# Irish Coastal Protection Strategy Study Phase 5 - North West Coast

## Work Packages 2, 3 & 4A - Appendix 3- Flood Mapping

IBE0388/January 2014

# Office of Public Works

## Irish Coastal Protection Strategy Study - Phase 5

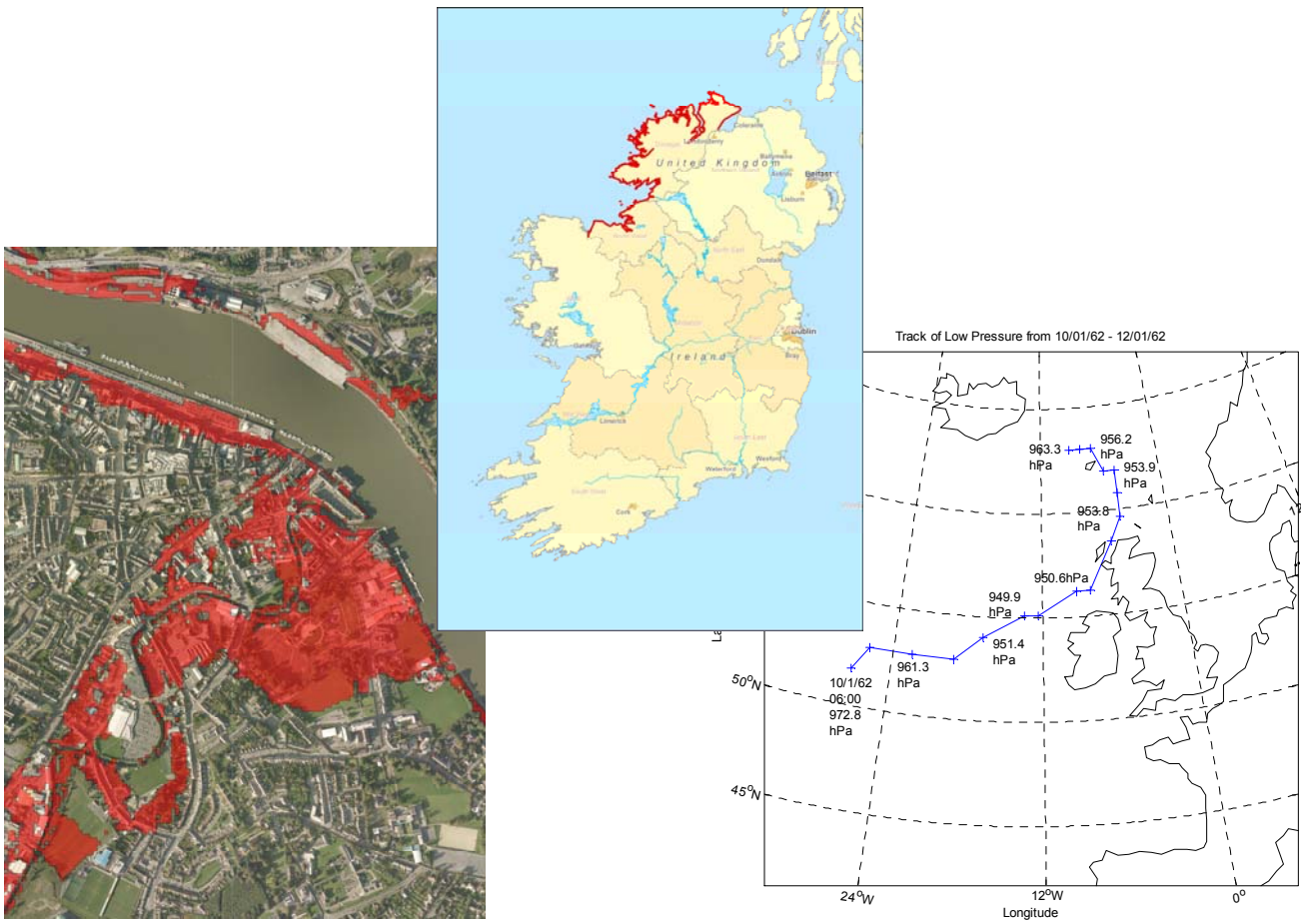
## Work Packages 2, 3 & 4A

## Strategic Assessment of Coastal Flooding and Erosion Extents

## North West Coast - Killala Bay to Lough Foyle

Appendix 3- Extreme Flood Outline and Flood Plain Mapping

January 2014



# Office of Public Works

# Irish Coastal Protection Strategy Study - Phase 5

# Work Packages 2, 3 & 4A

# Strategic Assessment of Coastal Flooding and Erosion Extents

# North West Coast - Killala Bay to Lough Foyle

Appendix 3- Extreme Flood Outline and Flood Plain Mapping

January 2014

## DOCUMENT CONTROL SHEET

| | | | | | | |
|---|---|---|---|---|---|---|
| Client | Office of Public Works | | | | | |
| Project Title | Irish Coastal Protection Strategy Study, Phase 5, Work Package 2, 3, & 4A | | | | | |
| Document Title | Strategic Assessment of Coastal Flooding and Erosion Extents | | | | | |
| Document No. | IBE0388/Rev01_APP | | | | | |
| This Document Comprises | DCS | TOC | Text | List of Tables | List of Figures | No. of Appendices |
| | 1 | - | 6 | - | - | 1 |

# IMPORTANT DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE FOR FLOOD MAPS

**Please read the disclaimer, guidance notes and conditions of use below carefully to avoid incorrect interpretation of the information and data provided on the maps contained in this volume. The maps must be used only in conjunction with these notes, and must not be used in isolation.**

## PURPOSE OF THE MAPS

The maps contained within this bound volume were prepared under the following project:

– ***Project Name: Irish Coastal Protection Strategy Study (ICPSS)***
– ***Project Period: 2005 – 2014***

The maps were prepared for the purpose of assessing the degree of flood hazard and risk to assist in the identification and development of measures for managing the flood risk. They may, however, also be of use to the public, Local Authorities and other parties as indicative maps of flood-prone areas for a range of purposes, including raising awareness of flood hazard and risk, preparedness and response planning for flood events, assisting in planning and development decisions, etc.

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## GUIDANCE NOTES

This bound volume contains a number of different types of map. How these maps have been derived, and what they do and do not present, is described below.

