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Environmental Impact Assessment Report
Development at Waterford Airport

Volume 2 – Chapter 6 – Land, Soils, Geology & Hydrogeology

Prepared for: Waterford City & County Council in Partnership with Waterford Regional Airport PLC

Comhairle Cathrach & Contae Phort Láirge
Waterford City & County Council

Waterford Airport
Serving the Southeast for 30 years

Date: **July 2020**

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6. LAND, SOILS, GEOLOGY & HYDROGEOLOGY

6.1 Introduction

Waterford City & County Council in partnership with Waterford Regional Airport plc are proposing to extend and widen the existing runway and extend the passenger terminal at Waterford Airport, Killowen, Co. Waterford. This Environmental Impact Assessment Report (EIAR) has been prepared to examine the potential impacts of the proposed development on land, soils and geology in the local environment.

The effects of the proposed development are considered, taking account of mitigation measures to reduce or eliminate any residual impacts on land, soils and geology. The assessment also considers the cumulative impacts associated with other nearby developments.

6.2 Methodology

6.2.1 Study Area

The extent of the study area for the proposed Waterford Airport Extension development is illustrated in Figure 2.2 which is included in Chapter 2 – Description of the Development of this document. The proposed site is located approximately 10 km from Waterford City and approximately 6 km from Tramore. The site is predominantly made up of existing runway, passenger terminal and associated car parking areas.

Principal works for the proposed project comprise the following:

- 491m of new runway extending north from the existing.
- 363m of new runway extending south from the existing.
- Widening of the entire length of the runway by 15m to extend the runway width to 45m.
- Widening of taxiway by 8m to provide a width of 23m.
- Extension to car parking area to provide up to 205 no. additional spaces.
- Set down area for public transport within the demarcated area within the existing road layout at the airport terminal.
- Re-alignment of airport security fencing.
- New navigation lighting, aligned to runway, to be provided within airport lands and on adjoining lands, including associated ducting.
- Underground Holding Tank (cold weather storage).
- Alterations to drainage system.
- Extension of the existing terminal building of ca. 1,170sqm.
- Demolition of 2 no. houses adjacent to the north runway.
- Upgrade of existing wastewater treatment plant.

For the purposes of assessing impacts on land, soils and geology, published literature and data was reviewed within the study area to establish regional baseline conditions. A more focused assessment was conducted within the planning boundary at proposed infrastructure locations of the development, including walkover surveys and intrusive site investigations.

6.2.2 Relevant Guidance

This section presents the methodology used in assessing the baseline soil, geological and hydrogeological environment of the proposed development. As well as considering the relevant EPA Guidelines [1] [2] on the information to be contained in Environmental Impact Statements, with respect to the preparation of an Environmental Impact Assessment Report (EIAR) the scope and methodology for the baseline assessment has been devised in consideration of the following guidelines:

- Geology in Environmental Impact Statements [3]
- Geology of Waterford [4]
- General Soil Map of Ireland [6]
- Groundwater Protection Schemes for County Waterford [7]
- Online historic aerial photographs [9]
- Online landslide database [12]
- Online heritage database [6]
- Online Aggregate Potential Mapping database [7]
- EPA Envision Map Viewer [15]

6.2.3 Consultation

The scope for this assessment has been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties as summarised in Chapter 4 of this EIAR.

6.2.4 Desk Study

Prior to undertaking a site walk-over a desk study was undertaken in order to help determine the baseline conditions within the study area and planning boundary to provide relevant background information.

The desk study included an assessment of the sources of information listed in Section 6.2.2.

6.2.5 Evaluation Criteria

During each phase (construction, operation, maintenance and decommissioning) of the proposed development, a number of activities will take place on site, some of which will have the potential to cause impacts on the geological regime and the associated soils, geology and hydrogeology. These potential impacts are discussed in Section 6.4. Mitigation measures are presented in Section 6.5.

6.3 Existing Environment

6.3.1 Bedrock Geology

The bedrock geology of the site and surrounding area as shown in Figure 6.1 – Bedrock Geology. The Geological Survey of Ireland (GSI) 1:100,000 scale bedrock geology map shows that the southern portion of the site is underlain by the Booley Bay Formation with the northern portion of the site underlain by the Ballyhack Member.

The Booley Bay Formation of Cambrian age is described by the GSI as comprising *'repetitively interbedded grey siltstone and mudstone succession with fine sandstones and para-conglomerates up to 30m thick also occurring'* with a total estimated thickness of approximately 2,250m. The Booley Bay Formation is part of the Lower to Middle Cambrian age Cahore Group.

The Ballyhack Member of Ordovician age is described by the GSI as comprising *'thinly interbedded grey slaty mudstones and fine sandstones or siltstones.'* The total thickness of the member is estimated to be approximately 400m.

The boundary between the Ballyhack Member and the Booley Bay Formation at the site is delineated by an east-west trending fault. There are a number of north-south trending fault situated to the east and west of the site boundary.

A section at the northern-most extent of the site is located on the Campile Formation, described by the GSI as being formed of Felsic volcanics.

There are no karst features within the site of the proposed development route as indicated on the GSI online mapping.

6.3.2 Overburden Geology

The land use across the site generally consists of level ground, predominantly covered by existing runway, carparking and terminal buildings with grassland at the vicinity of these. The typical elevations of the site are between 60 – 150m AOD. The subsoils present at the study area are taken from the GSI online mapping as shown in Figure 6.2 Quaternary Geology and comprise:

- Made Ground; and
- Till derived from Acidic Volcanic Rocks
- Bedrock outcrop or subcrop

Soil mapping by Teagasc indicates that the soils underlying the development predominantly comprise:

- Surface Water and Groundwater Gleys

6.3.3 Hydrogeology

Groundwater is an important natural resource, with increasing dependence on it as a drinking water supply source. The site is located within the Dunmore East groundwater body as shown in Figure 6-3.

The GSI classifications for the aquifers in the study area, including the principle aquifer characteristics are summarised in Table 6.1, and shown on Figure 6-3. All aquifers in the study area are bedrock aquifers; there are no gravel aquifers within the study area (i.e. a gravel deposit of greater than 1 km^2 with a saturated thickness of greater than 5 m).

Table 6-1: Summary of Aquifer Classifications & Characteristics

Aquifer Name	GSI Aquifer Classification	Groundwater Body	Transmissivity (m^2/day)
Unnamed	Poorly Productive aquifer which is generally unproductive except in local zones (Pl)	Dunmore East	Unknown

Figure 6.3 also shows the location of groundwater wells included in the GSI dataset. There may be other wells in the study area in additional to those included in the GSI dataset. The available details for these wells are summarised in Table 6.2.

