BVG Associates

GDG GAVIN & DOHERTY GEOSOLUTIONS

South Coast Designated Maritime Area Plan: Maritime Area identification

A report for Department of the Environment, Climate and Communications

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Executive summary

This document has been prepared by BVG Associates (BVGA) and Gavin and Doherty Geosolutions (GDG), supported by RPS. It describes the methodology undertaken to identify the Maritime Areas within which proposed future fixed wind farm developments may take place within the Department of the Environment, Climate and Communications' (DECC's) Draft South Coast Designated Maritime Area Plan for Offshore Renewable Energy (SC-DMAP). Four Maritime Areas were identified:

- A single Maritime Area, suitable for a project with an installed capacity of approximately 900 MW, which aims for deployment by 2030 or as soon as feasible thereafter, to be developed by the winner of the forthcoming ORESS 2.1 auction, which will commence later in 2024 or early 2025.
- Three further Maritime Areas within the SC-DMAP area, to be considered for later deployment, each with sufficient spatial capacity to facilitate a project of at least 1 GW, contingent on the outcome of project level environmental assessments.

Method

The Maritime Area identification process is summarised in Figure 0.1.

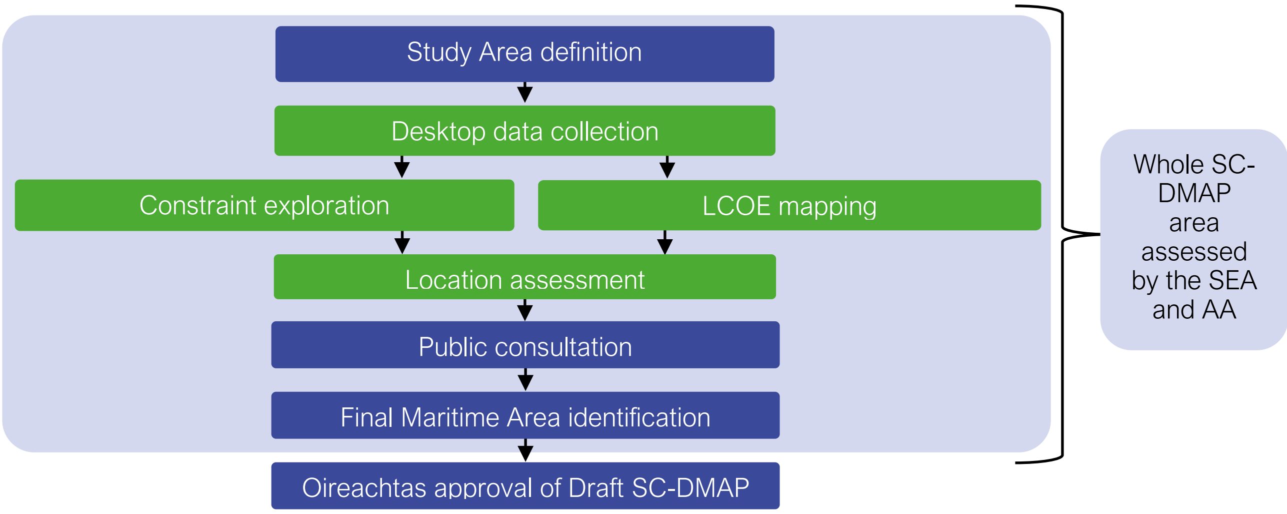

Figure 0.1 Summary of Maritime Area identification process. Blocks in green are covered in this methodology document.

Study area definition

The Study Area is defined by the geographical area of the SC-DMAP Proposal published by DECC in July 2023, and subsequently subject to a nine and a half week public consultation.[1]

Desktop data collection

In line with good international industry practice and an ecosystem-based approach, spatial data for environmental and technical attributes potentially constraining or otherwise impacting the location of offshore wind projects was collected. To support the assessment of attributes, a Geographic Information System (GIS) database was developed. RPS assessed 238 environmental data layers. Separately, BVGA and GDG assessed 21 technical data layers. Technical layers were either used as inputs for constraint mapping or as inputs to LCOE mapping.

[1] Designated Maritime Area Plan (DMAP) Proposal for Offshore Renewable Energy, DECC, July 2023, available online at gov.ie/en/publication/36d9a-designated-maritime-area-plan-dmap-proposal-for-offshore-renewable-energy/

Constraint exploration

Constraint ratings were prescribed to each data layer. This involved specific inputs from environmental and technical experts within the RPS and GDG project teams and was based on good international industry practice and precedent from other countries.

Areas of either high consolidated (cumulative) environmental constraint or highest individual environmental constraint for a given data layer were excluded from consideration for locating offshore wind projects at this stage. This is to avoid and minimise the risk of potential adverse environmental impact, and decrease developers' permitting risk during the development process and increase the chance of timely delivery of new offshore wind capacity.

Technical exclusions were water depths greater than 75 m and areas of exposed bedrock. These were excluded as deep waters will decrease availability of suitable installation vessels, thereby delaying project development timelines, and exposed bedrock will increase installation costs.

Levelized cost of energy mapping

As well as identifying areas of low environmental and technical constraint, it is important to identify the more economically attractive locations for offshore wind. A generic assessment of this is best delivered through the derivation of a spatial LCOE layer based on representative project assumptions. LCOE maps were produced for both the proposed ORESS 2.1 development area (known as Maritime Area A) and the further Maritime Areas.

Location assessment

The Maritime Areas were identified by considering together environmental and technical constraints, and LCOE. The four Maritime Areas A, B, C and D were then identified where there were no exclusions and environmental constraint and LCOE are lowest. It is important to highlight that both the proposed ORESS 2.1 Maritime Area, and the further Maritime Areas, are therefore not located in the areas with the lowest LCOE. Instead, the exclusions shown in Figure 0.2 have been applied and constraint ratings been accounted for. If only LCOE were to be considered, then the Maritime Areas would likely be much closer to shore, where the costs of project development are lower. Further, the Maritime Areas leave sufficient space between each other to account for individually assessed environmental and technical attributes. This space is primarily to allow shipping and navigation routes, but also to reduce potential cumulative environmental impacts and loss of wind resource.

Figure 0.2 shows the Maritime Areas identified against constraints mapping.

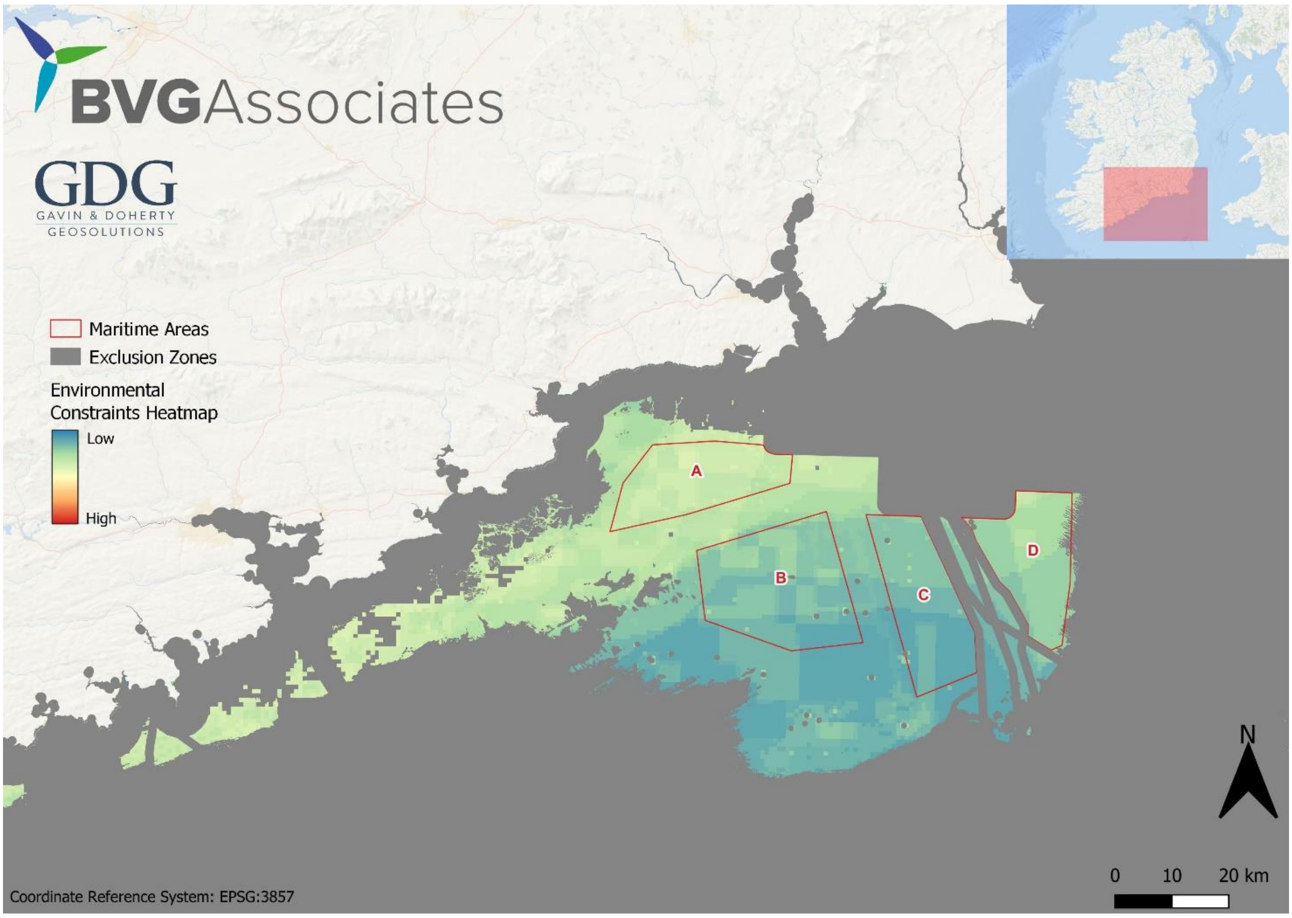

Figure 0.2 Location for ORESS 2.1 (A) and further (B, C, D) Maritime Areas, also showing exclusions and environmental consolidated constraint rating.

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1. Introduction

This document has been prepared by BVG Associates (BVGA) and Gavin and Doherty Geosolutions (GDG), supported by RPS. It describes the methodology undertaken to identify the Maritime Areas within which proposed future fixed wind farm developments may take place within the Department of the Environment, Climate and Communications' (DECC's) Draft South Coast Designated Maritime Area Plan for Offshore Renewable Energy (SC-DMAP). Four Maritime Areas were identified:

- A single Maritime Area, known as Maritime Area A, suitable for an individual project with an installed capacity of approximately 900 MW, to be developed by the winner of the forthcoming ORESS 2.1 auction, which will commence later in 2024 or early 2025. It is intended that this project will aim for deployment by 2030, or as soon as feasible thereafter, to contribute to Ireland's renewable energy and legally binding decarbonisation objectives.
- Three further Maritime Areas within the SC-DMAP area, known as Maritime Areas B, C and D, to be considered for later deployment, each with sufficient spatial capacity for a project of at least 1 GW, contingent on the outcome of project level environmental assessments.

The whole draft SC-DMAP area is undergoing a Strategic Environmental Assessment (SEA)[2], Appropriate Assessment (AA)[3] and will be subject to a period of public consultation before confirmation of the size and location of each of the Maritime Areas identified for future offshore wind development, including the Maritime Area to be developed by the winner of the forthcoming ORESS 2.1 auction. Any proposed future offshore wind project located within the SC-DMAP must secure a Maritime Area Consent and conduct a project level environmental impact assessment (EIA) and AA and adhere to the policy objectives within the SC-DMAP potentially informed by additional project level primary data gathered. It is on the basis of these that final permitting decisions are made. The Maritime Area identification process is summarised in Figure 1.1.

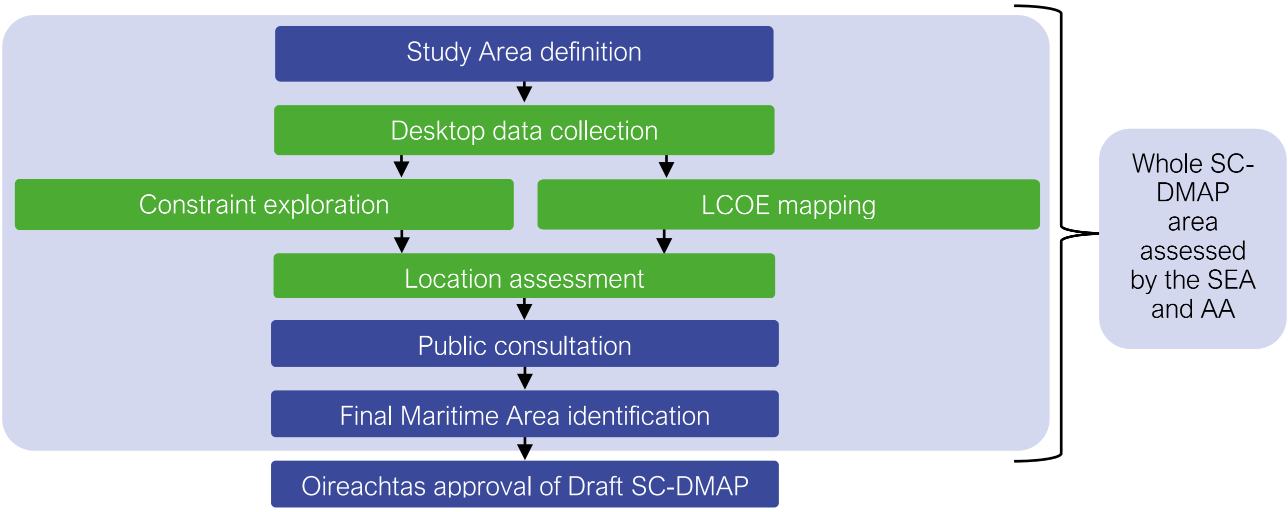

Figure 1.1 Summary of Maritime Area identification process. Blocks in green are covered in this methodology document.

RPS' work was delivered under a separate contract to that of BVGA and GDG. Much of the environmental constraints mapping was carried out by RPS prior to BVGA involvement and using a method agreed with DECC, which has been summarised here.

[2] The SEA is a process for the formal, systematic evaluation of the likely significant environmental effects of implementing the SC-DMAP, before a decision is made to adopt it.

[3] The AA is a process to determine if the SC-DMAP would be likely to have significant effects or result in adverse effects on site integrity of any protected site in Europe.

2. Methodology

The process of Maritime Area identification can be broken down into the following consecutive steps:

- Study Area definition
- Desktop data collection
- Constraint exploration (environmental and technical)
- Levelized cost of energy (LCOE) mapping[4]
- Location assessment

Each of these is discussed in detail below. Overall, the process identifies areas of low environmental and technical constraint and low LCOE.

The process followed is deemed to be suitable for the SC-DMAP area and the latest understanding of future offshore wind technology at the time of writing. However, should this process be used as a precedent for future DMAPs around the coasts of Ireland, the methodology will necessarily have to be amended, having regard to the particular circumstances of the relevant maritime area, and updated in accordance with the good international industry practice and international regulations at the time of that future assessment.

2.1. Study Area definition

The Study Area is defined by the geographical area of the SC-DMAP Proposal published by DECC in July 2023, and subsequently subject to a nine and a half week public consultation.[5] The Study Area was defined with two types of Maritime Area in mind:

- A single Maritime Area suitable for a fixed offshore wind project with an installed capacity of approximately 900 MW project, or two smaller Maritime Areas, each suitable for a 450 MW project, to be developed by the winner of the ORESS 2.1 auction and
- Additional Maritime Areas for post 2030 deployment of fixed offshore wind projects, the number and size of which was to be determined by the environmental, technical, and LCOE analysis provided in this report.

2.2. Desktop data collection

In line with good international industry practice and an ecosystem-based approach, spatial data for environmental (including biodiversity and social attributes) and technical attributes potentially constraining or otherwise impacting the location of offshore wind projects was collected. To support the assessment of attributes, a Geographic Information System (GIS) database was developed, compiling available data.

2.2.1 Environmental data

Table 2.1 provides a list of relevant environmental data included in the analysis.

We have assumed that a wind turbine (or any other part of wind farm infrastructure or installation equipment) cannot extend over the edge of the Maritime Area. This means that when we refer to a buffer distance, it is to the most extreme part of a wind turbine structure (that could be a blade tip), offshore substation or subsea cable and any jack-up installation vessel seabed footprint that may be used in construction or repair of the wind farm.

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[4] LCOE is the revenue required (from whatever source) to earn a rate of return on investment equal to the weighted average cost of capital (WACC) over the life of the wind farm. Tax and inflation are not modelled. In other words, it is the lifetime average cost for the energy produced, quoted in today's prices. LCOE is used to evaluate and compare the cost of electricity production from different technologies and at different locations.

[5] Designated Maritime Area Plan (DMAP) Proposal for Offshore Renewable Energy, DECC, July 2023, available online at gov.ie/en/publication/36d9a-designated-maritime-area-plan-dmap-proposal-for-offshore-renewable-energy/

Table 2.1 Summary of geospatial environmental data used.

Attribute	Data source	No. of layers	Use
E1. Administrative (includes anchorage areas, pilot boarding locations, and restricted areas)	OceanWise	11	Input to constraint mapping
E2. Aquaculture	European Marine Observation and data Network (EMODnet) Ireland Marine Atlas OceanWise	16	Input to constraint mapping
E3. Aviation	Irish Aviation Authority (IAA)	1	Input to constraint mapping
E4. Commercial fisheries	EUTrade Marine Institute	9	Input to constraint mapping
E5. Designated sites	National Parks and Wildlife Service (NPWS) Ramsar United Nations Educational, Scientific and Cultural Organization (UNESCO)	8	Input to constraint mapping Seas off Wexford candidate special protection area (cSPA) not considered for inclusion in Maritime Areas with a 2 km buffer[6]
E6. Fish and shellfish	Ireland Marine Atlas	15	Input to constraint mapping
E7. Industrial (includes shoreline construction, commercial fishing and harbour facilities, and offshore piles)	OceanWise	29	Input to constraint mapping
E8. Marine habitats	EMODnet Ireland Marine Atlas	20	Input to constraint mapping
E9. Marine historic environment	UK Hydrographic Office (UKHO) Ireland Marine Atlas	2	Input to constraint mapping
E10. Marine infrastructure	EPA Ireland Marine Atlas	37	Input to constraint mapping Oil and gas pipelines excluded with 1852 m buffer Submarine cables excluded with 750 m buffer as per

[6] In this instance, a 2km buffer has been placed around this particular cSPA, excluding offshore wind development, due to environmental sensitivity. This should not be interpreted as precluding current and future offshore wind development within designated sites in Ireland outside the SC-DMAP. For the avoidance of doubt, each designated site should be considered separately on its specific environmental attributes.

Attribute	Data source	No. of layers	Use
	OceanWise EMODnet		European Subsea Cables Association (ESCA) guidance Offshore disposal sites excluded with 500 m buffer No UXO dumping grounds identified in the Study Area; site specific surveys are advised
E11. Marine mammals	Ireland Marine Atlas Marine Scotland NPWS	32	Input to constraint mapping
E12. Military	EMODnet OceanWise	3	Input to constraint mapping Excluded with 500 m buffer
E13. Obstructions and wreaks	OceanWise	13	Input to constraint mapping
E14. Ornithology	ObSERVE	2	Input to constraint mapping
E15. Seascape and landscape	DECC	4	Input to constraint mapping Excluded <5 km from shore
E16. Shipping and navigation	EMODnet Ireland Marine Atlas Irish Coast Guard OceanWise	29	Input to constraint mapping Navigation lines and ferry routes excluded with 750 m buffer in line with ESCA guidance
E17. Tourism and recreation	EMODnet EPA Marine Atlas Marine Institute	7	Input to constraint mapping

2.2.2 Technical data

Technical attributes were evaluated following assessment of the environmental constraints. Table 2.2 provides a list of relevant technical data assessed.

Table 2.2 Summary of geospatial technical data used.