### *Derivation of Maps*

The maps included within this bound volume are 'predictive' flood maps, as they provide predicted flood extent and other information for a 'design' flood event that has an estimated probability of occurrence (e.g., the 1% AEP event – see below), rather than information for floods that have occurred in the past (which is presented on 'historic' flood maps).

The predicted extents are based on analysis and modelling. This includes:

– Numerical Modelling of combined storm surges and tide levels which was used to estimate extreme water levels along the coastline

– Statistical extreme value analysis and joint probability analysis to both historic recorded tide gauge data and data generated by numerical modelling, which allowed an estimation of the extreme water levels of defined annual exceedance probability (AEP) to be established along the coastline

– Definition of the plan extent of the predictive floodplain, by use of a Digital Terrain Model (DTM) commissioned by the Office of Public Works. The predictive flood outlines and depths shown on these maps were calculated by combining the results of the surge and tide level modelling, the statistical analysis, and the DTM using GIS technology.

The maps have been produced at a strategic level to provide an overview of coastal flood hazard and risk in Ireland, and minor or local features may not have been included in their preparation. A DTM is used to generate the maps which is a 'bare earth' model of the ground surface with the digital removal of man-made and natural landscape features such as vegetation, buildings, bridges and embankments. The mapping process can show some of these man-made features, such as bridges and embankments, as flooded on the flood maps, when in reality they do not flood. In addition, 'cleansing' is undertaken during flood map production, which involves various processes such as the removal of very small areas of flooding that is remote and isolated, the removal of very small islands within the flooded area, etc. Therefore, the maps should not be used to assess the flood hazard and risk associated with individual properties or point locations, or to replace a detailed local flood risk assessment. Local factors such as flood defence schemes, structures in or around river channels (e.g. bridges), buildings and other local influences, which might affect a coastal flood, have not been accounted for.

The maps were produced based on survey data captured prior to, and during the early part of the project. They do not account for changes in development, infrastructure or topography that occurred after the date of survey data capture.