Table 6-2: Summary of Wells within the Study Area

Well ID	Grid Co-ordinates	Well Type	Well Use	Total Depth (m)	Depth to Bedrock (m)	Yield (m^3/day)	Yield Class
2609NWW015	E: 262,370.00 N: 106,110.00	Borehole	Unknown	37.5	3.1	Unknown	-
2609NWW005	E: 261,910.00 N: 105,250.00	Unknown	Unknown	25	2.4	27.3	Poor
2609NWW004	E: 261,910.00 N: 105,260.00	Borehole	Unknown	24.4	0	54.5	Moderate
2609NWW006	E: 261,320.00 N: 104,360.00	Spring	Unknown	Unknown	-	Unknown	-
2609NWW037	E: 261,770.00 N: 102,970.00	Borehole	Unknown	31.7	4.9	43.6	Moderate
2609NWW039	E: 261,760.00 N: 102,960.00	Borehole	Unknown	56.1	15.2	32.7	Poor
2609NWW031	E: 263,210.00 N: 104,550.00	Borehole	Unknown	21.3	4.6	54.5	Moderate
2609NWW020	E: 264,310.00 N: 104,750.00	Dug Well	Unknown	7.3	1.2	16.4	Poor
2609NWW068	E: 264,590.00 N: 103,900.00	Borehole	Domestic	Unknown	15	Unknown	-
2609NWW040	E: 264,540.00 N: 103,340.00	Borehole	Unknown	31.7	4.3	43.6	Moderate
2609NWW043	E: 263,940.00 N: 102,390.00	Borehole	Unknown	36	17.1	31.6	Poor

Well ID	Grid Co-ordinates	Well Type	Well Use	Total Depth (m)	Depth to Bedrock (m)	Yield (m^3/day)	Yield Class
2609NWW049	E: 263,360.00 N: 102,350.00	Borehole	Unknown	36.6	3.1	27.3	Poor
2609NWW041	E: 265,230.00 N: 102,830.00	Borehole	Unknown	43.3	3.1	32.7	Poor
2609NWW042	E: 265,300.00 N: 102,640.00	Borehole	Unknown	42.7	15.2	27.3	Poor
2609NWW002	E: 260,400.00 N: 105,000.00	Borehole	Unknown	Unknown	10.7	65.5	Moderate

According to the GSI datasets, there are no karst features recorded within the study area.

There are no groundwater-sourced drinking water protection areas within the study area. The closest is located approximately 25km to the east of the site at Ballyogarty.

The Groundwater Vulnerability is classified by the GSI as being 'Moderate' in the vicinity of the majority of the proposed infrastructure locations becoming 'Low' towards the western extent of the site. A portion of the site of limited aerial extent is described as having 'High' vulnerability to groundwater pollution. The GSI distribution of groundwater vulnerability for the site area is shown in Figure 6.4.

Based on the GSI aquifer vulnerability mapping (Figure 6.4), overburden deposits are generally between 5 and 10 m deep in the central portion of the site and <10m deep to the west of the site.

A summary of the groundwater vulnerability for the site is presented in Table 6.3. This table outlines the standard ratings of vulnerability used by the GSI, with the existing site conditions highlighted based on the findings of the site investigations.

Table 6-3: Groundwater Vulnerability

Vulnerability Rating	Hydrogeological Conditions		
	Subsoil Permeability (Type) and Thickness		
	High Permeability (sand/gravel)	Moderate Permeability (sandy soil)	Low Permeability (clayey subsoil, clay, peat)
extreme (E)	0 - 3.0 m	0 - 3.0 m	0 - 3.0 m
high (H)	> 3.0 m	3.0 -10.0 m	**3.0 - 5.0 m**
moderate (M)	N/A	>10.0 m	**5.0 - 10.0 m**
low (L)	N/A	N/A	**>10 m**

Notes: 1. N/A = not applicable.
2. Precise permeability values cannot be given at present.

6.3.4 Existing Slope Stability

The GSI Public Data Viewer [6] (Landslides Dataset) was accessed during June 2018. No landslide incidents were recorded within 500m of Waterford Airport.

6.3.5 Geological Heritage

The GSI - Irish Geological Heritage Section (IGH) and NPWS (National Parks and Wildlife Service) is undertaking a programme to identify and select important geological and geomorphological sites throughout the country for designation as NHAs (Natural Heritage Areas) – the Irish Geological Heritage Programme. This is being addressed under 16 different geological themes. For each theme, a larger number of sites (from which to make the NHA selection) are being examined, in order to identify the most scientifically significant. The criterion of designating the minimum number of sites to exemplify the theme means that many sites of national importance are not selected as the very best examples. However, a second tier of County Geological Sites (CGS) (as per the National Heritage Plan) means that many of these can be included in County Development Plans and receive a measure of recognition and protection through inclusion in the planning system.

The GSI Geological Heritage database shows three sites of significant geological heritage located on the south-eastern side of the development boundary. These are 'Quillia' (660869E 603728N), 'Tramore Burrow' (660261E 600950N) and 'Tramore' (657536E 600553N). Their locations are shown on Figure 6.1

6.3.6 Economic Geology

The GSI Online Minerals Database accessed via the Public Data Viewer shows a number of active and historic quarries and mineral occurrences in the study area. Their distribution is shown on Figure 6.1. These consist of rock quarries, recorded mineral occurrences and historic mines (Copper) none of which are located within the airport site. The nearest quarry is identified as the Kilcaragh Slate Quarry located approximately 2.7km north of the airport. The nearest recorded historical mine (Copper) held within the GSI database is located at Ballykinsella approximately 2.6km north-west of Waterford Airport.

The GSI Aggregates database indicates that there is a very low to low potential for crushed rock aggregate across much of the site as shown in Figure 6.5.

The GSI Aggregates database indicates that there is a low to moderate potential for granular aggregate beneath the eastern and western extents of the proposed development site.

The requirement for imported aggregate to meet the demands of the development during the construction phase has been identified. As such it is envisaged that the proposed development will impact on existing gravel pits/quarries from the extraction of aggregate during the construction phase of the development.

6.3.7 Soil Contamination

There are no known areas of soil contamination on the proposed development site. No evidence of soil contamination was noted during site walkovers. As agricultural/forestry equipment is used across much of the proposed development site it is possible that minor fuel spills and leaks have occurred locally in the past. Further, due to the presence of local roads within the study area, there is a risk of fuel leakages and other highway related contamination in the upper soils.

According to the EPA online mapping (http://gis.epa.ie/Envision), there are no licenced waste facilities or IPPC licenced facilities on or within the immediate environs of the project site. The nearest EPA Licenced Waste Facility is the Tramore Waste Disposal Site (EPA Licence W0075-02), located approximately 5km to the south west of the study area.

6.3.8 Site Investigations

Preliminary intrusive investigations were undertaken at selected locations to investigate ground conditions at the proposed development and identify any ground risks associated with the proposed works.

An intrusive investigation was undertaken by IGSL Ltd. during comprised the following scope of works:

- Advancement of 1 No. Cable Percussion Borehole to a maximum depth of 4.80m BGL;
- Advancement of 6 No. Window Sample holes to a maximum depth of 4.0m BGL;
- Installation of 2 No. Groundwater Monitoring Wells
- Advancement of 5 No. Trial Pits to a maximum depth of 2.0m BGL;
- Completion of soak-away testing at Trial Pit locations;
- In-situ Geotechnical testing; and
- Environmental Laboratory testing

The site investigation generally encountered Made Ground or Topsoil overlying *Firm to Stiff to Very Stiff silty or very silty, gravelly CLAY.* Made Ground encountered in trial pits TP01 and TP04 and Window Samples WS01 and WS04 were generally described as *Light brown gravelly very silty Clay with granular Fill* to a maximum depth of 1.3m BGL (WS04).