Attribute	Source	Extent	Use
T1. Bathymetry	Integrated Mapping for the Sustainable Development of Ireland's Marine Resource (INFOMAR)	National	Input to constraint identification and LCOE mapping Exclusion beyond 75 m depth applied
T2. Seismic activity	Peak ground acceleration (250 year return period), Coalition for Disaster Risk Response	Global	Input to constraint identification

Attribute	Source	Extent	Use
			Not a limiting factor in the Study Area
T3. Type of ground condition	INFOMAR/GDG	National	Input to constraint identification and LCOE mapping Areas of surface bedrock excluded
T4. Significant wave height	NOAA Wavewatch III Glo	Global	Input to constraint identification Not a limiting factor in the Study Area
T5. Tidal currents	NOAA Tides and Currents	Global	Input to constraint identification Not a limiting factor in the Study Area
T6. Extreme gust wind speed, 50-year return period	The Global Atlas of Siting Parameters, Danish Technical University	Global	Input to constraint identification Not a limiting factor in the Study Area
T7. Mean wind speed measured at 150m height	Global Wind Atlas, Danish Technical University, Vortex and World Bank Group	Global	Input to constraint identification and LCOE mapping
T8. Airports*	See E3 in Table 2.1		
T9. Submarine cables	See E10 in Table 2.1		
T10. Levelized cost of energy (LCOE)	BVGA	National	Input to Maritime Area identification
T11. Military practice, danger and other no-go areas*	See E12 in Table 2.1		
T12. Locations of oil and gas activity*	See E10 in Table 2.1		
T13. Aggregate and material extraction areas	INFOMAR	National	Input to constraint identification – not a limiting factor in the Study Area
T14. Offshore disposal sites	See E10 in Table 2.1		
T15. Unexploded ordnance (UXO)*	See E10 in Table 2.1		
T16. Pipelines*	See E10 in Table 2.1		

Attribute	Source	Extent	Use
T17. Ports	BVGA	Global, National	Input to LCOE mapping
T18. Shipping density*	See E16 in Table 2.1		
T19. Navigational lanes*	See E16 in Table 2.1		
T20. Substations	EirGrid	National	Input to LCOE mapping
T21. Transmission network (current and planned)	EirGrid	National	Input to LCOE mapping

* Typically considered as technical attributes, but considered in this assessment by RPS as part of its assessment of environmental attributes.

2.3. Constraint exploration

2.3.1 Environmental constraint rating

Many environmental attributes are characterised through more than one GIS data layer, as shown in Table 2.1. A constraint layer was created for each attribute, based on these GIS data layers and the ratings described in Table 2.3. This process was completed by specific environmental and technical experts within the RPS and GDG project teams and was informed by both their expertise and good international industry practice, as well as precedent from other markets. The ratings only apply to the wind farm area and do not consider export cable routes. The ratings for export cable routes are separate and will be defined by developers and/or EirGrid during the later consenting process. Note that rating is subjective, it is generalised for the whole of the Study Area and does not consider cumulative impact. This means that the level of constraint due to a given attribute in a given project location, to be installed at a given time and alongside other projects may be different to what is derived here. The consequence of this will be addressed during the permitting process.

To derive individual constraint layers and then a consolidated constraint layer, the following steps were taken:

1. Each GIS data layer was translated into a raster-gridded dataset. These were created to be the same size as each other and have the same 10 m x 10 m cell positions so that multiple raster datasets could be combined.
2. For data layers which vary spatially (for example, due to areas of higher and lower density of a population or frequency of observed activities) different constraint ratings were assigned at different thresholds, based on the scales described in Table 2.3.
3. For data layers showing either presence (or lack of presence) of a constraint, a single constraint rating was applied to the applicable area, and 0 applied outside this.
4. Ratings in each data layer were then squared, so that the range extended from 0 to 25. This was done to increase the contrast between the low and high constraint areas.
5. Multiple data layers were added to create a constraint layer for each attribute. The maximum rating for each attribute therefore depends on the number of data layers and constraint rating applied. Appendix B shows the constraint maps for each attribute separately. For each map, the same scale has been applied to allow easy comparison between attributes.
6. Constraint layers for all attributes were consolidated by adding their assigned ratings together to provide a consolidated constraint map. This method was used to highlight the level of cumulative constraints within the Study Area, where lots of individual constraints combine to create an overall more highly constrained area.

Table 2.3 Constraint rating scales used for environmental attributes and broad implications for offshore wind development.

Rating	Rating rationale	Broad implications
5	Constraint is likely to preclude development. Disturbance of this attribute would cause permanent loss, and/or represent a direct conflict where co-location or co-existence with offshore wind cannot be facilitated.	Avoidance of development in these areas is likely to be required. Further detailed studies and in-depth consultation would be required at the project level if development in these areas was to be considered.
4	Significant constraint with potential to significantly affect future project parameters e.g. wind farm size or turbine height. The attribute would be highly susceptibility to impact from offshore wind with low rates of recoverability. Co-location / co-existence with offshore wind would be challenging to achieve.	Development in these areas may need to be avoided. As a minimum, restrictions on development are likely to apply. To inform decisions on the development potential of these areas before projects are sited, further detailed investigations and related stakeholder engagement are required.
3	Constraint will require detailed assessment, but unlikely to stop development. The attribute would be of moderate susceptibility to impact from offshore wind, with a moderate degree of recoverability possible. There would be moderate potential for co-location / co-existence with offshore wind. Mitigations likely to be necessary at project level.	Restrictions on development are likely to be required, in line with the mitigation hierarchy. The project specific restrictions (for example, micro-siting of infrastructure, timing of construction activity, or specific construction or operational protocols), will be informed by project specific investigations and stakeholder consultation at the project development level.
2	Constraint present, but low likelihood of significant constraint on development. The attribute would be of low to moderate susceptibility to impact, with a high degree of recoverability possible. Opportunities for co-location / co-existence with offshore wind are possible.	Development in these areas is likely to be possible, subject to implementation of the mitigation outlined in the SEA and subject to detailed project-level investigations and stakeholder consultation alongside application of the mitigation hierarchy at all subsequent planning levels.
1	No likely constraint. The attribute would be of low to negligible susceptibility to impact from offshore wind with a high degree of recoverability. Opportunities for co-location / co-existence with offshore wind are possible.	Development in these areas is likely to be possible, in line with the mitigation outlined in the SEA and subject to detailed project-level investigations and stakeholder consultation.
0	No data available, or dataset is presented for information only and no constraint value can be ascribed at the broad scale.	N/A

All constraining environmental factors identified in Table 2.1 were assessed individually and cumulatively as input to determine the preferred Maritime Areas.

2.3.2 Technical constraint mapping

Technical layers in Table 2.2 were either used as inputs for constraint mapping or as inputs to LCOE mapping, as described in Section 2.4. Those that were inputs for constraint mapping were:

- Rated as 5 (so constraint is likely to preclude development of offshore wind in a given location, typically within a buffer zone around the presence of the attribute), or
- Rated as 0 (not a limit to offshore wind).

All constraining technical factors identified in Table 2.2 were assessed individually and cumulatively as input to determine the preferred development areas.

2.3.3 Consolidated constraint layers

Environmental constraint map and exclusions

The consolidated environmental layer is shown in Figure 2.1, highlighting the areas of highest and least constraint within the SC-DMAP. This final heatmap has constraint rating ranging from 35 for the least constrained areas to 270 for the most constrained areas. Areas closer to shore generally are more constrained, reflective of the high level of constraints relating to aquaculture, fisheries, recreation, biodiversity, landscape and seascape, among others. The areas south of Cork Harbour, south of Waterford Estuary and around the Saltee Islands are most highly constrained. When combining all attributes into a consolidated map, this method sums all data layer ratings within every attribute, so attributes with more data layers are likely to contribute more highly than those with fewer. The combined ratings indicate the level of cumulative constraints for a particular area and illustrates the relative variation in constraints across the DMAP region. This method reveals more subtlety about the underlying constraints than other methods, for example using the highest constraint rating for each location, but using such methods would not change the location assessment significantly as the highest rated individual data layers (those rated a 5) are excluded in the constraint mapping separately.

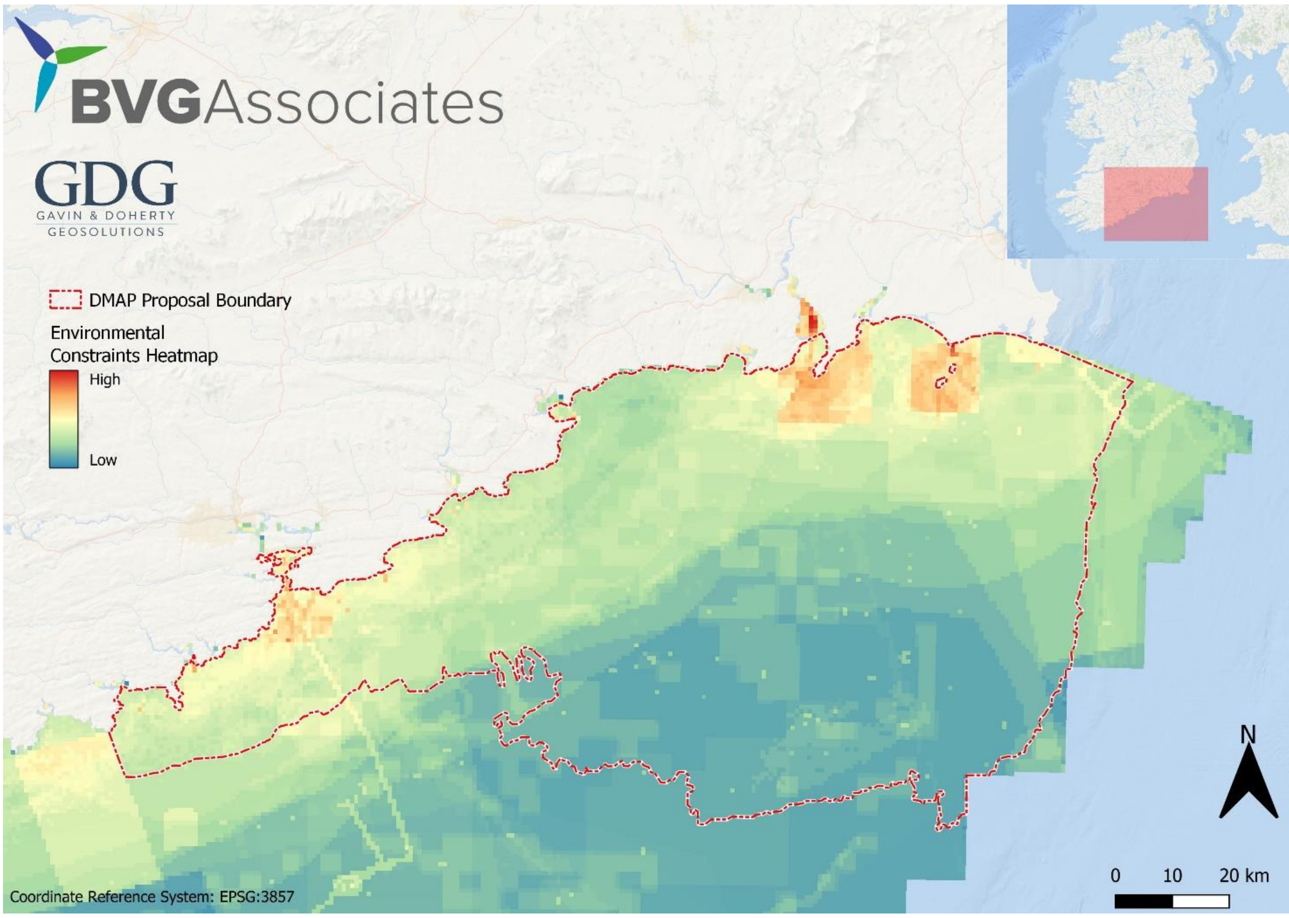

Figure 2.1 Consolidated environmental constraint map.

Areas of either high consolidated (cumulative) environmental constraint or highest individual environmental constraint for a given data layer (i.e. where a rating of 5 has been given) have been excluded from consideration for locating offshore wind projects at this stage. This is to avoid and minimise the risk of potential adverse environmental impact and decrease developers' permitting risk during the development process and increase the chance of timely delivery of new offshore wind capacity.

It is important to note that a low constraint rating at this stage does not guarantee successful future project development – rather it indicates areas which are likely to be most suitable for fixed bottom offshore wind development, when considering the constraints identified. EIA during project development, potentially based on new primary data gathered, may show high constraints that precludes development.

To identify areas of high cumulative constraint, areas where the consolidated rating is above 129 (within 60% of the maximum rating) are excluded. This threshold is more conservative than typically used in other jurisdictions, but is appropriate for the SC-DMAP given that it still allows sufficient room for identifying Maritime Areas for potential future development of offshore wind farms.[7]

Figure 2.2 shows the same constraint data as Figure 2.1, but with the above exclusions applied.

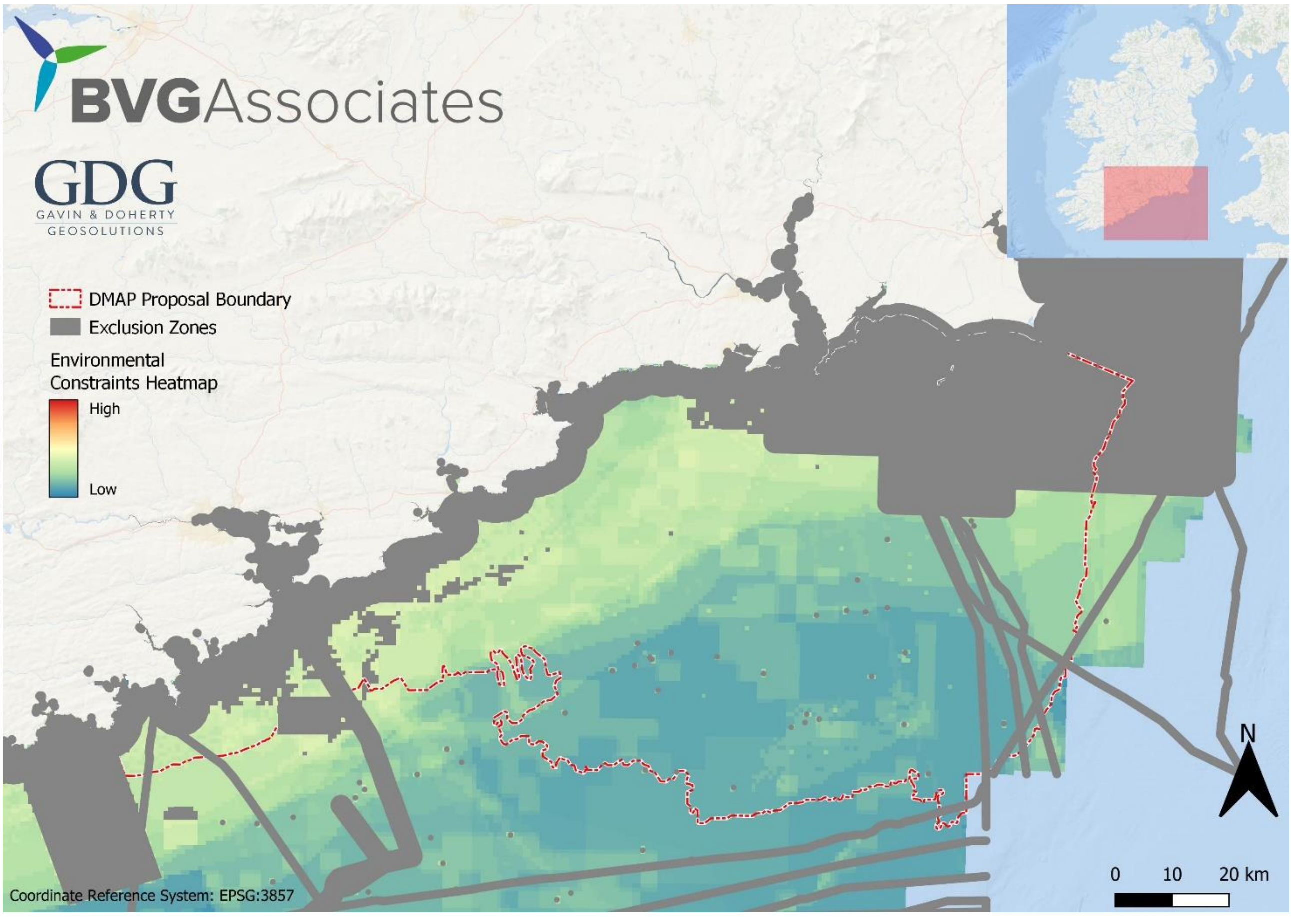

Figure 2.2 Consolidated environmental constraint map with environmental exclusions applied.

Technical exclusions

In addition to the environmental exclusions, technical exclusions have been applied. Figure 2.3 shows the consolidated impact of the following technical exclusions:

- Water depths greater than 75 m. This limit was applied as significant supply chain constraint is likely as projects access these deeper waters, with a limited number of installation vessels suitable for installing foundations of the size and weight required and then turbines.
- Where surface bedrock is identified. Surface bedrock will increase project cost and risk as the bedrock will have to be drilled to accommodate foundations, rather than using the less expensive and more common method of driving foundations.

[7] Resource and constraints assessment for offshore wind: Methodology report, The Crown Estate, September 2019, available online at thecrownestate.co.uk/media/3331/tce-r4-resource-and-constraints-assessment-methodology-report.pdf

Exclusions close to shore are due to surface bedrock, while exclusions towards the Study Area boundary to the south are where the sea depth is greater than 75 m. These exclusions have been applied to increase the chance of timely, cost effective delivery of new offshore wind capacity.

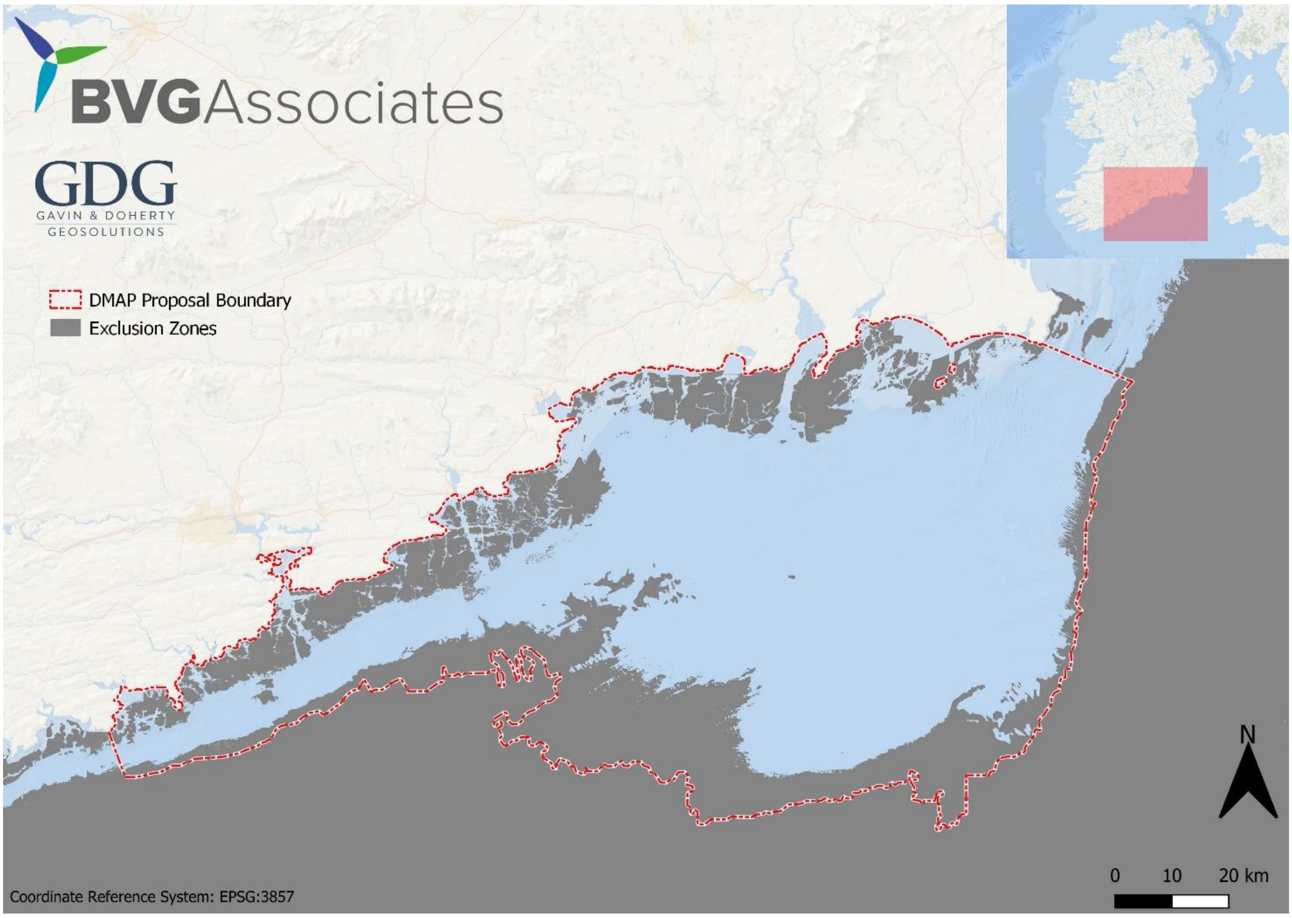

Figure 2.3 Consolidated technical exclusions.

Combined environmental and technical exclusions

Figure 2.4 shows environmental and technical exclusions, combined. Exclusions close to shore are due to surface bedrock, while exclusions towards the SC-DMAP boundary are where the sea depth is >75m.