The DTM is derived from airborne survey data. The majority of this data is Interferometric Synthetic Aperture Radar (IfSAR) data. Where Light Detection and Ranging (LiDAR) data was available, namely for some localised coastal areas in Sligo Bay, it was used in lieu of IfSAR data to derive the DTM.

Detailed explanations of the methods of derivation, survey data used, etc. are provided in the relevant reports produced for the project under which the maps were prepared. **Users of the maps should familiarise themselves fully with the contents of these reports in advance of the use of the maps.**

### *Flood Event Probabilities*

The maps refer to flood event probabilities in terms of a percentage Annual Exceedance Probability, or 'AEP'. This represents the probability of an event of this, or greater, severity occurring in any given year. These probabilities may also be expressed as odds (e.g., 100 to 1) of the event occurring in any given year. They are also commonly referred to in terms of a return period (e.g., the 100-year flood), although it should be understood that this does not mean the length of time that will elapse between two such events occurring, as, although unlikely, two very severe events may occur within a very short space of time.

Table 1 below sets out a range of flood event probabilities expressed in terms of AEP, and identifies their parallels under other forms of expression.

Table 1: Flood Event Probabilities

| Annual Exceedance Probability (%) | Odds of Occurrence in any Given Year | Return Period (yrs) |
|---|---|---|
| 50 | 2 : 1 | 2 |
| 20 | 5 : 1 | 5 |
| 10 | 10 : 1 | 10 |
| 5 | 20 : 1 | 20 |
| 2 | 50 : 1 | 50 |
| 1 | 100 : 1 | 100 |
| 0.5 | 200 : 1 | 200 |
| 0.2 | 500 : 1 | 500 |
| 0.1 | 1000 : 1 | 1000 |

***Uncertainty***

Although great care and modern, widely-accepted methods have been used to prepare the maps, there is a range of inherent uncertainties within the process of preparing the predicted flood extents maps. These include:

– Uncertainty in Flood Levels: This can arise due to uncertainties in topographic, bathymetric and other survey data, meteorological data, assumptions and / or approximations in the hydraulic / hydrodynamic models in representing physical reality, assumptions in the hydraulic / hydrodynamic modelling, and datum conversions, etc.

– Uncertainty in Flood Extents: This can arise due to uncertainties in flood levels, topographic and other survey data, assumptions and / or approximations in the way that flooding spreads over a floodplain, etc.

The flood maps are therefore only indicative, and the potential for inaccuracy should be recognised if these maps are to be used for any purpose. A detailed analysis of the confidence of flood extents has not been undertaken for the north west coastal region, but based on confidence analysis previously completed on the south coast it is likely that most of these flood extent maps would be classified as 'very low degree of confidence' (i.e. less than 40% confidence - see below). Therefore, for the purposes of these north west coast flood extents a very low confidence (less than 40%) may be assumed, at least for those flood extents not derived from LiDAR DTM data.

***Types of Flood Map***

There are various types of flood map available, as outlined below. Further details on each type of map, including the methods of derivation, assumptions made, data used, etc. are provided in the relevant project reports.

*Flood Extent Maps*

Flood extent maps contained in this volume show the predicted extents of flooding for flood events of two estimated probabilities of occurrence:

– 0.5% AEP flood event
– 0.1% AEP flood event

It should be noted that the flood extent maps indicate the predicted maximum extent of flooding (subject to limitations referred to herein), and flooding in some areas, such as near the edge of the flooded area, might be very shallow. The predicted depth of flooding is indicated on the Flood Depth Maps.

Due to the various uncertainties within the process of preparing the maps (see 'Uncertainty' above), it is not possible to state that the maps are absolutely accurate. An assessment of some of the principal sources of uncertainty has been undertaken for other coastal areas (north east, south east and south) to estimate the degree of confidence one may have in the mapped flood extent (refer to relevant project report for details and limitations of method used). The line type (solid, dashed, dotted etc) bounding the flood extent for each flood

event probability on the north east, south east and south coast extent maps provides an indication of the degree of confidence in those locations, whereby:

– A solid strikethrough line represents a very high degree of confidence, and it is estimated that, based on the confidence estimation method used, there is over 70% confidence in the location of the mapped flood extent line

– A solid line represents a high degree of confidence, and it is estimated that, based on the confidence estimation method used, there is a 60-70% confidence in the location of the mapped flood extent line

– A dashed line represents a medium degree of confidence, and it is estimated that, based on the confidence estimation method used, there is a 50-60% confidence in the location of the mapped flood extent line

– A dotted line represents a low degree of confidence, and it is estimated that, based on the confidence estimation method used, there is a 40-50% confidence in the location of the mapped flood extent line

– A dashed - dotted line represents a very low degree of confidence, and it is estimated that, based on the confidence estimation method used, there is below 40% confidence in the location of the mapped flood extent line.