A *Dense brown sandy very clayey GRAVEL with angular to sub-angular clast of Mudstone* was encountered in Window Sample WS01. The Window Sample logs provided indicate that Weathered Bedrock was potentially encountered at the base of WS01, WS03 & WAS06. This horizon was generally described as *Grey/Dark Grey MUDSTONE* recovered as GRAVEL.

The site walkover and ground investigations have generally confirmed the anticipated geology described in the Desk Study. A summary of the geological strata encountered during the ground investigations is summarised in Table 6.4 below.

Table 6-4: Summary of Geology Encountered

Strata	General Description	Depth to Top Range (m bgl)	Depth to Bottom Range (m bgl)
Topsoil	TOPSOIL: *Brown, slightly sandy, slightly gravelly SILT*	0.0	2.8 – 4.8
Made Ground	*Light brown gravelly very silty Clay with granular Fill*	0.3 – 3.0	>9.6m

Strata	General Description	Depth to Top Range (m bgl)	Depth to Bottom Range (m bgl)
Glacial Till	*Firm to Stiff to Very Stiff silty or very silty, gravelly CLAY.*	0.3 – 3.0	>9.6m
Gravels	*Dense brown sandy very clayey GRAVEL with angular to sub-angular clast of Mudstone*	1.55	3.0
Weathered Bedrock (MUDSTONE)	*Grey/Dark Grey MUDSTONE recovered as GRAVEL.*	2.7 – 3.0	Not Proved

6.3.9 Environmental Laboratory Testing

Laboratory testing was scheduled by IGSL to include a total of 6 No. groundwater samples recovered from boreholes WS1, WS3, WS4, WS6, BH01 & BH02 were analysed for the following parameters:

- pH
- Electrical Conductivity
- Total Organic Carbon
- Biological Oxygen Demand
- Chemical Oxygen Demand
- Ammonia
- Phosphate
- Sulphate as SO_4
- Total Oxidised Nitrogen
- Chloride
- Metals
- PAH
- TPH
- Ethylene Glycol

All samples were dispatched to Chemtest Laboratories for chemical testing under appropriate chain-of-custody procedures. Chemtest are a UKAS/MCERTS accredited laboratory. The results are presented below in Table 6.5 with laboratory analytical reports presented in Volume 3 of this EIAR.

Table 6-5: Groundwater Monitoring Results

Parameter	Units	WS1	WS3	WS6	WS4	BH01	BH02
pH		8.1	7.7	7.5	7.6	8.0	7.7
Electrical Conductivity	µS/cm	650	650	910	590	650	670
Biochemical Oxygen Demand	mg O2/l	8.2	11	8.1	6.8	13	12
Chemical Oxygen Demand	mg O2/l	26	39	26	23	40	50
Alkalinity (Total)	mg/l	320	300	410	250	330	320
Chloride	mg/l	35	43	54	43	43	39

Parameter	Units	WS1	WS3	WS6	WS4	BH01	BH02
Ammonia (Free)	mg/l	< 0.050	< 0.050	< 0.050	< 0.050	0.11	< 0.050
Orthophosphate as PO4	mg/l	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Sulphate	mg/l	44	33	100	54	< 1.0	12
Total Oxidised Nitrogen	mg/l	0.93	< 0.20	0.47	1.2	< 0.20	< 0.20
Arsenic (Dissolved)	µg/l	< 1.0	2.3	1.0	1.8	5.1	7.3
Cadmium (Dissolved)	µg/l	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080	< 0.080
Chromium (Dissolved)	µg/l	< 1.0	< 1.0	< 1.0	4.0	5.5	2.3
Copper (Dissolved)	µg/l	1.2	1.1	1.1	1.4	9.7	8.1
Mercury (Dissolved)	µg/l	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Nickel (Dissolved)	µg/l	2.6	3.1	< 1.0	< 1.0	3.5	6.3
Lead (Dissolved)	µg/l	< 1.0	< 1.0	< 1.0	< 1.0	2.8	1.6
Selenium (Dissolved)	µg/l	3.2	2.2	2.0	1.7	1.8	2.3
Zinc (Dissolved)	µg/l	8.2	3.2	2.3	1.7	16	9.9
Total Organic Carbon	mg/l	4.9	5.9	5.1	4.1	19	17
Total TPH >C6-C40	µg/l	< 10	< 10	< 10	< 10	< 10	< 10
Total Of 16 PAH's	µg/l	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Ethylene Glycol	mg/l	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

6.3.10 Infiltration Tests

Infiltration tests were carried out in general accordance with the BRE Digest 365, 2007 Soakaway Design Standards. The test measures the rate at which water soaks away from the test pit to give an infiltration coefficient (f) in m/s or m/h. A summary of the results of the infiltration testing completed at trial pit locations TP01 – TP05 is provided below in Table 6.6. No infiltration was recorded at any of the locations tested.

Table 6-6: Infiltration Test Results

Test Pit ID	Water level (start of test)	Water level (end of test)	Infiltration Coefficient (f) m/s
STP01	0.5	0.5	ND
STP02	0.5	0.5	ND
STP03	0.5	0.5	ND
STP04	0.5	0.5	ND
STP05	0.5	0.5	ND

