60.75	1077	28009	538	37754
61.00	4141	55067	2468	61165
61.25	11277	92401	8463	92628
61.50	24246	141446	19304	132668
61.75	43965		34720	180896
62.00	70665		55771	238190
62.25	104679		84241	306294
62.50	145986			387189

62.75				482516

Table 6.2.1 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Cuil na Gun Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

Cuil na Gun bog has pumping of surface water from low lying areas. These pumps have been dis-regarded for the flood modelling of the extreme rainfall events set out above as these pumps are not designed for such events. The pump sites at Cuil na Gun have a capacity of 30kW (centre site) and 14kW (western site) and have outlet levels of 61.905mOD and 62.426mOD.

Figure 6.2.10 Cuil na Gun Bog Pluvial Flooding, Pump Failure

At Cuil na Gun bog, the pump site in the west is located upstream of the silt ponds and outfall SW104, with a gravity flow from the outfall into receiving waters. The pump site in the centre of the site is downstream of the silt pond. If this pump were to fail top operate, water in this silt pond would rise to the tops of the banks and cause flooding upstream of the silt pond. If either pump fails, the surface water will pond in low lying areas on the bog to a level where it can discharge by gravity flow. The above figure models the flooding that will occur in the event that these pumps are turned off or breaks down. The expected flood water level in this situation is plotted in red. The flooding caused by the failure of this pump will be retained within the bog peat production area.

Levels in the area of the works compound are approximately 62.85mOD, which is above the maximum predicted flood level of 62.30mOD for a 1 in 1000 year event. While the flood water level in the basin to the east of the bog is higher that the buildings finished floor level, this is due to the topography of the bog in this area and will not cause flooding of the works area due to high ground between the two basins.

As discussed in section 6.2.5, local anecdotal evidence indicates that a low area in the centre of this bog is prone to local flooding when surface water pumps fail to operate. This is in line with the modelling results where the pumped location is indicative of a low-laying area within the bog.

6.2.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 6.2.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100 year event + 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case the maximum rainfall for the 100 year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000-year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 6.2.7**Error! Reference source not found.**, the High-Emissions Future Scenario (HEFS) has been considered which takes in account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

6.2.10 **Conclusions**

The Flood Risk Assessment for Cuil na Gun Bog identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area has occurred locally where levels in the River Inny have risen above the outfall levels, where pumps have failed to operate in the past or where drains have become blocked internally
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelling carried out indicated that the estimated

1000 year flood event would not lead to flooding to the works area on the eastern side of the bog.

This Flood Risk Assessment indicates that the works area on the eastern side of the site is not at risk of flooding from a 1000year event and therefore can be considered to be in a Low Risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Cuil na Gun Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 6.2.2 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   (i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;

(ii) *The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*

(iii) *The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*

(iv) *The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Cuil na Gun Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities (all within the works compound on the eastern side of the site) are located in an area of higher ground that is not at risk of flooding in a 1 in 1000year event and consequently potential risk of pollution as a result of flooding is minimal..
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Cuil na Gun Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

6.3 Milkernagh Bog

6.3.1 Introduction

Milkernagh bog is part of the Bord na Móna Mountdillon Bog Group which operates under an Integrated Pollution Control License (ref P0504-01). This bog supplies horticultural peat and horticultural sod moss and has a permanent rail line that connects it to Coolnagun bog to the south and Coolcraff bog to the north. The total area of the bog is 629 Ha.

6.3.2 Site Location

The Milkernagh bog site location is highlighted in red in the Figure below.

Figure 6.3.1 Milkernagh Bog Site Location

Milkernagh Bog is located along the border of Co Westmeath and Co Longford. It is approximately 2.5 km west of Coole and 7.5km northwest of Castlepollard. This bog is one of a cluster of six Bord na Mona bogs in the Coole area of Co. Longford and Co. Westmeath. The R395 regional road passes through the southern part of the bog in an east-west direction.

6.3.3 Bog Description

The bog layout is shown in the Figure.

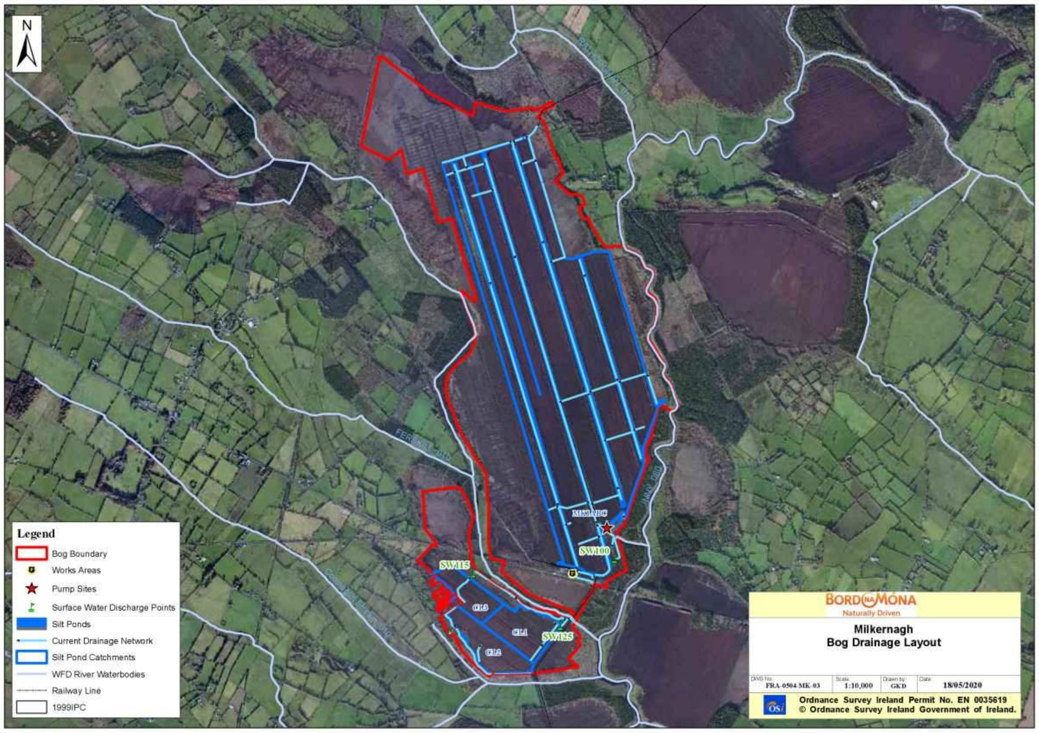


Figure 6.3.2 Milkernagh Bog Layout

From the records available, it appears that Bord na Móna commenced pre-development drainage of the Cuil na Gun bogs in 1947 and first produced peat on the bog in 1953. The land use surrounding the bog is comprised of peat harvesting on surrounding bogs and agriculture. There is a substantial amount of forestry present all around the site, particularly along the eastern boundary.

Only the smaller, southern portion of the bog is in active peat production. The area north of the R395 is now cutover or cutaway. There are some edge habitats present around the periphery of the bog. These edge habitats are typically remnant sections of raised bog and cutaway bog.

There is a small works area with peat loading facilities at the southern end of the bog, immediately adjacent to the R395, with access off the R395. This area includes basic welfare facilities and a peat outloading tippler for loading delivery HGVs. Levels in the area of the works compound are approximately 63.50mOD, with finished floor level of the welfare building at 63.459mOD. Levels over the southern area in active peat production are around 65.0mOD, whilst levels in the northern end of the bog adjacent to the River Inny are relatively low at 60 – 62.5mOD. Areas of remnant bog in the north and south are several metres higher than adjacent production fields.

In Milkernagh, there are four outfalls from the bog, with associated silt ponds, which discharge at the southern end of the site (SW100, 113 ,115 and 125). There is one pump site in the bog adjacent to outfall SW100, north of the R395 which houses two submersible pumps with a total power of 66kW, which operate on a duty and assist basis.

6.3.4 **Regional Hydrology**

The catchment area and water courses are shown in the figures below.

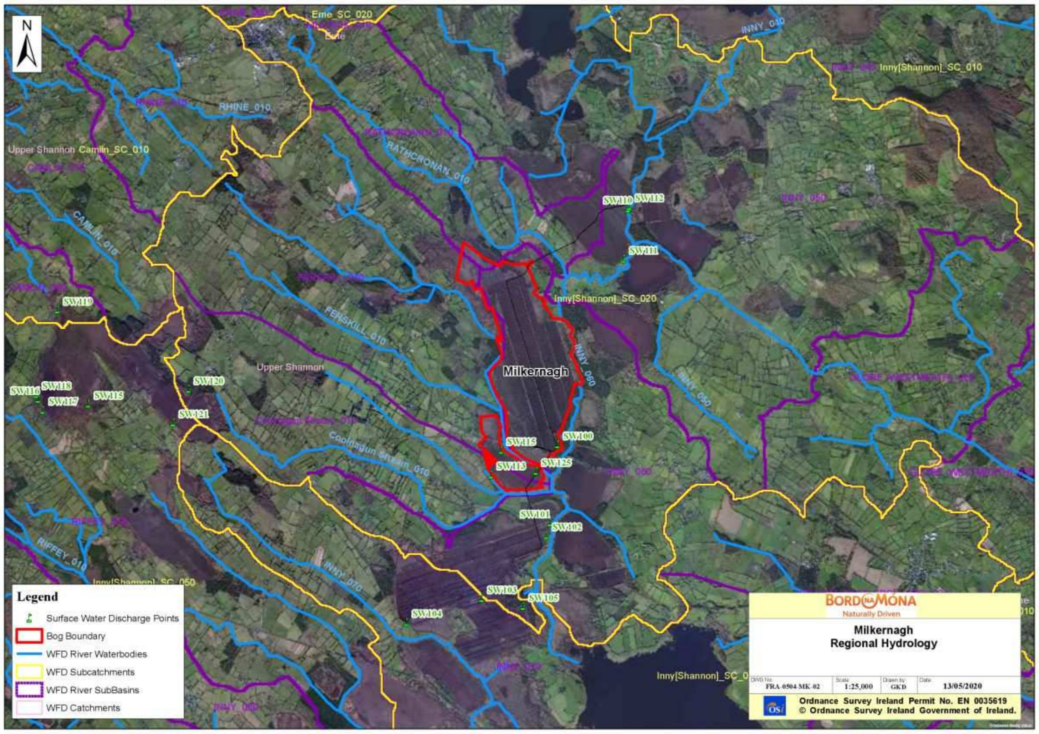


Figure 6.3.3 Milkernagh Bog Regional Hydrology

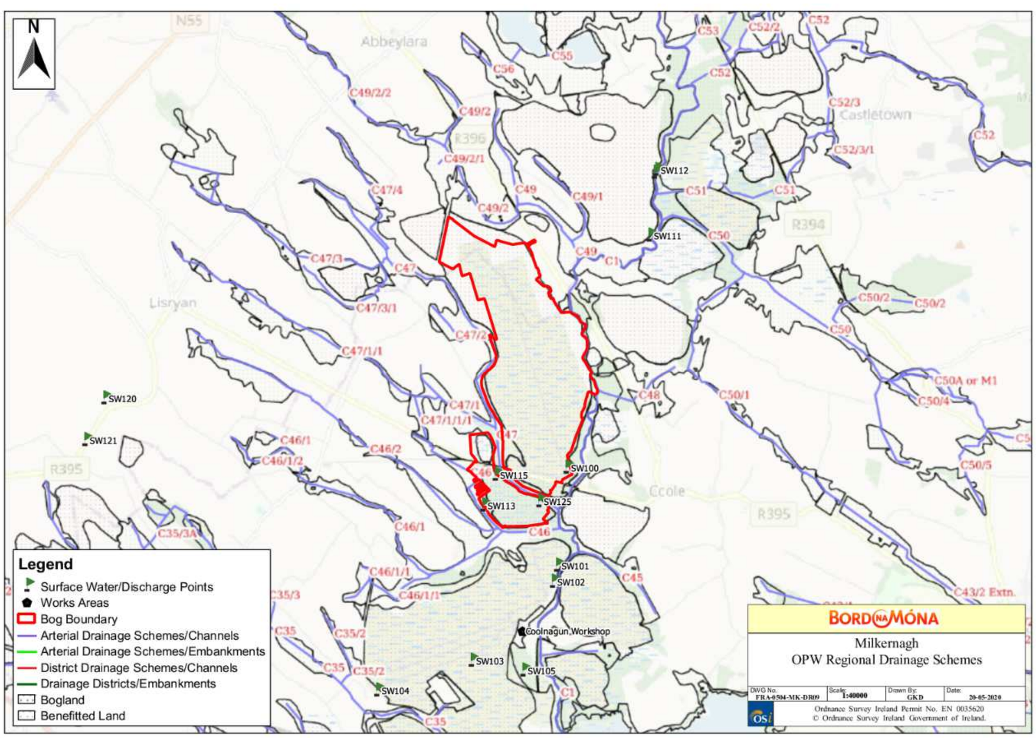


Figure 6.3.4 Milkernagh Bog District Drainage Schemes

Milkernagh Bog is within Upper Shannon (26F) catchment. The Upper Shannon catchment drains a total area of 1,229km² and is characterised by a southwestern region of flat, boggy land, an eastern region containing swarms of isolated relatively steep-sided hills and a northern section composed of more undulating topography entering the southern part of the drumlin belt. The catchment is generally underlain by impure limestones, although some karst has been identified in the lakes on the Meath-Westmeath border, with the northern part of the catchment underlain by metamorphic and volcanic rocks. An arterial drainage scheme was completed on the River Inny by the OPW between 1959 and 1963. The Upper Shannon (Inny) catchment comprises ten sub-catchments with 41 river water bodies, six lakes, and eight groundwater bodies. The Ferskill River runs along the western side of the site and the River Inny runs past the eastern boundary.

Three outfalls from this bog are located around the active peat production area at the southern end of the bog and a fourth is located to the north of the R395. In the south, water from outfall SW113 drains into the Coolnagun stream (CoolnagunStream_010), which discharges into the River Inny outside the southeast corner of the bog. Water from SW115 and SW125 drain into the Ferskill River (Ferskill_010), which also discharges to the River Inny (Inny_060). Finally, water from the outfall at SW100 drains into the River Inny (Inny_060) only 250m from the site boundary. All outfalls are within the WFD Sub-catchment Inny(Shannon)_SC_020. The River Inny itself discharges into the River Shannon at Lough Ree.

The Arterial Drainage and District Drainage schemes near Milkernagh Bog is shown in figures presented here. The benefitted land is also highlighted demonstrating the enhanced flood protection, as a result of this scheme, for the lands between the bog and the River Inny.

The Standard Annual Average Rainfall (SAAR) in this location is 994mm.

6.3.5 **Historical Flooding**

A map of historical flooding is shown in the Figure.

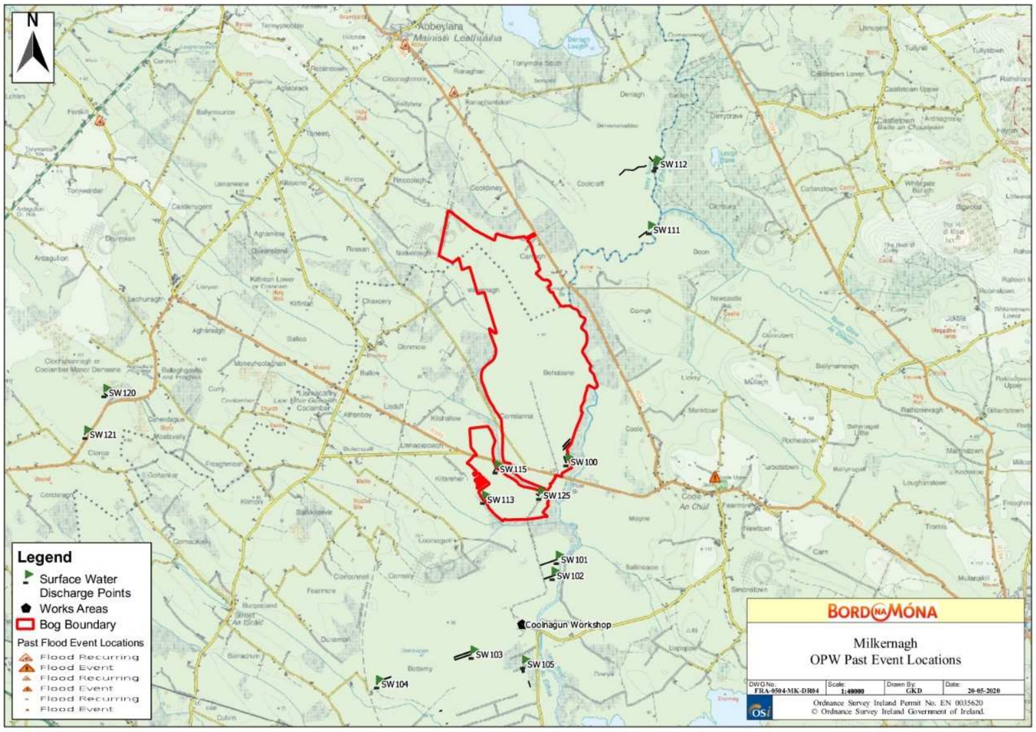


Figure 6.3.5 Milkernagh Bog Historical Flooding

Information from Bord na Móna operatives suggests that surface water flooding has occurred on this bog in the past. This is known to occur during winter months should surface water pumps fail to operate. It is also known locally that surface water flooding can occur where blockages to the existing drainage network have occurred over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production fields on an annual basis as part of the winter works schedule.

Historical flood records are taken from the OPW website, https://www.floodinfo.ie. Records of past rainfall flood events are given for one location at Coole in 2004. This was where intense rainfall flowing downhill caused some local damage. The local authority report notes that Coole is generally not a high flood risk. This location is approximately 2.5km from the site boundary.

Satellite imagery from a flood event in 2009 (recorded 30/11/2009) identifies flooding in the area of the River Inny to the east of the site and Loch Derravaragh to the southeast. It also identifies local flooding in the centre of the site.

Historical OSI 25” mapping was also examined for this area. There is no additional record of flooding to be taken from these maps for Milkernagh bog although there is an area of water and reeds identified in a low area on the eastern side of the site where there is currently an outfall (SW100)

6.3.6 **Groundwater Flood Risk**

A map of aquifers, karst features and known wells is shown in the Figure.

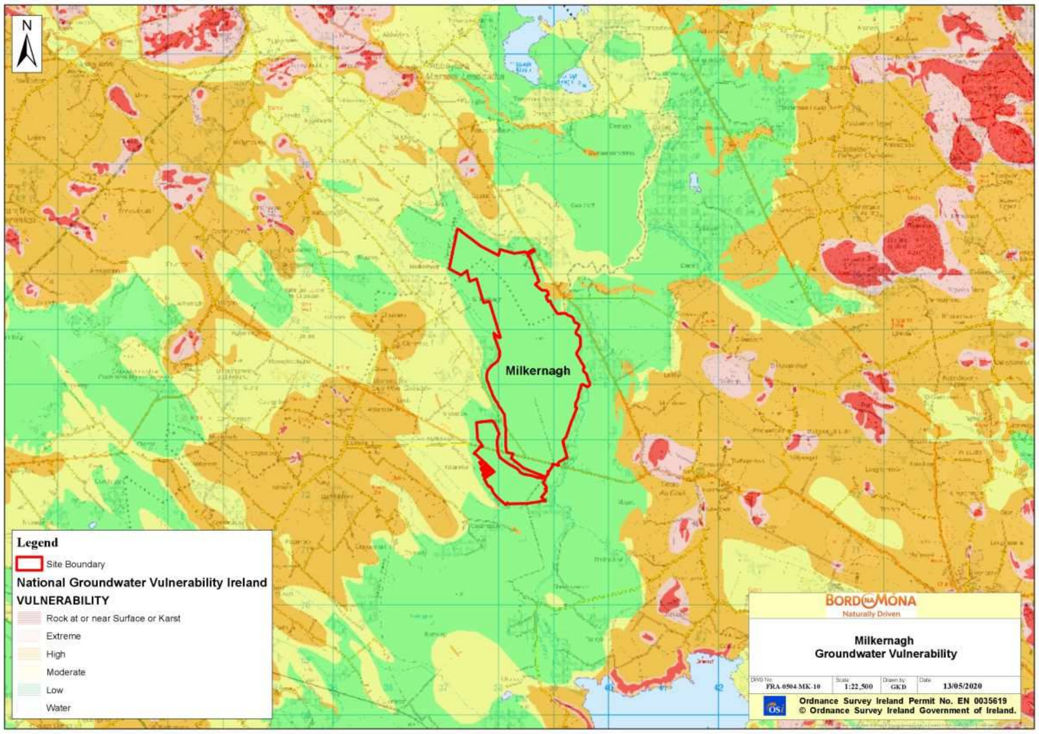


Figure 6.3.6 Milkernagh Bog Groundwater Vulnerability

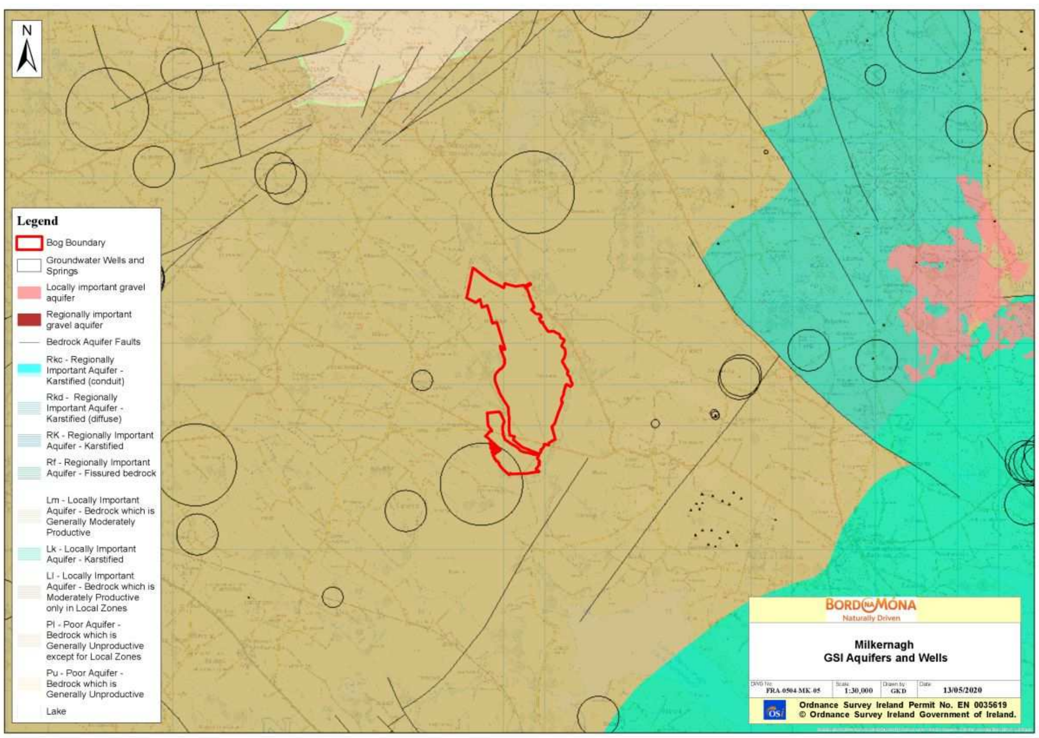


Figure 6.3.7 Milkernagh Bog Aquifers, Karst Features, Wells

There is a single aquifer underlaying the Milkernagh Bog area. This is known as a *Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll).* Groundwater vulnerability rating for the area is given as Low across entire bog.

There are records of a number of wells to the south, likely to be serving residential properties between Milkernagh bog and Coolnagun bog. There is no record of any karst features in the area.

There are no Bord na Móna records or local anecdotal evidence to suggest groundwater flooding has occurred at this bog.

6.3.7 Fluvial Flood Risk

CFRAM flood mapping is shown in the Figure below.

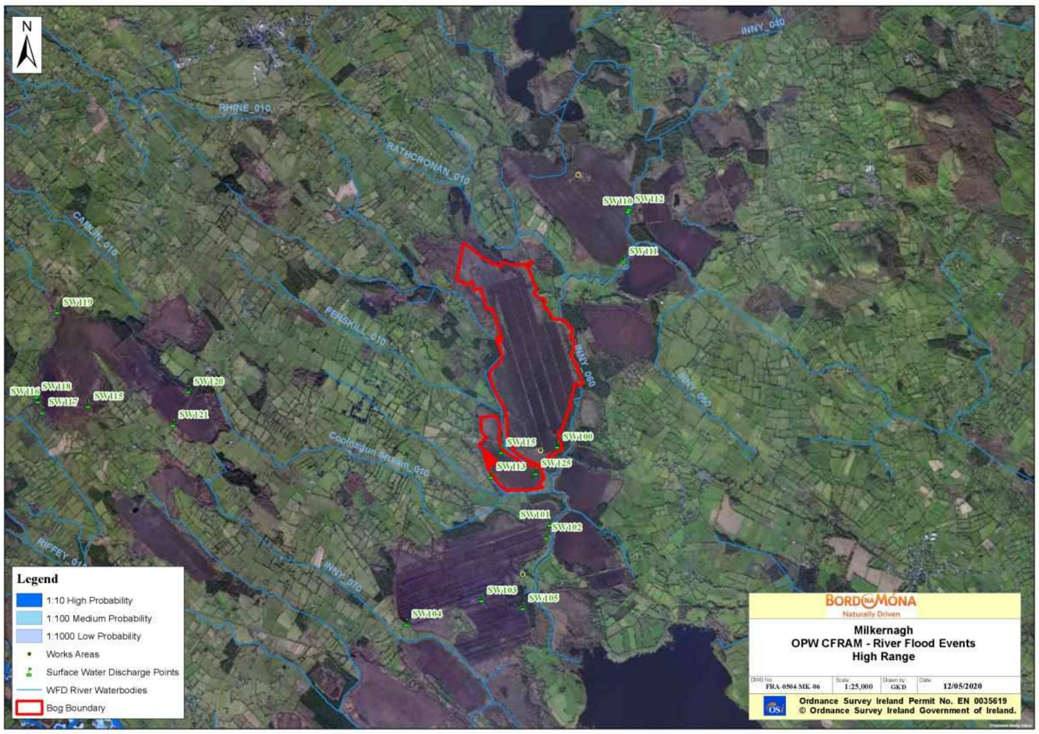


Figure 6.3.8 Milkernagh Bog CFRAM Flood Mapping

The rivers and streams in the vicinity of Milkernagh bog are described in terms of regional hydrology in section 6.3.4.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with the 'High-End Future Scenario extents' (generated taking in the potential effects of climate change using an increase in rainfall of 30% and sea level rise of 1,000 mm (40 inches))

Flooding is identified in the River Inny immediately south of Ballinalack, approximately 8.5km southwest of the site. There is no flooding identified further upstream of this location. There is no risk of flooding identified within the Milkernagh Bog boundary.