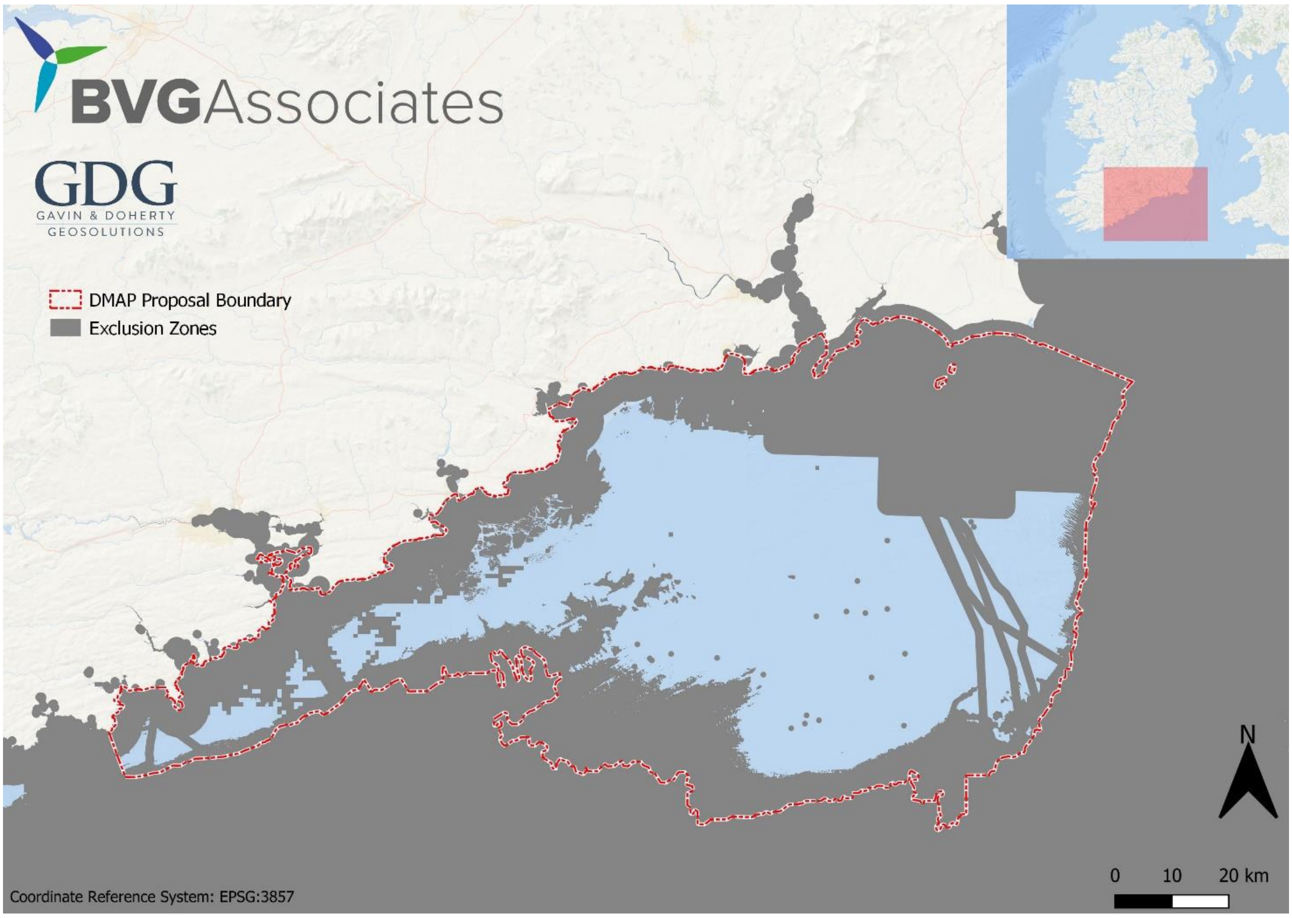

Figure 2.4 Consolidated environmental, and technical exclusions and highest cumulative environmental constraint areas.

2.4. Levelized cost of energy mapping

After identifying areas of low environmental and technical constraint, it is important to identify the more economically attractive locations for offshore wind from the remainder of the Maritime Area of the SC-DMAP (comprising the blue area in the above figure 2.4). A generic assessment of this is best delivered through the derivation of a spatial LCOE layer based on representative project assumptions, as discussed in Appendix A.

Key input layers for LCOE analysis are bathymetry and mean wind speed. These are presented in Figure 2.5 and Figure 2.6 for reference, as these are key drivers in LCOE. Bathymetry is a key factor as increased sea depth means larger, more expensive foundations are required to support the wind turbines and installation is typically more costly. Projects in shallower waters are also more likely to deploy within a shorter period of time due to supply chain availability, for instance including the availability of installation vessels. Mean wind speed is a key factor as increased wind speed typically increases energy production which reduces LCOE.

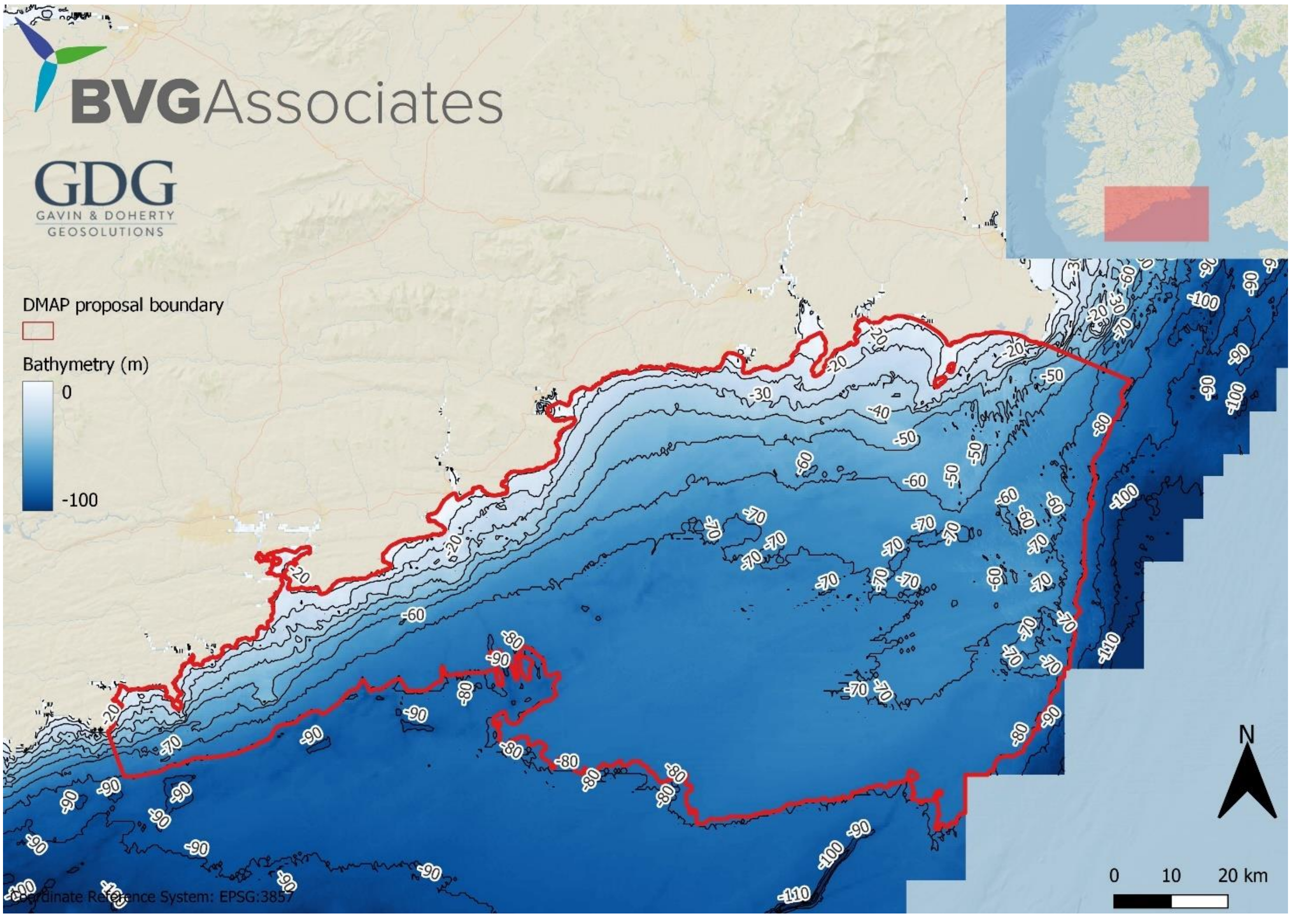

Figure 2.5 Bathymetry.[8]

Figure 2.5 shows the bathymetry for the Study Area. There is a relatively large flat area towards the south east with depths between 60 and 80 m, while south of Cork in the west and in the east, the seabed in much steeper, quickly falling to depths greater than 90 m, and is therefore significantly less suitable for fixed offshore wind development.

[8] Sourced from INFOMAR.

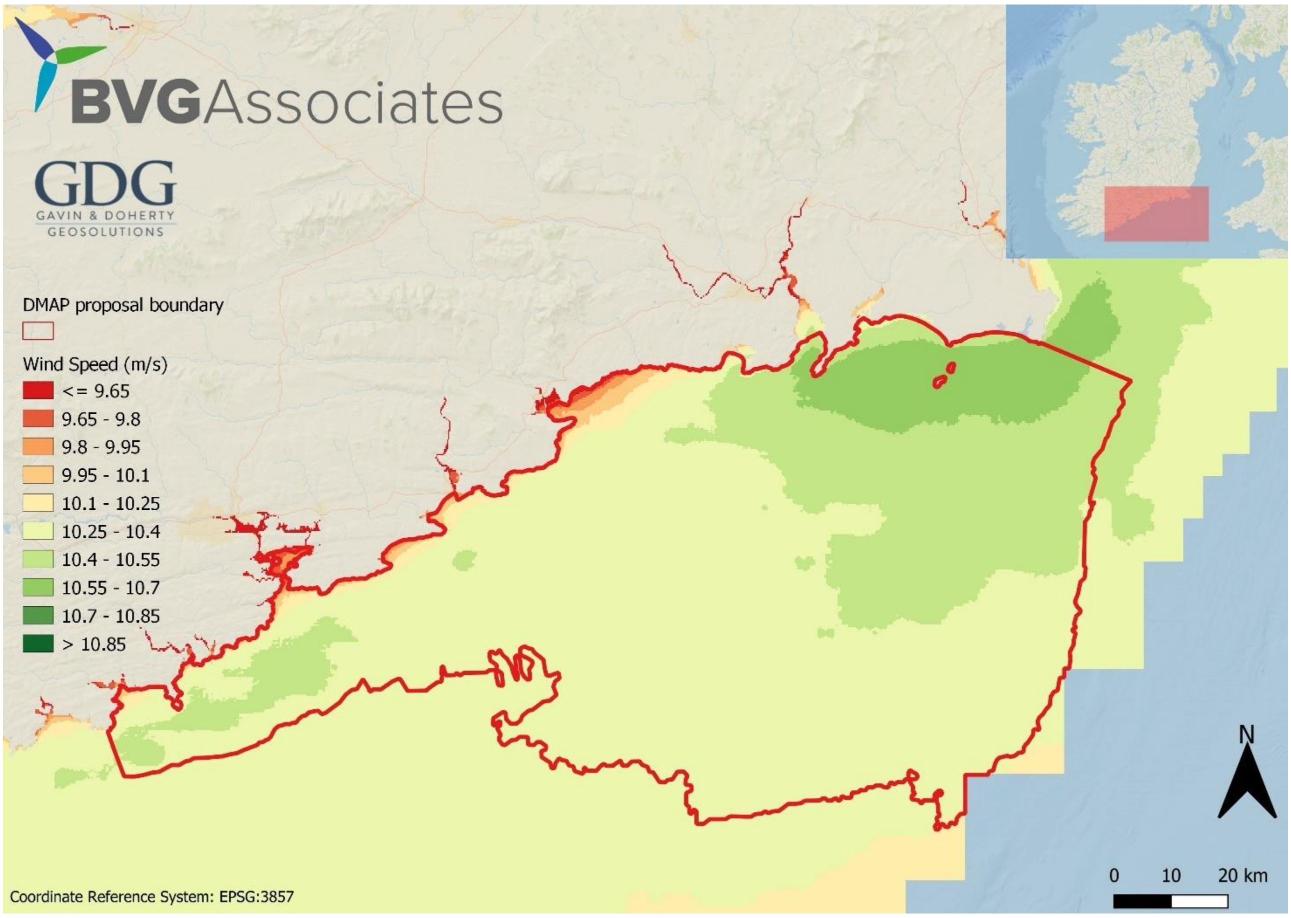

Figure 2.6 Mean wind speed.[9]

Figure 2.6 shows the mean wind speed across the Study Area, measured at 150 m height. Nearshore wind speeds are lower but they quickly increase to above 10.25 m/s across the rest of the area. Further from shore, wind speed is relatively uniform with only approximately 0.5 m/s variation between the highest winds in the north east and the lowest in the south west. These mean wind speeds are high when compared to those generally available in the rest of the world. This provides Ireland an excellent renewable energy resource to capitalise on.

Two LCOE maps were produced, one, shown in Figure 2.7 for Maritime Area A, which will contain the ORESS 2.1 development and one, shown in Figure 2.8 for the further development areas. Two maps were required as different assumptions are applied for a ORESS 2.1 project and for further projects. These assumptions are shown in Table 2.4.

For ORESS 2.1, as outlined in the *Public Participation Statement South Coast DMAP*, EirGrid has identified existing grid capacity to connect approximately 900 MW of offshore wind capacity to the onshore transmission system. It is understood that this capacity is to be split into two 450 MW offtakes. One 450 MW connection into the Great Island Power Station, Co Wexford and the second 450 MW connection into East Cork, with the specific location yet to be confirmed by EirGrid. Any decision regarding offshore cable routes will be determined by future analysis by EirGrid, including consideration of environmental and technical constraints. The offtake for the further development areas beyond ORESS 2.1 is not currently confirmed. Options could include connection to the upgraded transmission network, or connection directly to an energy demand, for instance an energy park or hydrogen electrolyser. As the system was not confirmed, the distance to shore has been used as a proxy for the offshore export cable length required.

[9] Sourced from Global Wind Atlas.

Table 2.4 LCOE assumptions.

Parameter	Assumption	
	ORESS 2.1	Further developments
Project capacity (MW)	900	1,200
Foundation type	Jacket	
Grid connection	HVAC Split between Cork and Waterford, no reactive compensation	Offtake for further development areas is unknown therefore distance from shore has been assumed as offshore connection length
Year of commercial operation date (COD)	2030	2035
Turbine rating (MW)	18	20
Lifetime	30	30
Operations and maintenance strategy	Service operations vessel (SOV)	

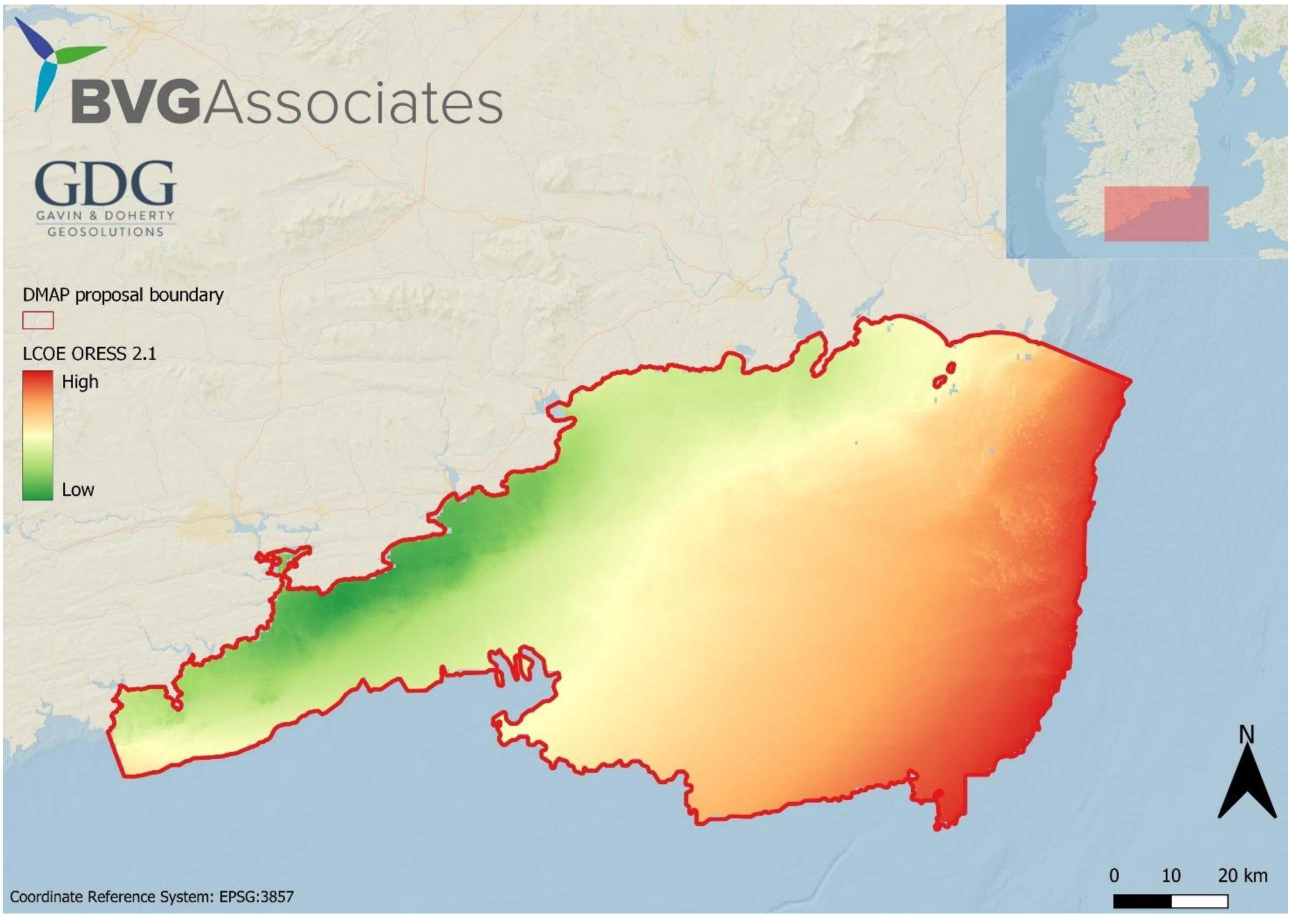

Figure 2.7 Maritime Area A / ORESS 2.1 LCOE map.

The area of lowest LCOE, and therefore best value to consumers, is in the western region, south of Cork. If a Maritime Area was to be selected purely based on LCOE then this is the region that would be chosen for an ORESS 2.1 project. This, however, would place the Maritime Area close to shore (<5 km), where environmental constraint is highest. Instead, the combination of LCOE and environmental and technical constraint has been used to identify Maritime Area A. This is shown in Section 2.5.