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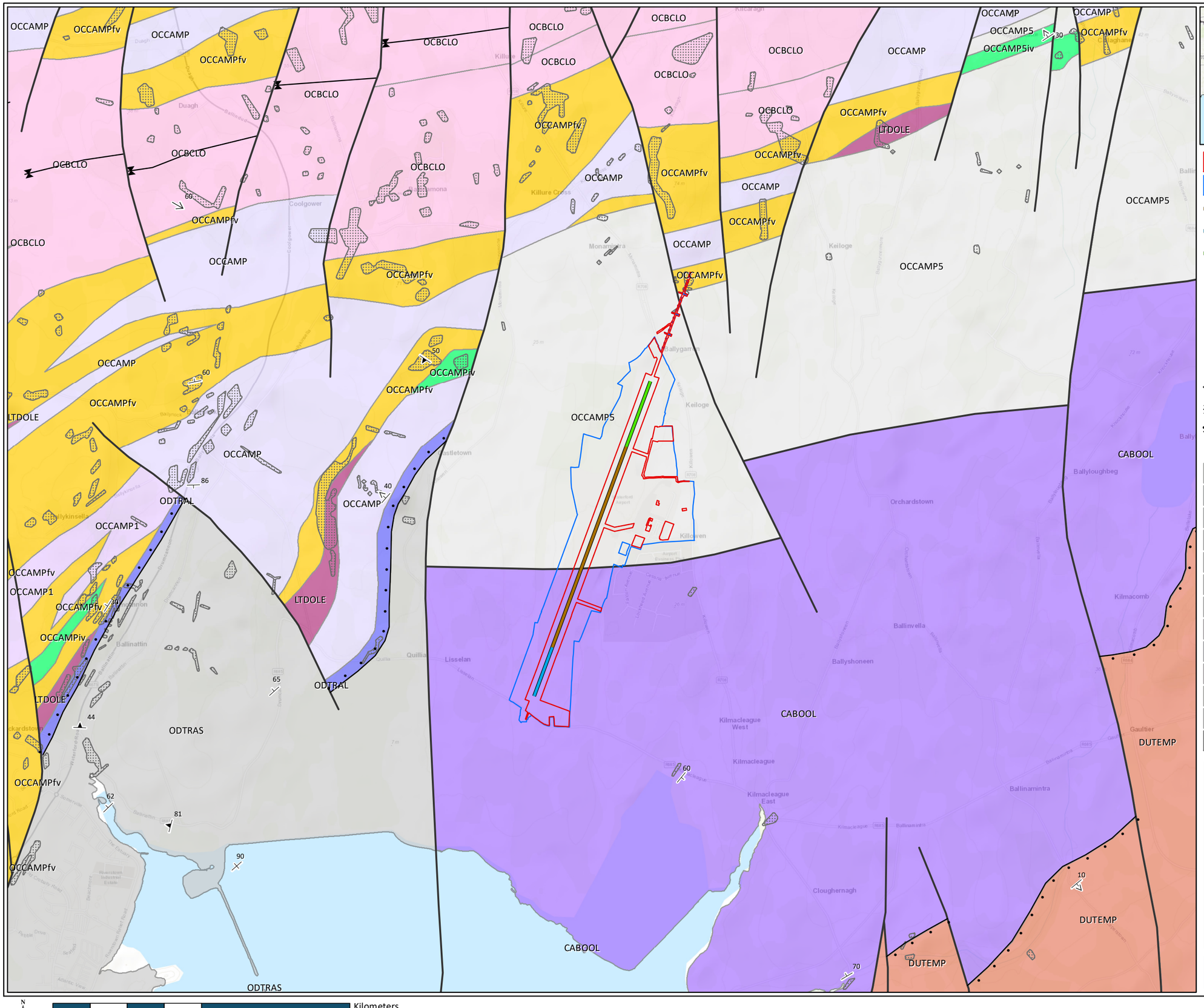

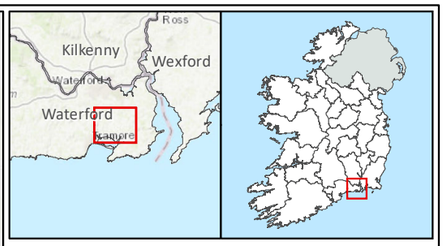

- Site Boundary
- Land under SERA (South East Regional Airport) and Waterford City and Council Ownership
- Existing Runway
- Permitted South Extension
- Proposed North Extension
- Dip of bedding or main foliation, old GSI data
- Strike and dip of bedding, right way up
- Strike and dip of bedding, way up unknown
- Strike and dip of first foliation
- Strike of vertical bedding/foliation
- Fault
- Synclinal Axis
- Unconformity, dots on younger side

Bedrock Geology

- Booley Bay Formation
- Templetown Formation
- Dolerite
- Ballynaclogh Formation
- Campile Formation
- Garraun Member
- Ballyhack Member
- in Ballyhack Member
- in Campile Formation
- in Campile Formation
- Tramore Limestone Formation
- Tramore Shale Formation
- Bedrock Outcrop

TITLE:	Bedrock Geology
PROJECT:	Waterford Airport Runway Extension
FIGURE NO:	6.1
CLIENT:	Waterford Airport
SCALE:	1:25000
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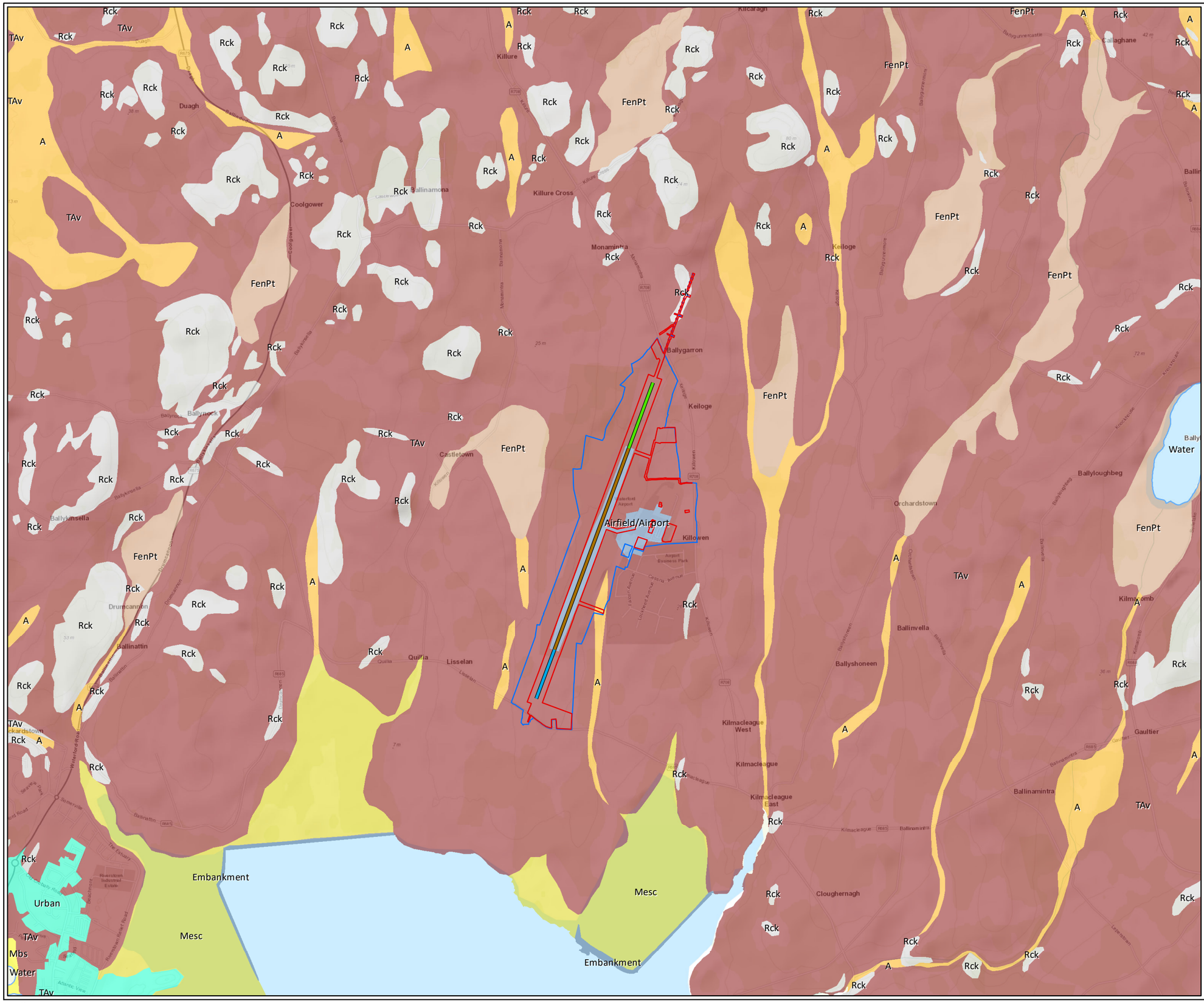