Information from Bord na Móna operatives indicates that levels in the Inny River have risen above the outfall levels and caused water to back-up into the outfalls from the bog. In such an event, outfalls would become submerged if water levels in receiving water were to rise.

The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

Surface Water Outfall ref:	Pipe Diameter (m)
SW100	0.600
SW113	0.450
SW115	0.450
SW125	0.450

Table 6.3.1 - Milkernagh Bog Surface Water Outfalls

It is noted that the limited pipe diameters at outfalls will also restrict run-off rates from the bog to the receiving waters.

6.3.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100 year and 1000 year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices.

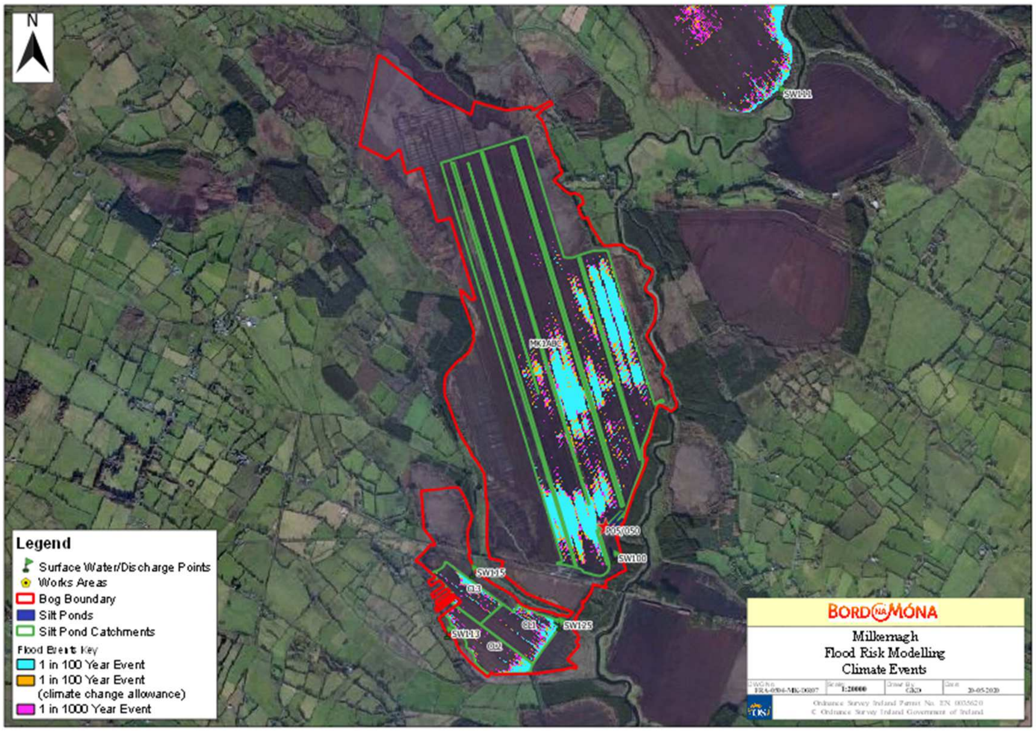


Figure 6.3.9 Milkernagh Bog Pluvial Flooding, Rainfall Events

Flooding modelling carried out for Milkernagh bog is presented here. The basins used in the model are the extent of the catchments that discharge through the surface water discharge points in the bog. Cuil na Gun Bog is modelled for four basins, MK1ABS, CL1, CL2 and CL3. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

From the modelling, it can be seen that surface water flooding is predicted mainly in the centre and along the eastern side of Milkernagh bog. There are also some areas predicted to flood around the periphery of the southern parts of the bog, south of the R395. The 1 in 1000-year event was the most onerous in terms of flood levels. The maximum predicted flood levels in the centre and east of the site is 60.57mOD, with maximum flood levels south of the R395 of 64.42mOD. Catchments are separated within the bog by topographical features such as ridges in surface levels and locally elevated rail lines and local elevated peat fields.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	CL1	CL2	CL3	MK1ABC
mOD	m^3	m^3	m^3	m^3
59.00	0	0	0	1025
59.25	0	0	0	4698
59.50	0	0	0	15330
59.75	0	0	0	41285
60.00	0	0	0	91390
60.25	0	0	0	175418
60.50	0	0	0	304869
60.75	0	1	0	490530
61.00	0	8	0	
61.25	1	19	0	
61.50	5	32	0	
61.75	20	47	4	
62.00	67	66	15	
62.25	179	95	40	
62.50	513	144	95	
62.75	1217	216	188	
63.00	2553	331	388	
63.25	5037	656	778	
63.50	9743	1422	1455	
63.75	17994	2875	2635	
64.00	31255	5257	4734	
64.25		9127	8333	
64.50		15337	14161	
64.75		25107	23744	

Table 6.3.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Milkernagh Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

Milkernagh bog has pumping of surface water from low lying areas. These pumps have been dis-regarded for the flood modelling of the extreme rainfall events set out above as these pumps are not designed for such events. The pump site at Milkernagh has a capacity of 66kW and has an outlet level of 61.282mOD.

Figure 6.3.10 Milkernagh Bog Pluvial Flooding, Pump Failure

At Milkernagh bog, the pump site is located upstream of the silt ponds and outfall SW100, with a gravity flow from the outfall into receiving waters. In the event that a pump fails, the surface water will pond in low lying areas on the bog to a level where it can discharge by gravity flow. The above figure models the flooding that will occur in the event that these pumps are turned off or breaks down. The expected flood water level in this situation is plotted in red. The flooding caused by the failure of this pump will be retained within the bog peat production area.

Levels in the area of the works compound are approximately 63.50mOD, which is above the maximum predicted flood level in both the 1 in 1000year flood event and in the case of failure of surface water pumps. While the modelled flood level in the southern catchments exceed the finished floor level these are separated from the Works Area by a river, high bog and a road and will not cause flooding in the Works Area.

As discussed in section 6.3.5, local anecdotal evidence indicates that a low area in the centre of this bog is prone to local flooding when surface water pumps fail to operate. This is in line with the modelling results where the pumped location is indicative of a low-laying area within the bog.

6.3.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 6.3.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100 year event (+ 30% climate change allowance (High*

End Emissions Scenario). In the climate change model run case the maximum rainfall for the 100 year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000-year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 6.3.7, the High-Emissions Future Scenario (HEFS) has been considered which takes in account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

6.3.10 **Conclusions**

The Flood Risk Assessment for Milkernagh Bog identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** There are records of local flooding having occurred within the peat production areas of the bog. However from local knowledge, flooding of the peat production area has occurred locally where levels in the River Inny have risen above the outfall levels, where pumps have failed to operate in the past or where drains have become blocked internally
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelling carried out indicated that the estimated 1000 year flood event would not lead to flooding to the works area in the southern end of the bog

This Flood Risk Assessment indicates that the works area in the southern end of the site is not at risk of flooding from a 1000year event and therefore can be considered to be in a Low Risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Milkernagh Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 6.3.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
    - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
    - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
    - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
    - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Milkernagh Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities (all within the works compound on the southern end of the site) are located in an area of higher ground that is not at risk of flooding in a 1 in 1000year event and consequently potential risk of pollution as a result of flooding is minimal.:
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Milkernagh Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

6.4 Coolcraff Bog

6.4.1 **Introduction**

Coolcraff bog is part of the Bord na Móna Mountdillon Bog Group which operates under an Integrated Pollution Control License (ref P0504-01). This bog supplies horticultural peat and has a permanent rail line that connects it to Milkernagh bog and Coolnagun bog to the south. The total area of the bog is 412 Ha.

6.4.2 **Site Location**

The Coolcraff Bog site location is highlighted in red in the Figure below.

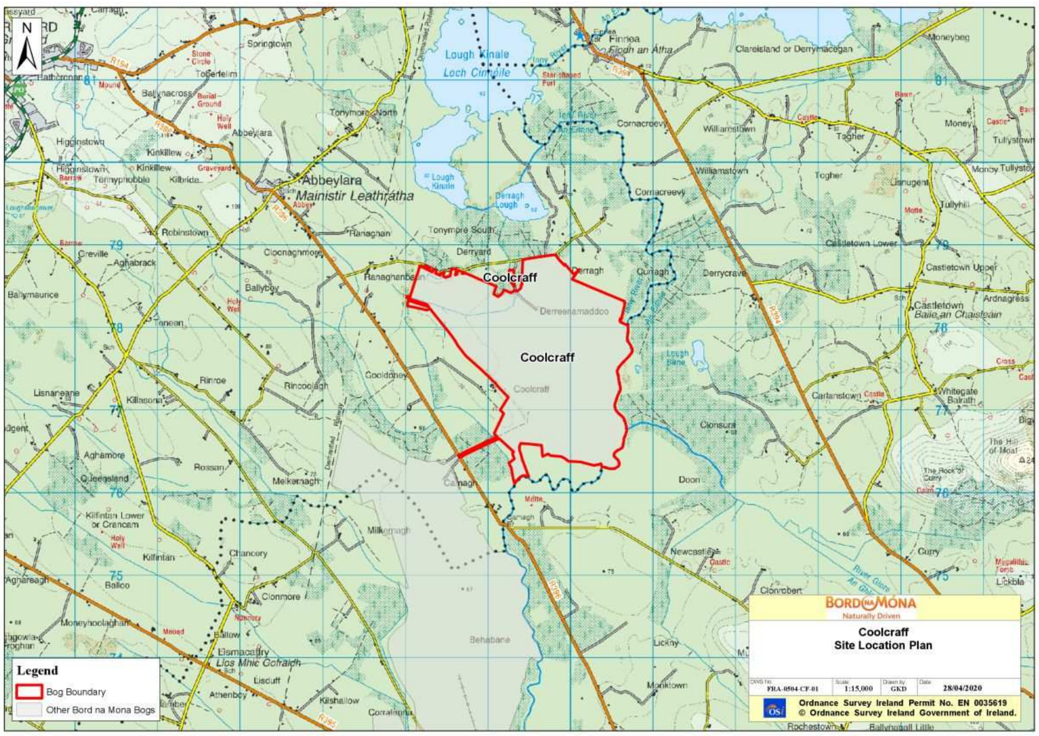


Figure 6.4.1 Coolcraff Bog Site Location

Coolcraff Bog is located in Co Longford and is approximately 4 km northwest of Coole and 5km southeast of Granard. This bog is one of a cluster of six Bord na Mona bogs in the Coole area of Co. Longford and Co. Westmeath. The R396 regional road passes the southern boundary of the site in a northwest-southeast direction.

6.4.3 **Bog Description**

Pre-development gravity drainage commenced in Coolcraff Bog in 1981 and peat production then first took place in 1989. The land use surrounding the bog is comprised of peat harvesting on surrounding bogs, forestry and agriculture.

The majority of the site is in active peat production. There are some edge habitats present around the periphery of the bog. These edge habitats are typically remnant sections of raised bog and cutaway bog.

The site is accessed via a machine and rail level crossing on the R396 at the southern end of the site. There is a small welfare centre at the northern end of the site with a portacabin at a finished floor level of 68.694mOD. Levels typically fall from approximately 68.0mOD in the north to 65.2mOD in the south. Areas of remnant bog in the north and south are several metres higher than adjacent production fields.

In Coolcraff, there are three outfalls from the bog, with associated silt ponds, which discharge at the southern and western boundaries of the site (SW110, 111 and 112). There are no pumps in this bog, with all drainage via gravity discharge.

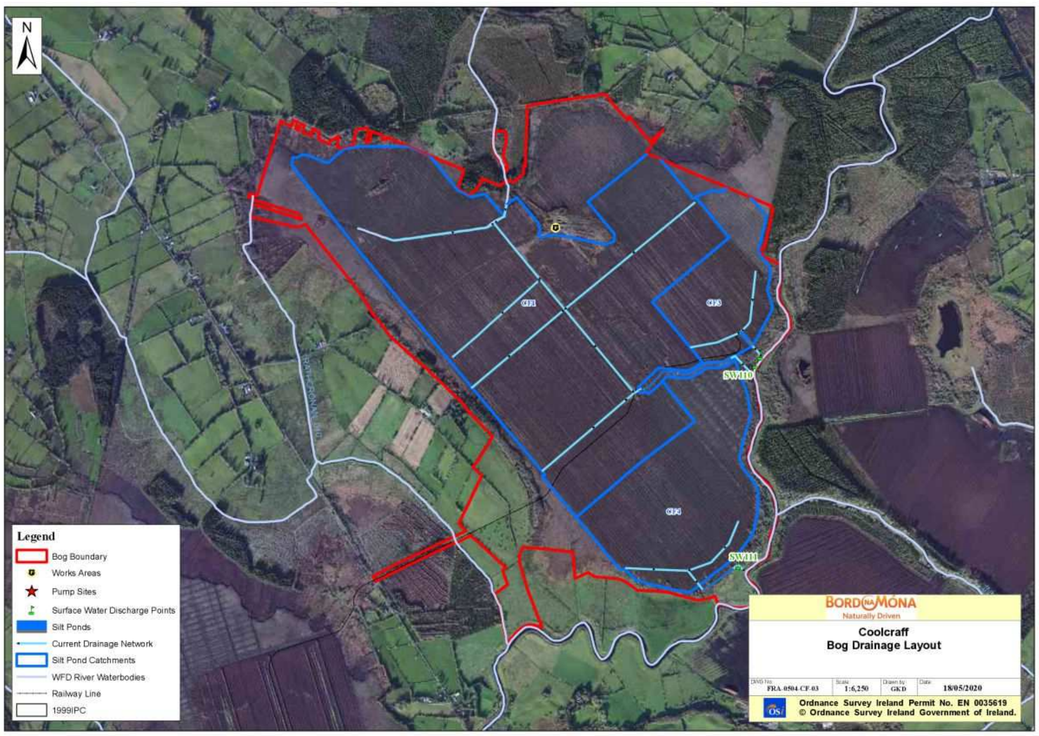


Figure 6.4.2 Coolcraff Bog Drainage Layout

6.4.4 **Regional Hydrology**

Coolcraff Bog is within Upper Shannon (26F) catchment. The Upper Shannon catchment drains a total area of 1,229km² and is characterised by a southwestern region of flat, boggy land, an eastern region containing swarms of isolated relatively steep-sided hills and a northern section composed of more undulating topography entering the southern part of the drumlin belt. The catchment is generally underlain by impure limestones, although some karst has been identified in the lakes on the Meath-Westmeath border, with the northern part of the catchment underlain by metamorphic and volcanic rocks. An arterial drainage scheme was completed on the River Inny by the OPW between 1959 and 1963. The Upper Shannon (Inny) catchment comprises ten sub-catchments with 41 river water bodies, six lakes, and eight groundwater bodies.

The River Inny (Inny_050) runs past the eastern boundary of the bog, with the Rathcronan and Tony_more watercourses also draining the areas adjacent to the bog. Two small lakes known as Derragh Lough and Lough Kinale are present to the north.

The three outfalls from this bog are located along the eastern boundary of the bog. Each discharge directly into the River Inny (Inny_050), immediately outside the bog boundary. All outfalls from this bog are within the WFD Sub-basin Inny_050 and sub-catchment Inny(Shannon)_SC_020.

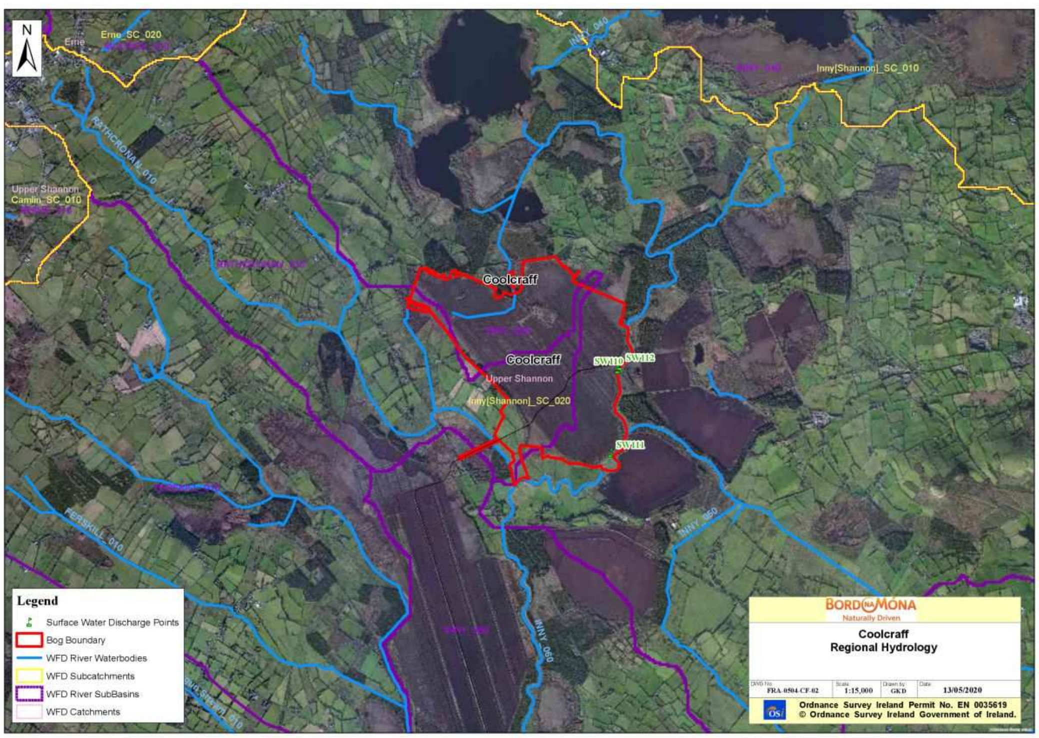


Figure 6.4.3 Coolcraff Bog Regional Hydrology

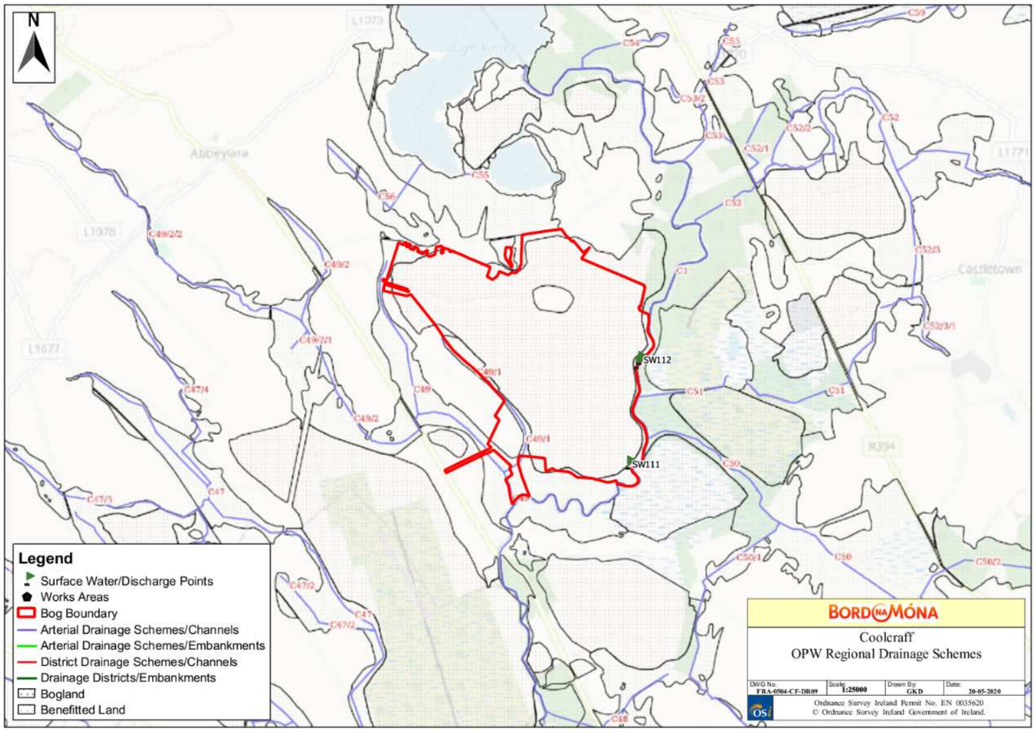


Figure 6.4.4 Coolcraff Bog District Drainage Schemes

The Arterial Drainage and District Drainage schemes near Coolcraff Bog are shown in the Figure above. The benefitted land is also highlighted demonstrating the enhanced flood protection, as a result of this scheme, for the lands between the bog and the River Inny.

The Standard Annual Average Rainfall (SAAR) in this location is 1001mm.

6.4.5 **Historical Flooding**

A map of historical flooding is shown in the Figure below.

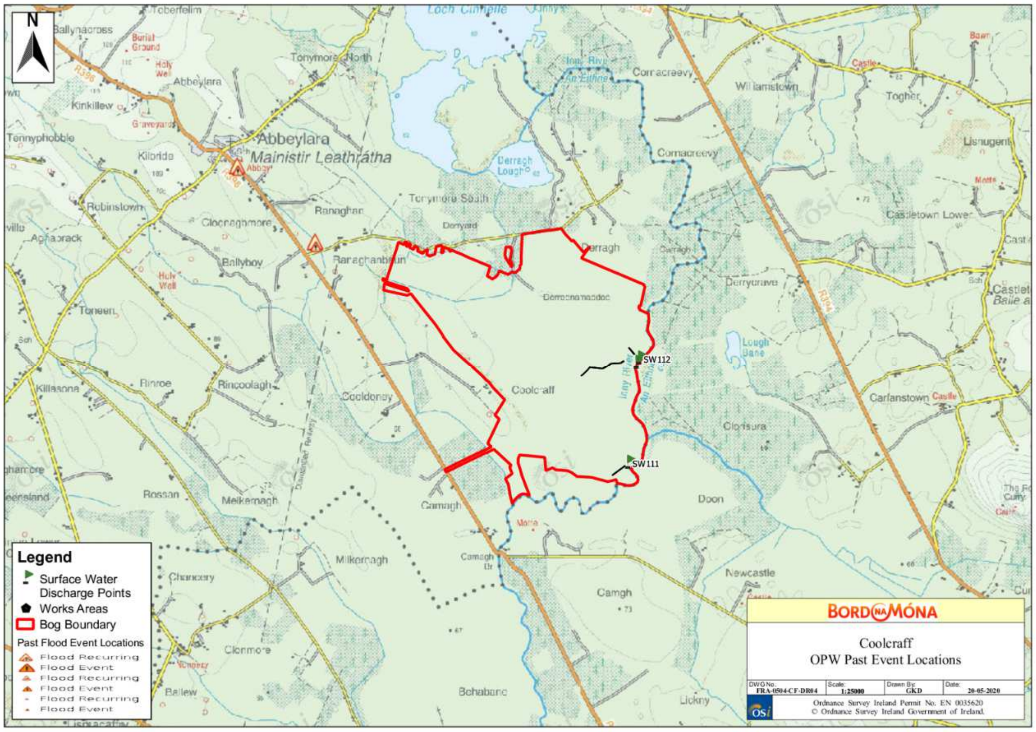


Figure 6.4.5 Coolcraff Bog Historical Flooding

There is no anecdotal evidence to suggest flooding at this bog, nor is there any local knowledge of flooding. It is accepted that local surface water flooding can occur where blockages to the existing drainage network occur over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production fields on an annual basis as part of the winter works schedule. There is no knowledge of flooding where water levels in receiving waters rise above outfall levels or where levels in the River Inny have risen above the levels of its banks.

Historical flood records are taken from the OPW website, https://www.floodinfo.ie. Records of past rainfall flood events are given for one location at Coole in 2004 and at two locations in Abbeylara from 2005. Both events were due to heavy rainfall. The closest of these was at Abbeylara, which is approximately 3km north of the site boundary. Minutes from a Local Authority meeting in 2005 note that the river "overflows its banks every year after heavy rain." It also notes that "the road is liable to flood and a pub can be affected."

Historical OSI 25" mapping was also examined for this area. There is no additional record of flooding to be taken from these maps for Coolcraff bog.

6.4.6 **Groundwater Flood Risk**

A map of aquifers, karst features and known wells is shown in the Figure.

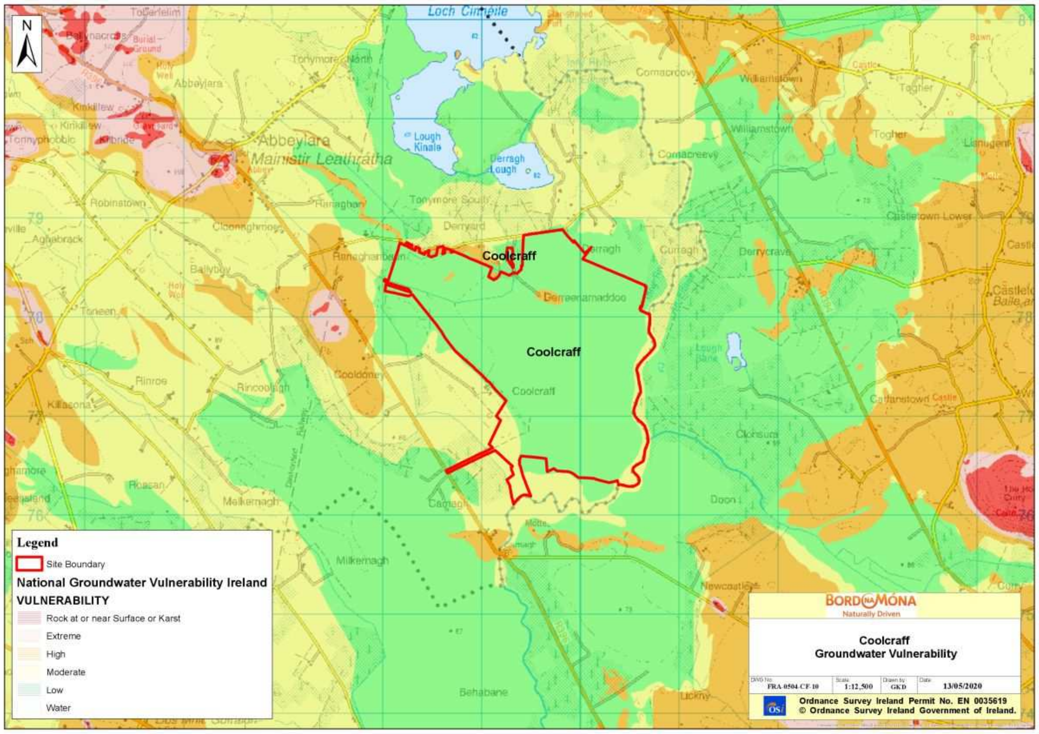


Figure 6.4.6 Coolcraff Bog Groundwater Vulnerability

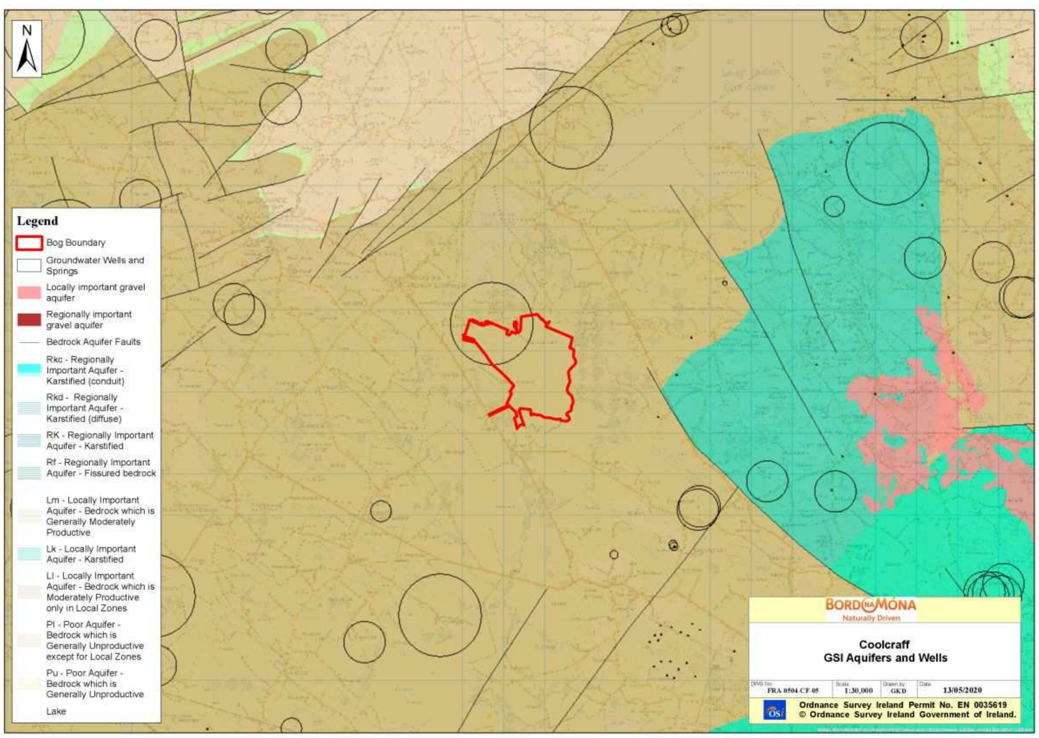


Figure 6.4.7 Coolcraff Bog Aquifers, Karst Features, Wells

There is a single aquifer underlaying the Coolcraff bog area. This is known as a *Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll).* Groundwater vulnerability rating for the area is given as Low across the majority of the bog although there is a relatively small local area in the northern end of the bog which is given a High vulnerability rating.