*Flood Depth Maps*
The flood depth maps indicate the estimated depth of flooding at a given location, for a flood event of a particular probability (i.e. 0.5% AEP).

The flood depths are calculated by subtracting the DTM ground level, from the predicted water level. The flood depths are mapped as constant depths over grid squares, whereas in reality depths may vary within a given square.

The flood depth maps also show the limited extent of the LiDAR DTM used in the flood hazard and risk assessment, namely for some localised coastal areas in Sligo Bay.

### *Consideration of Projected Future Changes in Climate*
These flood maps have been produced for existing conditions only and do not currently include for projected future changes in climate.

### *Sources of Flooding Not Mapped*
The maps indicate only the extents and depths associated with flooding from coastal areas and the sea. There are however many other possible sources of flooding, such as fluvial flooding from rivers, surcharged urban drainage systems, ponding rainwater, groundwater, overtopping or breaching of water retaining structures (such as embankments and reservoirs), etc. Flooding from these other sources have not been mapped, and so areas that are not shown as being within a flood extent may therefore be at risk from flooding from one of these other sources.

## CONDITIONS OF USE

Please read the following statements and conditions of use of the maps in this bound volume carefully. Use of these maps is conditional upon the following:-

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## CONTACTS REGARDING MAP INFORMATION

Any user who has reason to believe that these maps contain an error, or who wishes to contribute additional information, is requested to contact the Office of Public Works
Engineering Services Section at the following address:

Flood Mapping Queries
Engineering Services
Office of Public Works
17-19 Lower Hatch Street
Dublin 2