Site Boundary

Land under SERA (South East Regional Airport) and Waterford City and Council Ownership

Existing Runway

Permitted South Extension

Proposed North Extension

Quaternary Sediments

A, Alluvium

Airfield/Airport

Embankment

FenPt, Fen Peat

Mbs, Marine beach sands

Mesc, Esturine silts and clays

Rck, Bedrock outcrop or subcrop

TAv, Till derived from acidic volcanic rocks

Urban

Water

N W E S

0 0.5 1 2 Kilometers

TITLE:	Quaternary Geology		
PROJECT:	Waterford Airport Runway Extension		
FIGURE NO:	6.2		
CLIENT:	Waterford Airport		
SCALE:	1:25000	**REVISION:**	0
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Ibrook
SE_G_176

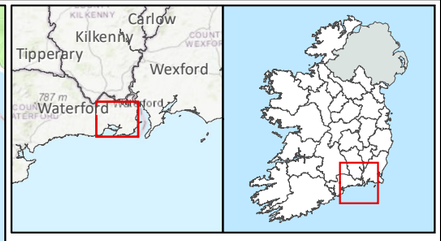
Kilbarry
Landfill
SE_G_175

Waterford
SE_G_149

Fethard
SE_G_065

Tramore
SE_G_146

Dunmore
East
SE_G_057



Site Boundary

Land under SERA (South East Regional Airport) and Waterford City and Council Ownership

Existing Runway

Permitted South Extension

Proposed North Extension

WFD Ground Water Bodies

Dunmore East

Fethard

Ibrook

Kilbarry Landfill

Tramore

Waterford

TITLE:	Groundwater Bodies		
PROJECT:	Waterford Airport Runway Extension		
FIGURE NO:	6.3		
CLIENT:	Waterford Airport		
SCALE:	1:50000	**REVISION:**	0
DATE:	12/06/2020	**PAGE SIZE:**	A3

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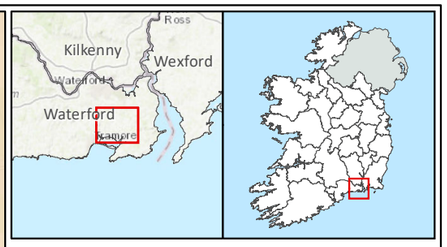

Site Boundary

Land under SERA (South East Regional Airport) and Waterford City and Council Ownership

Existing Runway

Permitted South Extension

Proposed North Extension

Bedrock Aquifers

Ll: Locally Important Aquifer - Bedrock Mod Productive Locally

Pl: Poor Aquifer Bedrock Generally Unproductive Except Locally

Rf: Regionally Important Aquifer - Fissured Bedrock

Kilometers
0 0.5 1 2

TITLE:	Aquifer Classification		
PROJECT:	Waterford Airport Runway Extension		
FIGURE NO:	6.4		
CLIENT:	Waterford Airport		
SCALE:	1:25000	**REVISION:**	0
DATE:	13/05/2020	**PAGE SIZE:**	A3

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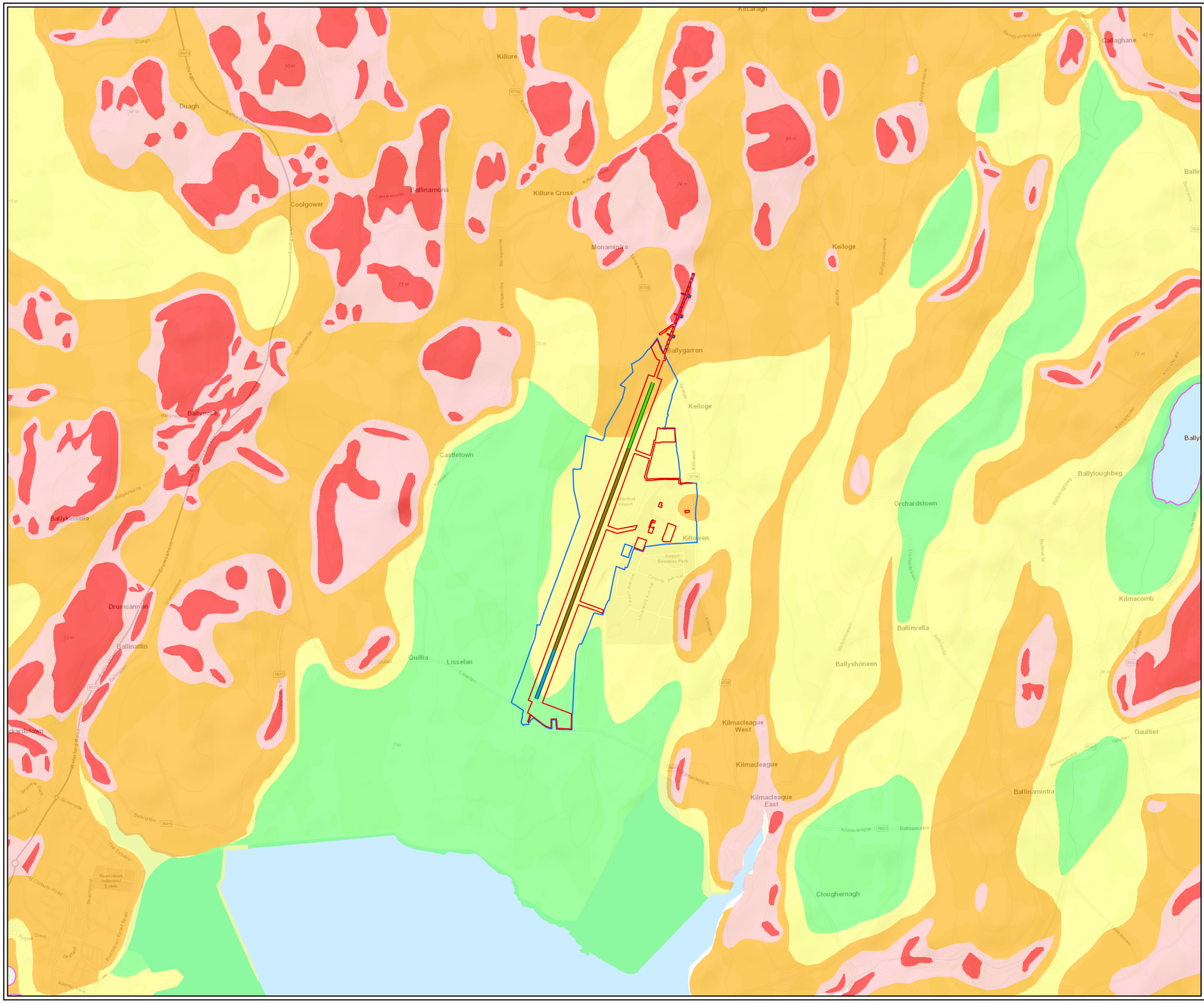