There is a single borehole well identified outside the northern boundary of the site. There is no record of any karst features in the area.

There are no Bord na Móna records or local anecdotal evidence to suggest groundwater flooding has ever occurred at this bog.

6.4.7 **Fluvial Flood Risk**

CFRAM flood mapping is shown in the Figure below.

Figure 6.4.8 Coolcraff Bog CFRAM Flood Mapping

The rivers and streams in the vicinity of Coolcraff bog are described in terms of regional hydrology in section 6.4.4.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with the 'High-End Future Scenario extents' (generated taking in the potential effects of climate change using an increase in rainfall of 30% and sea level rise of 1,000 mm (40 inches))

Flooding is identified in the River Inny immediately south of Ballinalack, approximately 13km southwest of the site. There is no flooding identified further upstream of this location. There is no risk of flooding identified within the Coolcraff Bog boundary.

There are no Bord na Móna records or local anecdotal evidence to suggest fluvial flooding has ever occurred at this bog. In such an event, outfalls would become submerged if water levels in receiving water were to rise. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events. Any such flow into the bog would be limited to the capacity of the outfall pipe. It is noted that the limited pipe diameter will also restrict run-off rates from the bog to the receiving waters.

6.4.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100 year and 1000 year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices.

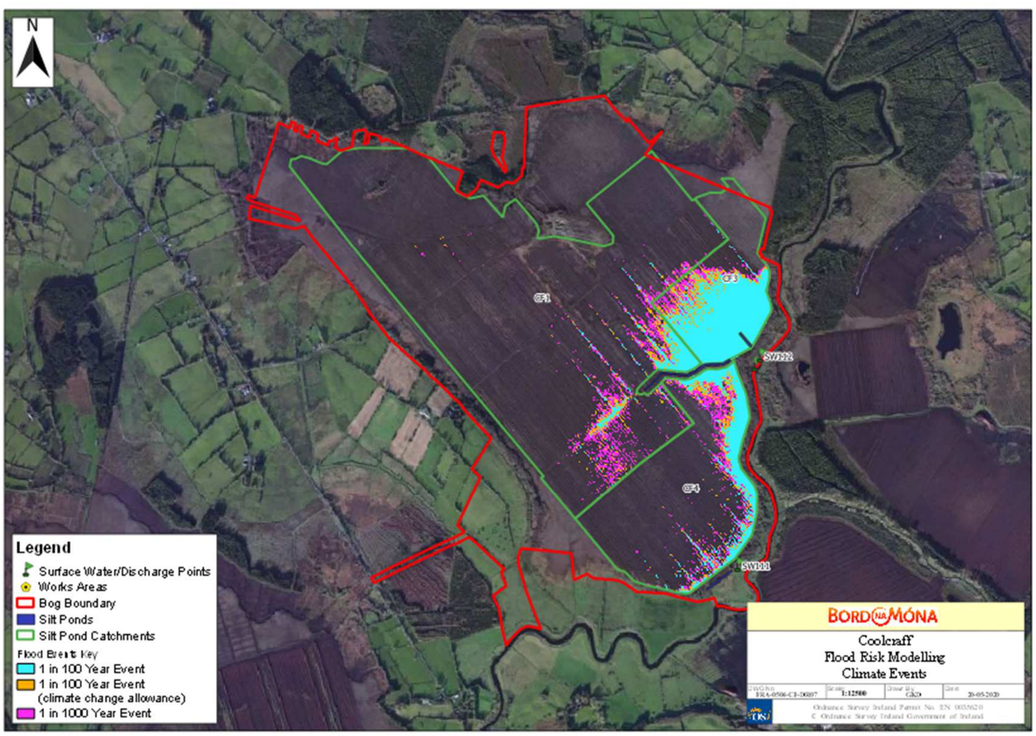


Figure 6.4.9 Coolcraff Bog Pluvial Flooding, Rainfall Events

Flooding modelling carried out for Coolcraff bog is presented here. The basins used in the model are the extent of the catchments that discharge through the surface water discharge points in the bog. Cuil na Gun Bog is modelled for two basins, CF1&CF3 and CF4. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

From the modelling, it can be seen that surface water flooding is predicted for areas along the eastern side of bog. This is to be expected given the topography of the bog. The 1 in 1000-year event was the most onerous in terms of flood levels. The maximum predicted flood level was 65.3mOD. Catchments are separated within the bog by topographical features such as ridges in surface levels and locally elevated rail lines and local elevated peat fields.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

Access to the site is taken from the rail link and machine pass on the western side of the site which does not appear to be affected by predicted flooding. The welfare centre at the northern end of the site is in an area not predicted to be impacted by flooding.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

Level	***CF1andCF3***	***CF4***
mOD	***m^3***	***m^3***
63.00	4164	606
63.25	8768	1239
63.50	17040	2633
63.75	30398	5396
64.00	49907	10475
64.25	76123	19838
64.50	109812	35651
64.75	152661	61007
65.00	206055	100091
65.25	273811	
65.50	365619	

Table 6.4.1 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Coolcraff Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

6.4.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 6.4.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100 year event + 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case the maximum rainfall for the 100 year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000-year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 6.4.7, the High-Emissions Future Scenario (HEFS) has been considered which takes in account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

6.4.10 **Conclusions**

The Flood Risk Assessment for Coolcraff Bog identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area has occurred locally where drains have become blocked internally.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the receiving waters into which they are discharging are high. There is no record of this having occurred previously on this site. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the river.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. Modelling carried out indicated that the estimated 1000 year flood event would not lead to flooding to the welfare centre of access points to the site.

This Flood Risk Assessment indicates that the welfare centre in the northern end of the site is not at risk of flooding from a 1000year event and therefore can be considered to be in a Low Risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Coolcraff Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 6.4.2 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design,*

implementation and funding of any future flood risk management measures and provisions for emergency services access; and

(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.

Following on from the completion of this flood risk assessment for Coolcraff Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the main point of access for the site and the welfare centre is located in an area of higher ground that is not at risk of flooding in a 1 in 1000year event.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Coolcraff Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

FLOOD RISK ASSESSMENT – CHAPTER 7
Kilberry Bog Group

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7 FLOOD RISK ASSESSMENTS – KILBERRY BOG GROUP

7.1 Kilberry Bog Group - IPC License 506

The Kilberry group of bogs in County Kildare are sited between Clane, Co. Kildare in the east to Monasterevin, Co. Kildare in the west and between Johnstown Bridge, Co. Kildare in the North and Athy, Co. Kildare in the South. Bord na Móna's licence for the Kilberry Bog Group (Ref. PO506-001) was granted to Bord na Móna Energy Limited on 26th April 2000 and regulates Bord na Móna's activities across 5 bog units. Of these 5 bogs units, 4 are included in the Substitute Consent applications and in this Flood Risk Assessment Report. The 4 Kilberry bogs included in this report are:

- Gilltown – County Kildare
- Allen – County Kildare
- Prosperous – County Kildare
- Kilberry – County Kildare

The bogs are located in the River Barrow 14, River Boyne 07 and River Liffey and Dublin Bay 09 catchments.

Development of Kilberry bog commenced in the 1940's with the bog in production in the 1950s. Drainage development commenced in Allen Bog in the 1960s, in Gilltown in the 1970s and in Prosperous Bog in the 1990s. Peat from all four Kilberry bogs is used for horticultural purposes.

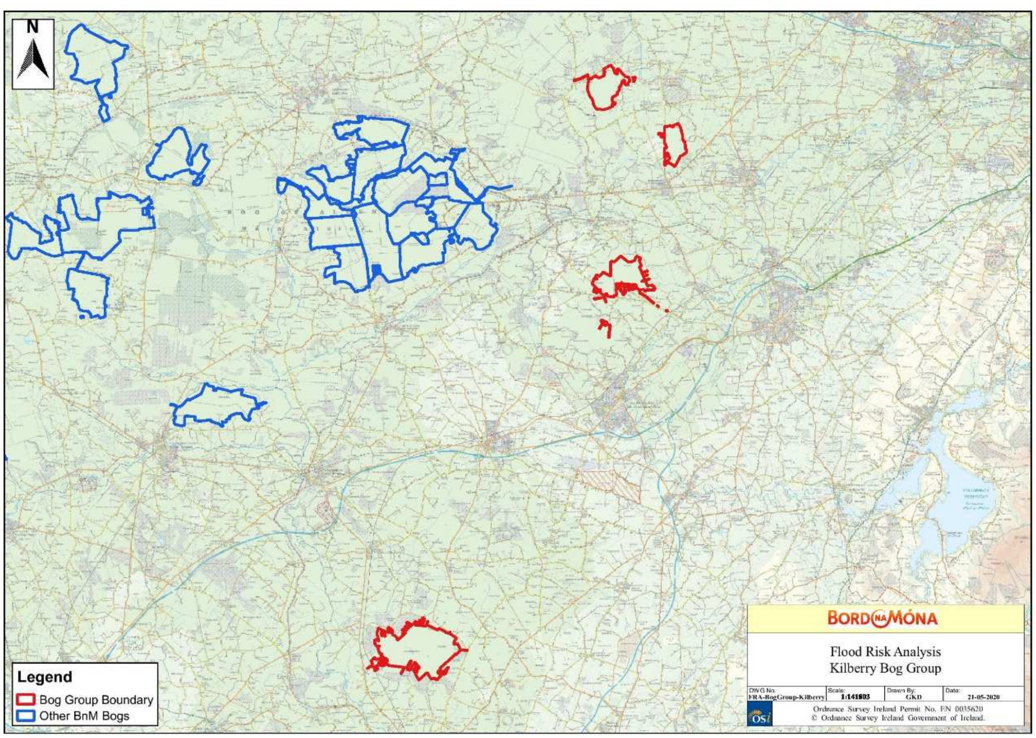

Figure 7.1-1 - FRA, Kilberry Bog Group

7.2 Gilltown

7.2.1 Introduction

Gilltown Bog is part of the Bord na Móna Kilberry Bog Group which operates under an Integrated Pollution Control licence (ref P0506-01). The Bog is used primarily to produce milled horticultural peat and the total area within Bord na Móna ownership is 344 hectares.

7.2.2 Site Location

Gilltown Bog is a production bog in County Kildare located circa 6 km north of Prosperous Village. The bog is accessed via the L1017 local road at the north of the site. The site location is highlighted in red in the figure below.

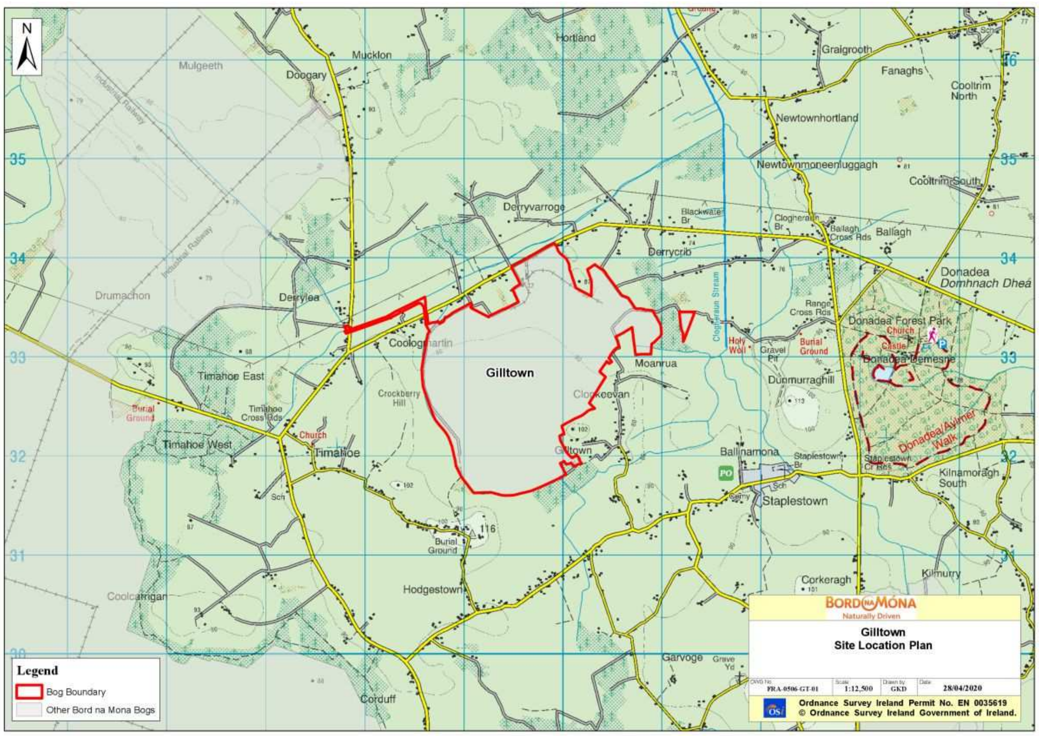

Figure 7.2-1 Gilltown Bog Site Location

7.2.3 Bog Description

Gilltown bog is used primarily for the production of milled horticultural peat. From the records available it appears that drainage of Gilltown bog began in 1977, and peat production commenced in 1982. There are cutaway areas in the bog that are no longer in active production and there are areas colonised with birch and remnants of raised bog remaining around the margins. The land use surrounding the bog is primarily comprised of agriculture lands with some mature Coillte woodlands present also.

There is a peat outloading facility at the northern end of the site which includes a workshop, welfare facilities and a mechanical tippler for outloading peat to HGVs, which is accessed via the L1017 local road. The existing finished floor levels of the buildings at the outloading facility range from 75.45mOD to 76.00mOD. The topography of the bog itself falls in a northerly direction with levels ranging from circa 82mOD in the southern part of the site falling to circa 74.6mOD in the northern part of the site. The existing ground level of the railway line embankment between the Works Area and the adjacent low lying bog is generally at a level of above 77mOD.

Gilltown bog is divided into three drainage basins that each drain to separate surface water gravity outfalls at the north, south and east of the site. There are no pumped outfalls in Gilltown bog. The bog drainage layout is shown in the figure below.

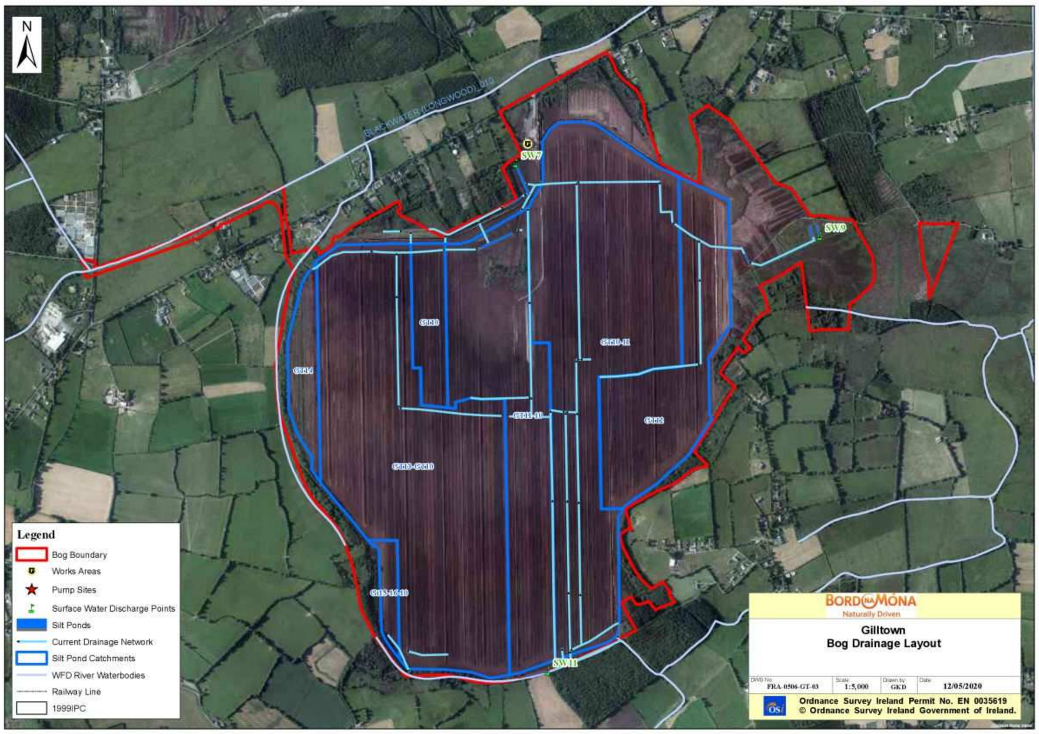

Figure 7.2-2 Gilltown Bog Drainage Layout

7.2.4 **Regional Hydrology**

Gilltown bog is within in the Boyne 07 catchment (Hydrometric Area 07). The Boyne 07 catchment drains an area of 2694km² and is underlain by metamorphic rocks in the north and limestone bedrock in the centre and south of the catchment. There are extensive sand and gravel areas in this catchment, particularly along the upper reaches of the Boyne. The Boyne catchment comprises 20 sub catchments with 114 river water bodies, 11 lakes, one transitional and three coastal water bodies, and 25 groundwater bodies

Gilltown bog is divided into three drainage basins that each drain to separate surface water gravity outfalls, with associated silt ponds. All three outfalls discharge to watercourses that drain into to the Blackwater(Longwood)_010 sub basin in the Blackwater (Longwood)_SC_010 sub catchment. The SW7, SW9 and SW11 outfalls discharge to watercourses at the north, east and south of the bog respectively.

The catchment area and water courses are shown in Figure 7.2.3 The district drainage schemes are shown in Figure 7.2.4.

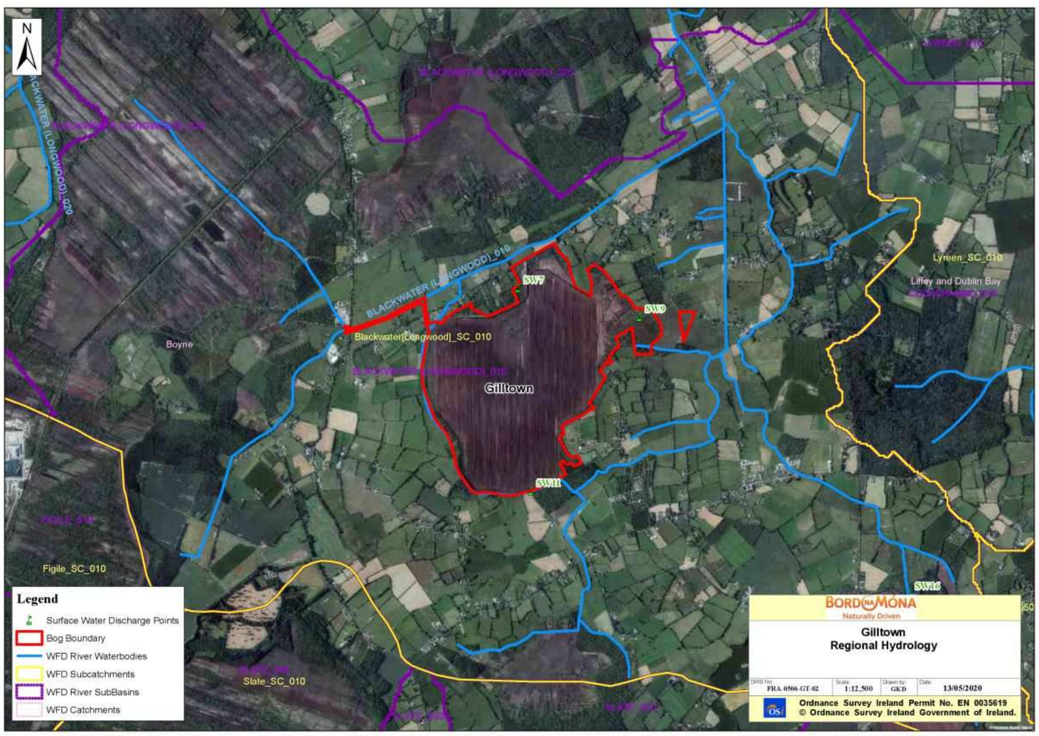

Figure 7.2-3 Gilltown Bog Regional Hydrology

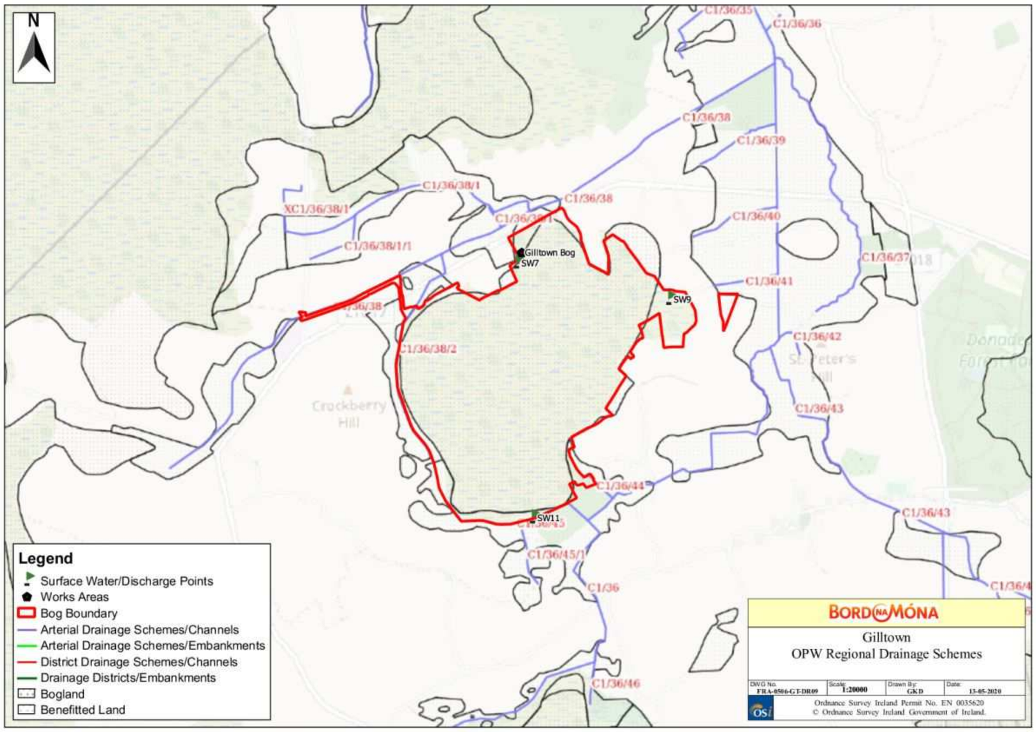

Figure 7.2-4 Gilltown Bog Drainage Schemes

7.2.5 **Historical Flooding**

A map of historical flooding is shown in the Figure.

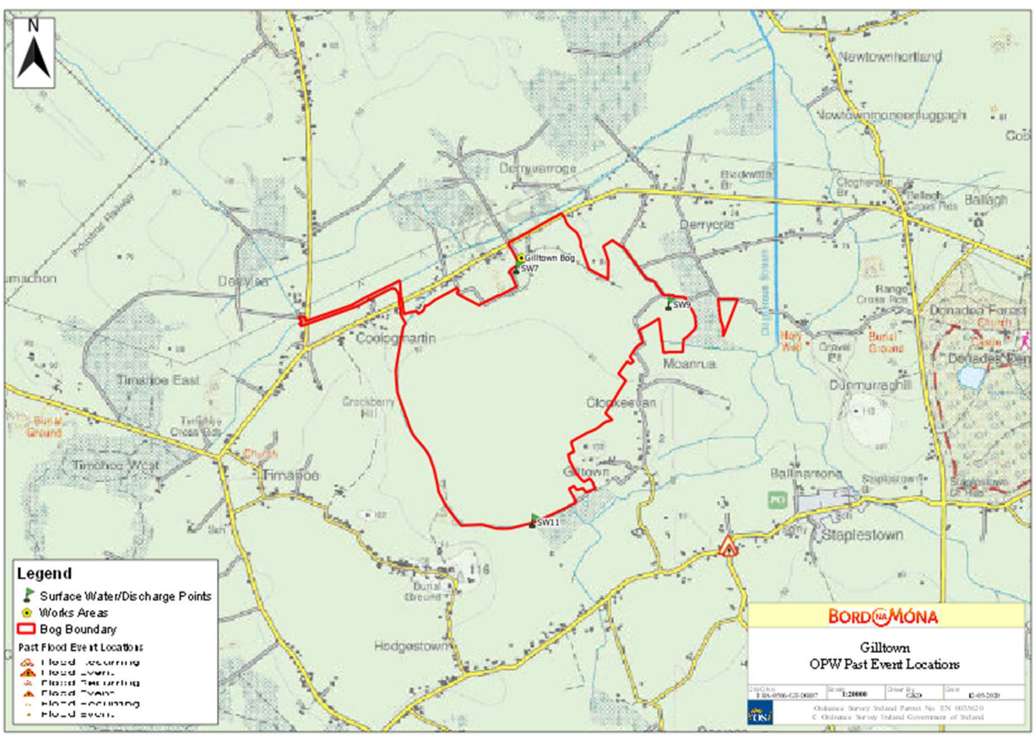

Figure 7.2-5 Gilltown Bog Historical Flooding

Local operations knowledge indicates that flooding of the works area or the production fields is not known to have occurred within Gilltown bog due to the receiving waters backing up, but confirmed that surface water flooding of the production fields has, on occasion occurred during winter months and have been associated with blockages in the existing bog drainage network. Local operations indicated that historically there was occasionally some minor flooding at a low-lying field north of the outfall SW7 due to high water levels in the drainage channel. This issue was addressed through modifications to the internal gravity drainage network in the bog. Drainage maintenance works are carried out annually as part of the winter works schedule to minimise flooding to the peat production fields. The car park and buildings at the works area have not been known to flood.