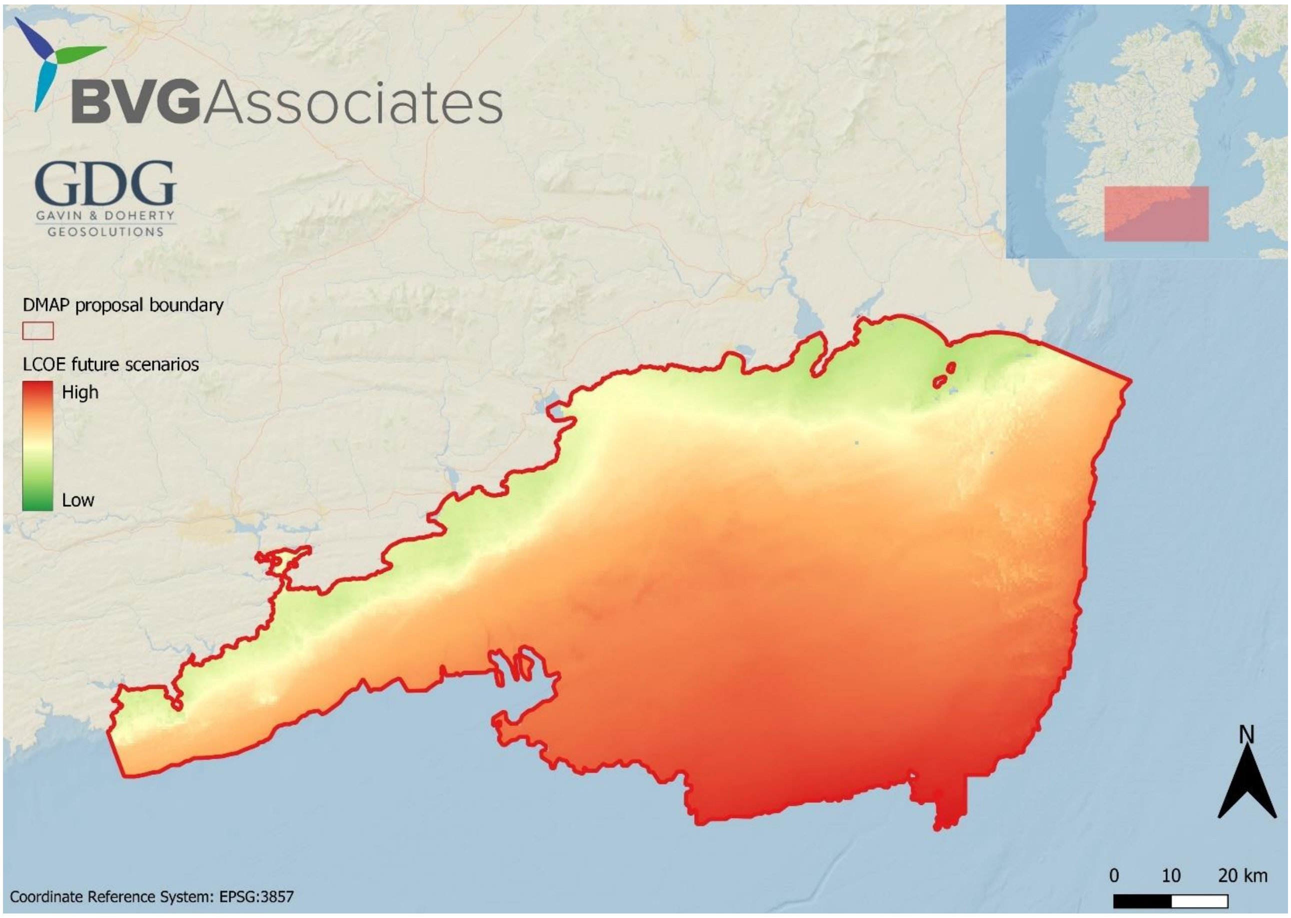

Figure 2.8 Further developments LCOE map.

As with ORESS 2.1, the area of lowest LCOE, is close to shore. This is due to the shallower seabed and reduced export cable distance. The lowest LCOE areas are south of Cork and around the Saltee Islands. If a Maritime Area was to be selected purely based on LCOE then these areas would be the preferred locations. This, however, would place the project close to shore where the environmental constraint is highest. Further, the area around the Saltee islands is within the Seas off Wexford cSPA, and within the area of highest cumulative environmental constraint ratings are found. Therefore, the combination of LCOE and environmental and technical constraint has been used to identify the post 2030 additional Maritime Areas. This is shown ins Section 2.5.

2.5. Location assessment

The Maritime Areas were defined by considering together Figure 2.1 (consolidated environmental constraint), Figure 2.4 (consolidated environmental, and technical exclusions) and either Figure 2.7 or Figure 2.8 (LCOE). The four Maritime Areas A, B, C and D were then identified where there were no exclusions and environmental constraint and LCOE are lowest.

2.5.1 Single Maritime Area to be auctioned in ORESS 2.1

The preferred location for the single Maritime Area A to be auctioned in ORESS 2.1 is shown in Figure 2.9 and Figure 2.10.

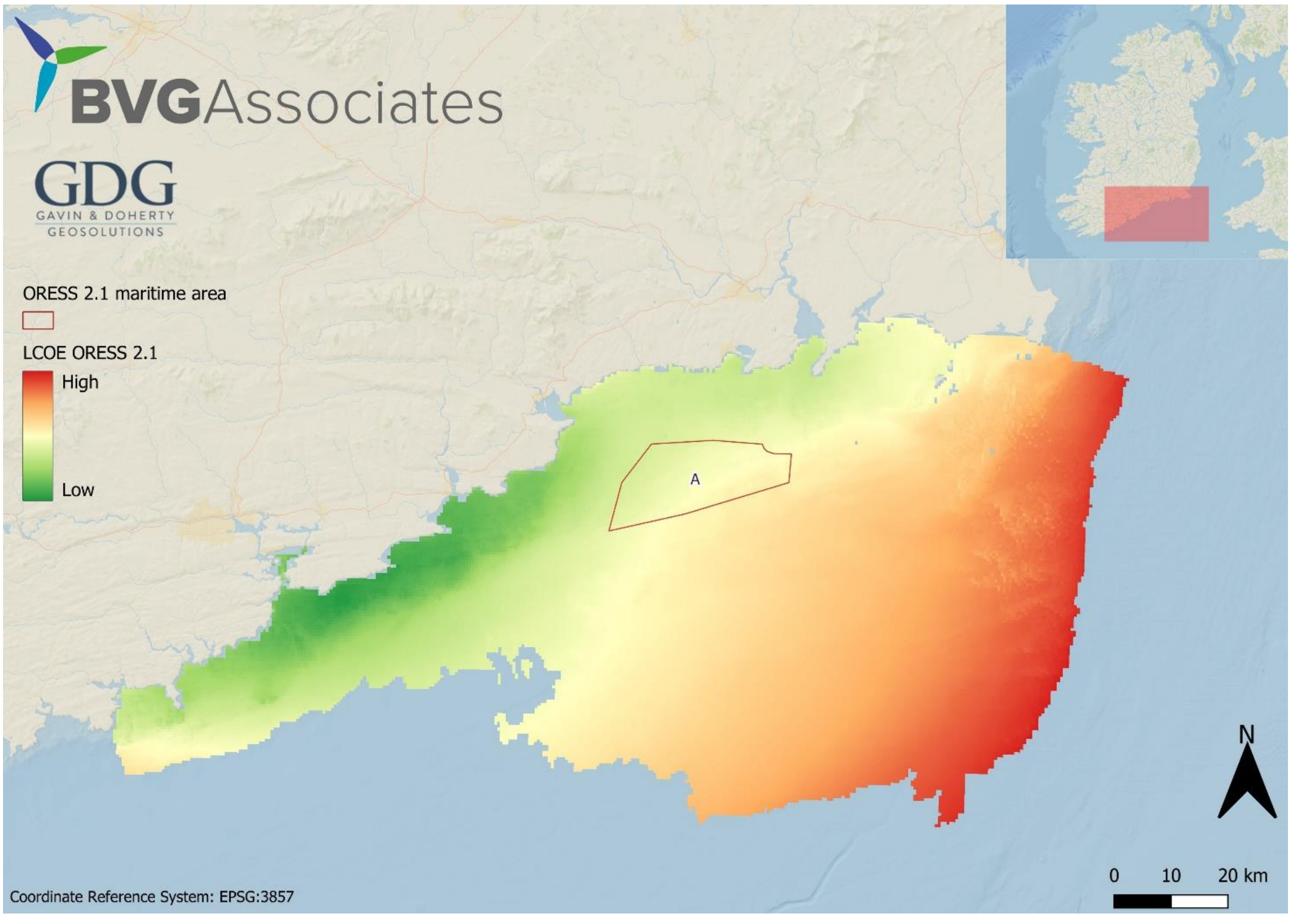

Figure 2.9 Location for ORESS 2.1 Maritime Area, also showing LCOE.

Figure 2.9 shows the Maritime Area A overlaid on the ORESS 2.1 LCOE map. Maritime Area A is not located in the area with the lowest LCOE. Instead, the exclusions shown in Figure 2.10 have been applied and constraint ratings been accounted for. Maritime Area A is therefore pushed out of the area of lowest LCOE, further from shore. Of the remaining Study Area, Maritime Area A is in the location of lowest LCOE where there is sufficient room for a 900 MW wind farm.

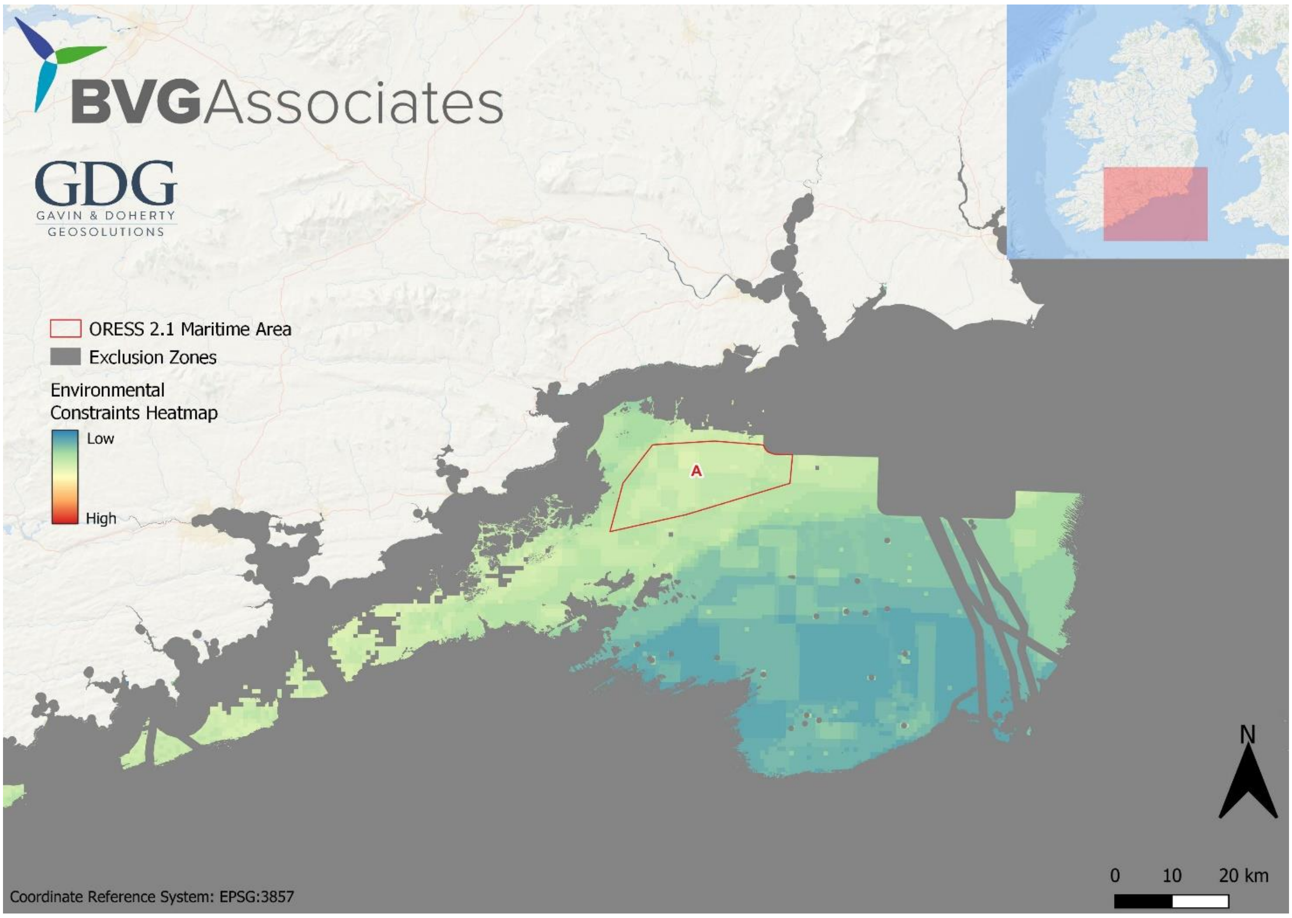

Figure 2.10 Location for ORESS 2.1 Maritime Area, also showing exclusions and environmental consolidated constraint rating.

Maritime Area A is situated off the coast of County Waterford and has a total area of 313 km². The distance to shore varies between 12.2 km along the western boundary and 12.4 km along the northern boundary. Maritime Area A has a mean water depth of 57 m with a minimum water depth of 48 m and a maximum water depth of 69 m, giving an overall range of 21 m. The average wind speed at 150 m height in the area is 10.4 m/s. With a typical density of 4.5 MW/km^2, a 900 MW project would use 65% of the Maritime Area shown. This margin gives room for a project developer to optimise wind farm layout within the Maritime Area, including with regard to environmental constraints identified following project-level data gathering and analysis, and efforts to maximise co-existence opportunities between offshore wind and other marine activities, including commercial fishing.

Maritime Area A's southern and eastern boundaries were selected to avoid the areas of higher shipping density, while allowing sufficient space between development zone B to its south. The western boundary is constrained by areas of surface bedrock. The northern boundary is constrained by areas of surface bedrock and the 60% highest cumulative constraint scores. Its north eastern corner is constrained by the buffer around the Seas off Wexford cSPA.

Maritime Area A has been identified as the best place to deliver an offshore wind farm with an installed capacity of approximately 900 MW, that aims to deploy before 2030, as it has relatively short export cable lengths, compared to the other Maritime Area identified, to both the east and west connections. Its position in shallower water also increases the number of suitable installation vessels currently available, reducing supply chain constraint and maximising the possibility of project deployment by 2030, or as soon as feasible thereafter. It is for these reasons that Maritime Area A is located closer to shore that Maritime Areas B, C and D. Further, the Maritime Area A has the lowest LCOE of the Study Area remaining, making it the most attractive Maritime Area for the ORESS 2.1 project.

2.5.2 Further Maritime Areas

Figure 2.11 shows the locations of further Maritime Areas.

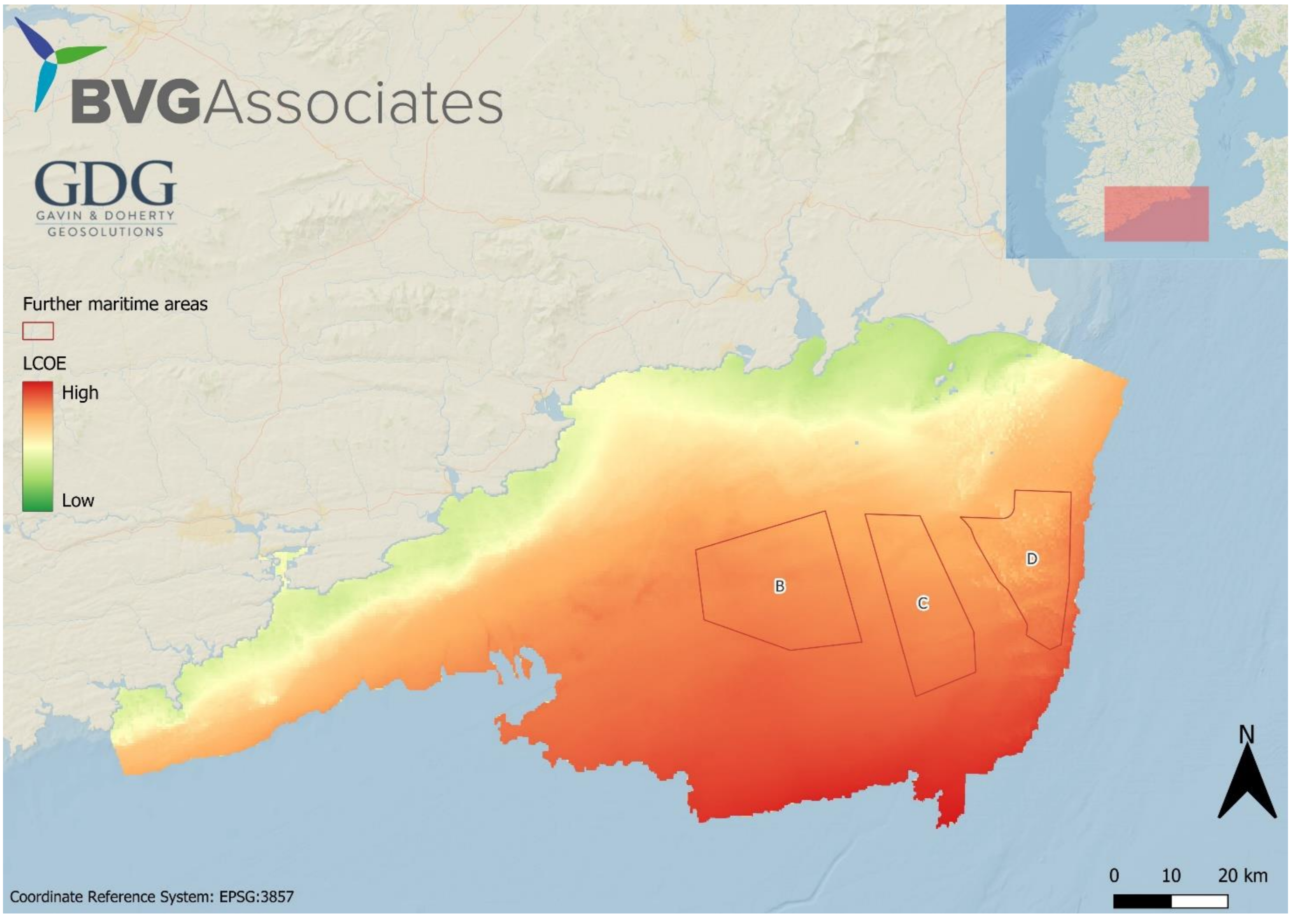

Figure 2.11 Location of further Maritime Areas.

Figure 2.11 shows the Maritime Areas B, C and D overlaid on the further developments LCOE map. Again, the Maritime Areas are not located in the area with the lowest LCOE. Instead, the exclusions shown in Figure 2.12 have been applied and constraint ratings been accounted for. Further, Maritime Areas B, C, and D, leave sufficient space to Maritime Area A and space between each other to account for individually assessed environmental and technical attributes. This space is primarily to allow shipping and navigation routes, as shown in Appendix B, Figure B.16, to pass between them, but also to reduce potential cumulative impacts and loss of wind resource.

Based on currently best available data, Maritime Areas B, C and D are considered suitable locations for future fixed offshore wind farms which aim for deployment from the mid-2030s onwards. However, it is important to note that these three areas would be less suitable than Maritime Area A for locating a project that aims to deploy by 2030, or as soon as feasible thereafter. This is largely due to distance to grid connection and supply chain constraints associated with developing offshore wind in deeper waters, notably with regard to installation vessel availability, as well as greater current costs associated with developing fixed wind in deeper waters, but which are anticipated to decline over coming years.

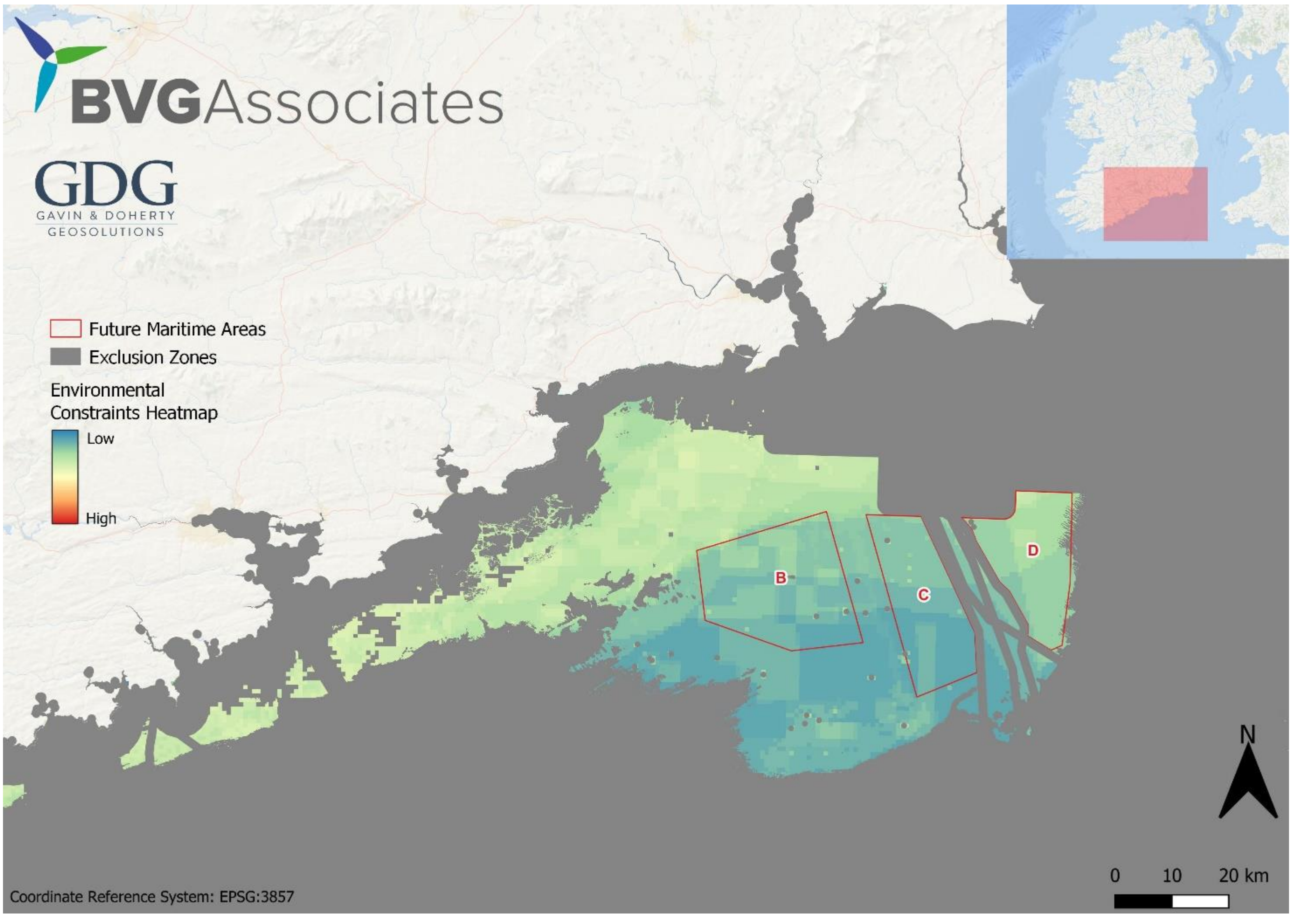

Figure 2.12 Location of further Maritime Areas with exclusions.