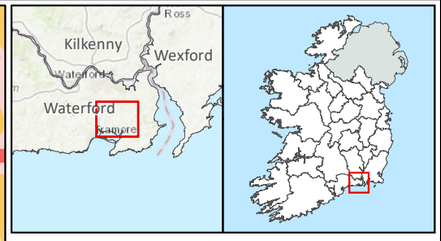

- Site Boundary
- Land under SERA (South East Regional Airport) and Waterford City and Council Ownership
- Existing Runway
- Permitted South Extension
- Proposed North Extension

Groundwater Vulnerability

- E - Extreme
- H - High
- M - Moderate
- L - Low
- Water
- X - Rock Near Surface or Karst

N W E S

0 0.5 1 2 Kilometers

TITLE:	Groundwater Vulnerability		
PROJECT:	Waterford Airport Runway Extension		
FIGURE NO:	6.5		
CLIENT:	Waterford Airport		
SCALE:	1:25000	**REVISION:**	0
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6.4 Potential Impact

The main characteristics of the proposed development at Waterford Airport that could impact on soils, geology and hydrogeology are:

- Construction of extension to existing runway and unpaved hard-shoulder
- Construction of extension of existing terminal building and associated car parking
- Construction of the extension of existing taxiway and additional unpaved hard-shoulder
- Construction of additional drainage
- Soil and rock excavation/reuse
- Temporary Material storage areas
- Vehicular movement

Mitigation measures to minimise these potential impacts are described in the following section.

6.4.1 Do Nothing Scenario

If the proposed Waterford Airport extension was not constructed, it is likely that the current land uses will continue for the foreseeable future, i.e. existing airport. The impact on the soils, geology and hydrogeology would remain largely unaltered as a result.

6.4.2 Assessment of Significance of Geological Impact on the Receiving Environment

An impact rating has been developed for each of the phases of development of the airport infrastructure based on the Institute for Geologists Ireland (IGI) Guidance for the preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements. In line with IGI Guidance the receiving environment (Geological Features) was first identified, then the importance of the geological features is rated (Table 6-7) followed by an estimation of the magnitude of the impact (Table 6-8). This determines the significance of the impact prior to application of mitigation measures as set out in Table 6.9.

Table 6-7: Criteria Rating Site Importance of Geological Features (NRA, 2008)

Magnitude	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and/or soft organic soil underlying the site is significant on a national or regional scale	• Geological feature on a regional or national scale (NHA). • Large existing quarry or pit. • Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying the site is significant on a local scale	• Contaminated soil on site with previous heavy industrial usage • Large recent landfill site for mixed wastes • Geological feature of high value on a local scale (County Geological Site) • Well drained and/or high fertility soils • Moderately sized existing quarry or pit • Marginally economic extractable mineral resource
Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and/or soft organic soil underlying the site is moderate on a local scale	• Contaminated soil on site with previous light industrial usage • Small recent landfill site for mixed wastes • Moderately drained and/or moderate fertility soils • Small existing quarry or pit • Sub- economic extractable mineral resource
Low	Attribute has a low quality, significance or value on a local scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying the site is small on a local scale	• Large historical and/or recent site for construction and demolition wastes • Small historical and/or recent landfill site for construction and demolition wastes • Poorly drained and/or low fertility soils • Uneconomic extractable mineral resource

Assessment of Magnitude of the Impact on Geology Attribute (NRA, 2008).

The assessment of the magnitude of an impact incorporates the timing, scale, size and duration of the potential impact. The magnitude criteria for geological impacts are defined as set out in Table 6.8.

Table 6-8: Estimation of Magnitude of Impact on Geological Features (NRA, 2008)

Magnitude	Criterion	Description and Example
Large Adverse	Results in loss of attribute	• Loss of high proportion of future quarry or pit reserves • Irreversible loss of high proportion of local high fertility soils • Removal of entirety of geological heritage feature • Requirement to excavate / remediate entire waste site • Requirement to excavate and replace high proportion of peat, organic soils and/or soft mineral soils beneath alignment
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	• Loss of moderate proportion of future quarry or pit reserves • Removal of part of geological heritage feature • Irreversible loss of moderate proportion of local high fertility soils • Requirement to excavate / remediate significant proportion of waste site • Requirement to excavate and replace moderate proportion of peat, organic soils and/or soft mineral soils beneath alignment
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	• Loss of small proportion of future quarry or pit reserves • Removal of small part of geological heritage feature • Irreversible loss of small proportion of local high fertility soils and/or • high proportion of local low fertility soils • Requirement to excavate / remediate small proportion of waste site • Requirement to excavate and replace small proportion of peat, organic soils and/or soft mineral soils beneath alignment
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	No measurable changes in attributes

Magnitude	Criterion	Description and Example
Minor Beneficial	Results in minor improvement of attribute quality	Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality	Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

Assessment of Significance of Geological Impacts (NRA, 2008).

The matrix in Table 6.9 determines the significance of the impacts based on the importance and magnitude of the impacts as determined by Tables 6.7 and 6.8.

Table 6-9: Ratings of Significance of Impacts for Geology (NRA, 2008)

Importance of Attribute	Magnitude of Impact			
	Negligible	Small Adverse	Moderate Adverse	Large Adverse
Very High	Imperceptible	Significant/ Moderate	Profound/ Significant	Profound
High	Imperceptible	Moderate/ Slight	Significant/ Moderate	Profound/Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

The determination of the significance of each impact for this site is discussed in Section 6.4.7.

6.4.3 Potential Impacts – Construction

6.4.3.1 Potential Direct Impacts of Proposed Development

The characteristics of the proposed development that present potential impacts to land, soils and geology are outlined in Section 6.4.

In general, the potential impacts on soils and geology typically associated with this development include excavation of soils for the various elements of the development (runway extension, hardstands, foundations, drainage trenches, etc.), use of stone and aggregate for construction of the runway, foundations, hardstands etc., use of concrete for foundations, use and storage of fuels presenting a contamination risk and erosion of soils exposed during earthworks.

Potential impacts on hydrogeology from the development are typically of much lower magnitude and occurrence. Potential impacts include use and storage of fuels presenting a contamination risk to groundwater, construction of foundations below the groundwater level, excavations below the groundwater level requiring dewatering which could impact nearby wells, and creation of preferential pathways along cable routes for groundwater / contamination movement.

6.4.3.2 Summary & Discussion of Potential Direct Impacts

It is considered that the importation of granular fill and other products in the form of concrete or other construction related products will therefore have a permanent Moderate /Slight impact on the source quarries.