The OPW website, floodinfo.ie indicates that there are several areas within a few kilometres of Gilltown bog that are liable to flooding. Records of past flood events are given for locations at Staplestown at Mill Pond, Newtown, Timoltan/Fanagh and Knockanally. The closest flooding events occurred at Staplestown at Mill Pond and Newtown, which are approximately 1.5km southeast and 3km northeast of the bog respectively. These recurring events were recorded in 2005 in an oral report given by Kildare Co. Council as part of an OPW project (OPW Flood Hazard Mapping – Phase 1). The report notes for Staplestown at Mill Pond – '*Mill pond over flows after heavy rain a couple of times per year. County road is liable to flooding'.*
And notes for Newtown – '*River Blackwater overflows its banks after heavy rain. This occurs every year.'*

Historical OSI 25" maps do not indicate any additional areas liable to flooding in the vicinity of Gilltown bog.

7.2.6 **Groundwater Flood Risk**

There are two groundwater aquifers underlaying the Gilltown bog area. The majority of the bog is underlain with an aquifer that is categorised as a *Locally Important Aquifer - Bedrock which is Generally Moderately Productive (Lm).* To the south there is an area of the bog that is underlain with an aquifer that is categorised as a *Locally Important Aquifer – Karstified (Lk).* Both of these aquifers have a low vulnerability code. There is no record of any karst landforms within the bog or its surrounds.

There are no Bord na Móna records or local anecdotal evidence to suggest groundwater flooding has occurred in Gilltown bog.

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below:

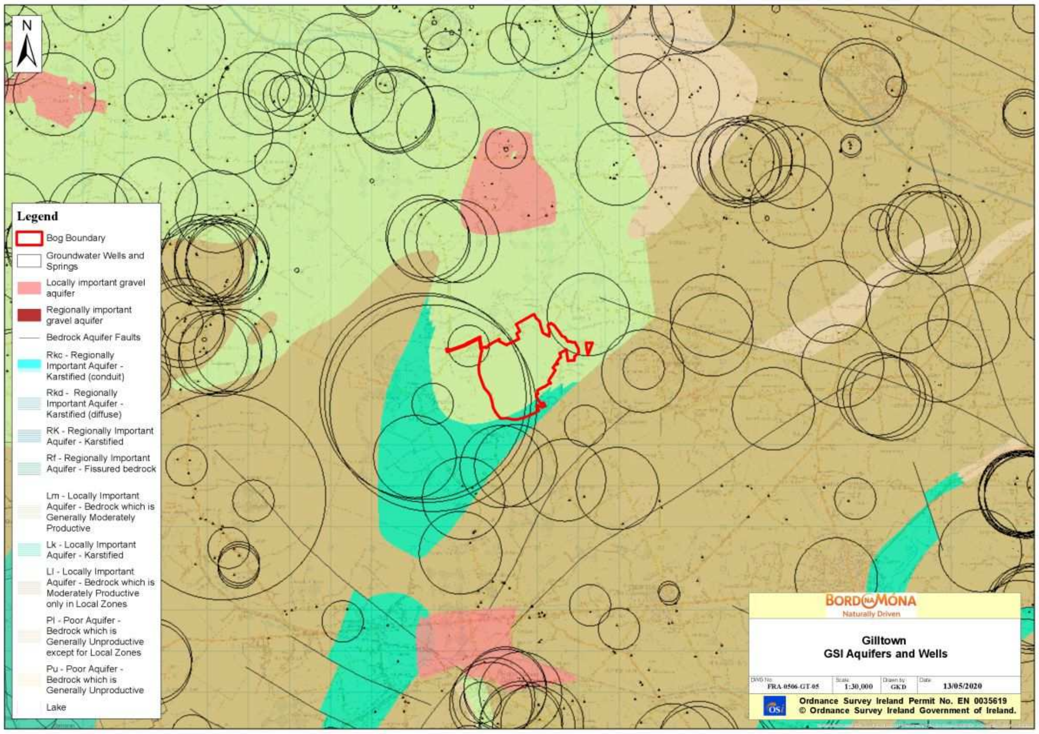

Figure 7.2-6 Gilltown Bog Aquifers, Karst Features, Wells

7.2.7 **Fluvial Flood Risk**

The rivers and streams in the vicinity of Gilltown Bog are described in terms of regional hydrology in section 7.2.4. The three surface water outfalls in Gilltown Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods. The pipe diameters of these outfalls are shown in the Table below.

Surface Water Outfall ref:	Pipe Diameter (m)
SW7	0.450
SW9	0.450
SW11	0.450

Table 7.2.1 Gilltown Bog Surface Water Outfalls

Information from Bord na Móna operatives familiar with Gilltown Bog confirmed that outfalls may become submerged when the water levels of the watercourses into which they are discharging are high. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Gilltown Bog. River Flood Events High Range mapping has been examined in the region of this bog. No CFRAM mapping exists for the Blackwater River in the vicinity of the bog. Fluvial flooding is not predicted to encroach into Gilltown bog.

CFRAM flood mapping is shown in the Figure below.

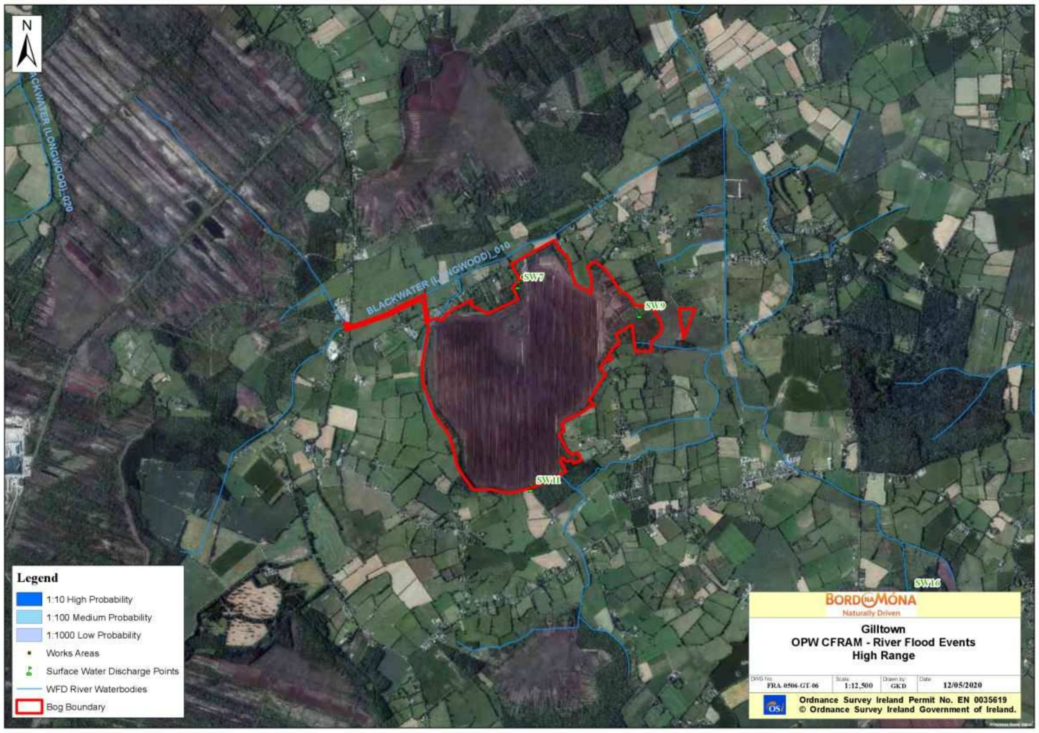

Figure 7.2-7 Gilltown Bog CFRAM Flood Mapping

7.2.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices

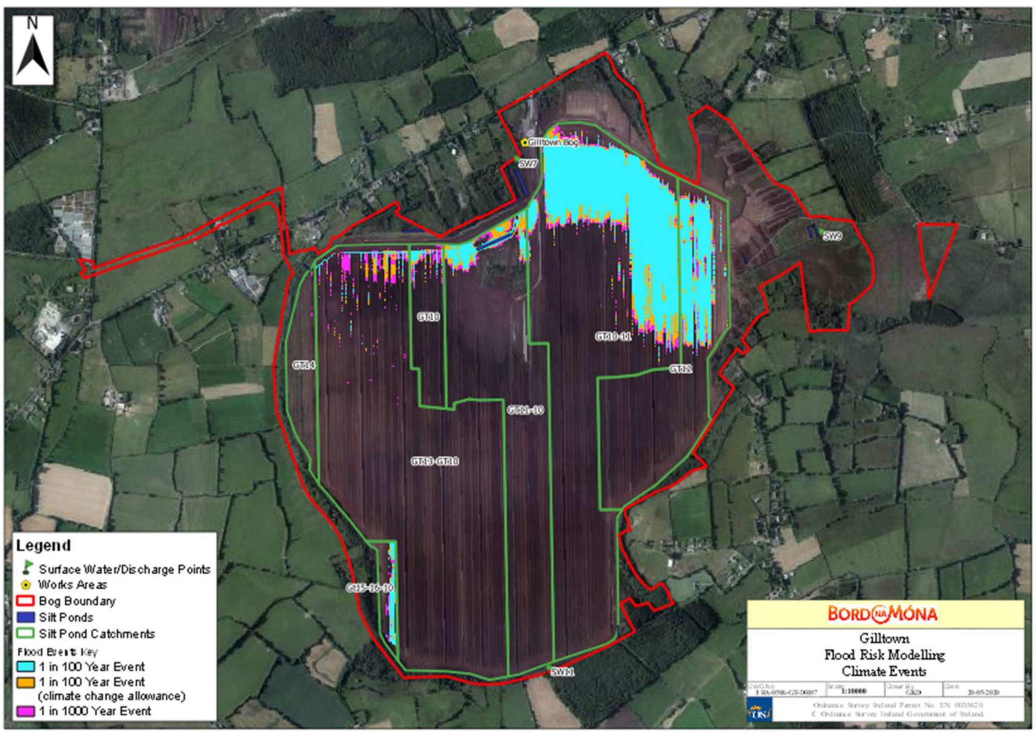

Figure 7.2-8 Gilltown Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the Surface water discharge points in the bog. Gilltown Bog is modelled for three separate basins: *GT10 & GT11-10 & GT13-10 & GT10-11 & GT14* that discharges through the SW7 outfall, *GT12* that discharges through the SW9 outfall, and *GT15-16-10* that discharges through the SW11 outfall. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

The model shows that flood waters predominately collect at the north and northeast of the bog, where rainfall generated over most of the bog drains to, with some minor flooding at the southwest of the site also. The maximum flood levels for the modelled areas to the north and northwest of the bog for the 1 in 1000 year event are 76.68mOD and 76.8mOD respectively, while the maximum flood level for the same flood event in the southwest of the bog is 81.4mOD. Catchments are separated within the bog by topographical features such as ridges in the surface levels and locally elevated rail line embankments and peat fields.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The maximum predicted flood level on the northern part of the site closest to the works area is 76.68mOD. This level is above the ground level within the works area, however an elevated rail line and headlands form a barrier between the works area and the area where this flooding is predicted, and as such, this flooding will be limited to the catchment area, without impacting the works area footprint. Anecdotal knowledge from Bord na Mona operatives who have worked in Gilltown bog for many years also note that there have not been any issues with significant ponding of floodwaters in this catchment area in the past.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

	Catchment Storage		
Level	**GT10_GT11-10_GT13-10_GT10-11_GT14**	**GT12**	**GT15-16-10**
mOD	**m^3**	**m^3**	**m^3**
74.00	72	0	0
74.25	379	0	0
74.50	1506	0	0
74.75	5365	0	0
75.00	14315	3	0
75.25	29839	36	0
75.50	52933	256	0
75.75	84543	1195	0
76.00	127243	3922	0
76.25	182033	10320	0
76.50	248843	22186	0
76.75	325830	39162	0
77.00		59247	0
77.25			0

77.50			0
77.75			0
78.00			0
78.25			0
78.50			0
78.75			0
79.00			0
79.25			0
79.50			1
79.75			28
80.00			91
80.25			193
80.50			367
80.75			662
81.00			1268
81.25			2573
81.50			4939

Table 7.2.2 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Gilltown Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

7.2.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 7.2.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100 year event + 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case the maximum rainfall for the 100 year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000 year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 7.2.7, the High-Emissions Future Scenario (HEFS) has been considered which takes in account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

7.2.10 **Conclusions**

The Flood Risk Assessment for Gilltown Bog identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the works area, however from local Bord na Mona operatives' knowledge, flooding of the peat production area does occur on occasion if the outfall pipes get blocked. A historical flooding issue north of SW7 appears to have been resolved through the diversion of drainage within the bog.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls may become submerged when the water levels of the rivers into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the adjoining water courses if their levels ever rise during flood events. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk:*** The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. Flooding of the production fields is predicted within the northern and north-eastern catchments of the bog, however this flood water will be retained by the elevated rail line and headlands situated between the peat production areas and the works area.

This Flood Risk Assessment indicates that the Works Area in Gilltown Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low Risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Gilltown Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 7.2.3 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Gilltown Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning

procedures further ensure minimal risk to people, property, the economy and the environment;

- The modelling for various flood event scenarios carried out in this assessment shows that the works area at Gilltown bog is not at risk of flooding.
- The high emission future scenario climate change has been taken into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Gilltown Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

7.3 Allen Bog

7.3.1 **Introduction**

Allen Bog, also known as Mouds Bog, is part of the Bord na Móna Kilberry Bog Group which operates under an Integrated Pollution Control licence (ref P0506-01). The Bog is used primarily to produce milled horticultural peat and the total area within Bord na Móna ownership is 433 hectares.

7.3.2 **Site Location**

Allen Bog is in County Kildare circa 2 kilometres south east of Kilmeage, between the R415 and R409 regional roads. The bog is accessed via the L7087 local road at the south of the site. The site location is highlighted in red in the figure below

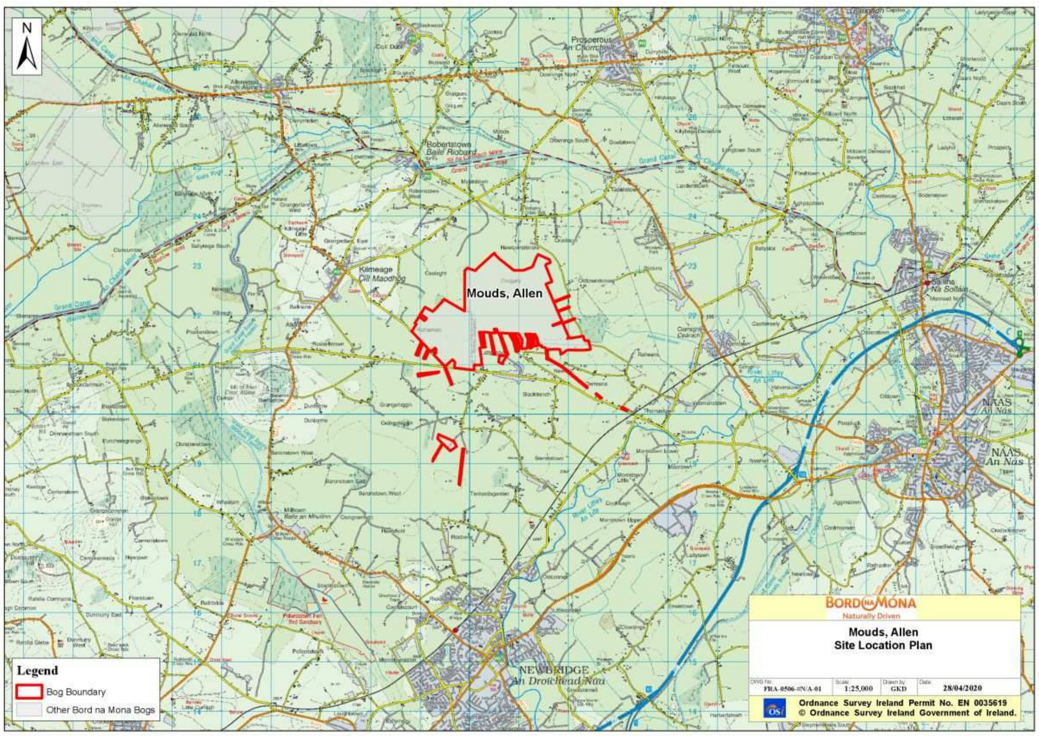

Figure 7.3-1 Allen Bog Site Location

7.3.3 **Bog Description**

Allen bog is used primarily for the production of milled horticultural peat. From the records available it appears that drainage of Allen bog began in 1966, and peat production began in 1972. A significant area to the west of the site has not been in production for a number of years. The land use surrounding the bog is primarily comprised of agriculture lands.

There is a peat outloading facility present at the southern end of the site which is accessed via the L7087 local road, and includes a workshop, welfare facilities and a mechanical tippler for outloading peat to HGVs. The existing finished floor levels of the buildings at the outloading facility range from 85.60mOD to 85.72mOD. The existing ground levels of the peat production areas range from circa 91mOD in the southwestern part of the site to circa 82mOD in the eastern end of the site.

Allen bog is divided into three drainage basins that each drain to separate surface water gravity outfalls at the southeast and southwest of the site. There are no pumped outfalls in Allen bog. The bog drainage layout is shown in the figure below.

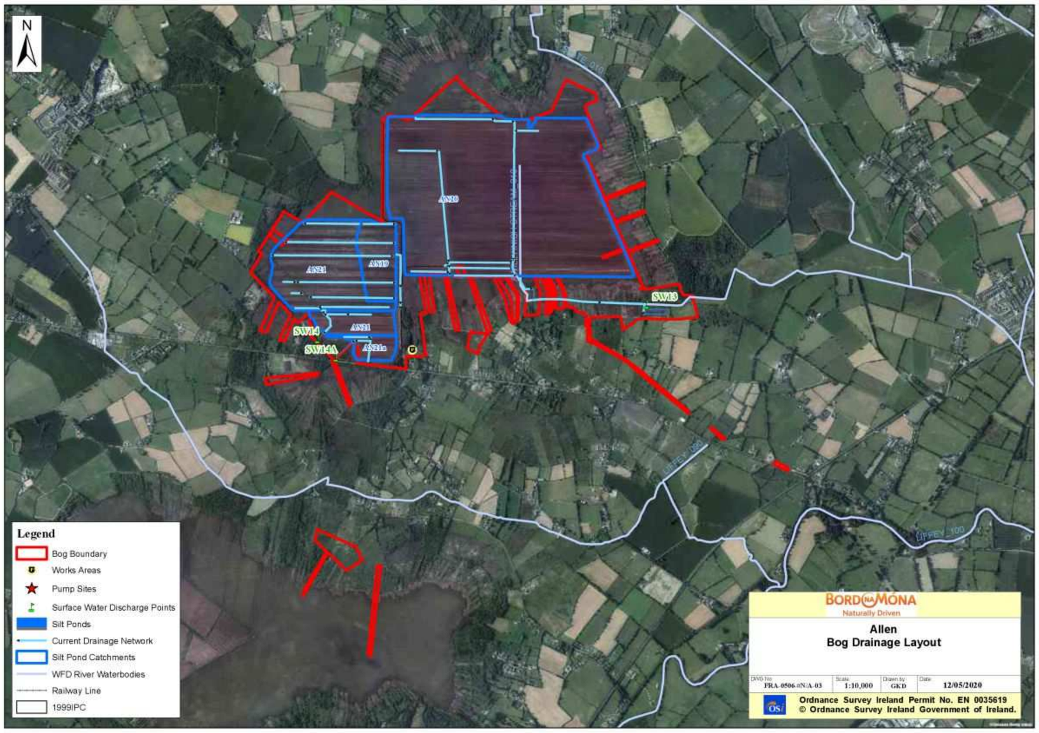

Figure 7.3-2 Allen Bog Drainage Layout

7.3.4 **Regional Hydrology**

Allen bog lies extensively within in the Liffey & Dublin Bay 09 catchment (Hydrometric Area 09). While a small area of the bog falls within the Barrow 14 catchment area (Hydrometric Area 14), internal Bord na Mona drainage within the site, drains these small areas into the Liffey & Dublin Bay 09 catchment. The Liffey & Dublin Bay 09 catchment drains an area of circa 1624km² and is underlain by granites in the upland areas to the south east of the catchment, and limestone bedrock in the remaining flat and low lying areas of the catchment basin. The Liffey catchment comprises 17 sub catchments with 77 river water bodies, six lakes, six transitional and five coastal water bodies, and 16 groundwater bodies.

Allen bog is divided into two drainage basins that drain to separate surface water gravity outfalls, with associated silt ponds. The eastern drainage basin drains through the SW13 outfall and discharges from the southeast of the site into the Awillyinish Stream_010 river sub basin in the Liffey_SC_050 sub catchment. The western drainage basin drains through the SW14 and SW14a outfalls and discharge from the southwest of the site into the Liffey_090 river sub basin in the Liffey_SC_040 sub catchment.

The catchment area and water courses are shown in Figure 7.3.3. The district drainage schemes are shown in Figure 7.3.4.

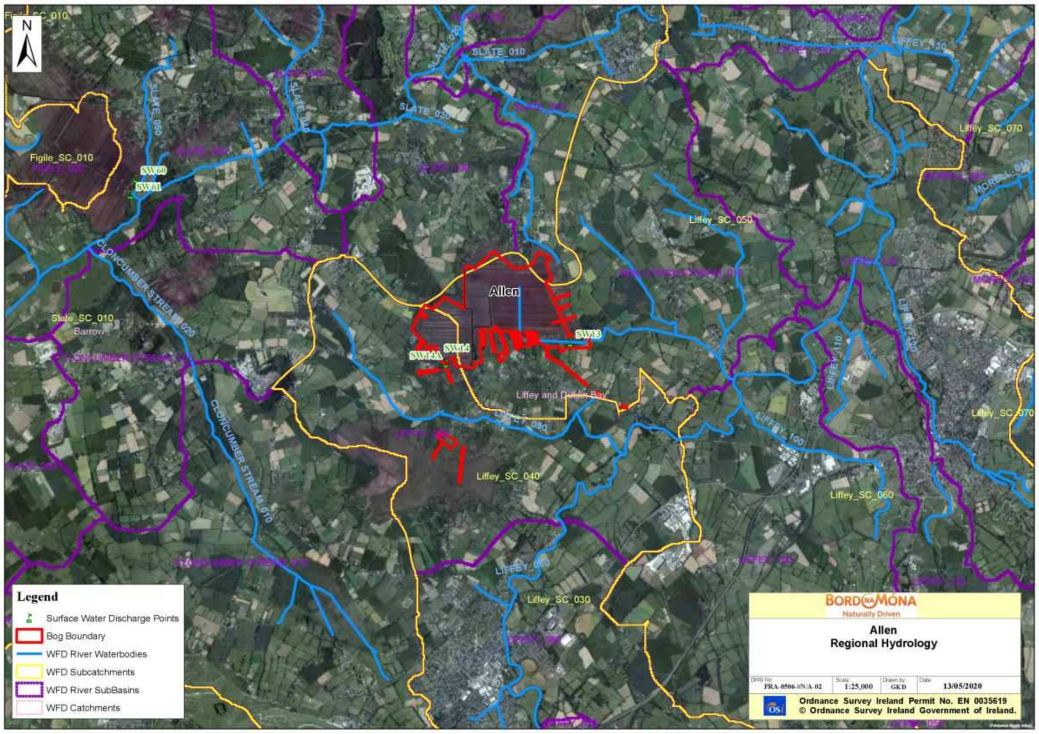

Figure 7.3-3 Allen Bog Regional Hydrology

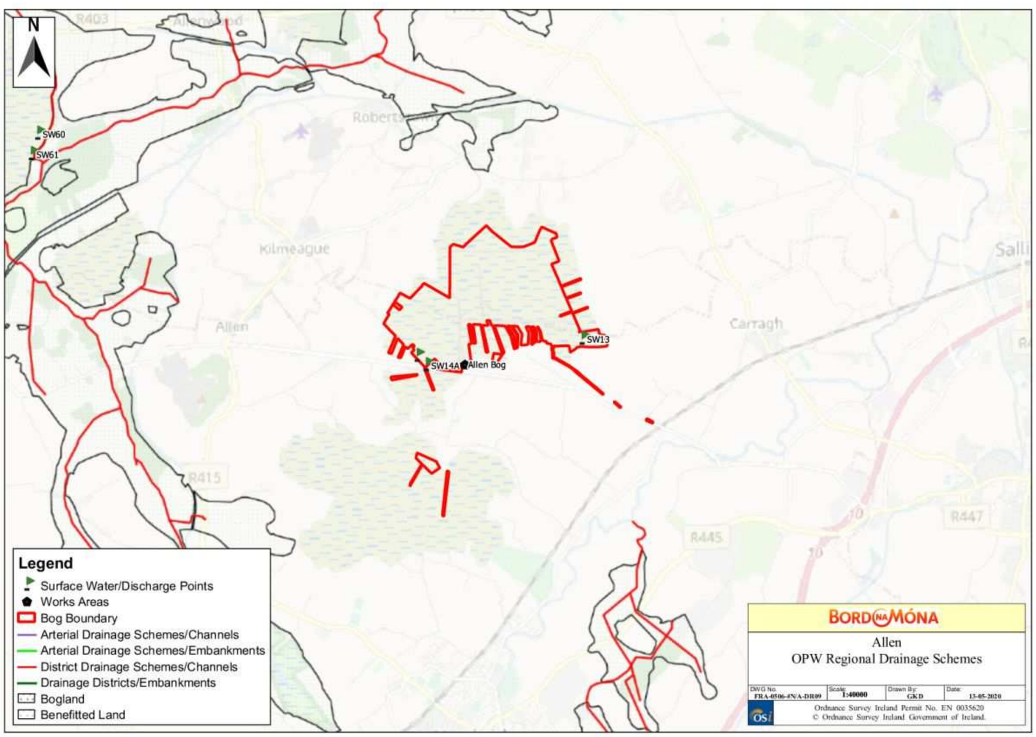

Figure 7.3-4 Allen Bog Drainage Schemes

7.3.5 **Historical Flooding**

A map of historical flooding is shown in the figure below.