Maritime Area B is situated off the coast of County Waterford and has a total area of 486 km². The distance to shore varies between 49 km along the western boundary and 29 km along the northern boundary. Maritime Area B has a mean water depth of 71 m with a minimum water depth of 66 m and a maximum water depth of 76 m, giving an overall range of 10 m. The average wind speed in the area is 10.4 m/s. Indicatively, within this Maritime Area, our early expectation is of a project rating of 1.4 to 2.0 GW. With a typical density of 4.5 MW/km^2, such a project would use 64 to 91% of the area. However, the exact specifications of any project within Maritime Area B will be informed and limited by the project level assessment, which will include cumulative impact assessments. Maritime Area B is bounded by an area of higher density shipping to its north, and allowance of a sufficient gap between Maritime Area A for shipping. Similarly, its eastern edge is also bounded by an area of high shipping density and allowance of a sufficient gap to Maritime Area C. Its southern boundary is dictated by increased sea depth and LCOE while allowing sufficient space for an offshore wind project of the required size.

Maritime Area C is situated off the coast of County. Wexford and has a total area of 342 km². The distance to shore varies between 52 km along the western boundary and 27 km along the northern boundary. Maritime Area C has a mean water depth of 69 m with a minimum water depth of 64 m and a maximum water depth of 72 m, giving an overall range of 8 m. The average wind speed in the area is 10.4 m/s. Indicatively, within this Maritime Area, our early expectation is of a project rating of 1.0 to 1.4 GW. With a typical density of 4.5 MW/km2, such a project would use 65 to 91 % of the area. However, the exact specifications of any project within Maritime Area C will be informed and limited by the project level assessment, which will include cumulative impact assessments. Maritime Area C is bounded at its northern edge by the buffered Seas off Wexford cSPA. Its eastern edge is bounded by submarine cables and pipelines with their buffers applied. Its western edge is bounded by an area of >75 m depth seabed. Its southern boundary is dictated by increased sea depth and LCOE while allowing sufficient space for an offshore wind project of the required size.

Maritime Area D is situated off the coast of County. Wexford and has a total area of 304 km². The distance to shore varies between 52 km along the western boundary and 27 km along the northern boundary. Maritime Area

D has a mean water depth of 67 m with a minimum water depth of 55 m and a maximum water depth of 78 m, giving an overall range of 23 m. The average wind speed in the area is 10.4 m/s. Indicatively, within this Maritime Area, our early expectation is of a project rating of 0.9 to 1.3 GW. With a typical density of 4.5 MW/km^2, such a project would use 65 to 95% of the area. However, the exact specifications of any project within Maritime Area D will be informed and limited by the project level assessment, which will include cumulative impact assessments. Maritime Area D's northern boundary is also dictated by the Seas off Wexford cSPA buffer. Its eastern and southern edges are bounded by the 75 m depth contour. As with Maritime Area C, Maritime Area D is also bounded by the submarine cable and pipelines.

3. Recommendations

The following recommendations are relevant to the SC-DMAP and future offshore wind spatial planning elsewhere in Ireland. They aim to ensure relevant data for the SC-DMAP proposal area is gathered, and a systematic approach is applied for future DMAP proposal areas. It is recommended that:

- DECC commissions a shipping and navigation study for the SC-DMAP proposal area. Shipping and navigation routes are a key factor in the development area selection; however, data available is limited to automatic identification system (AIS) data from EMODnet. This would inform project level plans for developers within the Maritime Areas.
- DECC ensures closer alignment between environmental and technical attribute analysis when identifying Maritime Areas within other DMAP proposal areas. Table 2.2 shows a number of layers typically considered as technical constraints assessed in the environmental analysis. Closer coordination will ensure a structured approach that can be succinctly conveyed during public consultation, based on good international industry practice, and that can be replicated across all of Ireland's seas.
- DECC commissions future DMAP identification using a similar process to the selection of Maritime Areas within the SC-DMAP proposal area. This will enable a more structured approach to DMAP identification fairly and robustly considering all areas of Ireland which could support future wind projects.

Appendix A Levelized cost of energy modelling

BVGA Cost model background

BVGA's cost model is built on information that has been obtained through commercial work, research, direct industry engagements, and our own experience as industry experts.

The first version of the model was created around 2012 to support the UK Government in understanding how the costs of offshore wind energy were likely to change over the coming years. The model has been evolving since.

The model is a combination of top-down approaches, such as the known cost of foundations for a particular project, and bottom-up, such as calculating the physical dimensions of a jacket foundation and estimating cost based on the associated costs of steel and labour. The underlying data points are obtained from a wide variety of sources, including:

- Published data
- BVGA projects where we have the rights to use data in an anonymised way
- Hundreds of direct industry engagements by BVGA staff, and
- Internal modelling by BVGA staff using data provided by industry.

We implement a constant process of re-assessing the underlying cost functions. The responsibility to keep individual models up to date is devolved to subject experts throughout our wider team. The model undergoes at least one complete review annually and is checked against all known project-level LCOE data points from capacity auctions around the world.

BVGA Cost model inputs and assumptions

General

The BVGA cost model has over 20 input parameters and produces estimates for over 30 cost items.

It can run in "project" mode, where it estimates costs for a specific project, or in "area" mode, where a number of inputs are provided as GIS layers rather than singular values, thus calculating an LCOE GIS layer, as used in this Maritime Area identification.

The LCOE model estimates costs for future years and for diverse geographies, talking account of local and regional supply chain impacts. It is also able model the impact of changing prices of commodity items.

Some high-level explanations of the assumptions that underlying the calculations are provided in the following sections.

Development phase costs

Development costs are built mostly bottom up using our knowledge and experience of the process globally.

The general process, particularly the split between pre- and post-consent, follow that of the UK regarding overall timing and general consenting needs.

It includes, but is not limited to, the following items:

- Project Management
- Stakeholders Engagement
- Technical Delivery Team
- Consent Applications
- Land Option Agreements
- Environmental Impact Assessment

- Desktop Studies
- Resource Assessments and Metocean Surveys
- Geo-Surveys
- Concept Engineering Designs
- Front End Engineering Designs
- Geotechnical Completion Campaign
- Detailed Engineering Designs, and
- Supply Chain.

Turbine

Turbine costs are derived from industry engagement. Turbine costs scale with turbine rating. Costs are scaled using an exponent method, with rotor, tower and nacelle cost exponents being used to scale the costs for those components individually.

Foundation

Foundation costs are driven by a bottom-up model validated through ongoing industry engagement.

We calculate dimensions of both monopile and jacket foundations based on depth, overall site conditions (including soil type) and turbine mass (using turbine capacity as a proxy).

These are converted to cost using an estimated global steel price per tonne, which makes up around 40% of total delivered cost.

Array cables

Array cable costs are built from understanding the cost of a typical cable. This cable is assumed to be a three-core copper HVAC cable, 66 kV, XLPE insulated with copper conductors of 800 mm2 (50% of total length) and 300 mm2 (50% of total length). Our costs have been verified through industry engagement.

Transmission

Topside

For HVAC offshore substations the steel structure is 50% of the total mass, and for HVDC it is 40%.

The topside mass for HVAC is 240 tonnes fixed with an additional 4.2 tonnes per MW. For HVDC, the variable topside mass is 7 tonnes per MW.

Compensator

Compensator costs were calculated for cable lengths between 50 and 250 km, as well as for ratings between 71 and 355 MVA. Costs for compensators are limited to a cable length of 250 km as there is limited data above this point.

Switchgear

Costs are based on work done in *Power transmission systems for offshore wind farms: Technical-economic analysis,* regularly verified through industry engagement and adjusted according to the year of commissioning.[10]

[10] https://upcommons.upc.edu/bitstream/handle/2117/77913/Bs_Thesis_Joaquin_Rebled_Lluch.pdf?sequence=1&isAllowed=y

Transformer

Transformer costs are for HVAC only. These costs are based on work done in *Power transmission systems for offshore wind farms: Technical-economic analysis,* regularly verified through industry engagement and adjusted according to the year of commissioning.

Convertor

Convertor costs are for HVDC only. These costs are based on work done in *Power transmission systems for offshore wind farms: Technical-economic analysis*, regularly verified through industry engagement and adjusted according to the year of commissioning.

Export cables

HVAC offshore export cable costs consider three-core 220 kV cables with conductor cross sections between 300 and 2200 mm^2.

HVAC onshore export cable costs consider single core 220kV cables with conductor cross sections between 185 and 2000 mm^2.

HVDC offshore export cable costs consider single core cables between 150 and 525 kV, with conductor cross sections between 1,000 and 3,000 mm^2.

HVDC onshore export cable costs also consider single core cables between 150 and 525 kV, with conductor cross sections between 1,000 and 3,000 mm^2.

It is assumed for HVAC that there will be three export cables, and for HVDC that there will be two.

Onshore substation

In all cases assumes connection to an existing transmission substation.

Covers only upgrade costs needed to facilitate new connection.

Assumes no further network reinforcement costs allocated to the developer.

HVAC

Uses indicative costs from the SPEN transmission charging statement 2021, Appendix 1.[11]

Each substation upgrade requires:

- One double busbar bay per transformer
- 100m of transformer cable per transformer
- 1 275/132kV 240MVA Transformer per 250MVA of power being connected

HVDC

For HVDC

- Converters are rated to the connection power.
- The equivalent of one double busbar bay is required per 250 MVA of connection.

Installation

Installation costs are taken from day rates for installation vessels. Average weather downtime is taken into account. This is informed by feedback from contractors. Variation with depth is taken into account using a multiplier.

[11] https://www.spenergynetworks.co.uk/userfiles/file/SPTransmission_2022-2023_Charging_Statement.pdf

For monopile installation, we are assuming a medium self-propelled jack-up vessel. This vessel can handle 4 monopiles per voyage up to 20 MW turbine monopiles, which have a payload of 3 per voyage. Monopile installation day rates include the cost of the vessel and the hammer.

For jacket installation, assuming a self-propelled floating heavy-lift vessel. This vessel can handle 4 jackets per voyage.

For turbine installation, assuming a self-propelled large jack-up vessel. This vessel can handle 6 turbines per voyage for 8 MW turbines, 5 turbines per voyage for 10 and 12 MW turbines, and 4 turbine per voyage for 15 and 20 MW turbines.

For array cable installation, assuming a self-propelled cable-lay vessel. Array cable installation day rates include costs for support vessels for pull in.

For each turbine rating, installation costs are assumed to scale linearly with distance to construction port.

Operational expenditure

This is a primarily based on top-down modelling, with costs taken from a variety of sources. Some costs are known for older (operating) wind farms, but many costs are based on expectations for wind farms with COD 2023 and beyond.

Detailed costs are difficult to obtain due to the majority of sites being tied up in long-term service agreements (LTSAs) with turbine suppliers. Much of our assessment of the details related to turbine operation and maintenance (O&M) has been established through extensive industry engagement with developers, owner/operators, and the supply chain.

Cost savings due to future technical and supply chain growth and innovations, with the site-specific O&M philosophy (mix of vessels, in-house vs turbine supplier LTSA, etc.) are particularly sensitive input choices. The industry is generally optimistic about what level of cost reduction can be achieved over the coming decade, and we have sought to bring rigour and challenge to these claims while still reflecting the general trends of cheaper O&M, particularly with increasing turbine capacity.

The bottom-up modelling incorporated into the model includes assumptions on:

- Crew transfer vessel (CTV) costs
- SOV costs
- Jack-up vessel costs
- Port-side facilities (varies across land lease, office space, warehouse, laydown areas, parking, etc.)
- Average employment cost of offshore technicians
- Average offshore presence (technicians per GW)
- Average employment cost of onshore legal/engineering/accounting
- Average onshore presence (staff per GW)

Wider operational costs

The model includes assumptions on use of system and seabed lease costs.

The model assumes values that are representative of the North Sea coast of the UK and includes:

- Transmission use of system costs
- Balancing market costs
- Seabed lease costs
- Community fund contributions

Other cost impacts

In addition to the basic building blocks described above, there are other inputs into the model which enable further refining of the costs.

Time based variation

Commodity prices

The model can evaluate the impact of the following seven commodity indices on each cost output, benchmarked against 2019 prices:

1. Consumer price index
2. Steel
3. Copper
4. Electricity
5. Fuel
6. Labour
7. Transport

The user can choose (or manually enter) the specific index for each commodity, using annual ratios from 2019 to 2035 and beyond.

Learning rates

Changes in future prices based on market volume-related learning rates are implemented. Learning rates are applied to each output cost individually, enabling reductions in cables to be modelled at a different rate to reductions in floating foundations, for example. Learning rates are based on our thorough understanding of technology and supply chain status in each area.

Geographies

The model defaults to northern European waters when estimating costs. It can adjust each cost output for a different geography, either pulling from a number of BVGA-created country lookup tables or using user-defined adjustments specified at runtime.

For this analysis, costs were aligned to those calculated for the economic benefits study BVGA produced for DECC[12]. This includes premiums in certain cost elements, such as development and tower costs, where the novelty of the Irish market will mean higher costs initially.

[12]Offshore renewable energy export potential for Ireland, BVGA, January 2024, available online at assets.gov.ie/281435/8d698eac-0112-4058-9524-e43d1668e979.pdf

Appendix B Environmental data layers

Figure B to Figure B below show the consolidated constraint maps for the 17 environmental attributes assessed.

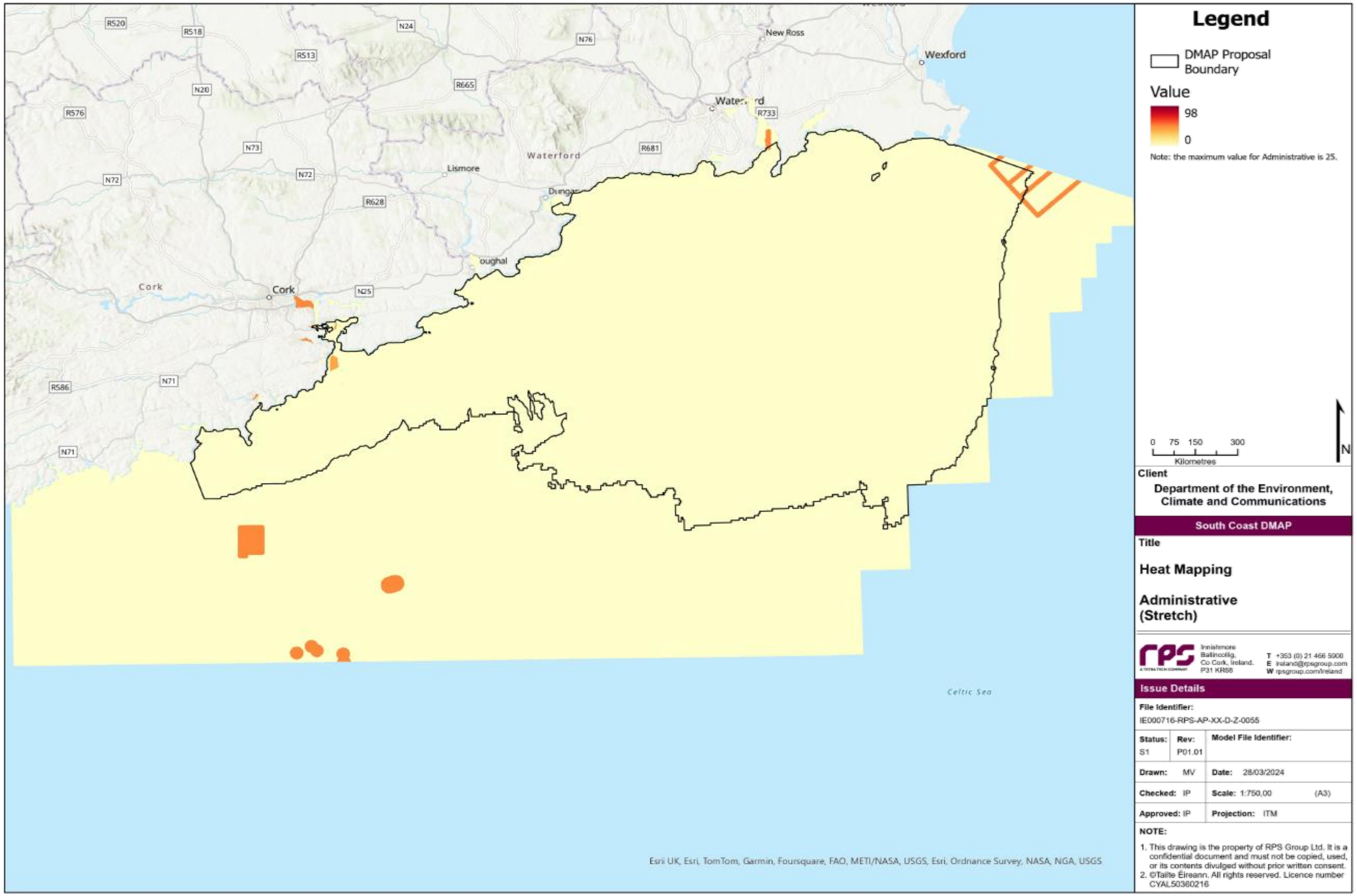

Figure B.1 E1 Administrative constraints.

Figure B.1 shows the administrative constraints. There are a number of small areas of constraint around the Study Area, these are from anchorage areas, pilot boarding locations, and restricted areas. The bulk of the Study Area is free from administrative constraints.

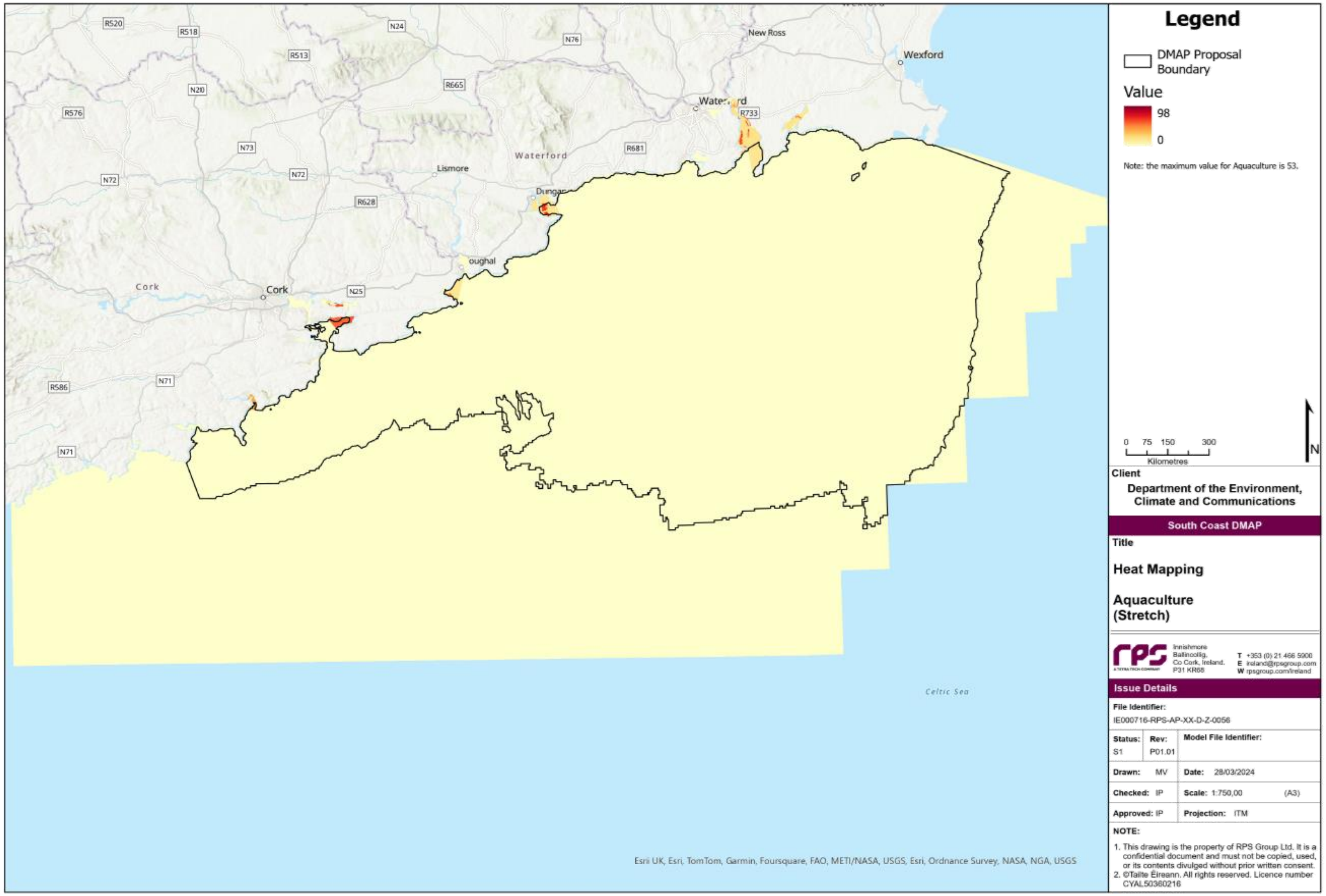

Figure B.2 E2 Aquaculture constraints.