# ICPSS PHASE V - NORTH WEST COAST

## Predicted Extreme Water Levels Associated with Combined Tide and Surge

| PREDICTION | ANNUAL EXCEEDANCE PROBABILITY (AEP) | | | | | | | | CO-ORDINATES OF PREDICTION POINTS | |
|---|---|---|---|---|---|---|---|---|---|---|
| POINT ID | 50% | 20% | 10% | 5% | 2% | 1% | 0.5% | 0.1% | EASTINGS | NORTHINGS |
| NW1 | 2.44 | 2.56 | 2.64 | 2.72 | 2.83 | 2.91 | 2.99 | 3.18 | 125831 | 331605 |
| NW2 | 2.45 | 2.57 | 2.66 | 2.74 | 2.85 | 2.94 | 3.02 | 3.22 | 130908 | 339542 |
| NW3 | 2.46 | 2.58 | 2.67 | 2.76 | 2.87 | 2.95 | 3.04 | 3.23 | 135922 | 339772 |
| NW4 | 2.48 | 2.60 | 2.69 | 2.78 | 2.90 | 2.98 | 3.07 | 3.27 | 145972 | 336000 |
| NW5 | 2.49 | 2.62 | 2.71 | 2.80 | 2.92 | 3.01 | 3.10 | 3.30 | 152125 | 336773 |
| NW6 | 2.50 | 2.64 | 2.73 | 2.82 | 2.94 | 3.03 | 3.12 | 3.33 | 159032 | 339205 |
| NW7 | 2.48 | 2.61 | 2.71 | 2.80 | 2.92 | 3.01 | 3.10 | 3.31 | 155154 | 345886 |
| NW8 | 2.49 | 2.63 | 2.72 | 2.81 | 2.94 | 3.03 | 3.12 | 3.33 | 159589 | 350666 |
| NW9 | 2.52 | 2.65 | 2.75 | 2.84 | 2.97 | 3.06 | 3.15 | 3.37 | 168255 | 354717 |
| NW10 | 2.54 | 2.68 | 2.78 | 2.88 | 3.00 | 3.10 | 3.20 | 3.42 | 173926 | 359134 |
| NW11 | 2.56 | 2.71 | 2.81 | 2.91 | 3.04 | 3.14 | 3.24 | 3.47 | 182560 | 362432 |
| NW12 | 2.58 | 2.74 | 2.85 | 2.95 | 3.09 | 3.20 | 3.30 | 3.55 | 185463 | 367885 |
| NW13 | 2.60 | 2.75 | 2.86 | 2.97 | 3.11 | 3.22 | 3.32 | 3.57 | 186025 | 372884 |
| NW14 | 2.58 | 2.73 | 2.84 | 2.94 | 3.08 | 3.18 | 3.29 | 3.53 | 179374 | 374134 |
| NW15 | 2.54 | 2.68 | 2.79 | 2.88 | 3.01 | 3.11 | 3.20 | 3.43 | 170964 | 372510 |
| NW16 | 2.51 | 2.65 | 2.74 | 2.84 | 2.96 | 3.05 | 3.14 | 3.35 | 159540 | 374267 |
| NW17 | 2.50 | 2.63 | 2.73 | 2.82 | 2.94 | 3.03 | 3.12 | 3.33 | 152268 | 377121 |
| NW18 | 2.42 | 2.55 | 2.65 | 2.74 | 2.86 | 2.95 | 3.03 | 3.24 | 147706 | 384631 |
| NW19 | 2.43 | 2.57 | 2.66 | 2.75 | 2.87 | 2.96 | 3.05 | 3.25 | 151729 | 390238 |
| NW20 | 2.46 | 2.59 | 2.68 | 2.77 | 2.89 | 2.99 | 3.08 | 3.29 | 156227 | 392445 |
| NW21 | 2.48 | 2.62 | 2.72 | 2.81 | 2.93 | 3.03 | 3.12 | 3.34 | 163891 | 393268 |
| NW22 | 2.49 | 2.62 | 2.71 | 2.80 | 2.92 | 3.01 | 3.10 | 3.30 | 165999 | 399708 |
| NW23 | 2.58 | 2.72 | 2.83 | 2.93 | 3.06 | 3.16 | 3.25 | 3.48 | 173346 | 403667 |
| NW24 | 2.50 | 2.64 | 2.73 | 2.83 | 2.95 | 3.04 | 3.13 | 3.35 | 167805 | 409715 |