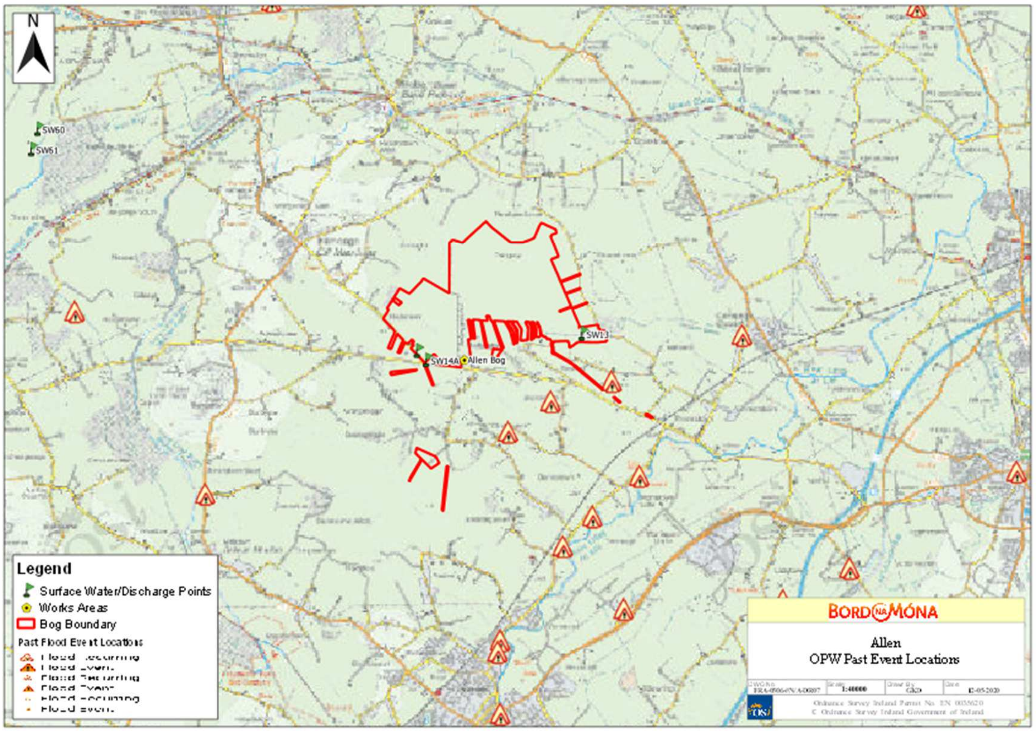

Figure 7.3-5 Allen Bog Historical Flooding

Local Bord na Mona operations knowledge indicates that the car park and buildings at the works area has not been known to flood, but that some flooding of the production fields in the vicinity of outfalls SW14 and SW14a has occurred occasionally due to the high water levels in the receiving watercourse. Surface water flooding of the production fields has, on occasion occurred during winter months and have been associated with blockages in the existing bog drainage network. Drainage maintenance works are carried out annually as part of the winter works schedule to minimise flooding to the peat production fields.

The OPW website, floodinfo.ie indicates that there are several low-lying areas within a few kilometres of Allen bog that are liable to flooding most years. Records of past flood events are given for locations at Clongorey, Blacktrench and Derreens, all within 1.5 – 2km of Allen Bog. These recurring events were recorded in 2005 in an oral report given by Kildare Co. Council as part of an OPW project (OPW Flood Hazard Mapping – Phase 1). The report notes for Clongarey, Blacktrench and Derreens – '*Low lying land floods after heavy rain every year*'. Historical OSI 25" maps do not indicate any additional areas liable to flooding in the vicinity of Allen bog.

7.3.6 **Groundwater Flood Risk**

Allen Bog is underlain with an aquifer that is categorised as a *Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (LI).* This aquifer has a low vulnerability code throughout most of the bog. In the southwestern corner of the bog in the vicinity of SW14 and SW14a discharge points, the aquifer vulnerability code is moderate.

There are no Bord na Móna records or local anecdotal evidence to suggest groundwater flooding has ever occurred in Allen bog.

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below:

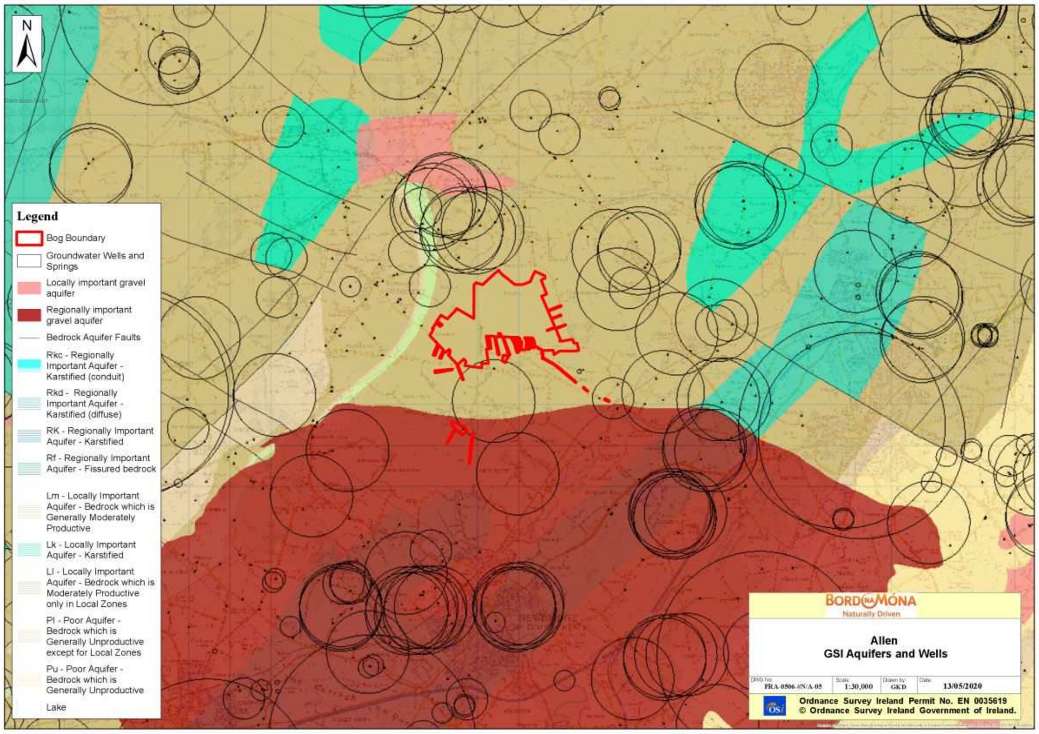

Figure 7.3-6 Allen Bog Aquifers, Karst Features, Wells

7.3.7 **Fluvial Flood Risk**

The rivers and streams in the vicinity of Allen Bog are are described in terms of regional hydrology in section 7.3.4. The three surface water outfalls in Allen Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods.

Information from Bord na Móna operatives familiar with Allen Bog confirmed that outfalls may become submerged when the water levels of the receiving watercourses into which they are discharging are high. This is particularly the case with the watercourse that outfalls SW14 and SW14a discharge into. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Allen Bog. River Flood Events High Range mapping has been examined in the region of this bog. No CFRAM mapping exists for the Awillyinish Stream in the vicinity of the bog. Fluvial flooding is not predicted in this mapping to encroach into Allen bog.

CFRAM flood mapping is shown in the Figure below.

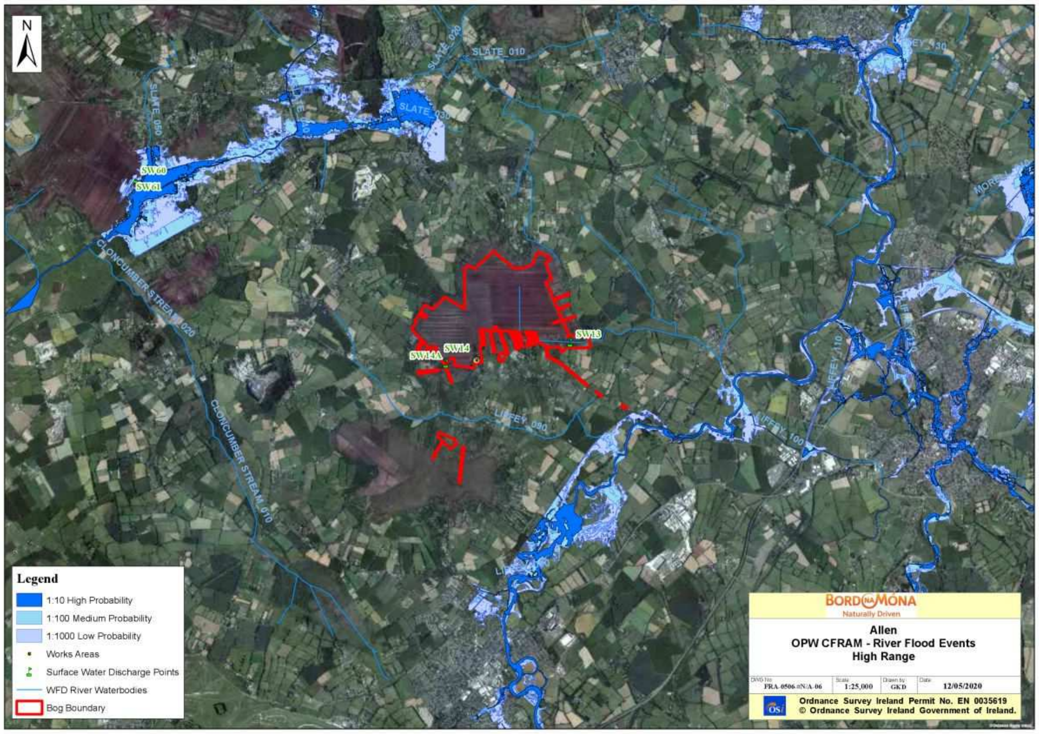

Figure 7.3-7 Allen Bog CFRAM Flood Mapping

7.3.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.
The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices.

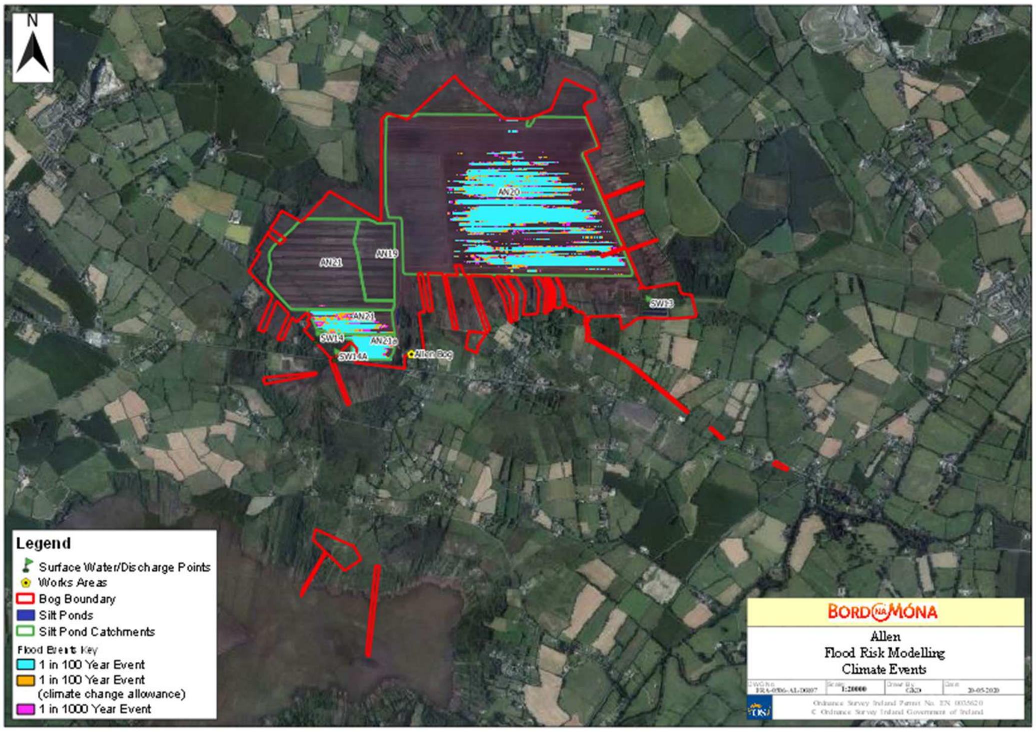

Figure 7.3-8 Allen Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the surface water discharge points in the bog. Allen Bog is modelled for two separate basins: *AN20* that discharges through the SW13 outfall, and AN19, AN21 & AN21a that discharge through the SW14 and SW14a outfalls. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

The model shows that flood waters are collecting in local areas in the southwest, middle and southeast of the bog. The most extensive flooding is shown in the southeast, where rainfall generated over the eastern basin is drained to this area of the bog. The maximum flood level in this area for the 1000 year event is 81.25mOD, and the maximum flood level for the catchment area to the west of the works area for the same event is 86.08mOD.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The maximum predicted flood level on the western side of the site closest to the works area is 86.08mOD. This level is above the ground level within the works area, however an elevated rail line and headlands form a barrier between the works area and the area where

this flooding is predicted, and as such, this flooding will be limited to the production fields in the catchment area without impacting the works area footprint, and will not cause flooding of the works area
The model indicates that Allen Bog works area which includes, workshops, welfare facilities, oil storage facilities, and a lorry tippler for loading of peat, is not as risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

	Catchment Storage	
Level	**AN19 AN21 and AN21a**	**AN20**
mOD	**m3**	**m3**
80		1329
80.25		5629
80.50		18822
80.75		53511
81.00		129940
81.25		259164
81.5.0		
81.75		
82.00	0	
82.25	0	
82.50	0	
82.75	0	
83.00	3	
83.25	32	
83.50	158	
83.75	551	
84.00	1599	
84.25	4437	
84.50	10465	
84.75	20987	
85.00	37486	
85.25	61288	
85.5	92371	
85.75	129070	

Table 7.3.1 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Allen Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

7.3.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 7.2.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100 year event + 30% climate change allowance (High*

End Emissions Scenario). In the climate change model run case the maximum rainfall for the 100 year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000 year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 7.2.7, the High-Emissions Future Scenario (HEFS) has been considered which takes in account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

7.3.10 **Conclusions**

The Flood Risk Assessment for Allen Bog identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the works area, however from local knowledge flooding of the peat production area does occur on occasion if the outfall pipes get blocked or back up due to high water level in the receiving waters.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the watercourses into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the adjoining water courses if their levels ever rise during flood events. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk:*** The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. Flooding in the catchment to the west of the works area is predicted to occur, however this flood water will be retained by the elevated rail line and headlands situated between the peat production areas and the works area.

This Flood Risk Assessment indicates that the Works Area in Allen Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in a Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Allen Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 7.3.2 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/ Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Allen Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The modelling for various flood event scenarios carried out in this assessment shows that the works area at Allen bog is not at risk of flooding.
- The high emission future scenario climate change has been taken into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Allen Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

7.4 Prosperous Bog

7.4.1 Introduction

Prosperous Bog is part of the Bord na Móna Kilberry Bog Group which operates under an Integrated Pollution Control licence (ref P0506-01). The Bog is used primarily to produce milled horticultural peat and the total area within Bord na Móna ownership is 217 hectares.

7.4.2 Site Location

Prosperous Bog is in County Kildare, approximately 4 kilometres north west of Clane and circa 1.5 kilometres north of Prosperous Village. The bog is accessed via the L1021 local road at the west of the site. The northern part of the site falls within the Boyne 07 catchment (Hydrometric Area 07), while the southern part of the site falls within the Barrow 14 catchment area (Hydrometric Area 14). The site location is highlighted in red in the figure below.

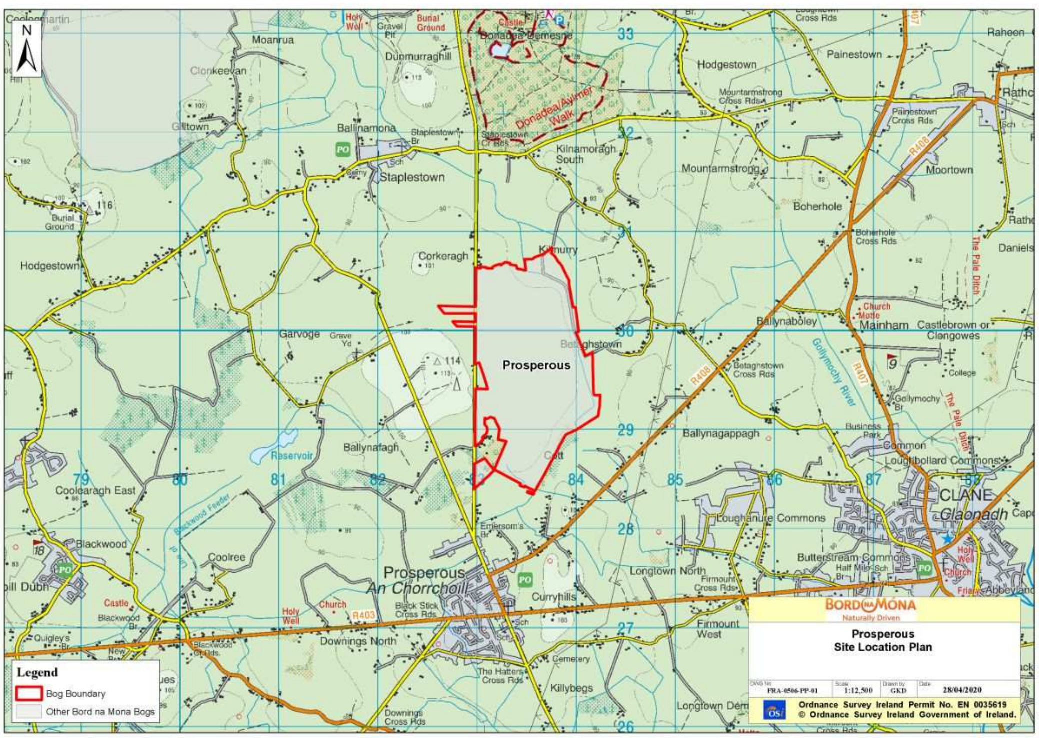

Figure 7.4-1 Prosperous Bog Site Location

7.4.3 Bog Description

Prosperous bog is used primarily for the production of milled horticultural peat. From the records available it appears that drainage in Prosperous bog began in 1991, and peat production commenced in 2003. There are cutaway areas in the bog that are no longer in active production, and areas colonised with birch around the margins. The land use surrounding the bog is primarily comprised of agriculture lands

There is a peat outloading facility present to the west of the site which is accessed via the L1021 local road. The Works Area includes welfare facilities, oil storage and a mechanical tippler for outloading peat to HGVs. The existing finished floor levels of the buildings at the outloading facility range from 93.05mOD to 93.44mOD.

Prosperous bog is divided into three drainage basins that each drain to separate surface water gravity outfalls at the north, south and east of the site. There are no pumped outfalls in Prosperous bog. The bog drainage layout is shown in the figure below.

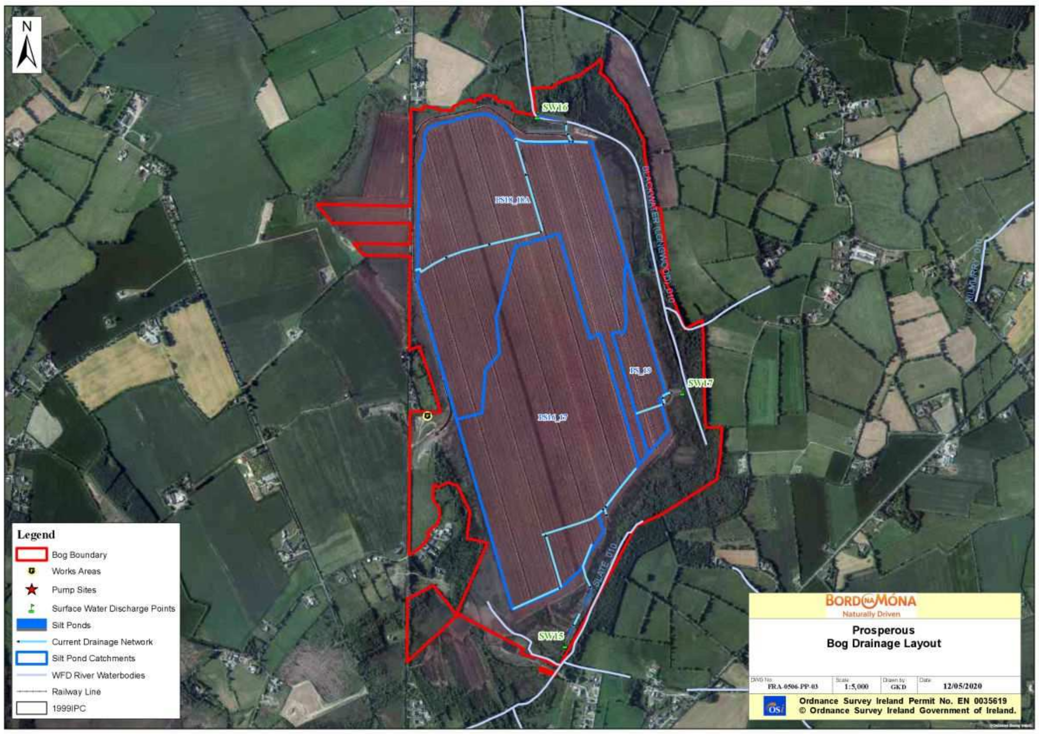

Figure 7.4-2 Prosperous Bog Drainage Layout

7.4.4 **Regional Hydrology**

The northern part of Prosperous bog lies within in the Boyne 07 catchment (Hydrometric Area 07). The Boyne 07 catchment drains an area of 2694km² and is underlain by metamorphic rocks in the north and limestone bedrock in the centre and south of the catchment. There are extensive sand and gravel areas in this catchment, particularly along the upper reaches of the Boyne. The Boyne catchment comprises 20 sub catchments with 114 river water bodies, 11 lakes, one transitional and three coastal water bodies, and 25 groundwater bodies

The southern part of Prosperous bog lies within in the Barrow 14 catchment (Hydrometric Area 14). The Barrow 14 catchment drains a total area of 3,025km2. The Barrow catchment is underlain in its flat northern area by limestones of varying purity which continue down the western side of the catchment and sustain good groundwater resources in places. On the eastern side of the catchment, granites dominate, culminating in the summits of the Blackstairs Mountains. The Barrow catchment comprises 20 sub catchments with 145 river water bodies, six transitional water bodies, and 29 groundwater bodies.

Prosperous bog is divided into three drainage basins that each drain to separate surface water gravity outfalls, with associated silt ponds. The SW16 and SW17 outfalls are located at the north and east of the bog respectively, and discharge to watercourses that drain into to the River Blackwater in the Blackwater(Longwood)_SC_010 sub catchment of the Boyne 07 catchment. The SW15 outfall discharges to watercourses in the Slate_010 river sub basin of the Barrow 14 catchment.

The catchment area and water courses are shown in Figure 7.4.3 The district drainage schemes are shown in Figure 7.4.4.

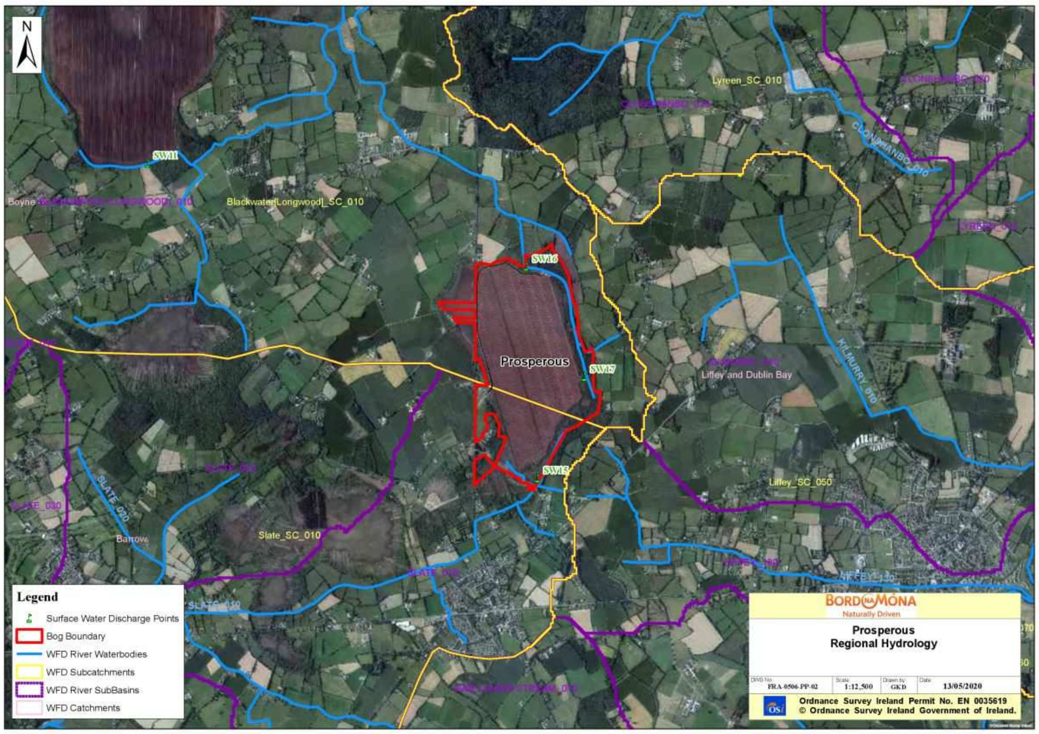

Figure 7.4-3 Prosperous Bog Regional Hydrology

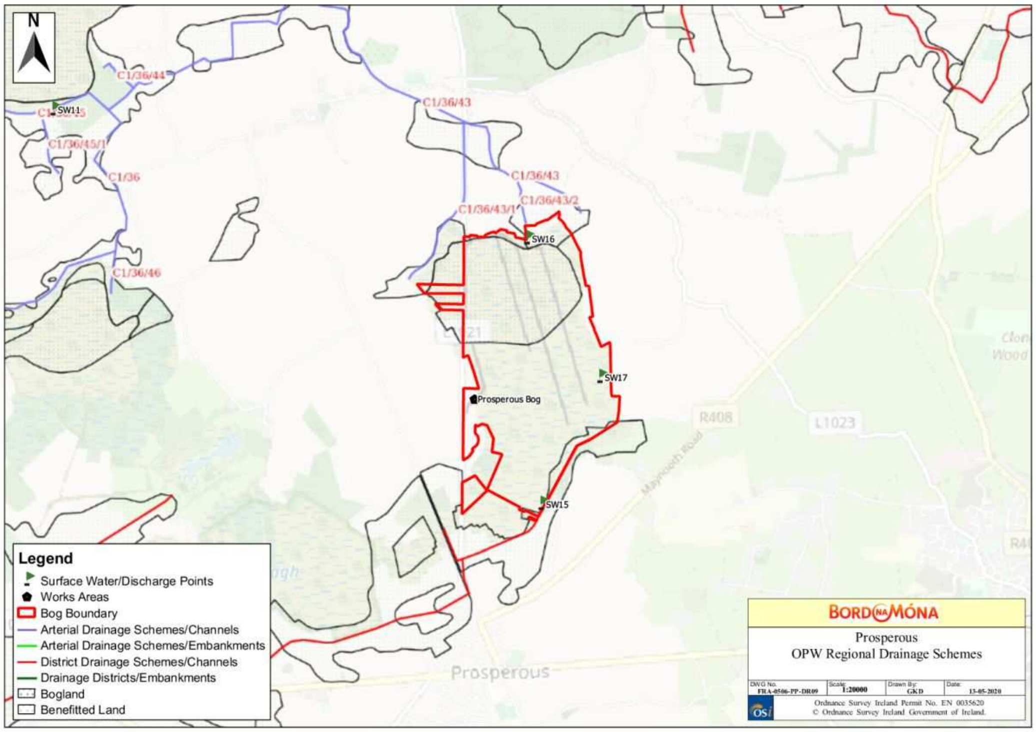

Figure 7.4-4 Prosperous Bog Arterial & District Drainage Schemes

7.4.5 **Historical Flooding**

A map of historical flooding is shown in the Figure.