Figure B.2 shows the aquaculture constraints. The highest constraint areas are concentrated around the coastline and in bays and inlets.

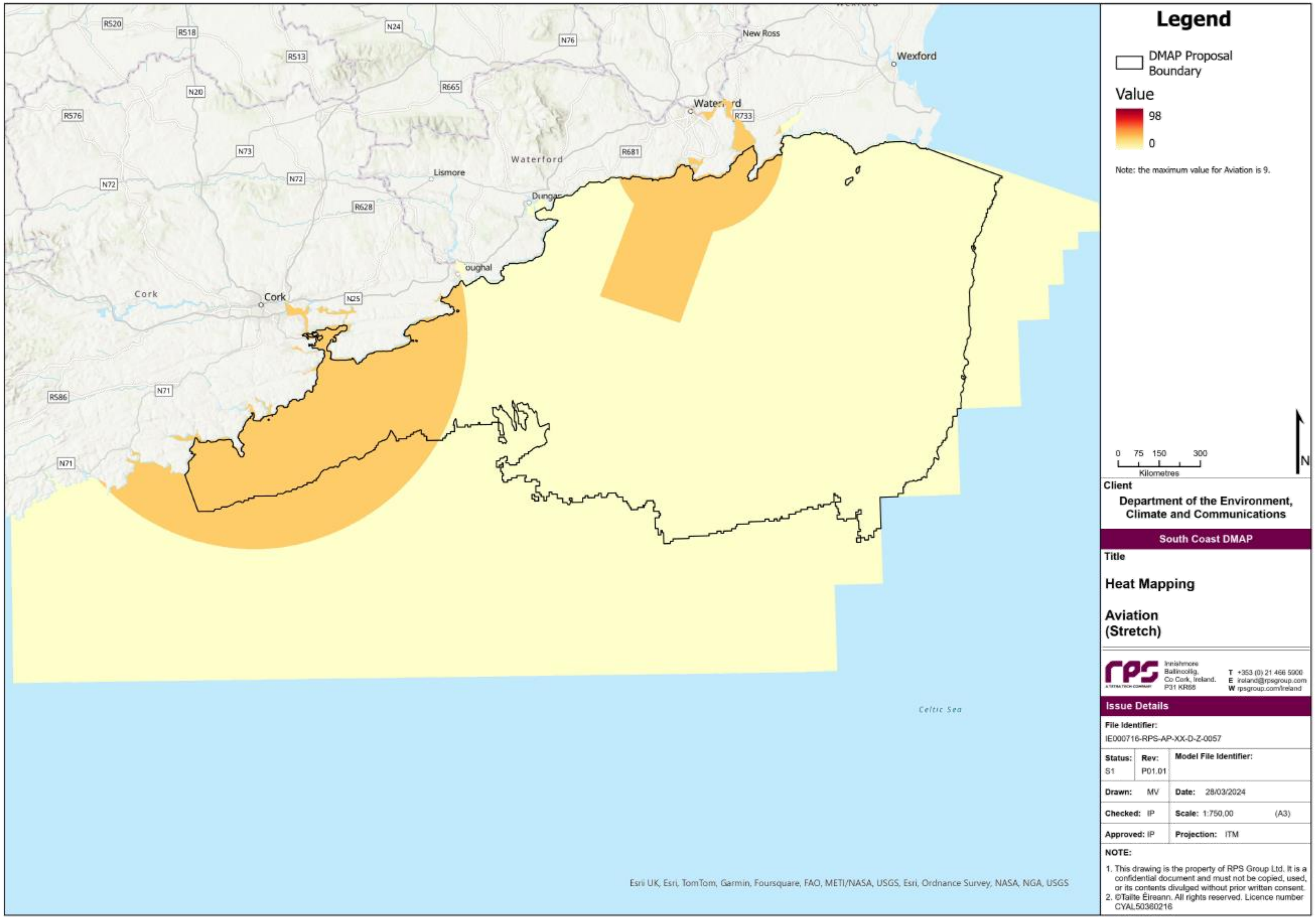

Figure B.3 E3 Aviation constraints.

Figure B.3 shows the aviation constraints. The majority of the Study Area is free from aviation constraints, however around Cork, and Waterford, some constraint exists from aviation radar. This is not an excluding factor for offshore wind, as it is high altitude radar only.

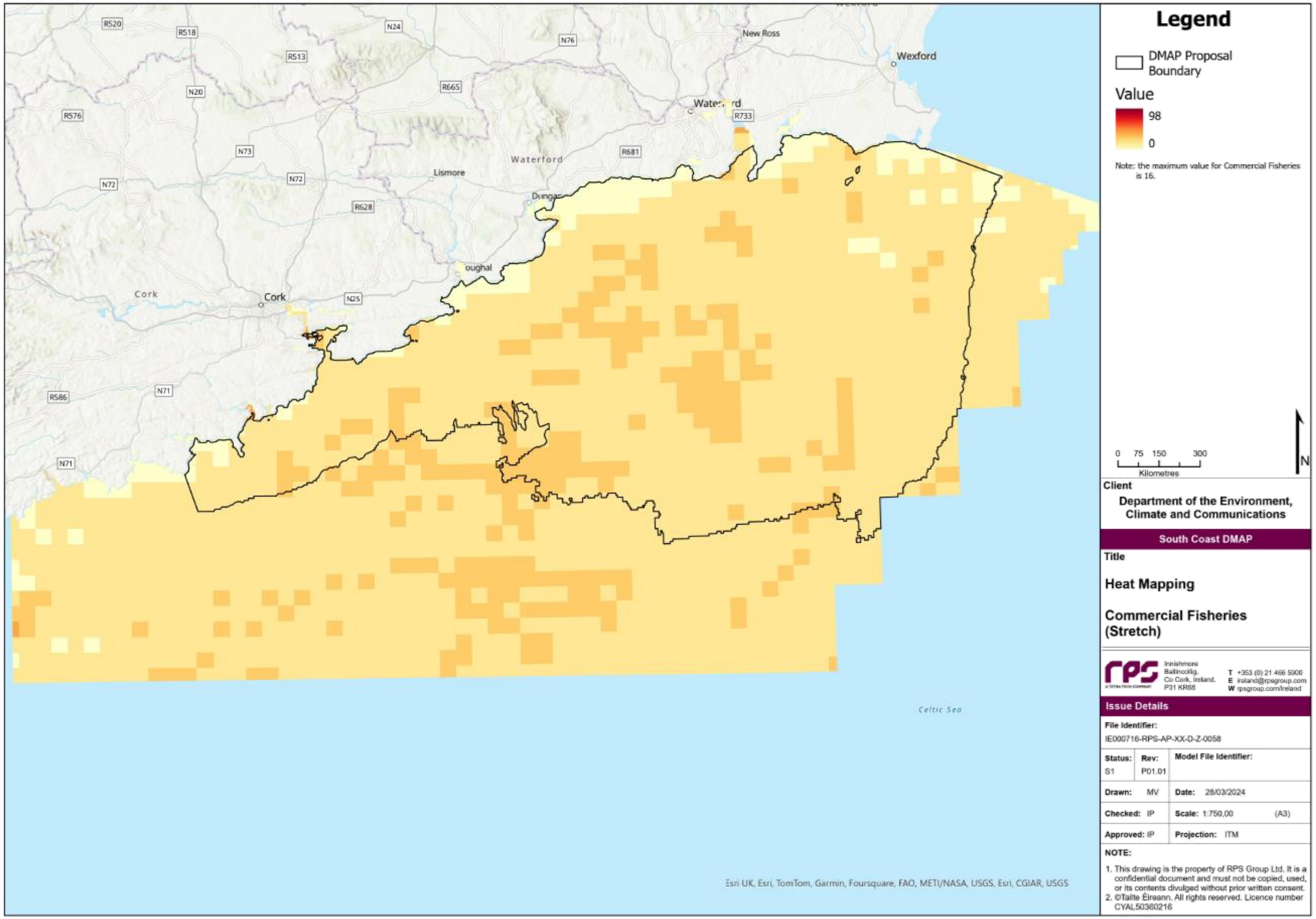

Figure B.4 E4 Commercial fisheries constraints.

Figure B.4 shows the commercial fishery constraints. The areas of constraint are spread around the Study Area relatively evenly, however, constraint generally reduces close to the coastline.

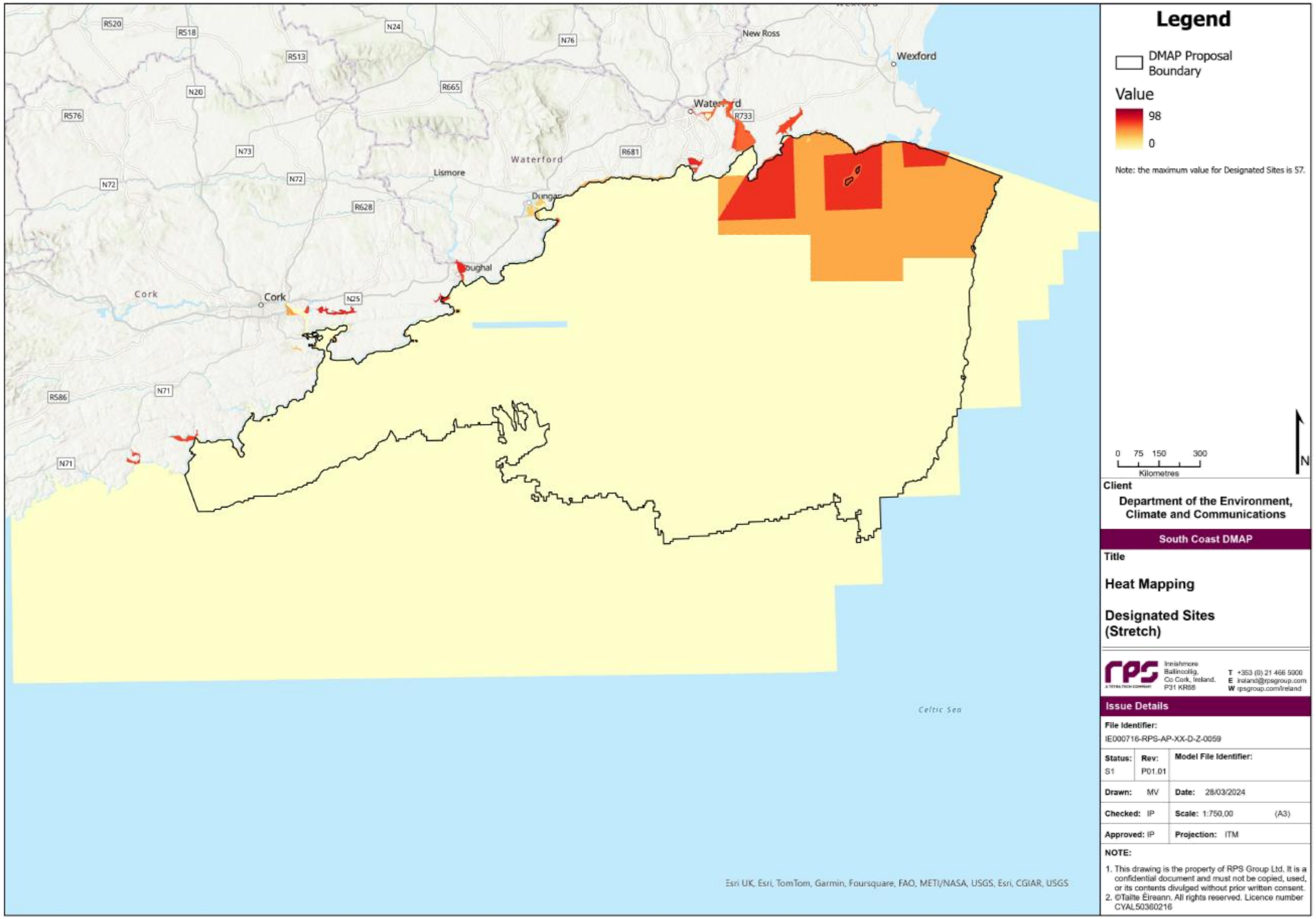

Figure B.5 E5 Designated sites constraints.

Figure B.5 shows the designated sites constraints. The highest constraint areas are concentrated around the coastline and in particular around the Saltee islands where the Seas off Wexford cSPA is located.

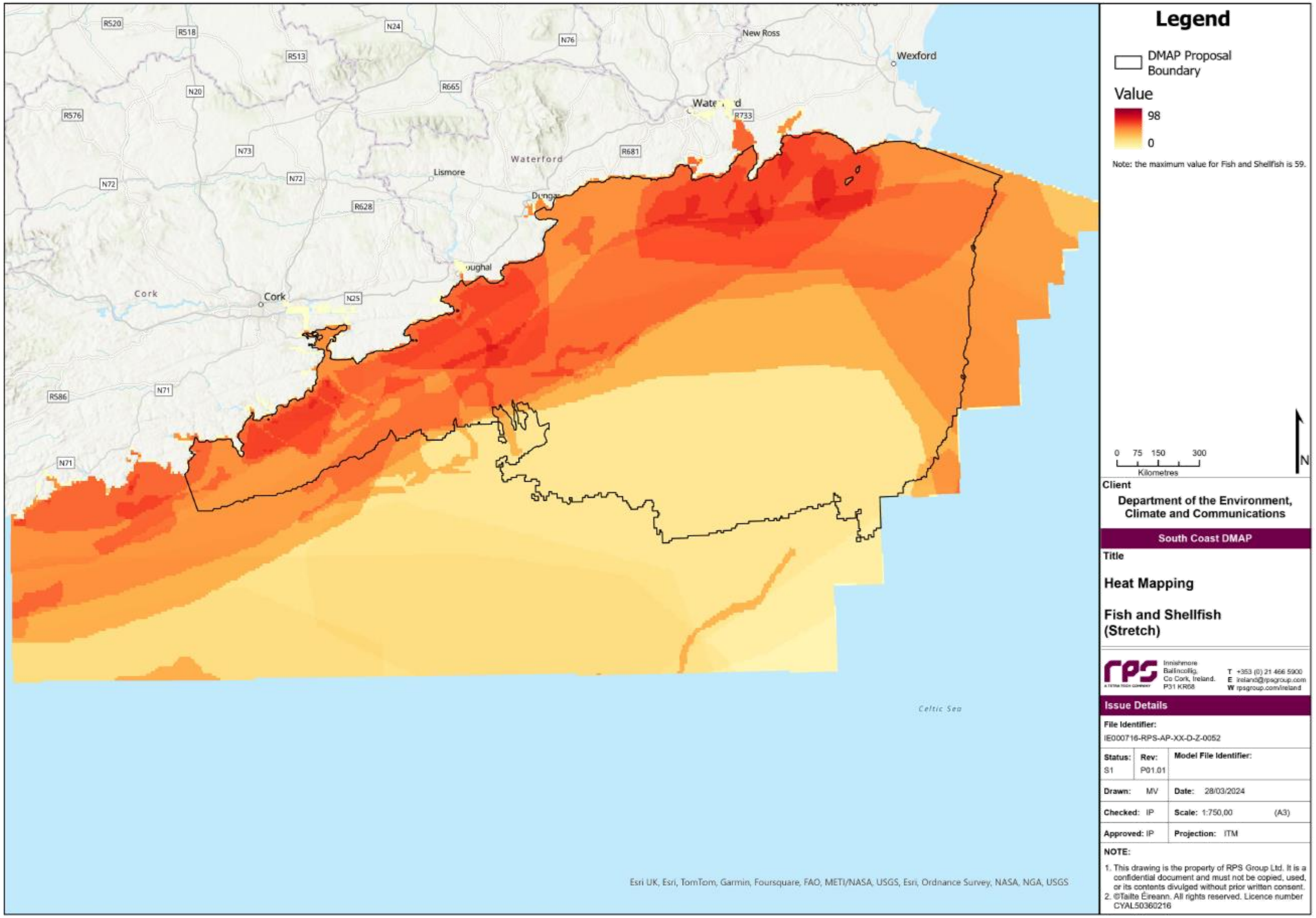

Figure B.6 E6 Fish and shellfish constraints.

Figure B.6 shows the fish and shellfish constraints, including spawning and nursery grounds. The highest constraint areas are concentrated around the coastline, but higher constraints extend out into the centre of the Study Area.

BVGAssociates

GDG
GAVIN & DOHERTY
GEOSOLUTIONS

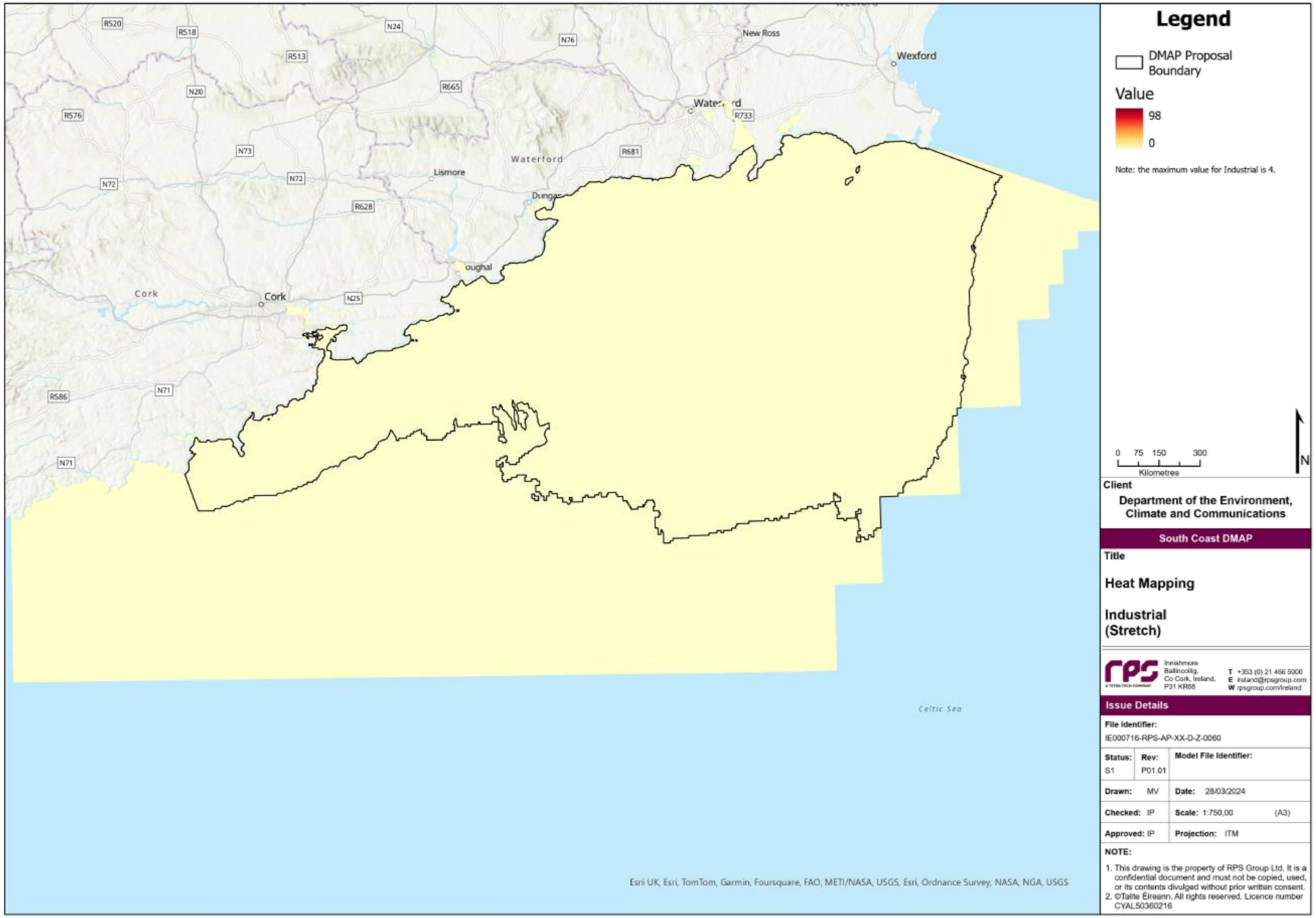

Figure B.7 E7 industrial constraints.