| NW25 | 2.47 | 2.60 | 2.69 | 2.78 | 2.90 | 2.98 | 3.07 | 3.28 | 163570 | 417095 |
| NW26 | 2.49 | 2.62 | 2.71 | 2.80 | 2.92 | 3.01 | 3.09 | 3.30 | 169981 | 418717 |
| NW27 | 2.51 | 2.64 | 2.74 | 2.83 | 2.95 | 3.04 | 3.13 | 3.34 | 174484 | 423143 |
| NW28 | 2.53 | 2.66 | 2.76 | 2.85 | 2.97 | 3.06 | 3.15 | 3.36 | 177574 | 427412 |
| NW29 | 2.54 | 2.68 | 2.77 | 2.87 | 2.99 | 3.08 | 3.17 | 3.38 | 179633 | 431021 |
| NW30 | 2.57 | 2.70 | 2.79 | 2.88 | 2.99 | 3.08 | 3.16 | 3.36 | 185068 | 434784 |
| NW31 | 2.51 | 2.64 | 2.72 | 2.81 | 2.92 | 3.01 | 3.09 | 3.29 | 183461 | 448039 |
| NW32 | 2.60 | 2.74 | 2.84 | 2.93 | 3.05 | 3.15 | 3.24 | 3.46 | 189339 | 434772 |
| NW33 | 2.61 | 2.74 | 2.83 | 2.92 | 3.03 | 3.12 | 3.21 | 3.41 | 194696 | 437212 |
| NW34 | 2.64 | 2.77 | 2.86 | 2.95 | 3.07 | 3.16 | 3.25 | 3.46 | 200048 | 441439 |
| NW35 | 2.65 | 2.79 | 2.88 | 2.97 | 3.09 | 3.18 | 3.27 | 3.48 | 206415 | 439551 |
| NW36 | 2.72 | 2.85 | 2.94 | 3.04 | 3.16 | 3.25 | 3.34 | 3.55 | 209605 | 436774 |
| NW37 | 2.66 | 2.80 | 2.89 | 2.99 | 3.11 | 3.20 | 3.29 | 3.51 | 209718 | 443342 |
| NW38 | 2.67 | 2.80 | 2.89 | 2.98 | 3.10 | 3.19 | 3.27 | 3.48 | 214549 | 444580 |
| NW39 | 2.67 | 2.80 | 2.90 | 2.99 | 3.11 | 3.20 | 3.29 | 3.49 | 219115 | 447604 |
| NW40 | 2.69 | 2.83 | 2.92 | 3.01 | 3.13 | 3.22 | 3.31 | 3.51 | 224398 | 446182 |
| NW41 | 2.81 | 2.94 | 3.04 | 3.13 | 3.25 | 3.34 | 3.43 | 3.64 | 224882 | 439282 |
| NW42 | 2.93 | 3.06 | 3.15 | 3.23 | 3.35 | 3.43 | 3.52 | 3.71 | 231332 | 427633 |
| NW43 | 2.89 | 3.03 | 3.12 | 3.21 | 3.33 | 3.42 | 3.51 | 3.72 | 230002 | 435417 |
| NW44 | 2.72 | 2.86 | 2.95 | 3.05 | 3.17 | 3.26 | 3.35 | 3.56 | 229310 | 443762 |
| NW45 | 2.68 | 2.81 | 2.91 | 3.00 | 3.13 | 3.22 | 3.31 | 3.52 | 234086 | 451368 |
| NW46 | 2.70 | 2.85 | 2.95 | 3.06 | 3.19 | 3.29 | 3.39 | 3.63 | 241922 | 452568 |
| NW47 | 2.46 | 2.59 | 2.68 | 2.77 | 2.88 | 2.97 | 3.06 | 3.26 | 239334 | 461098 |
| NW48 | 2.29 | 2.42 | 2.51 | 2.60 | 2.72 | 2.81 | 2.90 | 3.11 | 248236 | 458402 |
| NW49 | 2.13 | 2.26 | 2.36 | 2.45 | 2.57 | 2.66 | 2.75 | 2.96 | 253679 | 454011 |
| NW50 | 2.09 | 2.23 | 2.32 | 2.42 | 2.54 | 2.63 | 2.73 | 2.94 | 257848 | 450724 |
| NW51 | 1.97 | 2.11 | 2.21 | 2.30 | 2.43 | 2.52 | 2.61 | 2.83 | 263612 | 447462 |
| NW52 | 1.83 | 1.97 | 2.07 | 2.16 | 2.28 | 2.37 | 2.47 | 2.68 | 269403 | 443095 |