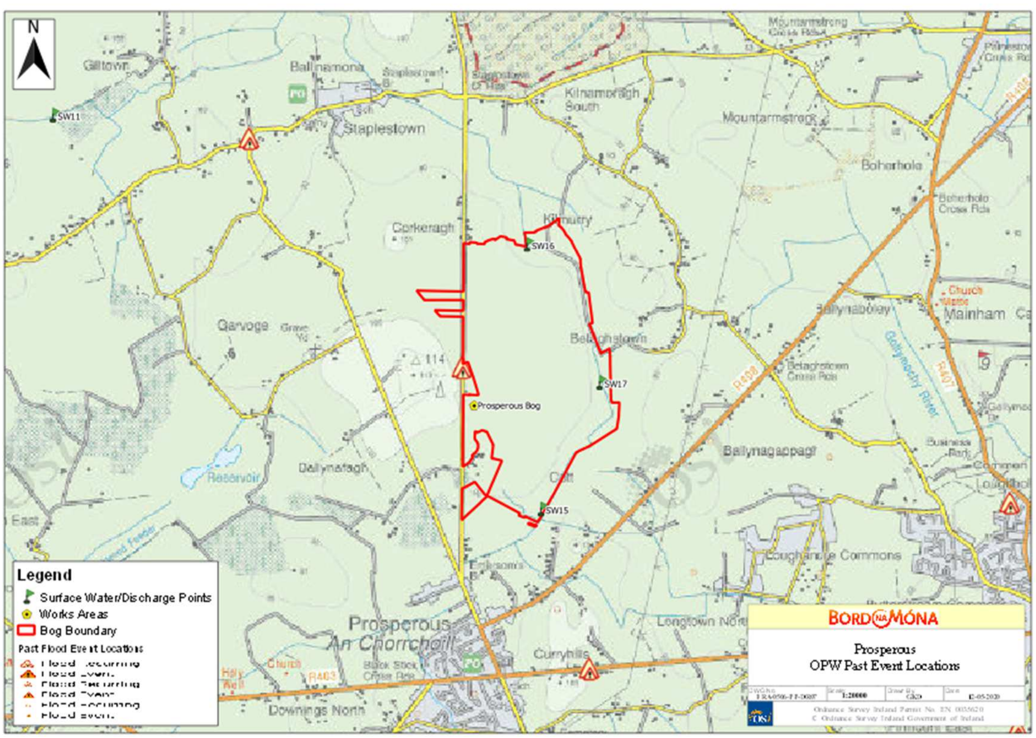

Figure 7.4-5 Prosperous Bog Historical Flooding

Local operations knowledge indicates that flooding is not known to have occurred in Prosperous bog due to the receiving waters backing up, but confirmed that surface water flooding of the production fields has, on occasion occurred during winter months and have been associated with blockages in the existing bog drainage network. Drainage maintenance works are carried out annually as part of the winter works schedule to minimise flooding to the peat production fields. The car park and buildings at the works area have not been known to flood.

The OPW website, floodinfo.ie indicates that there are several areas within a few kilometres of Prosperous bog that are liable to flooding. Records of past flood events are given for locations on the L1021 local road to the west of the bog in the vicinity of the entrance to the site, and on the R403 road near Prosperous Village circa 1.5km south of the bog. These recurring events were recorded in 2005 in an oral report given by Kildare Co. Council as part of an OPW project (OPW Flood Hazard Mapping – Phase 1). The report notes for the flooding on the L1021 Local Road at Staplestown (Prosperous) Bog – '*Road is liable to flooding after heavy rain every year'*, and notes for the flooding on the R403 near Prosperous Village – '*A property is flooded after heavy rain every year'*.

Historical OSI 25" maps do not indicate any additional areas liable to flooding in the vicinity of Prosperous bog.

7.4.6 **Groundwater Flood Risk**

Prosperous Bog is underlain with an aquifer that is categorised as a *Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (LI).* This aquifer has a low vulnerability code throughout most of the bog. There is an area to the northeast of the bog where the aquifer vulnerability code is moderate.

There are no Bord na Móna records or local anecdotal evidence to suggest groundwater flooding has ever occurred at this bog.

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below:

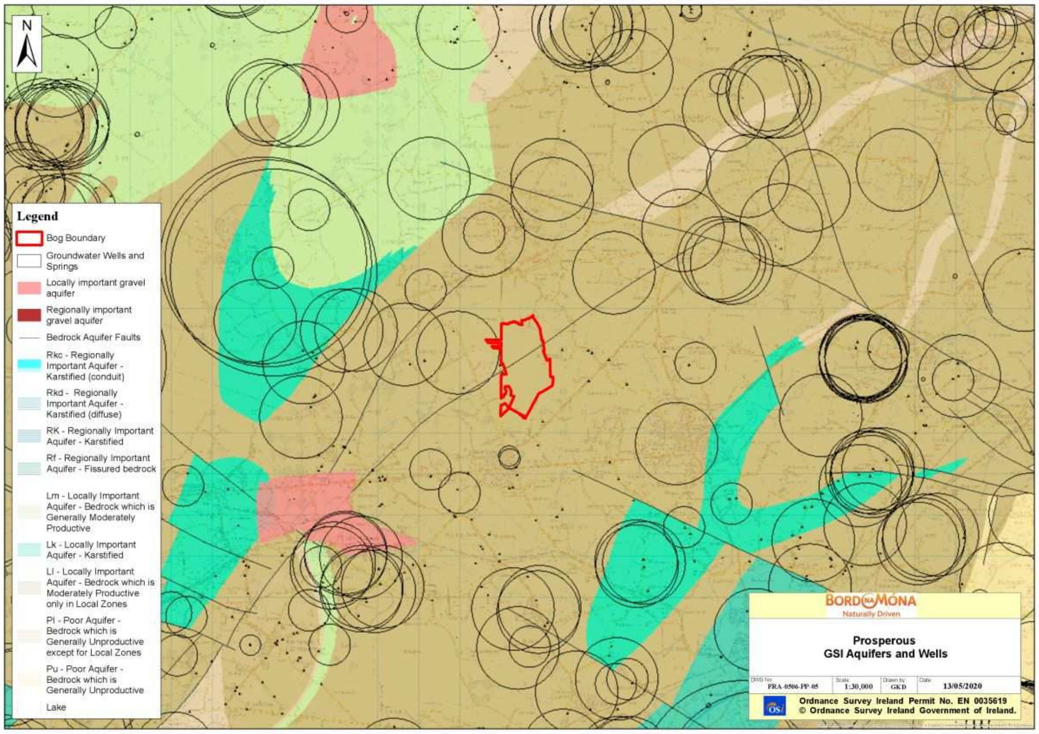

Figure 7.4-6 Prosperous Bog Aquifers, Karst Features, Wells

7.4.7 **Fluvial Flood Risk**

The rivers and streams in the vicinity of Prosperous Bog are are described in terms of regional hydrology in section 7.4.4. The three surface water outfalls in Prosperous Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large floods.

Information from Bord na Móna operatives familiar with Prosperous Bog confirmed that outfalls may become submerged when the water levels of the rivers into which they are discharging are high. The receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded. There is available storage capacity in the peat production area for these flood events.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Prosperous Bog. River Flood Events High Range mapping has been examined in the region of this bog. No CFRAM mapping exists for either the Blackwater(Longwood) _010 or the Slate_10 watercourses in the vicinity of the bog. Fluvial flooding is not predicted to encroach into Prosperous bog.

CFRAM flood mapping is shown in the Figure below.

Figure 7.4-7 Prosperous Bog CFRAM Flood Mapping

7.4.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices.

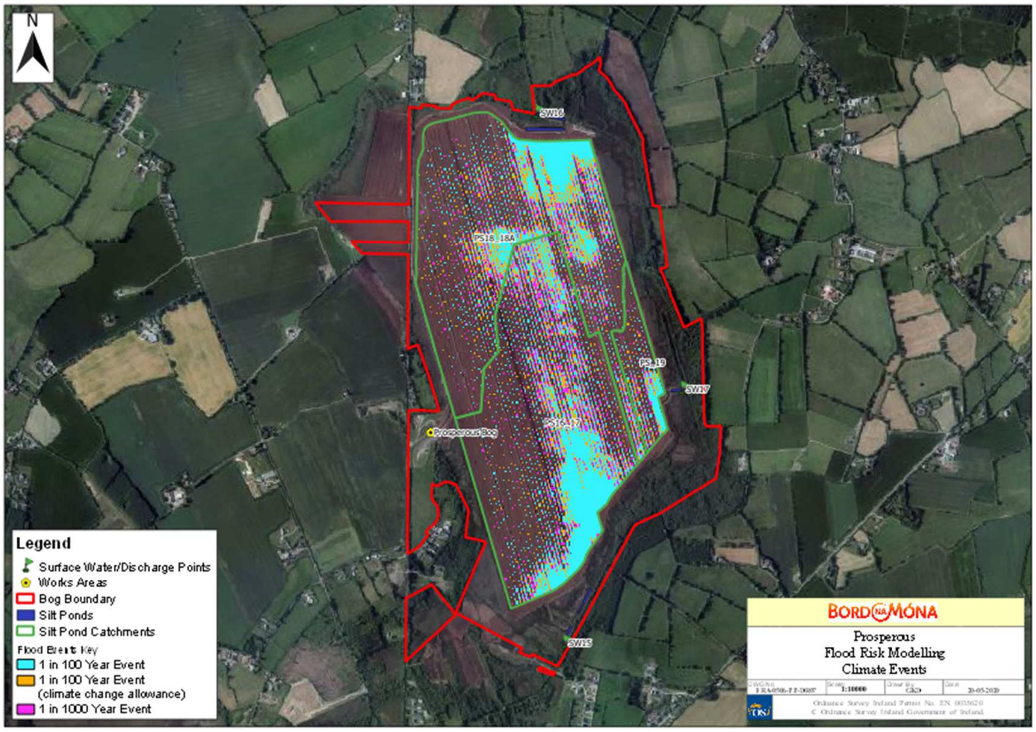

Figure 7.4-8 Prosperous Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the surface water discharge points in the bog. Prosperous Bog is modelled for three separate basins: *PS16 _17* that discharges through the SW15 outfall, *PS18_18A* that discharges through the SW16 outfall, and *PSNew* that discharges through the SW17 outfall. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

The model shows that flood waters are collecting in local areas in the north and south parts of the bog. The most extensive flooding is shown in the south, where rainfall generated over the southern basin drains to. The maximum flood level in this area for the 1 in 1000 year event is 88.74mOD, and the maximum flood level for the areas to the north and to the east of the site for the same event are 88.94mOD and 88.8mOD respectively.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field run-off rate and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The existing ground levels in the works area located to the west of the bog are in excess of 91.50mOD and the finished floor levels of the buildings are all above 93.0mOD. The elevations of these buildings are higher than the modelled flood waters in the bog. The model indicates that Prosperous Bog works area which includes welfare facilities, oil storage facilities and a lorry tippler for loading of peat, is not as risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

	Catchment Storage		
Level	**PS16_17**	**PS18_18A**	**PS_19**
mOD	**m^3**	**m^3**	**m^3**
85.00	0	0	0
85.25	0	5	0
85.50	0	19	0
85.75	0	48	0
86.00	0	98	0
86.25	0	208	0
86.50	0	510	0
86.75	0	1079	0
87.00	7	1961	7
87.25	79	3199	38
87.50	431	4896	136
87.75	1756	7312	346
88.00	5848	10907	784
88.25	16309	16708	1735
88.50	39918	27177	3810
88.75	89936	49623	7825
89.00		96716	15127

Table 7.4.1 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Prosperous Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

7.4.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 7.4.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100 year event + 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case the maximum rainfall for the 100 year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000 year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 7.4.7, the High-Emissions Future Scenario (HEFS) has been considered which takes in account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

7.4.10 **Conclusions**

The Flood Risk Assessment for Prosperous Bog identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the works site, however from local knowledge flooding of the peat production area does occur on occasion. OPW records indicate that recurring on the local road close to the works entrance has been an issue in the past.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** Outfalls will become submerged when the water levels of the rivers into which they are discharging are high. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the adjoining water courses if their levels ever rise during flood events. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings and peat lorry loading area would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Works Area in Prosperous Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low Risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Prosperous Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 7.4.1 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Prosperous Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Prosperous Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

7.5 Kilberry Bog

7.5.1 Introduction

Kilberry bog is part of the Bord na Móna Kilberry Bog Group which operates under an Integrated Pollution Control License (ref P0506-01). This bog supplies horticultural peat and has its own internal permanent rail line. The total area of the bog is 1001 Ha.

7.5.2 Site Location

The Kilberry site location is highlighted in red in the Figure below.

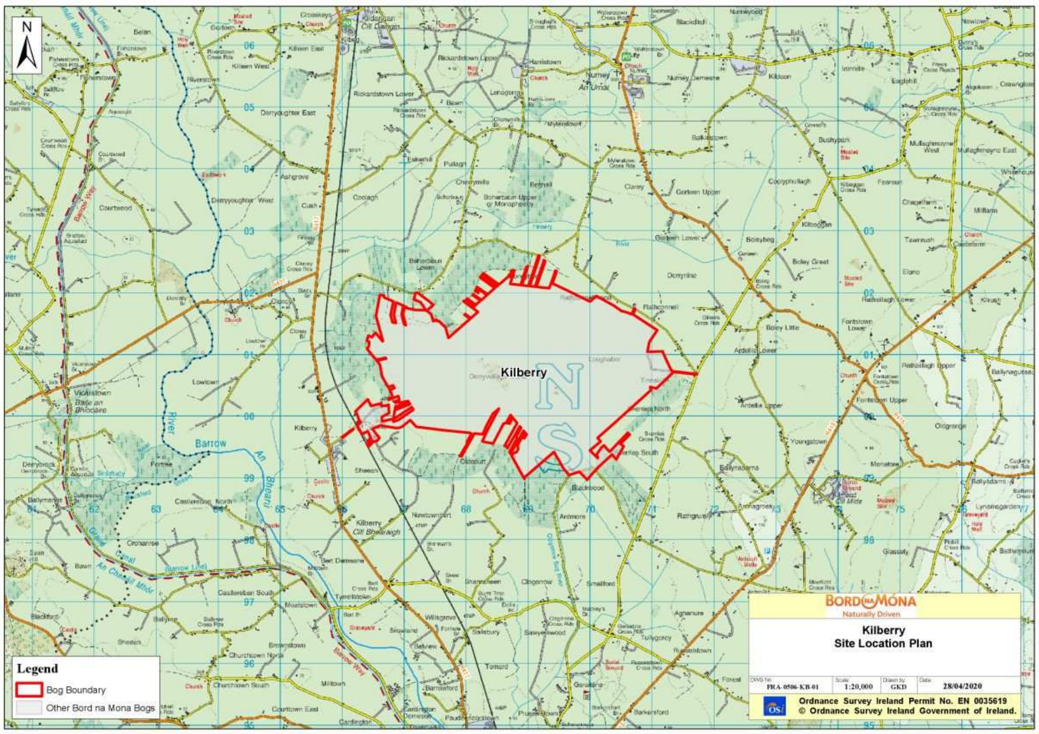

Figure 7.5-1 Kilberry Site Location

Kilberry Bog is in County Kildare, approximately 5 km north of Athy and to the east of the regional road R417. A CIE rail line passes the western boundary of the site.

7.5.3 Bog Description

The bog layout is shown in the Figure.

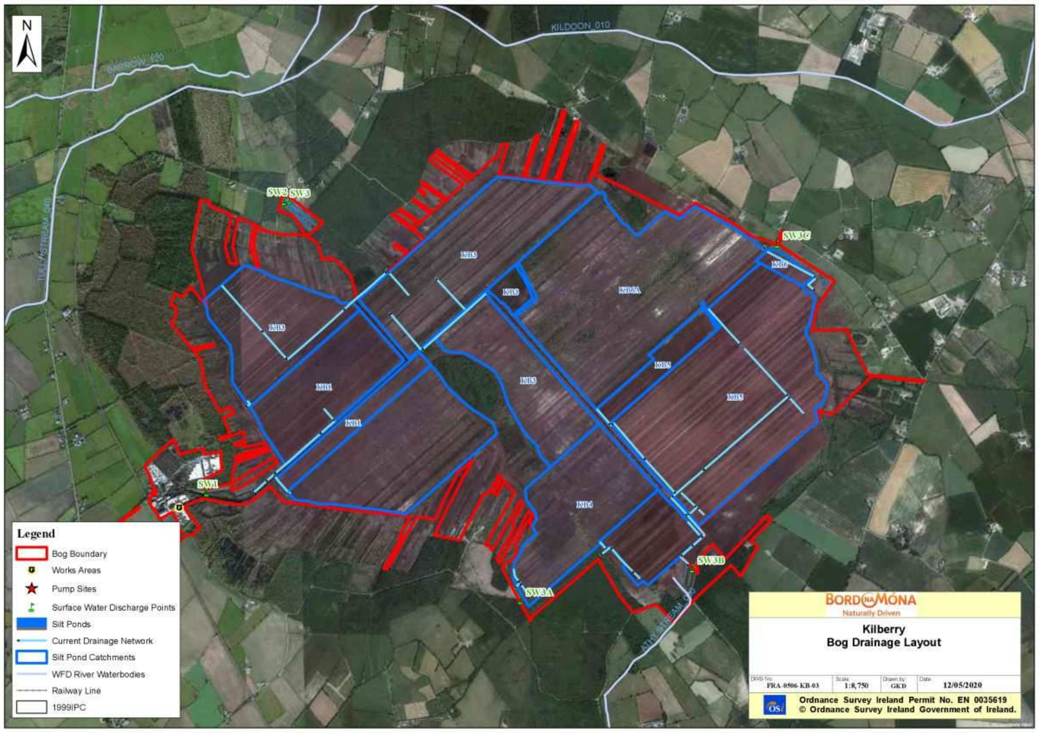

Figure 7.5-2 Kilberry Layout

From the records available, it appears that Bord na Móna commenced the production of moss peat in Kilberry in 1948, after having first developed drainage on the bog in 1945. The land use surrounding the bog is comprised forestry and agriculture. A CIE rail line is present outside the western boundary of the site, running in a north-south direction.

Active peat production areas are limited to parts of the north and eastern areas of the bog. There is a woodland area and a biodiversity area in the centre of the site. Areas of cutover and cutaway bog which are no longer in peat production have begun to re-vegetate. There are some edge habitats present around the periphery of the bog. These edge habitats are typically remnant sections of raised bog and cutaway bog.

A horticultural peat factory and works area is present on the western side of the site and includes processing and packaging buildings as well as warehouse storage and external yard area storage and a green waste/composting yard. This factory is not included in the Substitute Consent application as it is subject to existing planning permissions. This area is at a level of between 57.5mOD and 59.50mOD. Access to this factory is available from the R417 to the west. The primary access to the bog area is via the rear of the factory grounds as well as from local access roads around the periphery of the bog. The bog levels typically fall from higher areas in the east of circa 66.0m OD to low areas in the west of circa 60.0 mOD, however the woodland area in the centre of the site is on higher ground to the surrounding peatland and is typically at 66.0 mOD.

In Kilberry, there are six surface water gravity outfalls from the bog, with associated silt ponds. These outfalls (SW 1, 2, 3, 3A, 3B, 3C) are located at locations all around the periphery of the bog in all directions. Outfalls in the north drain into watercourses which drain into the River Barrow to the west of the site, whereas outfalls in the south drain into watercourses which drain into the River Barrow at a location further south in Athy. There are no pump sites present on this bog and all drainage is via gravity.

7.5.4 **Regional Hydrology**

The catchment area and water courses are shown in the figures below.

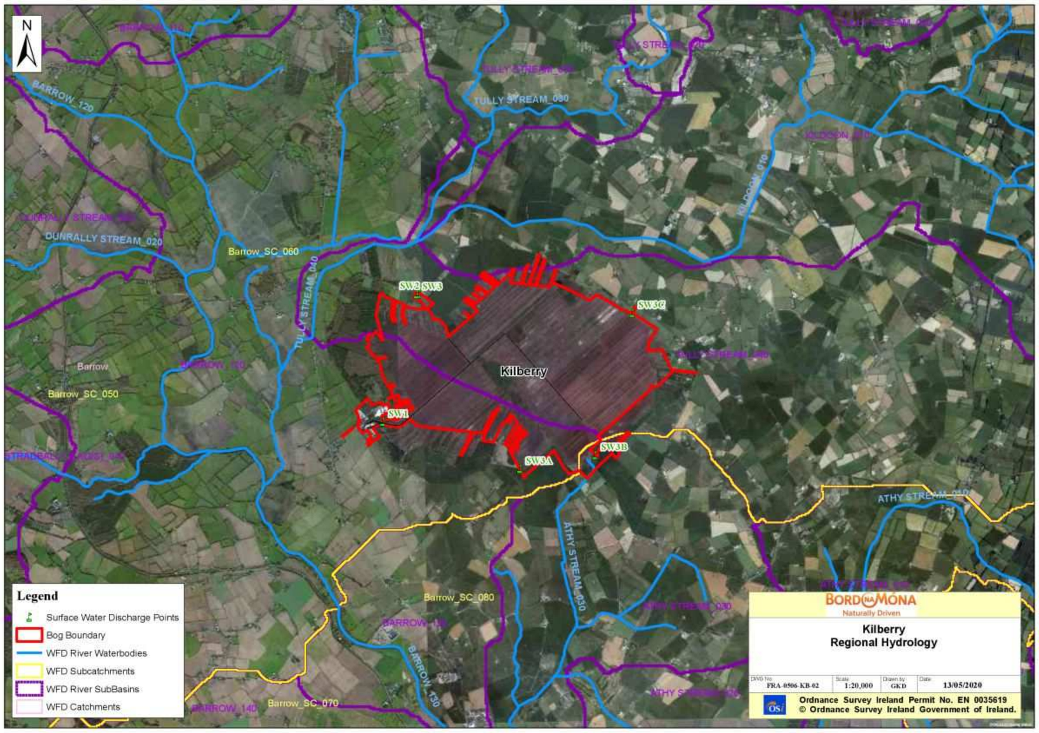

Figure 7.5-3 Kilberry Regional Hydrology

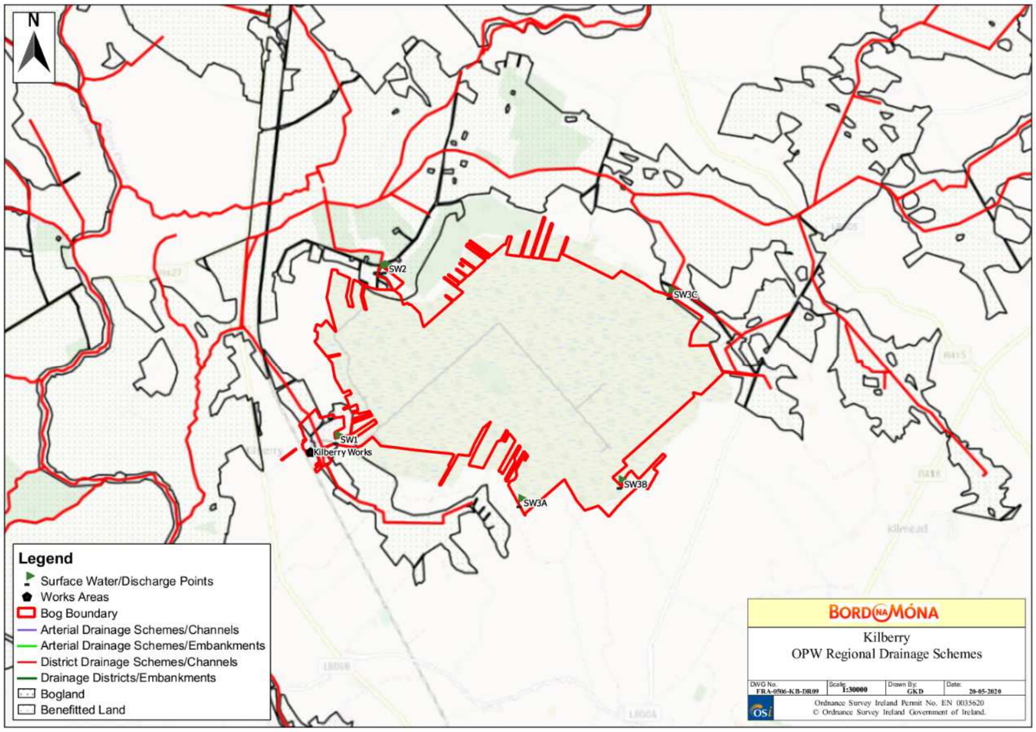

Figure 7.5-4 Kilberry District Drainage Schemes

Kilberry bog is within the Barrow 14 catchment. The Barrow 14 catchment drains a total area of 3,015km^2. The Barrow catchment is underlain in its flat northern area by limestones of varying purity which continue down the western side of the catchment and sustain good groundwater resources in places. On the eastern side of the catchment, granites dominate, culminating in the summits of the Blackstairs Mountains.

The River Barrow is located circa 3km of the western boundary of the bog and flows from north to south. To the rear of the horticultural peat factory, SW1 discharges in a north-westerly direction to the Tully Stream (Tully Stream_040), which drains into the Barrow 3km from the site. Outfalls SW2 and SW3 to the north also discharge into the Tully stream slightly further upstream of SW1. Outfall SW3C on the eastern side of the site drains to the north into the Kildoon (Kildoon_010) watercourse which flows to the west and in turns drain into the Tully stream. Outfalls SW3A and 3B both drain to the south into the Athy stream (Athy Stream_030), which flows south into Athy where it drains into the River Barrow. Outfalls SW1 and 3A are within the Barrow_120 WFD Sub-basin and the Barrow_SC_060 sub-catchment. SW2, 3 and 3C are within the Tully Stream_040 sub-basin and Barrow_SC_060 sub-catchment, while outfall SW3B lies within the Barrow_SC_080 sub-catchment.