Figure B.7 shows the industrial constraints. Areas of industrial constraint are small and concentrated near the coastline so are hard to see at this map scale. The constraint includes submerged diffusers, fishing and harbour facilities and shoreline construction. This is likely to have little impact on development area location.

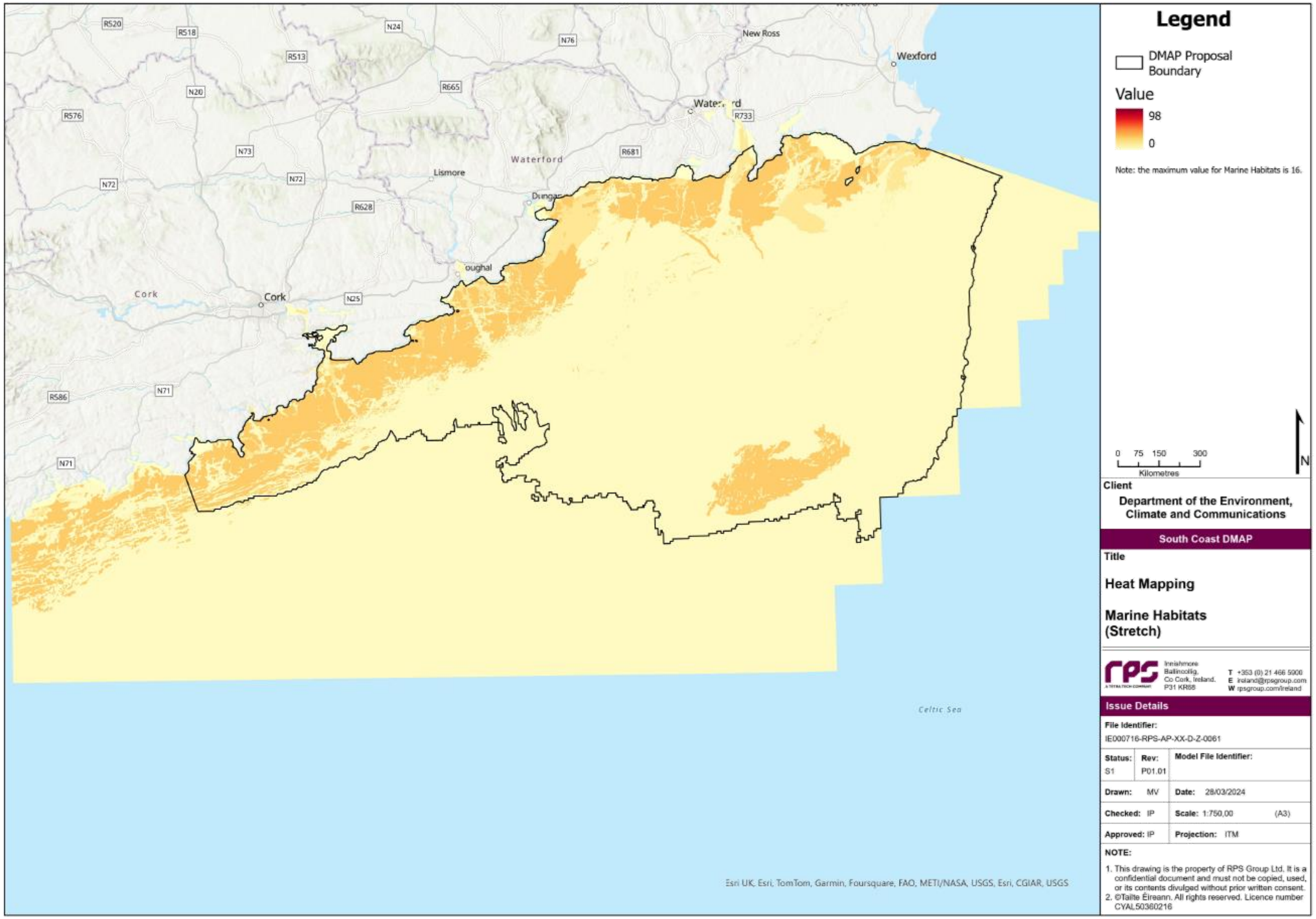

Figure B.8 E8 Marine habitats constraints.

Figure B.8 shows the marine habitats constraints. The highest constraint areas are concentrated around the coastline, however there is an area of higher constraint towards the south of the Study Area.

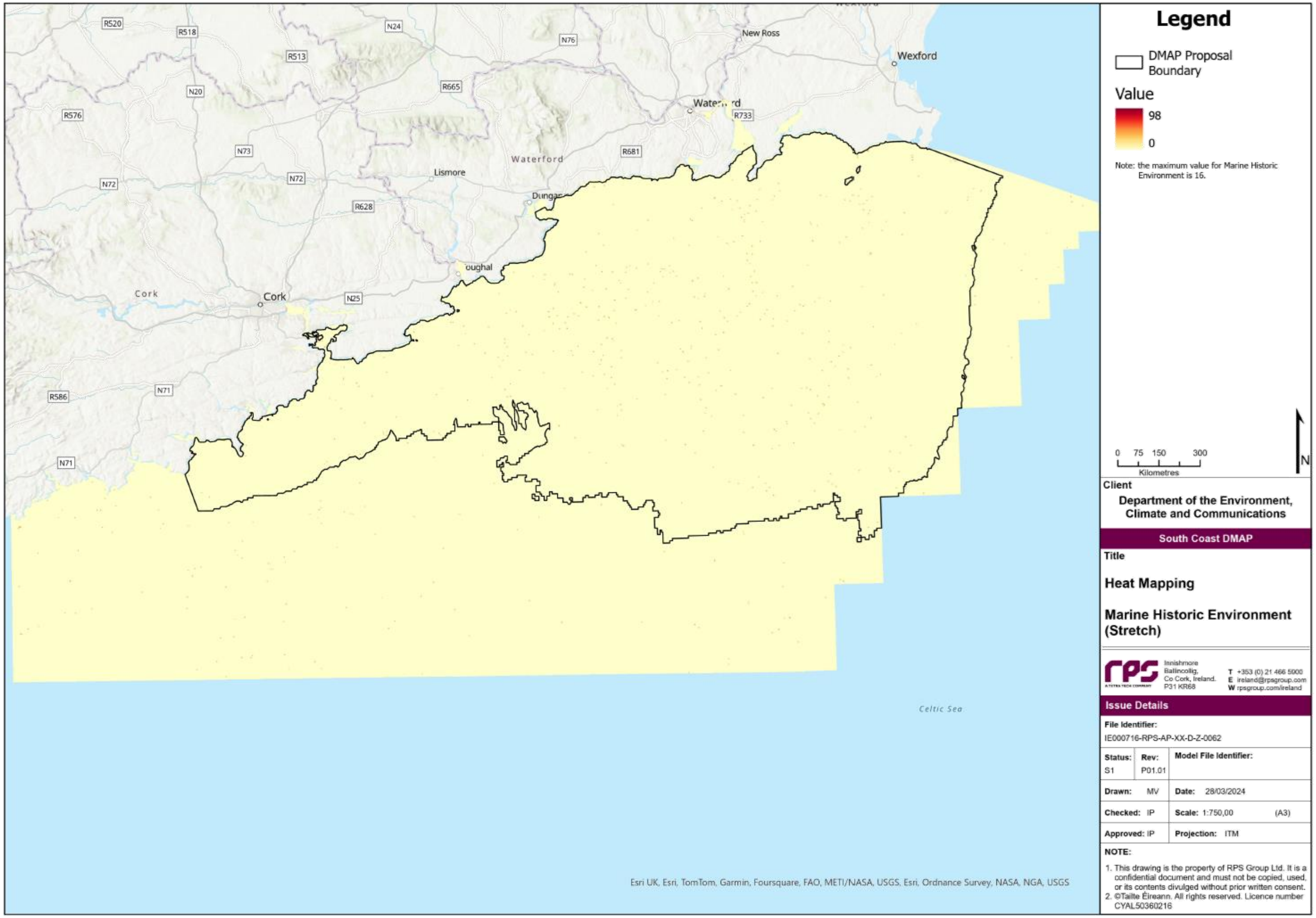

Figure B.9 E9 Marine historic environment constraints.

Figure B.9 shows the marine historic environment constraints. There are a number of small areas of marine historic environment constraint, such as historic wreaks within the Study Area. These will not affect the Maritime Area identification and should be verified with site specific surveys and micro sighted to avoid.

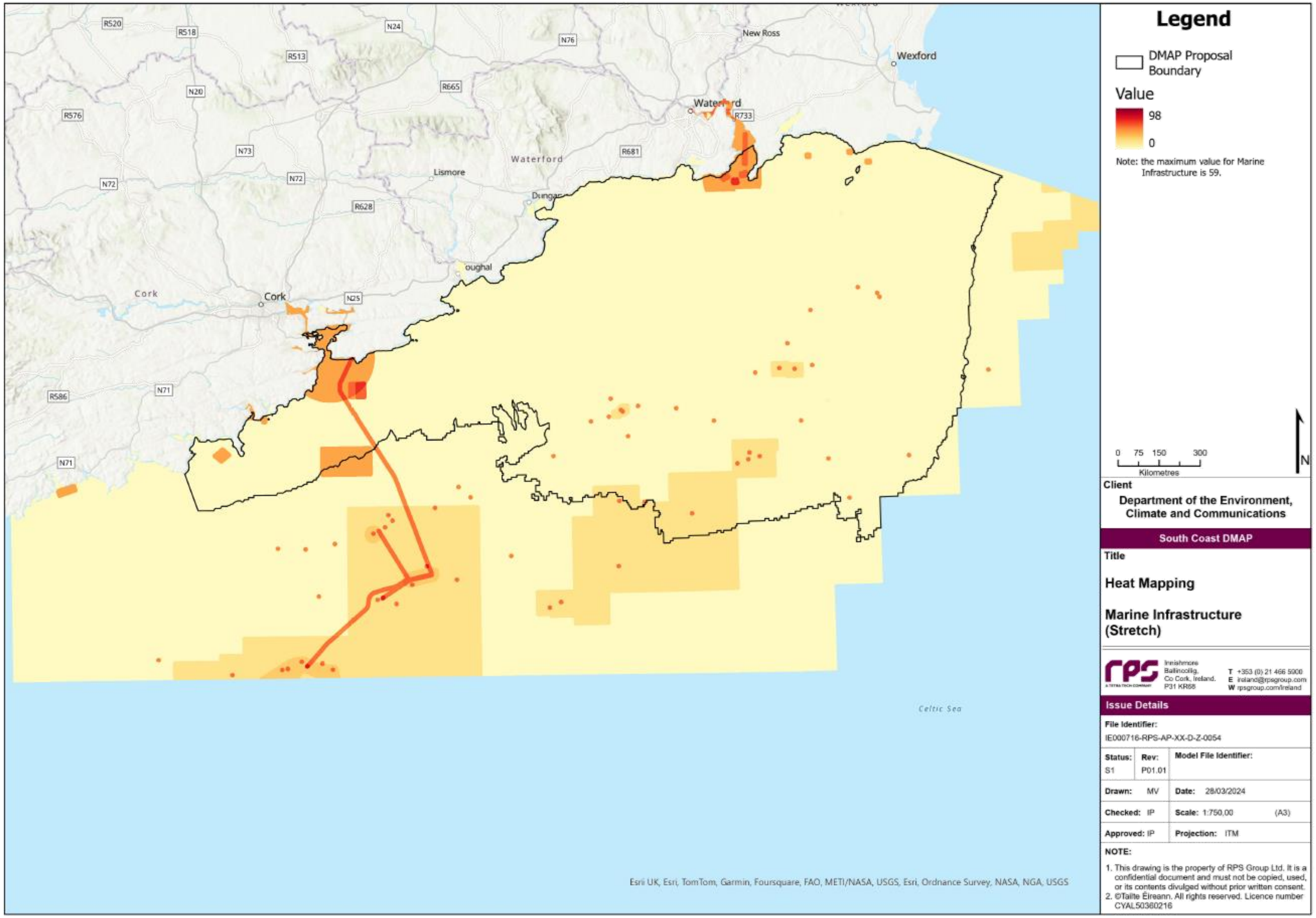

Figure B.10 E10 Marine infrastructure constraints.

Figure B.10 shows the marine infrastructure constraints. Constraint is higher around Cork harbour and Waterford Estuary, with some areas of higher constraint from gas pipelines, exploration wells, and dumping grounds further south.

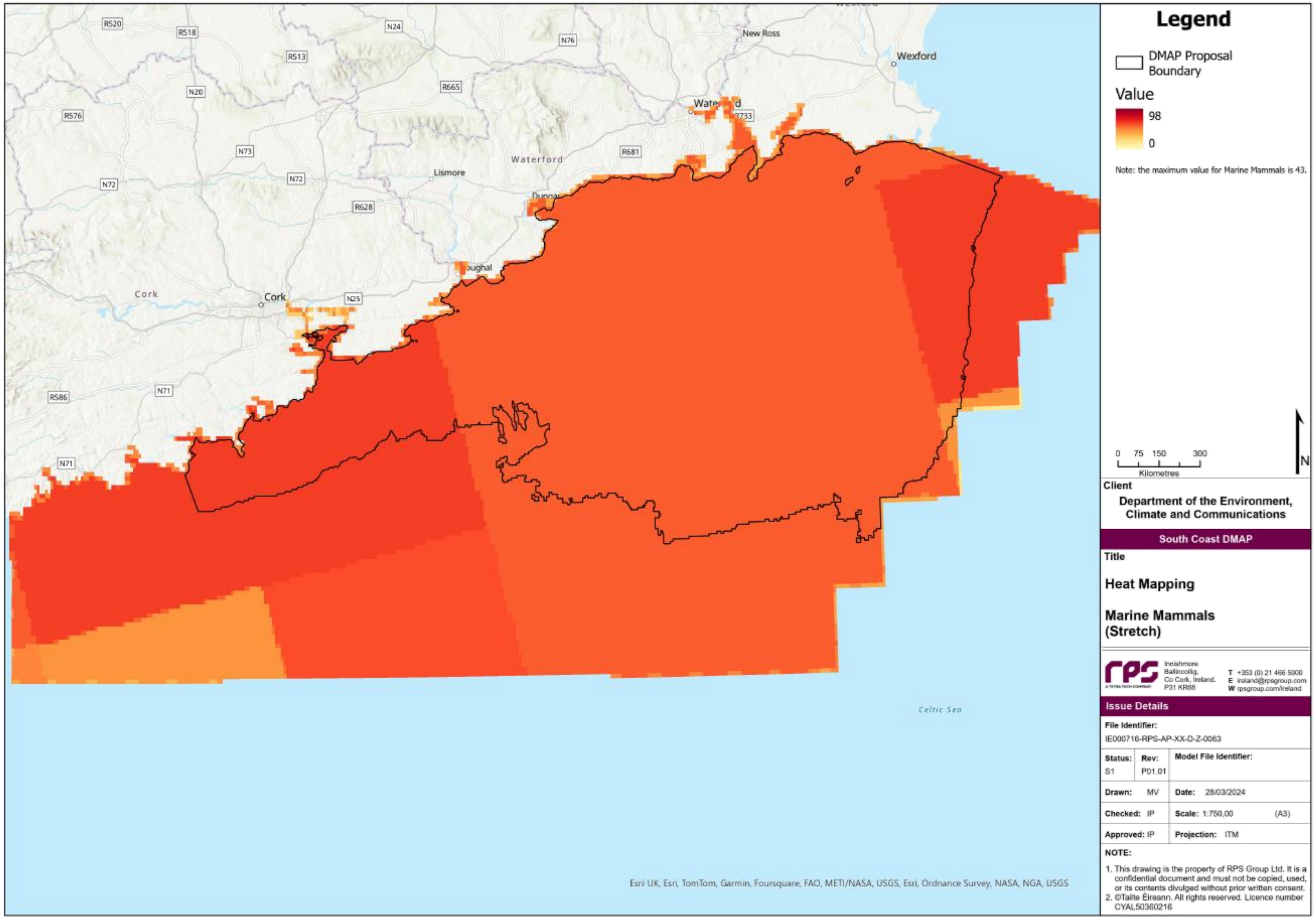

Figure B.11 E11 Marine mammals constraints.

Figure B.11 shows the marine mammals constraints. There is significant marine mammal constraint across the Study Area, which slightly higher impacts on the east and west edges.

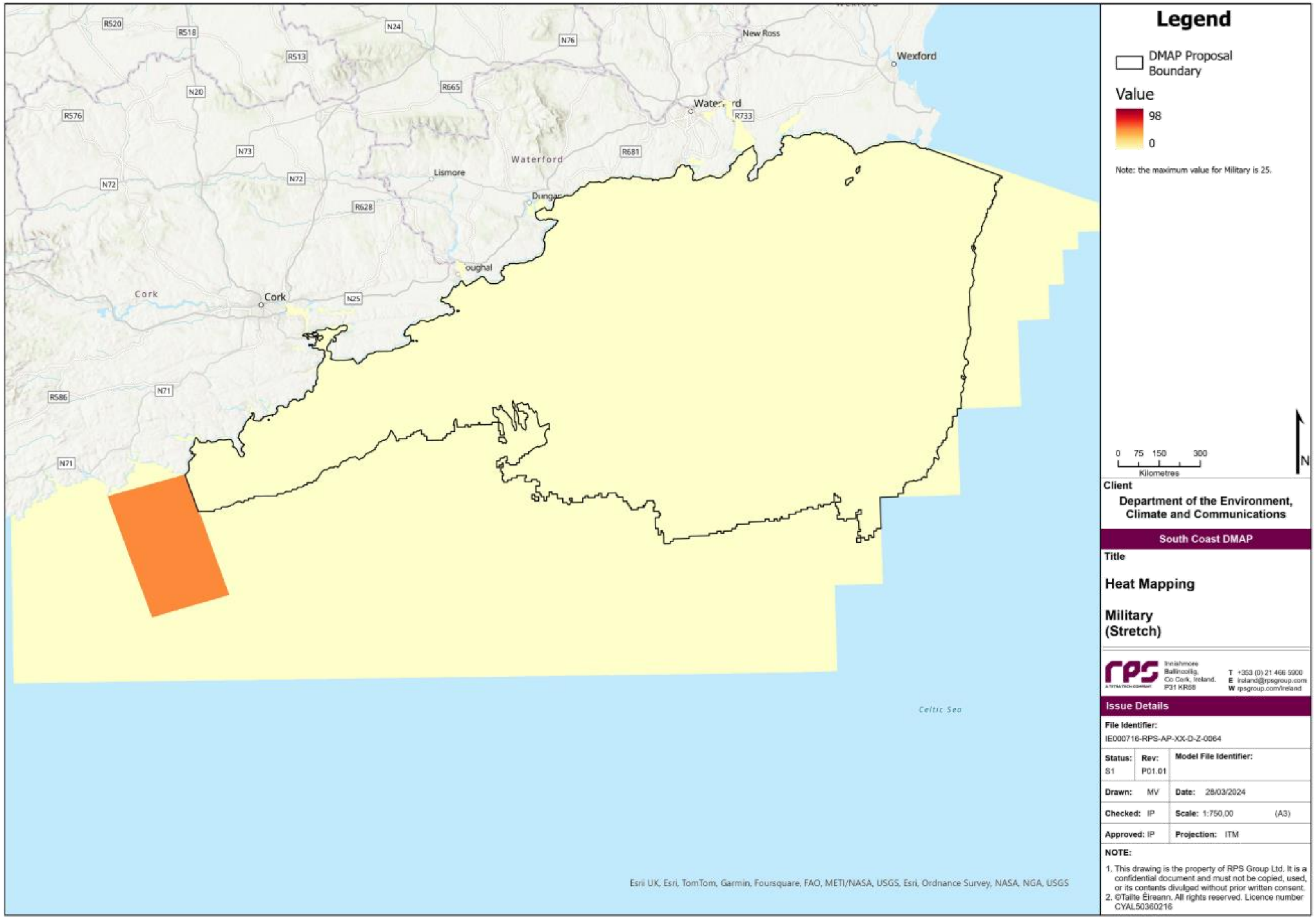

Figure B.12 E12 Military constraints.