**Notes**

**1 - All water levels shown are in metres and referenced to Ordnance Datum Malin**

**2 - All co-ordinates shown are in Irish Grid (TM65)**

**3 - AEP denotes Annual Exceedance Probability**

| | | | |
|---|---|---|---|
| Prepared By: | RPS | Date: | June 2011 |
| Checked By: | JMC | Date: | June 2011 |
| Table No.: NW/WL/1 | | Revision: | 2 |

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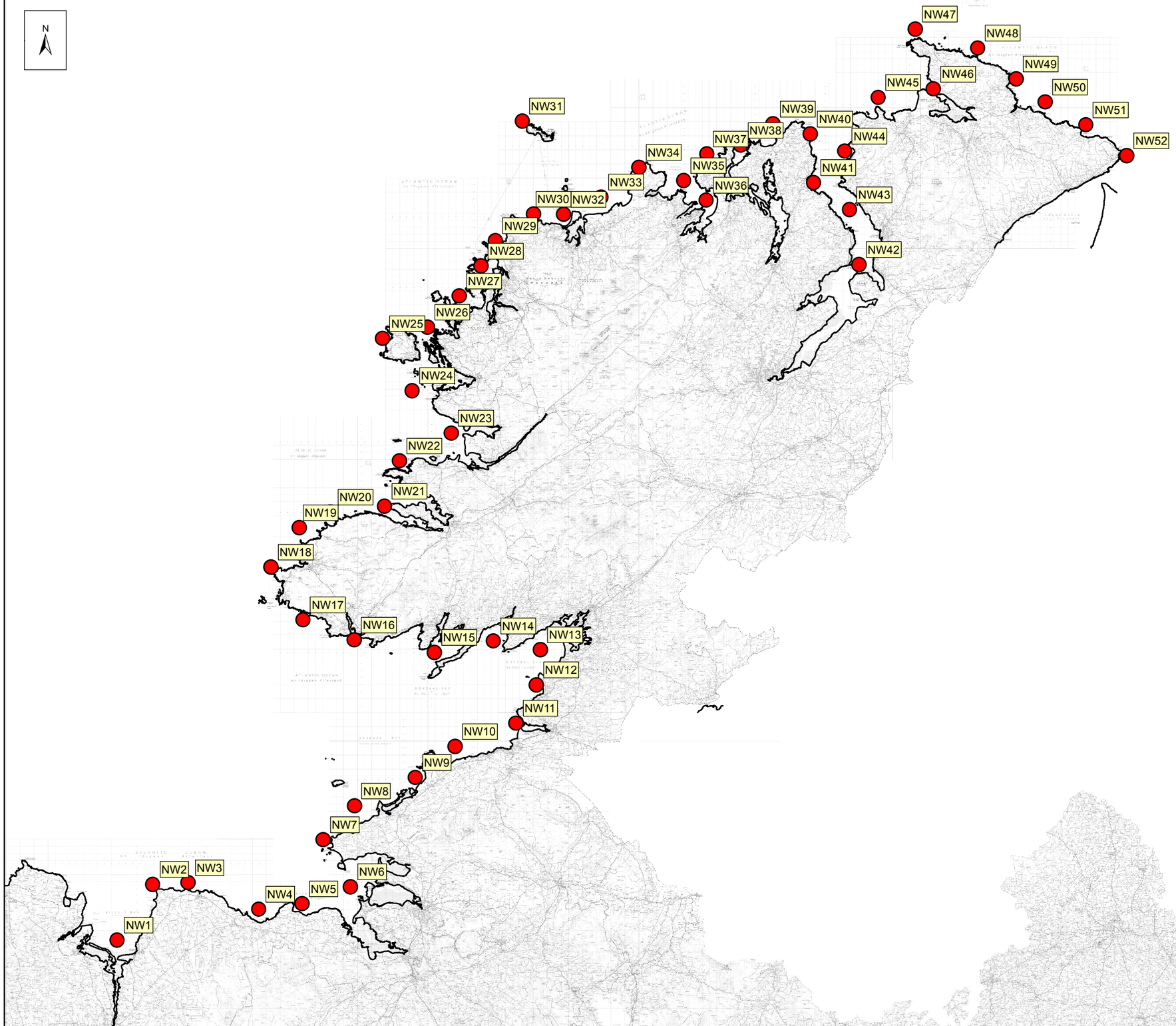
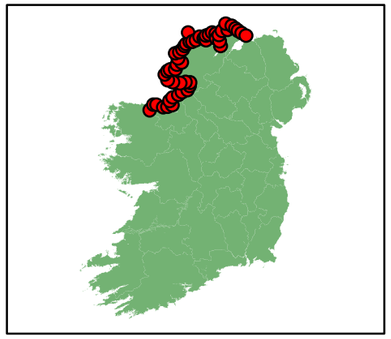



5 2.5 0 5 10 15 20 25 30 35 40 45 50 Kilometers

Location Plan :



**PREDICTION POINT ID**

Legend:

- Denotes Prediction Point
- Denotes High Water Mark (HWM)
- NW 18 — Denotes North West Prediction Point No. 18 (REFER TO TABLE NW/WL/1)

USER NOTE :

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Project :
IRISH COASTAL PROTECTION STRATEGY STUDY - PHASE V

Map :
NORTH WEST COAST -
EXTREME WATER LEVEL PREDICTION POINTS

| | | |
|---|---|---|
| Map Type : | PREDICTION POINT ID | |
| Source : | COMBINED TIDE & SURGE LEVELS | |
| Map area : | INDEX SHEET | |
| Scenario : | CURRENT | |
| Figure By : | EL | Date : November 2013 |
| Checked By : | JMC | Date : November 2013 |

Figure No. :
NW / POINT ID/ 1

Drawing Scale : 1:550,000 Plot Scale : 1:1 @ A3