The Arterial Drainage and District Drainage schemes near Kilberry bog is shown in the figures presented here.

The Standard Annual Average Rainfall (SAAR) in this location is 796mm.

7.5.5 **Historical Flooding**

A map of historical flooding is shown in the Figure.

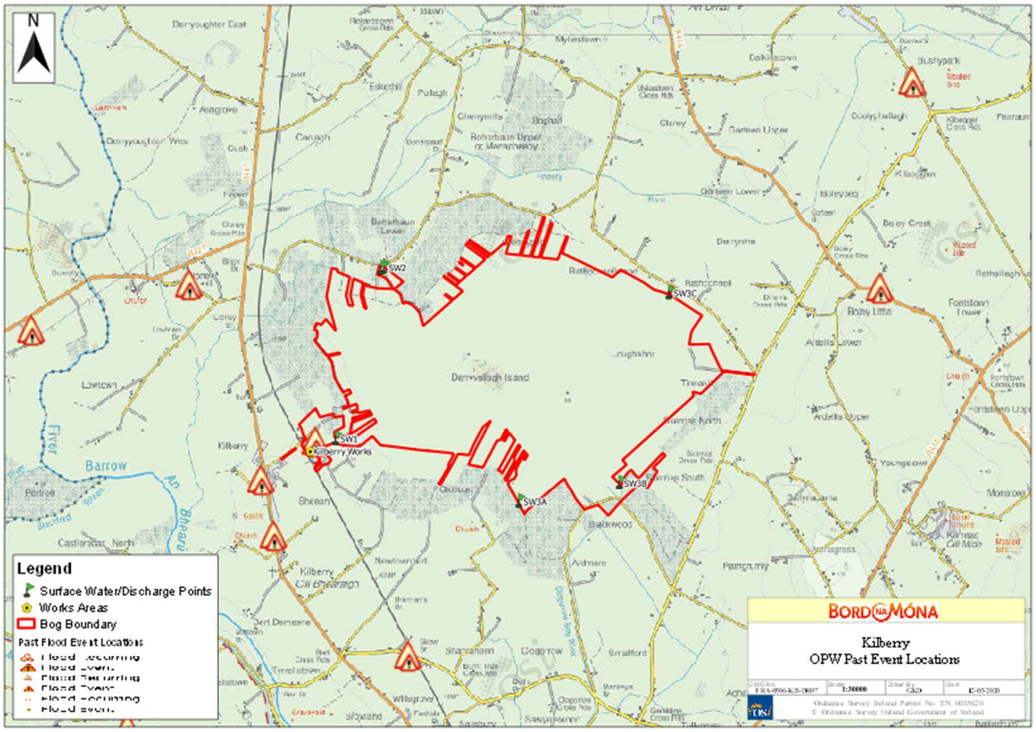

Figure 7.5-5 Kilberry Historical Flooding

Information from Bord na Móna operatives suggests that there has been no historical flooding on this bog. Local knowledge has confirmed that sections of cutover bog are being actively restored for ecological reasons and in these areas the original peat production drainage network has been blocked and as a result, the water table is held close to the surface level in these areas. In the areas that are actively drained, it is accepted that local surface water flooding can occur where blockages to the existing drainage network occur over winter months. Drainage maintenance works are carried out to minimise flooding to the peat production fields on an annual basis as part of the winter works schedule. There is no knowledge of flooding where water levels in receiving waters rise above outfall levels.

Historical flood records are taken from the OPW website, https://www.floodinfo.ie. Records of past rainfall flood events are given for locations east and west of the site as well as within the horticultural factory immediately west of the site. Photographic records from 2002 indicate flooding within the horticulture factory on the western side of the site. There are also a number of records slightly further east, indicating areas adjacent to the River Barrow which are said to experience recurrent flooding as they are 'low-lying land'.

Historical OSI 25" mapping was also examined for this area. There is no additional record of flooding to be taken from these maps for Kilberry bog.

7.5.6 **Groundwater Flood Risk**

Kilberry bog is underlain by two aquifers. Over the eastern side of the site, the aquifer is known as a *Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (Ll).* In the west, the aquifer is known as a *Regionally Important Aquifer - Karstified (diffuse) (Rkd).* Groundwater vulnerability rating for the area is given as Moderate across the entire area of the bog.

There is a substantial number of wells and boreholes recorded around the periphery of the bog, particularly to the south on the outskirts of Athy.

An area in the centre of the site which has undergone ecological rehabilitation now retains surface water at a level close to the surface of the bog. Anecdotal evidence suggests that this area may include local springs as the area has historically been challenging in terms of drainage.

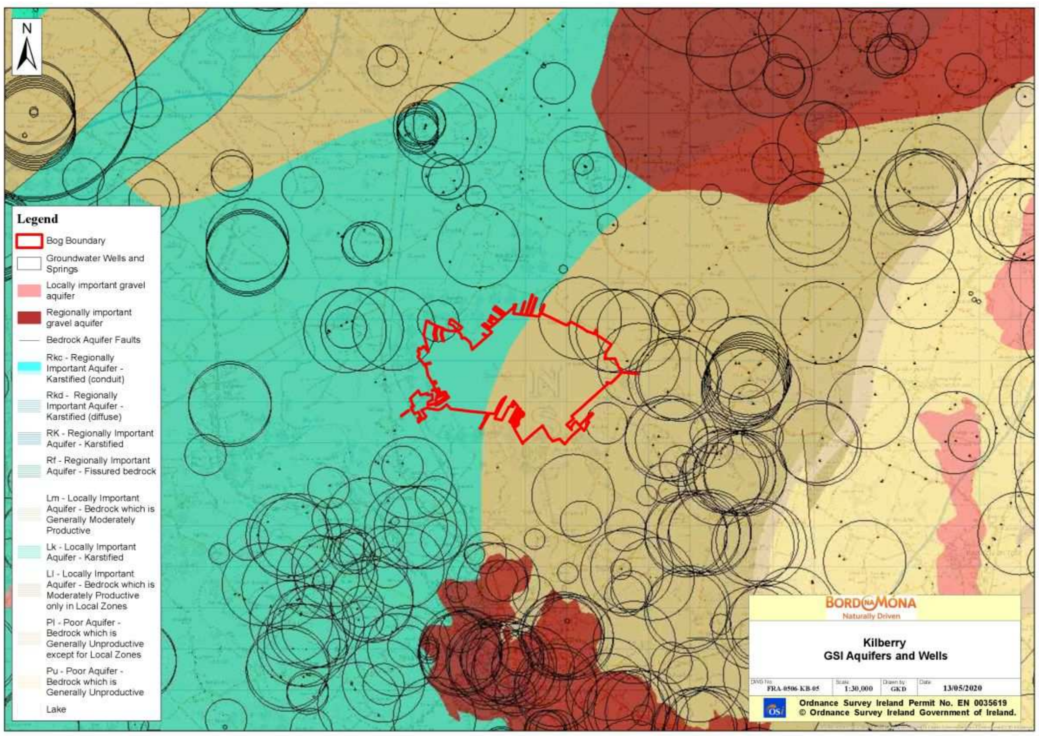

Figure 7.5-6 Kilberry Bog Aquifers, Karst Features, Wells

7.5.7 **Fluvial Flood Risk**

CFRAM flood mapping is shown in the Figure below.

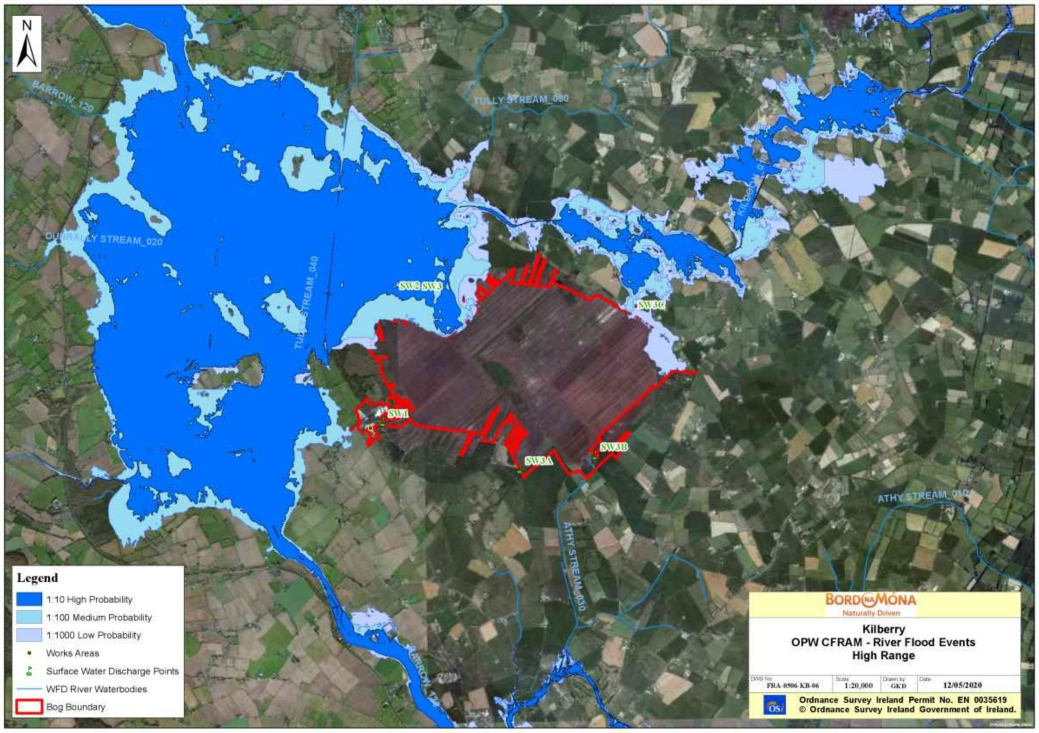

Figure 7.5-7 Kilberry CFRAM Flood Mapping

The rivers and streams in the vicinity of Kilberry bog are described in terms of regional hydrology in section 7.5.4.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with the 'High-End Future Scenario extents' (generated taking in the potential effects of climate change using an increase in rainfall of 30%.

Flooding is identified in the Tully stream and the Kildoon watercourse immediately north of the site. Flooding is also identified in the Barrow, to the west. The 1 in 1000 year event for fluvial flooding identifies local areas in the north and east of Kilberry bog which are predicted to flood including silt pond locations at surface water discharge points SW2, SW3 and SW3C.

There are no Bord na Móna records or local anecdotal evidence to suggest fluvial flooding has occurred at this bog or at these locations in the past. However, if outfalls become submerged due to high water levels, the receiving watercourses would then backwater the outfalls reducing the head for discharge and causing water to be stored on the bog until such time as the rivers have receded.There is available storage capacity in the peat production area for these flood events.

Any such flow into the bog would be limited to the capacity of the outfall pipe. It is noted that the limited pipe diameter will also restrict run-off rates from the bog to the receiving waters.

7.5.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100 year and 1000 year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below and included at a larger scale in the appendices.

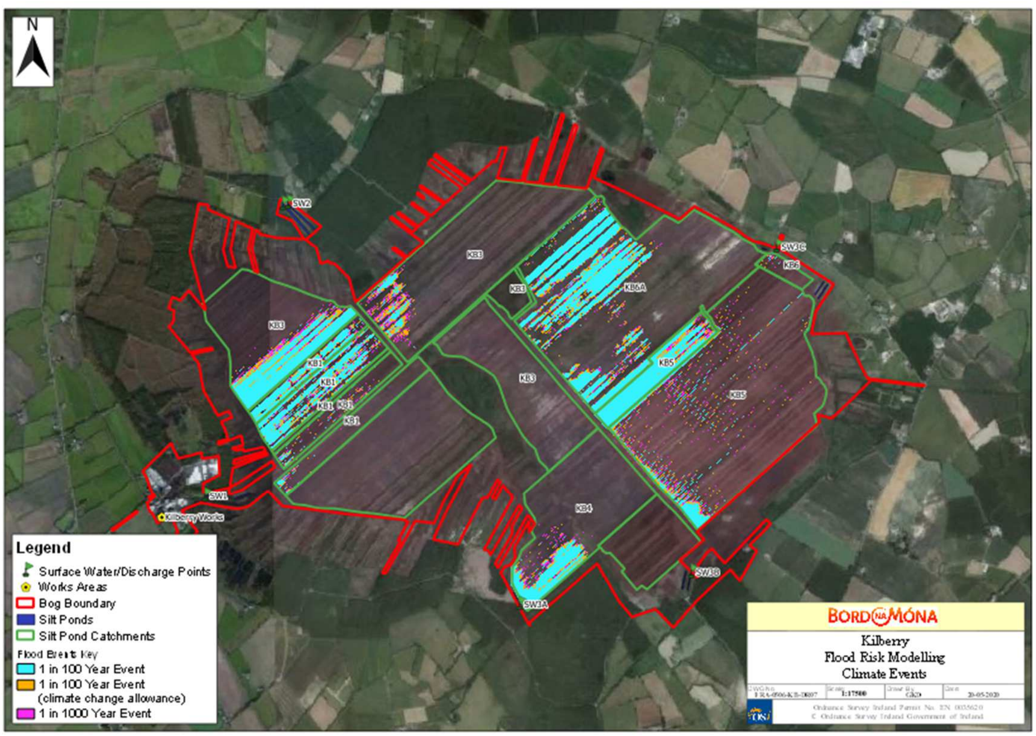

Figure 7.5-8 Kilberry Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the surface water discharge points in the bog. Kilberry Bog is modelled for five basins, KB1, KB3, KB4, KB5&KB6 and KB6A. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands, both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

From the modelling, it can be seen that surface water flooding is predicted for areas in the centre and west of the bog. This is to be expected given the topography of the bog. The 1 in 1000-year event was the most onerous in terms of flood levels. In the west, to the rear of the horticultural peat factory, a flood level of 59.44mOD is predicted. A high flood level of 64.90mOD is predicted in the centre and east of the bog. Catchments are separated within the bog by topographical features such as ridges in surface levels and locally elevated rail lines and local elevated peat fields.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field rate run-off and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The maximum predicted flood level on the western side of the site closest to the horticultural peat factory is 59.44mOD. This level is above the ground level within the compound area, however elevated headlands and undeveloped/non-production areas surround the peat production fields where this flooding is predicted and as such, this flooding is assumed to be limited to the catchment area, without impacting the factory footprint. In addition, the outfall pipes between the production areas and the outfall SW1 will limit the discharge rate.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

	Catchment Storage				
Level	**KB1**	**KB3**	**KB4**	**KB5 and KB6**	**KB6A**
mOD	**m^3**	**m^3**	**m^3**	**m^3**	**m^3**
59.00	5487	850	0	0	0
59.25	26934	4701	0	0	0
59.50	79922	14340	1	0	0
59.75		29575	26	0	0
60.00		50231	217	0	0
60.25		78681	1133	0	0
60.50		117865	3392	0	0
60.75		169972	9166	0	0
61.00		236775	21263	0	0
61.25			39491	0	0
61.50			63559	0	0
61.75				0	0
62.00				0	0
62.25				0	0

62.50				0	0
62.75				0	1
63.00				10	15
63.25				71	157
63.50				408	2889
63.75				3323	24766
64.00				16463	81188
64.25				42408	179081
64.50				81298	
64.75				133585	
65.00				205000	

Table 7.5.1 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Kilberry Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

7.5.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 7.5.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100 year event (+ 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case the maximum rainfall for the 100 year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000-year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 0, the High-Emissions Future Scenario (HEFS) has been considered which takes in account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30%.

7.5.10 **Conclusions**

The Flood Risk Assessment for Kilberry Bog identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** There are records of flooding having occurred within the yard areas of the existing horticultural peat factory on the western side of the site. Information from Bord na Móna operatives suggests that flooding of the peat production area has occurred locally where drains have become blocked internally.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site although there is evidence of local springs in an area of the bog that is no longer in production.

- ***Fluvial Flood Risk:*** OPW CFRAM mapping identifies flooding of a number of watercourses in the area including the River Barrow, Tully Stream and Kildoon watercourse. The extent of this flooding is predicted to extend into northern and eastern parts of Kilberry bog.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. Flooding is identified with the western and eastern/central catchments of these bogs. Flooding to catchments to the rear of the horticultural peat factory is predicted to occur, however this flood water will be retained by the elevated lands situated between the peat production areas and the horticulture factory.

This Flood Risk Assessment indicates that the peat production fields and drains in Kilberry Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 7.5.2 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
   - *(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
   - *(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.*

Following on from the completion of this flood risk assessment for Kilberry Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the main point of access for the site is located in an area of higher ground that is not at risk of flooding in a 1 in 1000year event and consequently potential risk of pollution as a result of flooding is minimal. The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Kilberry Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.

FLOOD RISK ASSESSMENT – CHAPTER 8
Cuil na Móna Bog Group

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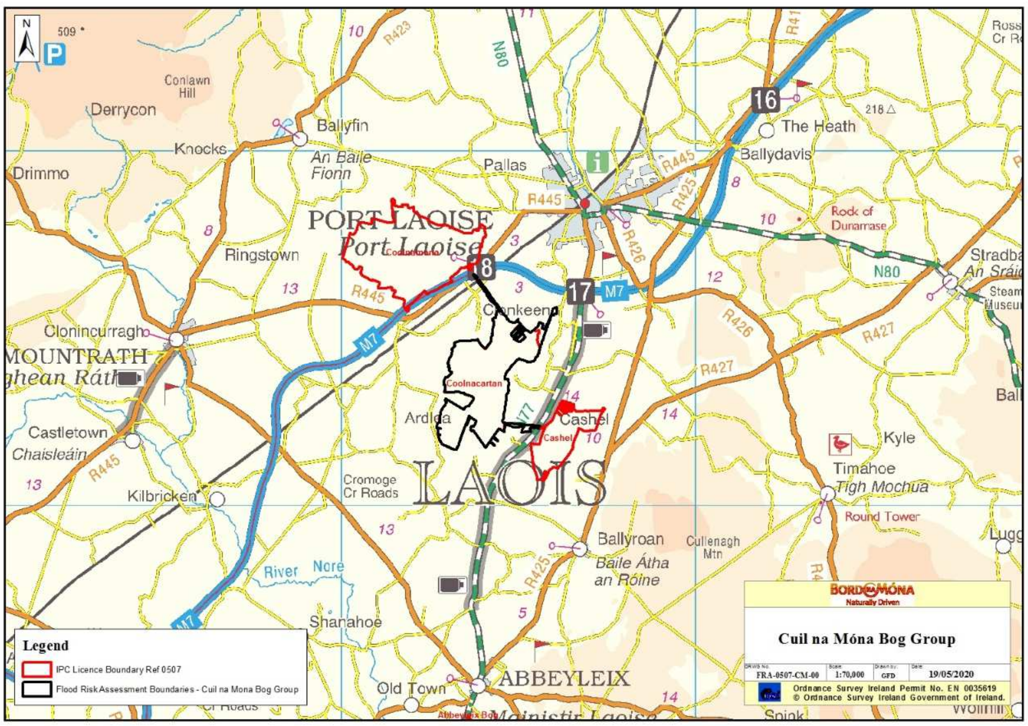
8 FLOOD RISK ASSESSMENTS – CUIL NA MONA BOG GROUP

8.1 Cuil na Mona Bog Group - IPC License 507

The bogs in the Cuil na Móna Bog Group are located in County Laois with three of the bogs located approx. 4 km south-west of Portlaoise. Abbeyleix Bog, which is located south of Abbeyleix village, was originally included in the Cuil na Móna licence but was removed from the licence boundary in 2017. Bord na Móna's licence for the Cuil na Mona Bog Group (Ref. PO507-001) was granted to Bord na Móna Energy Limited in February 2000 and regulates Bord na Móna's activities across 3 bog units. Of these 3 bogs units, 1 bog, Coolnacarton Bog, (also known as Cuil na Carton) is included in the Substitute Consent applications and in this Flood Risk Assessment Report.

Cuil na Carton Bog is located in the River Barrow catchment and the River Nore catchment.

Development of Kilberry bog commenced in the 1962 with peat extraction commencing in 1966. Peat from Cuil na Carton is used for horticultural purposes.



8.2 Coolnacartan Bog

8.2.1 Introduction

Coolnacartan Bog, (also known as Cuil na Carton Bog) is part of the Bord na Móna Cuil na Mona Bog Group which operates under an Integrated Pollution Control licence (ref P0507-01). The Bog is used primarily to produce milled horticultural peat and the total area within Bord na Móna ownership is 568 hectares.

8.2.2 **Site Location**

Coolnacartan is in County Laois, circa 4 kilometres south west of Portlaoise and lies between the M7 motorway and the national N77 road. The majority of the site falls within Nore 15 catchment area (Hydrometric Area 15), while an area to the north of the site falls within the Barrow 14 catchment area (Hydrometric Area 14). The Coolnacartan site location is highlighted in red in the figure below.

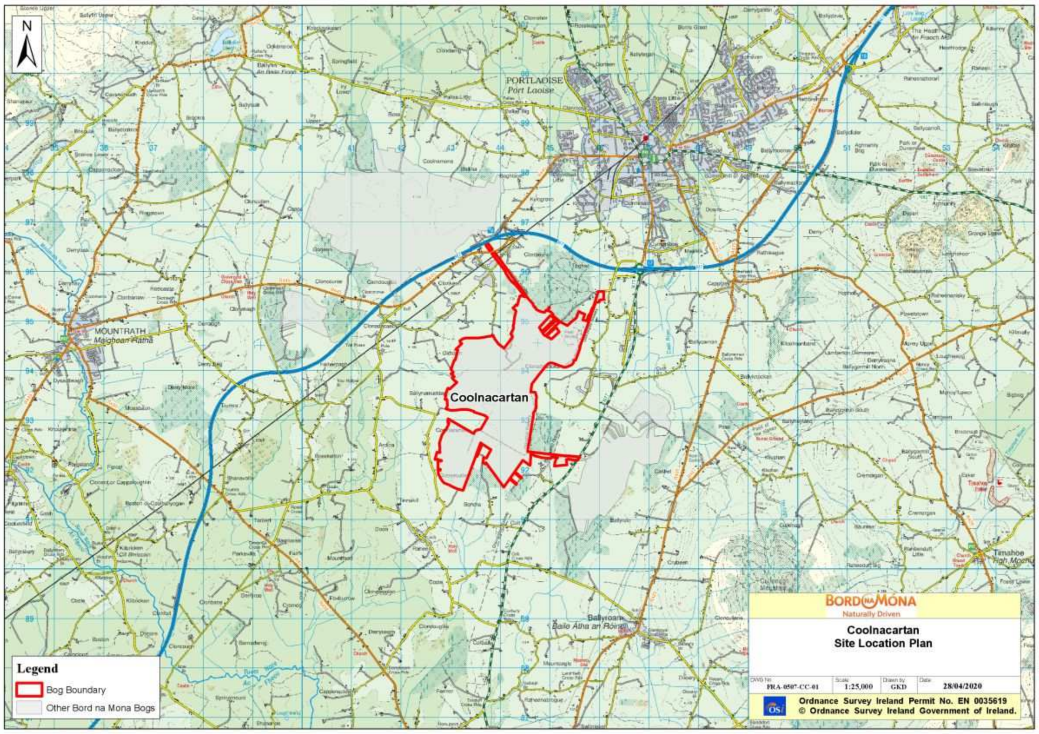


Figure 8.2.1 Coolnacartan Bog Site Location

8.2.3 Bog Description

Coolnacartan Bog is used primarily for the production of horticultural peat. From the records available it appears that drainage in Coolnacartan bog began in 1962, and peat production commenced in 1966. There are significant areas of the bog that are no longer in active production, and much of these areas are colonising with heather and birch. The land use surrounding the bog is primarily comprised of agriculture lands. There is mature forest to the north of the site, and Coillte have further forested areas adjoining the southeast of the site.

The Cul na Mona works site is located at the north end of the site, which includes numerous workshop buildings, offices, welfare facilities and peat outloading facilities for outloading peat to HGVs. This site is not included in the Substitute Consent application as it is subject to other existing planning permissions. The site is accessed via the L26965 local road from Junction 17 on the M7 motorway. The existing finished floor levels of the buildings at the Cuil na Mona Works facility are all in excess of 119.0mOD.

Coolnacartan bog is divided into six drainage basins that each drain into separate surface water gravity outfalls around the site. There are no pumped outfalls in Coolnacartan bog. The bog drainage layout is shown in the figure below.

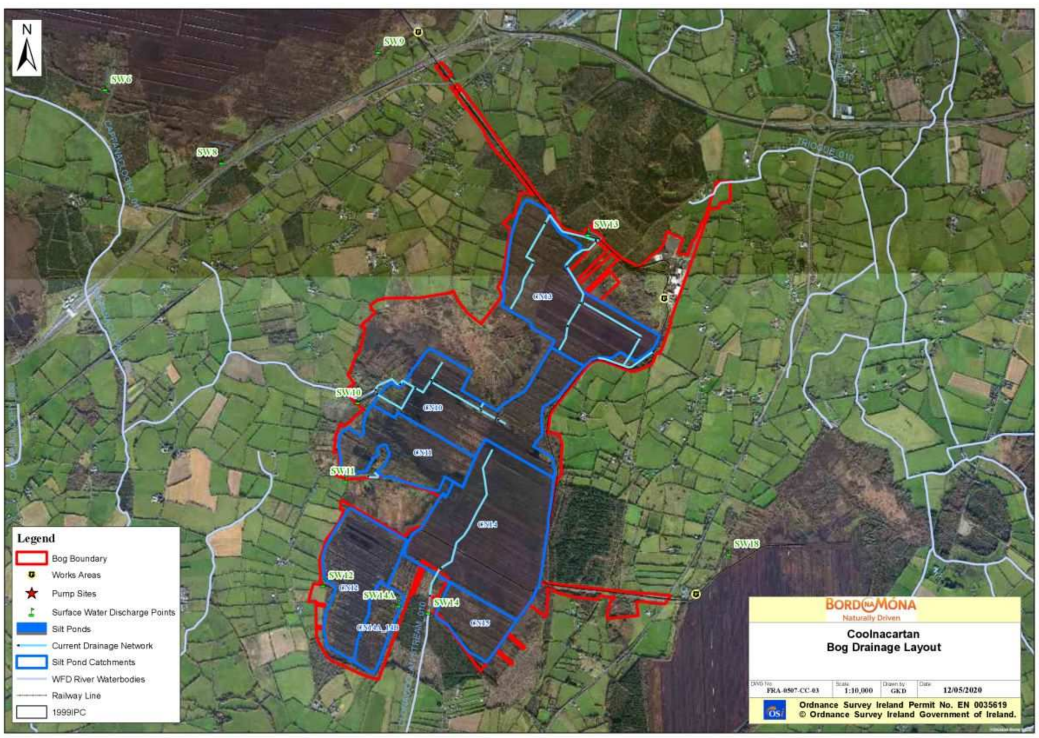


Figure 8.2.2 Coolnacartan Bog Drainage Layout

8.2.4 Regional Hydrology

The majority of Coolnacartan bog lies within in the Nore 15 catchment (Hydrometric Area 15). The Nore 15 catchment drains a total area of 2,595km2. The Slieve Bloom uplands at the northern tip of the catchment are underlain by old red sandstone. South of this limestones of varying purity underly the flat low land areas of the catchment. The Nore catchment comprises 21 sub catchments with 123 river water bodies, four transitional and coastal water bodies, and 28 groundwater bodies.