Soil compaction may occur due to movement of construction and maintenance traffic. This will occur particularly along off-alignment sections where existing conditions are greenfield and along areas with the proposed Temporary Works Area is required in order to complete the construction works. This could lead to a temporary increase in runoff and subsequently to an increase in erosion. Unmitigated this would be a short-term, Moderate/Slight impact.

During construction, soils maybe exposed in excavations. These soils will be subject to erosion by wind and rain which could deposit silt in streams with an indirect impact on water quality. Unmitigated this would be a short-term, Moderate/Slight impact.

The use of plant and machinery during construction will require the storage and use of fuels and oils. Their storage and use presents potential for spills and leaks which could contaminate soils and groundwater. Unmitigated, this would be a short-term Slight/Moderate impact on soil quality. If spills/leaks reach the aquifer, medium term Slight/Moderate impacts on groundwater quality would be considered likely.

During the construction phase Topsoil where encountered along off alignment sections of the proposed development will be stockpiled in Temporary Stockpiles within the site for reuse where possible. Surplus Topsoil will be transported to the temporary construction compound for storage prior to removal offsite to an authorised facility.

The use of plant and machinery during construction will require the storage and use of fuels and oils. Their storage and use presents potential for spills and leaks which could contaminate soils and groundwater. Fuel storage tanks on construction sites are typically no larger than 1,300 litres. Unmitigated, this would be a short-term slight-moderate negative impact on soil quality. If spills/leaks reach the aquifer, impacts on groundwater quality could be medium term in duration.

There is no potential impact envisaged on the geological heritage sites in the wider area due to the distance of the proposed development to the geological heritage area and the nature of the works to be carried out.

The significance of these potential impacts, prior to mitigation, is considered to range between Imperceptible to Moderate /Slight.

6.4.3.3 Potential Indirect Impacts

Construction of the proposed development will require excavation of the soil/rock to founding level. The importation of granular fill and other products in the form of concrete or other construction related products will have a permanent impact on the local source quarries.

Erosion of soil from stockpiles or soils exposed in excavations could impact on quality of receiving surface waters.

Drainage trenches may present a preferential pathway for the movement of groundwater and / or contamination in the subsurface.

The magnitude of these potential impacts, prior to mitigation, is considered to be of Moderate/Slight significance.

6.4.3.4 Potential Cumulative Impacts

No cumulative impacts are envisaged during construction.

6.4.4 Potential Impacts – Operation

6.4.4.1 Potential Direct Impacts

Very few potential direct impacts are envisaged during the operational phase of the airport. These include:

- Maintenance/service vehicles using the site may result in accidental leaks or spills of fuel/oil which may impact soils, surface water and groundwater.

6.4.4.2 Potential Indirect Impacts

A small amount of granular material may be required to maintain carparks and hardstands which will place intermittent minor demand on local quarries.

6.4.4.3 Potential Cumulative Impacts

No cumulative impacts on land, soil and geology are envisaged during operation.

6.4.5 Summary of Potential Impacts

A summary of unmitigated potential impacts on land, soils and geology due to the development of the proposed development is provided in Table 6.10. The sensitivity of the environments is based on the perceived importance of the receptor on a local, national or international scale as discussed in Section 6.4.2.

Table 6-10: Summary of Potential Geological Impact Significance on Geological Attributes

Activity	Potential Impact	Attribute	Importance	Prior to Mitigation	
				Magnitude	Significance
Construction Phase					
Excavations for runway extensions, buildings, carpark & drainage	Removal of material, soil compaction, increased runoff causing erosion, and possible contamination.	Soil, rock & aquifers. Moderately drained and/or moderate fertility soils Poorly Productive Aquifer	Medium	Small Adverse	Slight
Excavations for runway extensions, buildings, carpark & drainage	Slope failure	Soil, rock & aquifers. Moderately drained and/or moderate fertility soils Poorly Productive Aquifer	Medium	Small Adverse	Slight
Construction of runway extensions, buildings, carpark & drainage	Importation of granular fill and other products in the form of concrete or other construction related products	Small existing quarries	Medium	Moderate Adverse	Moderate/Slight
Operation Phase					
Runway, carpark, hardstands	Increase in rate of run-off causing erosion, possible contamination	Soil, rock & aquifers. Moderately drained and/or moderate fertility soils Poorly Productive Aquifer	Medium	Small Adverse	Slight

It can be observed from Table 6.10 that some activities during the construction of the proposed development, if unmitigated, could have a Slight to Moderate/Slight effect on the receiving environment. Operation and maintenance activities are expected to have a Slight effect on the site geology or hydrogeology.

6.4.6 Mitigation Measures during Construction

The following sections outline appropriate mitigation measures to avoid or reduce the potential impact of the proposed development:

- In order to minimise disruption a Construction Management Plan will be developed and implemented during the construction phase of the development. The Plan will be reviewed regularly and revised as necessary to ensure that the measures implemented are effective;
- Temporary storage of any spoil will be carefully managed in such a way as to prevent any potential negative impact on the receiving environment and the material will be stored away from the watercourses;
- Excavated spoil will be stockpiled at appropriate heights and slope angles;
- Bunds for the storage of chemicals and hydrocarbons will be lined or constructed of materials resistant to damage by the materials stored therein. In addition, the capacity of such bunds will be a minimum of 110% of the volume of the largest container stored therein. Bunds will be designed in accordance with EPA guidance in relation to the storage of potentially polluting liquids ("IPC Guidance Note on Storage and Transfer of Materials for Scheduled Activities", 2004);
- Where refuelling is to take place on site it will be within a designated impermeable, bunded area, away from all drains. In the event of a machine requiring refuelling outside of this area, fuel will be transported in a mobile double skinned tank. An adequate supply of spill kits and hydrocarbon adsorbent packs will be stored in this area. All relevant personnel will be fully trained in the use of this equipment. Guidelines such as "Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors" (CIRIA C532, 2001) will be referred to;
- Portable chemical toilets will be provided for the duration of the works and all waste material will be removed from site and disposed of to an appropriately licensed facility;
- Drip trays will be used where hydrocarbons are being used for vehicle maintenance/refuelling;
- All plant will be inspected at the beginning and end of each shift and if leaks are evident, they are to be repaired immediately or removed from site and replaced;

It is expected that with the implementation of these mitigation measures there will be an imperceptible impact on the land, soils and geology.

6.4.7 Mitigation Measures for the Excavation, Storage and Removal of Subsoils and Rock

One of the primary mitigation measures employed at the preliminary design stage is the minimisation of volumes of soil excavation and lengths of track and trench construction.

Excavated soils will be reused as far as possible. This will include:

- Soils excavated for the development could potentially be used as general fill subject to assessment for suitability for reuse.

Surplus soil or rock excavated during the course of the works will be temporarily stored in a level area and will be either used for reinstatement of the development (following construction) or will be re-used on site in the form of landscaping and berms (during construction).

Some temporary stockpiles (not exceeding 2 meters in height) of material may be necessary prior to reinstatement, however no permanent stockpiles of material will remain after construction and no surplus/waste soil or rock will be removed from the proposed development.