Figure B.12 shows the military constraints. One military area is present in the region. It forms the western boundary of the Study Area, and does not affect development area positioning within it.

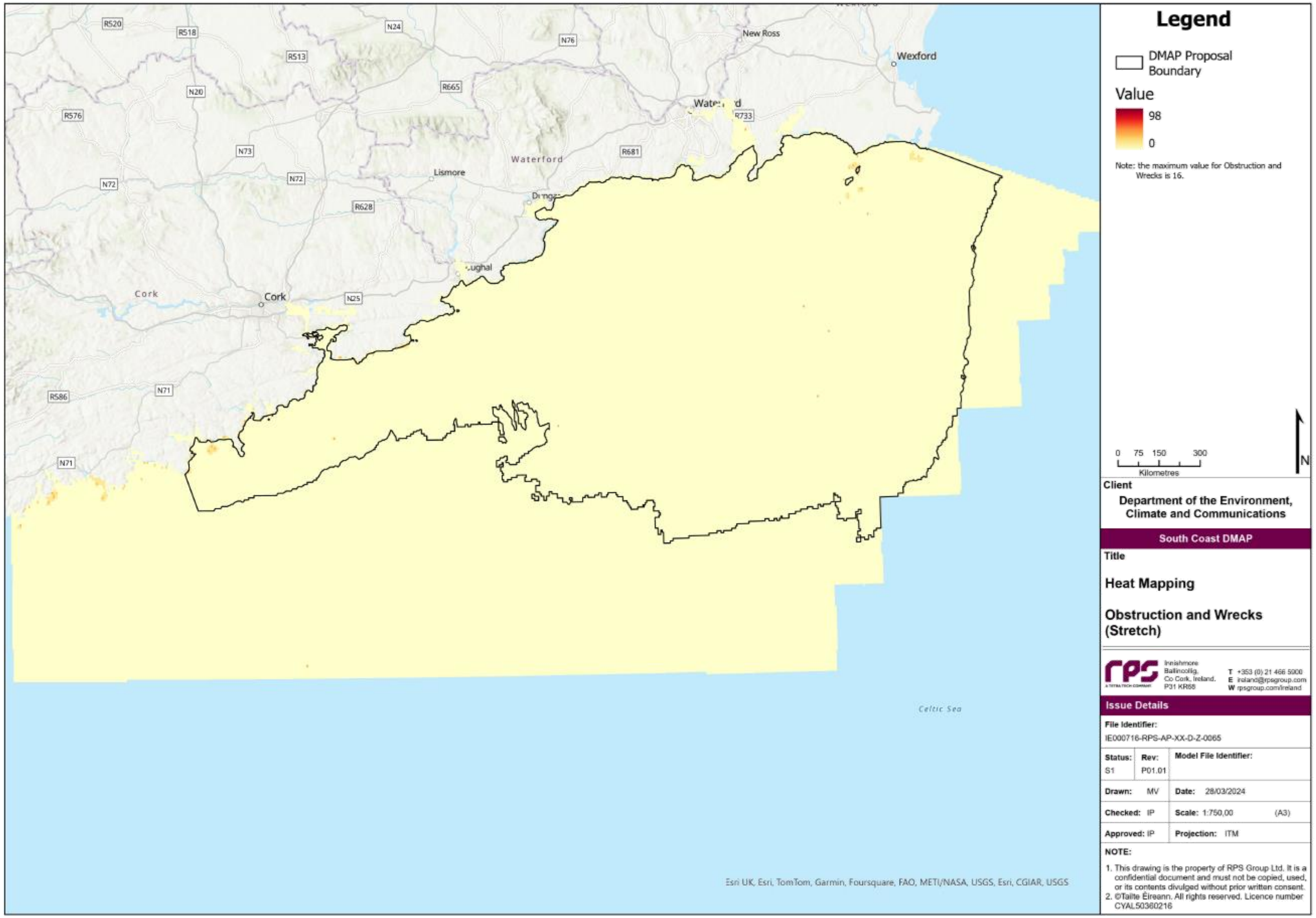

Figure B.13 E13 Obstruction and wreaks constraints.

Figure B.13 shows the obstruction and wreaks constraints. There are a number of more constrained areas, concentrated around the coast, with only a few constrained areas located further form shore. These will not affect the Maritime Area identification and should be verified with site specific surveys and micro sighted to avoid.

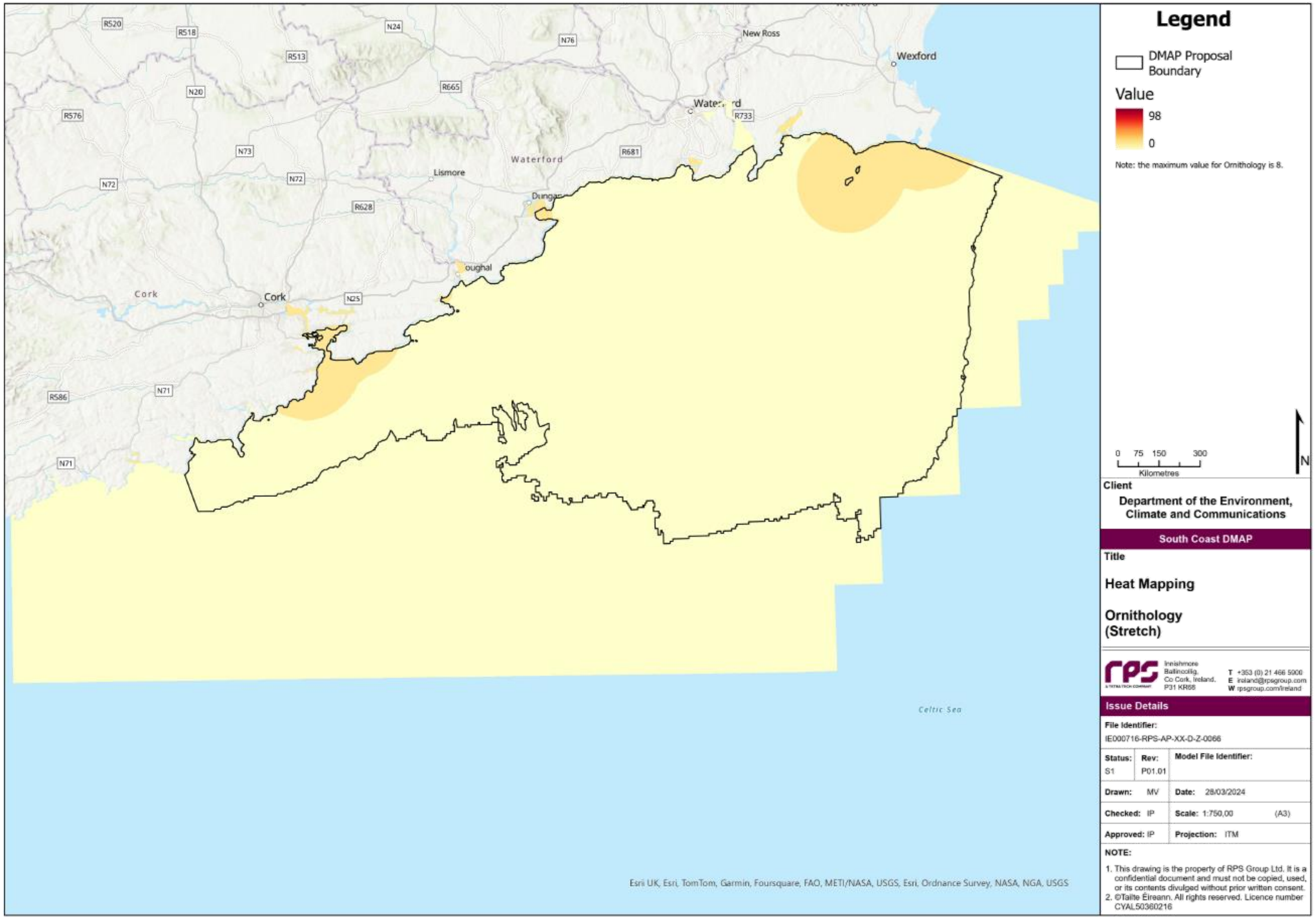

Figure B.14 E14 Ornithology constraints.

Figure B.14 shows the ornithology constraints. Areas of highest constraint are concentrated around the coast, particularly at estuaries and the Saltee islands. Impacts further offshore are likely to be less, however project specific analysis should be undertaken.

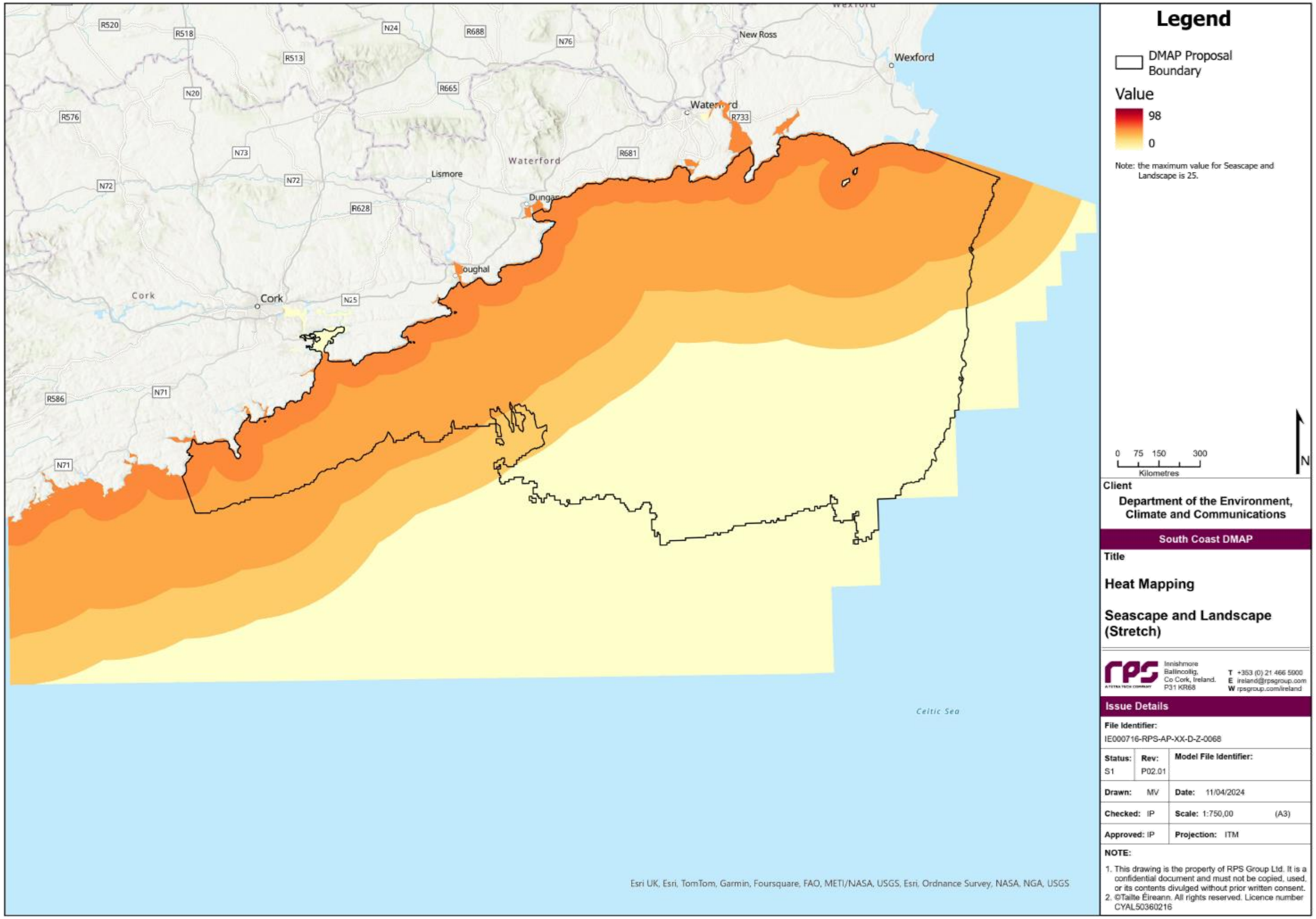

Figure B.15 E15 Seascape and landscape constraints.

Figure B.15 shows the seascape and landscape constraints. Constraint increases closer to shore with the area <5 km from shore the most sensitive.

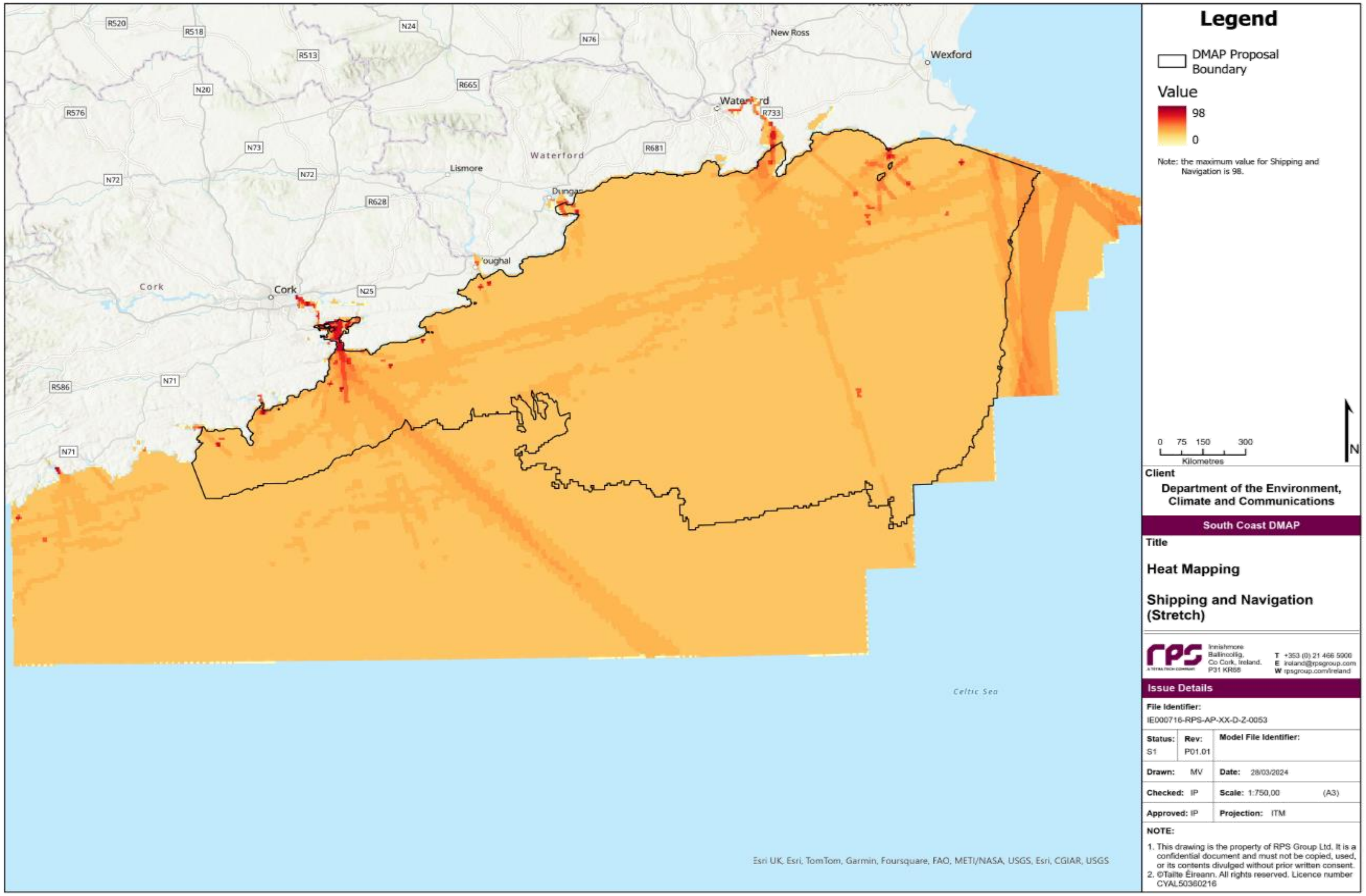

Figure B.16 E16 Shipping and navigation constraints.

Figure B.16 shows the shipping and navigation constraints. Many paths of high traffic cross the area. From Cork Harbour there is a shipping route heading south east, and another heading roughly west, which passes approximately 20 km from the shoreline by Waterford Estuary. The highest densities are found around Waterford Estuary and Cork Estuary, where a number of shipping routes converge. Maritime Area identification avoids areas of the highest density traffic, however some rerouting of traffic may be possible following detailed site specific assessments.

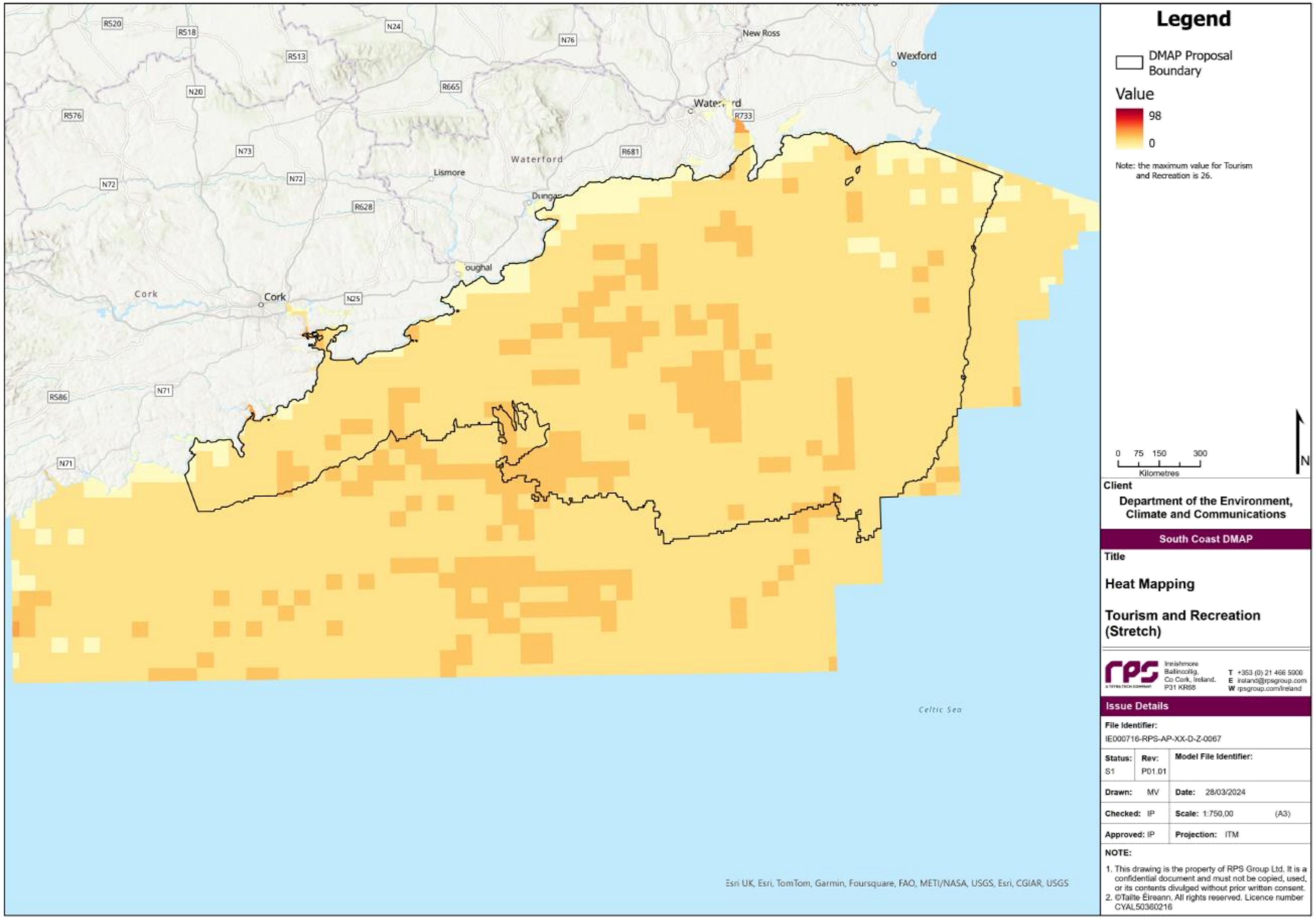

Figure B.17 E17 Tourism and recreation constraints.

Figure B.17 shows the tourism and recreation constraints. Tourism and recreation constraint is most concentrated at the coast where bathing locations, marinas and blue flag beaches are found, along with recreational activities such as kitesurfing, surfing and snorkelling. Constraint higher offshore is caused by sailing vessel density.