An area at the north end of Coolnacartan bog lies within in the Barrow 14 catchment (Hydrometric Area 14). The Barrow 14 catchment drains a total area of 3,025km2. The Barrow catchment is underlain in its flat northern area by limestones of varying purity which continue down the western side of the catchment and sustain good groundwater resources in places. The Barrow catchment comprises 20 sub catchments with 145 river water bodies, six transitional water bodies, and 29 groundwater bodies.

Coolnacartan bog is divided into six drainage basins that each drain to separate surface water gravity outfalls, with associated silt ponds. The SW13 outfall at the north of the site discharges into the Triogue_010 river sub basin of the Barrow 14 catchment. The rest of the bog drains into the Nore 15 catchment via SW14 and SW14A into the Clonawoolan Stream_010 river sub basin, and SW10, SW11, and SW12 outfalls into the Cappanacloghy river sub basin.

The catchment area and water courses are shown in Figure 8.2.3 The district drainage schemes are shown in Figure 8.2.4.

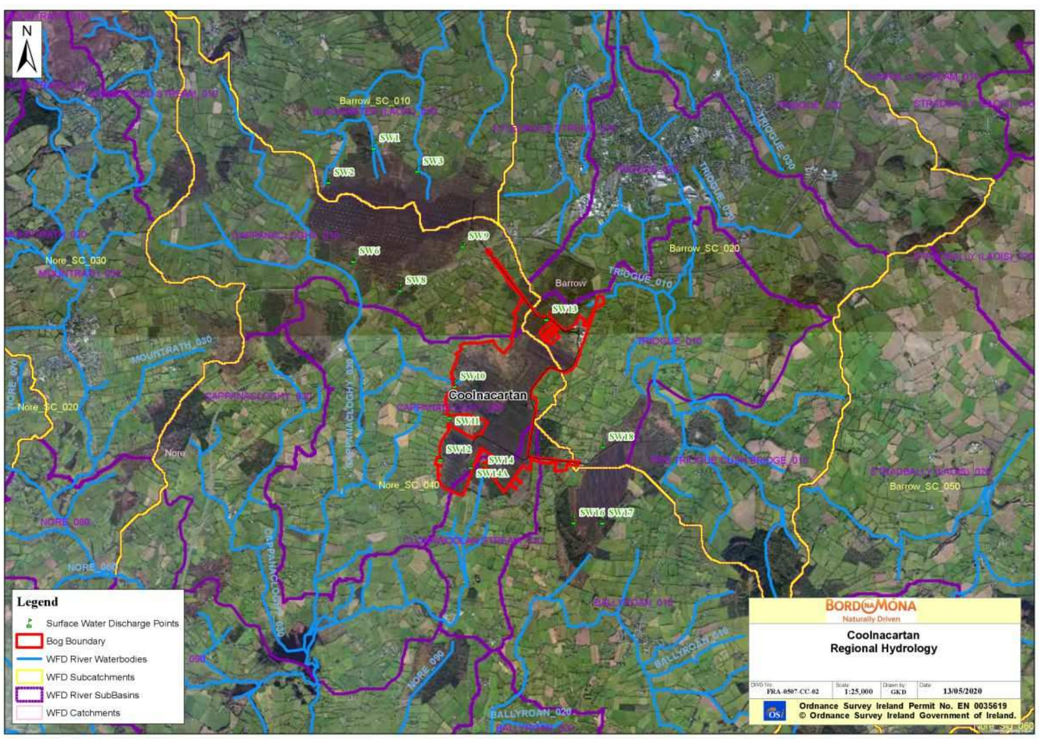


Figure 8.2.3 Coolnacartan Bog Regional Hydrology

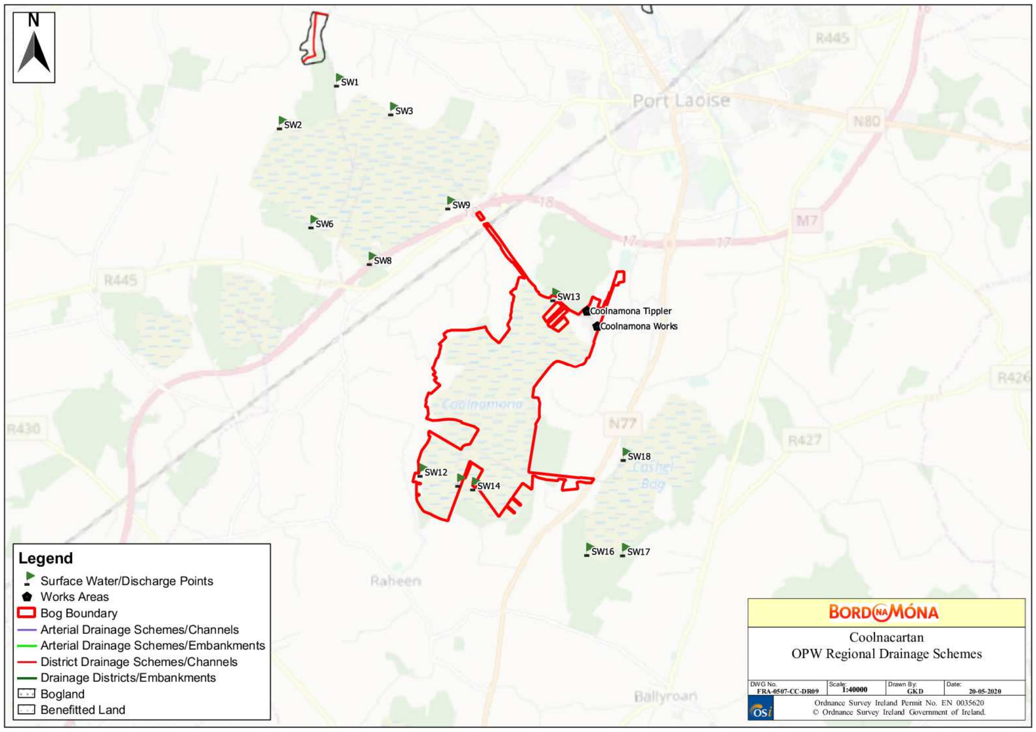


Figure 8.2.4 Coolnacartan Bog District Drainage Schemes

8.2.5 Historical Flooding

A map of historical flooding is shown in the Figure.

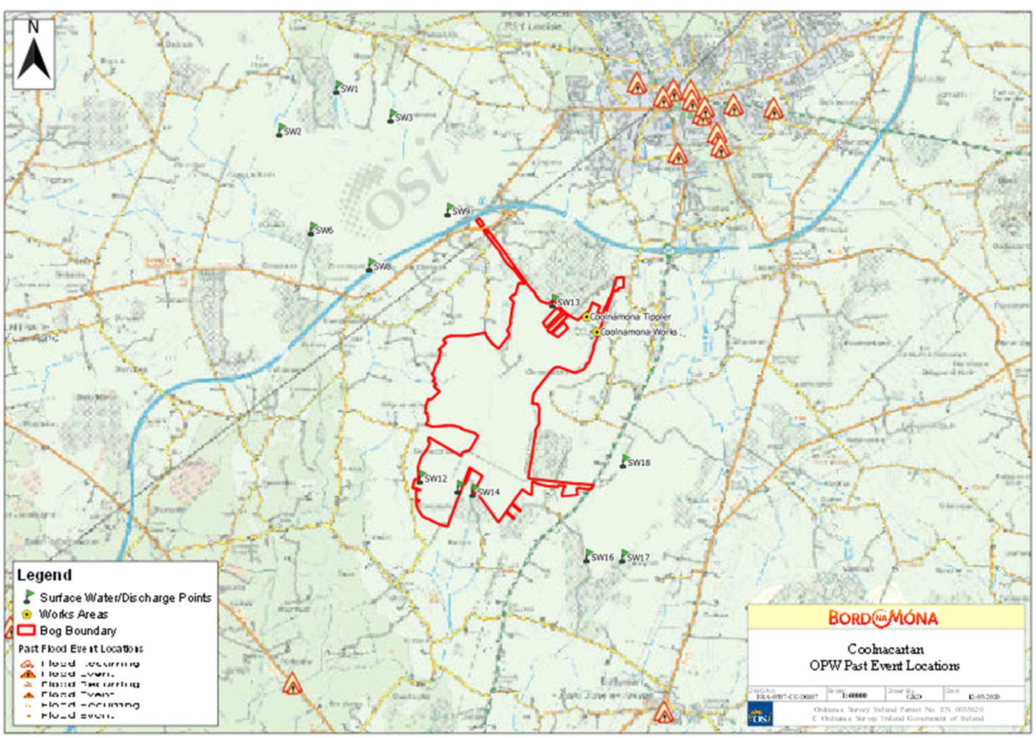


Figure 8.2.5 Coolnacartan Bog Historical Flooding

Local operations knowledge indicates that flooding is not known to have occurred in Coolnacartan bog due to the receiving waters backing up, but confirmed that surface water flooding of the production fields has, on occasion occurred during winter months and have been associated with blockages in the existing bog drainage network. Drainage maintenance works are carried out annually as part of the winter works schedule to minimise flooding to the peat production fields. The car park and buildings at the works area have not been known to flood.

The OPW website, floodinfo.ie indicates that there are several areas within a few kilometres of Coolnacarton bog that are liable to recurring flooding. Records of past flood events are given for numerous locations in Portlaoise town which is circa 3.5km north of the bog, and at Foxburrow which is about 3.5km south of the bog. Records indicate that tributaries of the Nore and Barrow have overflown their banks during periods of heavy rain. These recurring events were recorded in 2005 in an oral report given by Laois Co. Council as part of an OPW project (OPW Flood Hazard Mapping – Phase 1). The report notes for the flooding at Foxburrow – '*Tributary of the River Nore overflows its banks after heavy rainfall every year. Significant land area is flooded'*.

For the recurring flooding events recorded in Portlaoise town, the last reported floods were in the winter of 1994/1995. Remedial works undertaken by Laois Co. Council appear to have alleviated the issues, and flooding has not been recorded since. The report notes for Timahoe Road, Portlaoise – '*The River Triogue overflows its banks after very heavy rainfall. Last occurred in the winter of 1994/1995. The council has undertaken redial work and hasn't flooded since'*, and for Bridge Street, Portlaoise – *'The River Triogue overflows its banks after very heavy rainfall. Last occurred in the winter of 1994/1995. The council has undertaken redial work and hasn't flooded since'*, and for Stradbally Road, Portlaoise – *'A tributary of the river Triogue overflows its banks after very heavy rainfall. Last occurred in the winter of 1994/1995. The council and a developer have undertaken redial work and has not flooded since'*.

Historical OSI 25" maps do not indicate any additional areas liable to flooding in the vicinity of Coolnacarton bog.

8.2.6 **Groundwater Flood Risk**

Coolnacartan Bog is extensively underlain with an aquifer that is categorised as a *Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones (LI).* There is also an aquifer that is categorised as *Regionally Important Aquifer - Karstified (diffuse) (RKd)* underlying the northeast of the bog. These aquifers have a low vulnerability code throughout the bog.

There are no Bord na Móna records or local anecdotal evidence to suggest groundwater flooding has ever occurred at this bog.

The aquifers in the area and detail of the aquifer vulnerability are shown in the figures below:

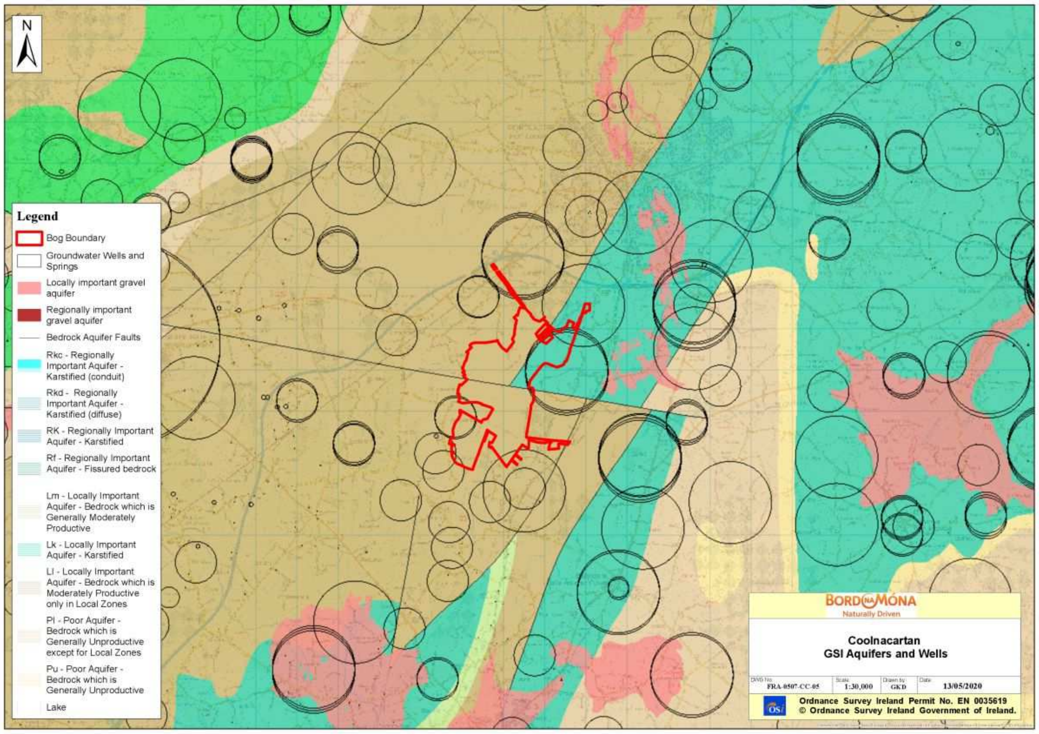


Figure 8.2.6 Coolnacartan Bog Aquifers, Karst Features, Wells

8.2.7 **Fluvial Flood Risk**

The rivers and streams in the vicinity of Coolnacartan Bog are described in terms of regional hydrology in section 8.2.4**.** The six surface water outfalls in Coolnacartan Bog limit outflow from the bog as well as limiting the potential inflow from rivers during large flood events.

Information from Bord na Móna operatives familiar with Coolnacartan Bog confirmed that there is no record of the outfalls in Coolnacartan bog backing up as a result of high water levels in the receiving waters.

OPW CFRAM mapping has been examined in the region of the bog. The figure presented here includes the High, Medium and Low Probability flood events (1 in 10, 1 in 100 and 1 in 1000 year events) associated with Coolnacartan Bog. River Flood Events High Range mapping has been examined in the region of this bog. There has been mapping carried out for the Nore River to the south, and the Triogue_10 and Kylegrove Stream_10 watercourses to the north of the bog, which identifies the potential for flooding for each watercourse. There is no mapping available for the watercourses within a kilometre of Coolnacartan bog. Fluvial flooding is not predicted to encroach into Coolnacartan bog.

CFRAM flood mapping is shown in the Figure below.

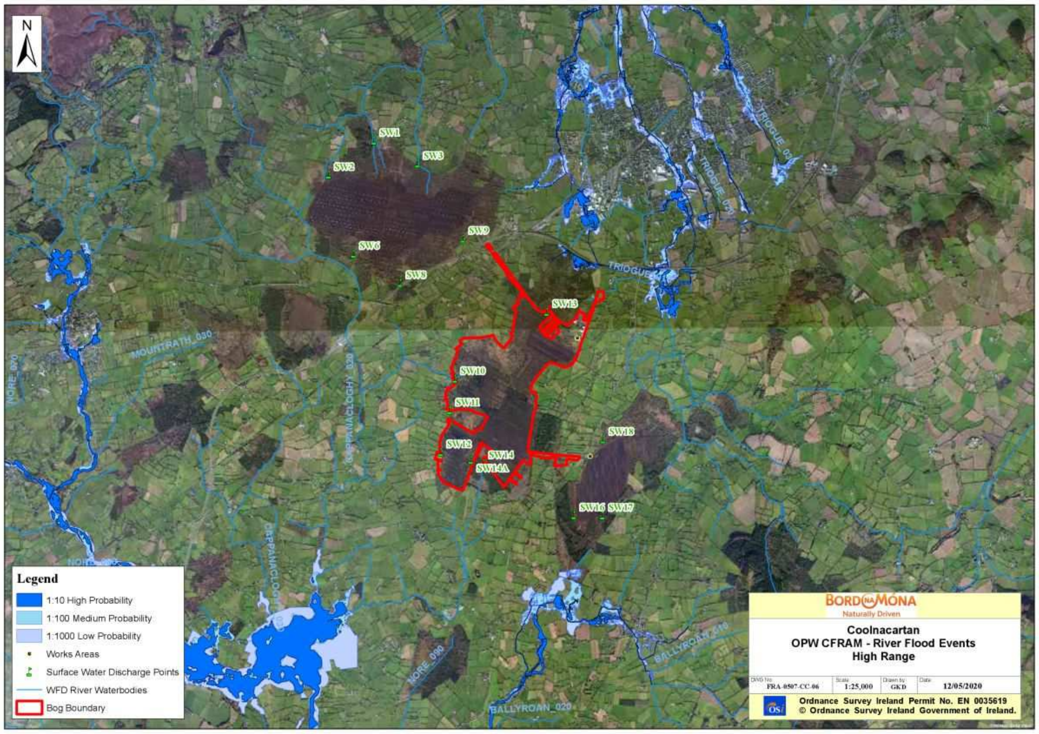


Figure 8.2.7 Coolnacartan Bog River Flood Events High Range

8.2.8 **Pluvial Flood Risk**

The pluvial flood risk has been analysed by flood risk modelling to estimate the volumes of flood waters attenuated within the bog under different rainfall events. This pluvial flood risk modelling developed a digital terrain map from the lidar and topographical data for the bog and predicted, under the estimated 100year and 1000year rainfall depths for critical durations, the resultant area of flood inundation with the outflow from the bog set to the greenfield flood runoff rate.

The following rainfall events have been used to generate the flood maps:

- 1 in 100yr rainfall event
- 1 in 100yr rainfall event (+30% climate change allowance)
- 1 in 1000yr rainfall

The results of flood risk analysis results are presented in the Figure below.

Figure 8.2.8 Coolnacartan Bog Pluvial Flooding, Rainfall Events

The basins used in the model are the extent of the catchments that discharge through the surface water discharge points in the bog. Coolnacartan Bog is modelled for six separate basins: *CN10* that discharges through the SW10 outfall*, CN11* that discharges through the SW11 outfall, *CN12* that discharges through the SW12 outfall, *CN13* that discharges through the SW13 outfall, *CN14 & CN15* that discharges through the SW14 outfall, and *CN14A-14B & CN14A & CN14B* that discharge through the SW14A outfall. Further details on the modelling is set out in the Appendix.

The above model is based on the assumption that the flood water, other than the green field rate runoff through the outflow pipes, is stored within the basins until it recedes via the greenfield flood runoff rate. As the bog edge tends to consist of either high bog or headlands both of which are at a higher level than the production fields, and as outfalls are piped as described above, this is a reasonable assumption.

The model shows that flood waters are collecting in local areas in the north, south and west-of the bog. The maximum 1000 year flood levels are recorded in the vicinity of SW13 at the north of the site and SW14 at the south of the site with levels of 118.18mOD and 117.5mOD respectively.

While the silt pond areas may be at a lower elevation than these extreme event flood levels, in the model the discharges from the flood area to the silt ponds are limited to green field rate run-off and therefore the flood waters are retained on the bog preventing flooding of the silt pond area. The existing piped outfall pipes between the production areas and the silt ponds will limit the discharge rate. Discharge from the silt ponds through the outfalls is assumed to continue at greenfield run-off rate throughout these rainfall events.

The existing finished floor levels of the buildings in Cul na Mona works to the north of the bog are all above 119.0mOD, and are higher than the modelled flood waters in the bog. From this model, Cul na Mona works which includes workshops, welfare facilities, oil storage facilities and a lorry tippler for loading of peat is not as risk of flooding from any of the modelled events.

A stage-storage relationship for each of the drainage basins has been estimated using the topographical information and is presented in the table below.

	Catchment Storage				
Level	CN10 and CN11	CN12	CN13	CN14 and CN15	CN14A_14B
mOD	m^3	m^3	m^3	m^3	m^3
111.00	0	0	0	0	0
111.25	0	0	0	0	0
111.50	10	0	0	0	0
111.75	135	0	0	0	0
112.00	741	0	0	0	0
112.25	2194	0	0	0	9
112.50	5170	0	0	0	57
112.75	10079	0	0	0	149
113.00	17602	0	0	0	269
113.25	28898	0	0	8	455
113.50	46814	0	0	58	868
113.75	73671	0	0	165	2146
114.00	108258	0	0	336	4952
114.25	148161	20	0	664	9339
114.50		120	0	1182	15925
114.75		460	0	1791	
115.00		1180	0	2472	
115.25		2442	0	3237	
115.50		4352	0	4142	
115.75		7866	1	5317	
116.00		18157	5	6981	
116.25		43517	14	9783	
116.50		93582	46	15233	
116.75			236	26609	
117.00			1040	47891	
117.25			4170	82788	
117.50			12125	132869	
117.75			28862		
118.00			55919		

118.25			91725		

Table 8.2.1 Level/Storage Relationship for Drainage Basins

This table illustrates the flood storage available within Coolnacartan Bog and the associated flood levels for the extreme rainfall event of 1 in 1000yr.

8.2.9 **Climate Change**

The Flood Risk Planning guidelines state that a precautionary approach should be adopted to take account of the potential effects of climate change.

Climate change has been taken into account in Section 8.2.8 above, the pluvial flood risk modelling using rainfall data for *1 in 100 year event + 30% climate change allowance (High End Emissions Scenario).* In the climate change model run case the maximum rainfall for the 100 year storm event was increased by 30% to predict the flood inundation volume within the Bog discharging via the outfalls at the current day greenfield runoff rates. This scenario resulted in less flooding than the 1000 year flood event which is addressed in the modelling section above.

When considering fluvial flooding in Section 8.2.7, the High-Emissions Future Scenario (HEFS) has been considered which takes in account the potential impacts of climate change and other future possible changes. This scenario allows for additional peak flood flows of 30% .

8.2.10 **Conclusions**

The Flood Risk Assessment for Coolnacarton Bog identifies the sources of flood risk and their impact. Historical information was also reviewed. The key findings of this assessment include the following:

- ***Historical Flooding:*** There are no historical records of any flooding events or any historical flooding of the site, however from local knowledge flooding of the peat production area does occur on occasion.
- ***Groundwater Flood Risk:*** Groundwater seepage has not been identified as a source of flooding within the site.
- ***Fluvial Flood Risk:*** There is no record of the outfalls in Coolnacartan bog backing up as a result of high water levels in the receiving waters. The culverted outfalls from the bog to the local drains reduce the potential for significant inflow from the adjoining water courses if their levels ever rise during flood events. If this were to occur, based on the size and characteristics of the watercourses the duration would be relatively short.
- ***Pluvial Flood Risk***: The principal flood risk to the development is from the pluvial ponding of direct rainfall building up within the peat production areas. Pluvial flood risk modelling was carried out using the estimated 100year and 1000year rainfall depths for critical durations including a 100year climate change scenario. This modelling demonstrated that there is significant storage available on the bog to attenuate this flood water. The modelled flood levels also indicated that the Works Areas including the buildings and peat lorry loading area would not be impacted by these flood events.

This Flood Risk Assessment indicates that the Cul na Mona Works in Coolnacartan Bog is not at risk of flooding from a 1000year event and therefore can be considered to be in the Low Risk Flood Zone C. This Flood zone is appropriate for all types of development. This development represents commercial and less vulnerable development which is permissible without justification in Flood Zones B and C.

This Flood Risk Assessment indicates that the peat production fields and drains in Coolnacartan Bog can be classified as Zone A as this area of the bog has a high probability of flooding.

	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

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Table 8.2.2 Vulnerability Matrix

From Table 3.2 of the Flood Risk Management Guidelines above, development other than Water-compatible Development in a Flood Zone A requires a Justification Test.

Peat extraction can only be carried out when the ground is dry and is carried out for a number of weeks each year during the Spring/Summer months. There is no permanent plant or equipment located in the peat production fields, other than rail lines and possibly peat stockpiles and while these production fields and rail lines cannot be used during periods of flooding, production can continue once the flood waters recede and the fields dry out. As no production will be carried out during periods of flooding it is considered that peat production is a water compatible development and is appropriate development under this table. However, as the activity is not specifically mentioned in The Flood Risk Guidelines as Water Compatible Development, a Justification test has been carried out for the development in accordance with Chapter 5 of the Flood Risk Management Guidelines.

This Justification Test requires that the following criteria are met:

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*
   - *(i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
   - *(ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*

(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and

(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to the development of good urban design and vibrant and active streetscapes.

Following on from the completion of this flood risk assessment for Coolnacartan Bog it is considered that peat production in the bog satisfies the justification test for the following reasons:

- There are no specific zoning requirements for peat production activities;
- Peat production as proposed can be considered a flood compatible type commercial development;
- The modelling demonstrates that the available storage on the bog will attenuate pluvial flooding and therefore will not increase flood risk elsewhere;
- Flooding of the production areas will cause minimal risk to people, property, the economy and the environment. The main impact of flooding is a cessation of peat extraction and rail haulage for the duration of the flooding. As peat production is a weather dependent activity, this risk is already incorporated into Bord na Móna business projections. Discharge of the flood waters will be limited by the piped outfalls and will therefore dissipate slowly allowing for the deposition of any silt in the field drains upstream of the outfall. The flow from the production area will then discharge through the silt ponds which are cleaned twice a year. Bord na Móna health and safety and environmental procedures including lone working, water safety and emergency policies and procedures, as well as silt pond cleaning procedures further ensure minimal risk to people, property, the economy and the environment;
- The flood modelling carried out in this assessment shows that the buildings, car parking areas, oil storage and peat loading activities are located in an area of higher ground that is not at risk of flooding and consequently potential risk of pollution as a result of flooding is minimal.
- The high emission future scenario climate change has been take into account in this assessment as per the precautionary principle set out in the flood Risk Management Planning guidelines and the proposed development operation and infrastructure is robust and protected against climate change.
- The proposed development is compatible with the wider planning objectives in that it does not affect the flood risk outside of the site boundary.

It is considered that peat extraction and ancillary works in Coolnacartan Bog is in accordance with the flood risk requirements as set out in the Department of Environment, Heritage and Local Government (Nov. 2009) Guidelines to Planning and therefore represents sustainable development in respect to flood risk management.