Due to the possibility of soil-borne diseases, all topsoil recovered from a study area will remain within the development boundary where required. See Chapter 12 (Biodiversity / Species & Habitats) for the management of soils and the control of invasive plant species.

To mitigate against the compaction of soil at the site, prior to the commencement of any earthworks, the works corridor will be pegged and machinery will stay within this corridor so that soils outside the work area is not damaged. Excavations will then be carried out from access tracks, where possible, as they are constructed in order to reduce the compaction of topsoil.

To mitigate against erosion of the exposed soil or rock, all excavations will be constructed and backfilled as quickly as possible. Excavations will stop during or prior to heavy rainfall events. To mitigate against possible contamination of the underlying bedrock/aquifer, refueling of machinery and plant will only occur at designated refueling areas. Refueling will be conducted from refueling trucks with drip trays and spill kits available. A designated refueling area will be located at the temporary site compound.

No off-site disposal of soil will be required from the development and no spoil stockpiles will be left on site after construction is completed.

All temporary cuts/excavations will be carried out such that they are stable or adequately supported. Gravel fill will be used to provide additional support to drains where appropriate. Unstable temporary cuts/excavations will not be left unsupported. Where appropriate and necessary, temporary cuts and excavations will be protected against the ingress of water or erosion. Temporary works will be such that they do not adversely interfere with existing drainage channels/regimes.

6.4.8 Mitigation Measures for Groundwater

Diesel tanks, used to store fuel for the various items of machinery, will be self-contained and double-walled. Refuelling will be carried out from these tanks or from delivery vehicles at designated refuelling areas. There will be a designated refuelling area at the temporary site compound. Specific mitigation measures relating to the management of hydrocarbons are as follows:

- Fuels, lubricants and hydraulic fluids for equipment used on the construction site will be carefully handled to avoid spillage, properly secured against unauthorised access or vandalism, and provided with spill containment according to best codes of practice;
- Any spillage of fuels, lubricants or hydraulic oils will be immediately contained and the contaminated soil removed from the site and properly disposed of;
- Waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the site for disposal or re-cycling; and
- Appropriate spill control equipment, such as oil soakage pads, will be kept within the construction compound and in each item of plant to deal with any accidental spillage.

The dewatering of the foundation excavations is not expected to cause interference with domestic wells in the area, due to large offset distances to known wells, shallow depths of excavation and temporary short-term nature of dewatering, if required. The GSI database is however not complete; it is probable that there are other wells in addition to those in the GSI databases. If, however, in the unlikely event of a domestic well being impacted by the proposed development, an alternative supply will be provided – either a connection to mains water will be provided or a replacement well will be drilled.

6.4.9 Mitigation Measures during Operation

There is potential that maintenance/service vehicles and aircraft using the airport site will leak / spill hydrocarbons onto the road surface. Hydrocarbons may potentially make their way into the underlying soils and groundwater, but more likely will be contained in the surface water environment. As the surface water runoff management measures will be improved over the existing infrastructure, this will be a long-term positive impact.

Overall, operational phase activities will result in permanent impacts which, without the implementation of mitigation measures, would result in a moderate/slight impact on the receiving environment.

6.4.10 Residual Impacts

Residual impacts that are most likely to occur at the proposed developments at Waterford Airport during the construction phase are as follows:

- There will be a change in ground conditions at the site with the replacement of natural materials such as glacial deposits and bedrock by concrete, sub-grade and surfacing materials. This is a direct permanent change to the material composition of the site.
- Limited temporary decrease in water quality on a local level is likely to arise from the release of suspended solids and sediments during the excavation and construction process, particularly following rainfall events after a sustained dry period. This local deterioration in water quality will be reduced naturally by dilution and managed mitigation measures prior to exiting from the site boundary to main catchments of the streams in question.

Residual impacts that are most likely to occur at the proposed development during the operational phase would be as follows:

- Changes in ground surfacing including areas of impermeable surfaces will impact on the hydrology of the site and may result in increased runoff of rainwater and increased drainage discharge.

The residual significance of the effects of the development of the runway extension on sensitive downstream receptors is expected to be low taking account of mitigation measures as outlined in Chapter 7 – Hydrology & Water Quality of this EIAR.

It can be observed from Table 6.11 that, following the implementation of mitigation measures, the residual impact significance to the receiving environment would be moderate/slight to imperceptible during the construction period and imperceptible in all respects assessed during the operation of the proposed development. Mitigation measures will be monitored throughout the construction and operational phases with mitigation systems in place before the proposed development works commence.

The proposed development works at Waterford Airport is not expected to contribute to any significant, negative cumulative effects of other existing developments in the vicinity. When the mitigation measures are implemented in full, any effects on the receiving environment will be of minor significance.

Table 6-11: Residual Geological Impact Significance for Sensitive Receptors

Activity	Potential Impact	Attribute	Importance	Before Mitigation		After Mitigation	
				Magnitude	Significance	Magnitude	Residual Significance
Construction Phase							
Excavations for runway extensions, buildings, carpark & drainage	Removal of material, soil compaction, increased runoff causing erosion, and possible contamination.	Soil, rock & aquifers. Moderately drained and/or moderate fertility soils Poorly Productive Aquifer	Medium	Small Adverse	Slight	Negligible	Imperceptible
Excavations for runway extensions, buildings, carpark & drainage	Slope failure	Soil, rock & aquifers. Moderately drained and/or moderate fertility soils Poorly Productive Aquifer	Medium	Small Adverse	Slight	Negligible	Imperceptible
Construction of runway extensions, buildings, carpark & drainage	Importation of granular fill and other products in the form of concrete or other construction related products	Small existing quarries	Medium	Moderate Adverse	Moderate/ Slight	Moderate Adverse	Moderate/ Slight
Operation & Maintenance Phase							
Runway, carpark, hardstands	Increase in rate of run-off causing erosion, possible contamination	Soil, rock & aquifers. Locally fertile well drained soils. Poorly Productive Aquifer	High	Small Adverse	Moderate/Slight	Negligible	Imperceptible

6.4.11 Cumulative Residual Impacts

There are no cumulative residual impacts over and above those considered for the proposed development and on-site infrastructure as detailed above.

6.5 Conclusions

The land use across the site generally consists of level ground, predominantly covered by existing runway, carparking and terminal building with grassland at the vicinity of these. The typical elevations of the site are between 60 – 150m AOD. The subsoils present at the study area generally comprise Glacial Tills derived from Volcanic Rock and Alluvium. The depth to bedrock beneath the site was not confirmed during site investigations completed.

A number of potential impacts have been identified associated with the excavation of soil and rock on the site. The significance of these potential impacts is assessed as being of Slight to Moderate/Slight significance prior to mitigation.

Mitigation measures have been proposed with regard to the design and construction of the proposed development. Provided that these mitigation measures are carefully implemented, the residual risks to the geology and hydrogeology associated with the construction and operation of the site are considered to be moderate/slight to imperceptible.

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