Coastal & Offshore Modelling Symposium
COMS2026
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Cork, Ireland

Developing a flood relief scheme for Galway City - The *Coirib go Cósta* Project

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Arup

Coirib go Cósta
Scéim Faoisimh Tuilte Chathair na Gaillimhe
Galway City Flood Relief Scheme

Historic Record

- Long history of Coastal Flooding in Galway
- Recent Significant Events:
  - *Storm Éowyn (Jan 2025)*
  - *Storm Debi (Nov 2023)*
  - *Storm Eleanor (Jan 2018)*

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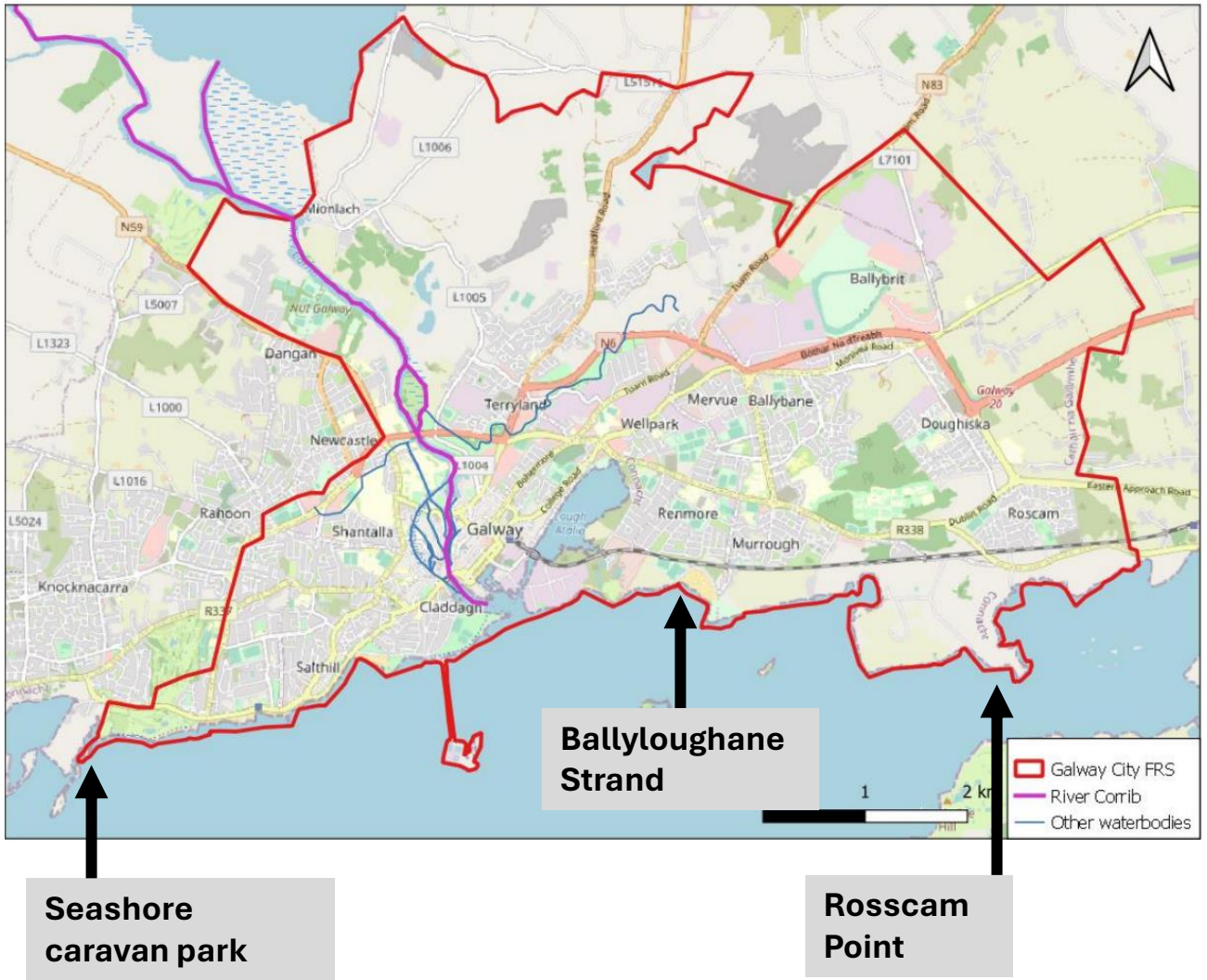
Galway City Flood Relief Scheme

The Coirib go Cósta project

- Arup was commissioned by Galway City Council to develop a Flood Relief Scheme for Galway City
- Scheme will consist of flood alleviation measures to protect against:
  - *Fluvial flooding - 1% AEP SoP*
  - *Coastal (Tidal and WOT) - 0.5% AEP SoP*
- Scheme is being funded through the €1.2 Billion allocated to Flood Relief Infrastructure as part of the National Development Plan 2021 - 2030



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Coastal Boundary Definition

- EVA of Tidal Water Levels
- WOT Assessment

Hydraulic Modelling

- Coastal floodplain model (2D only)

Flood Risk Mapping

- Maximum flood extent maps

Optioneering

- Initial Screening Assessment
- Defense types and alignments optioneering

Emerging Preferred Option for Galway

- To be presented before the Summer
- Further detailed assessment to follow before submission of the planning application

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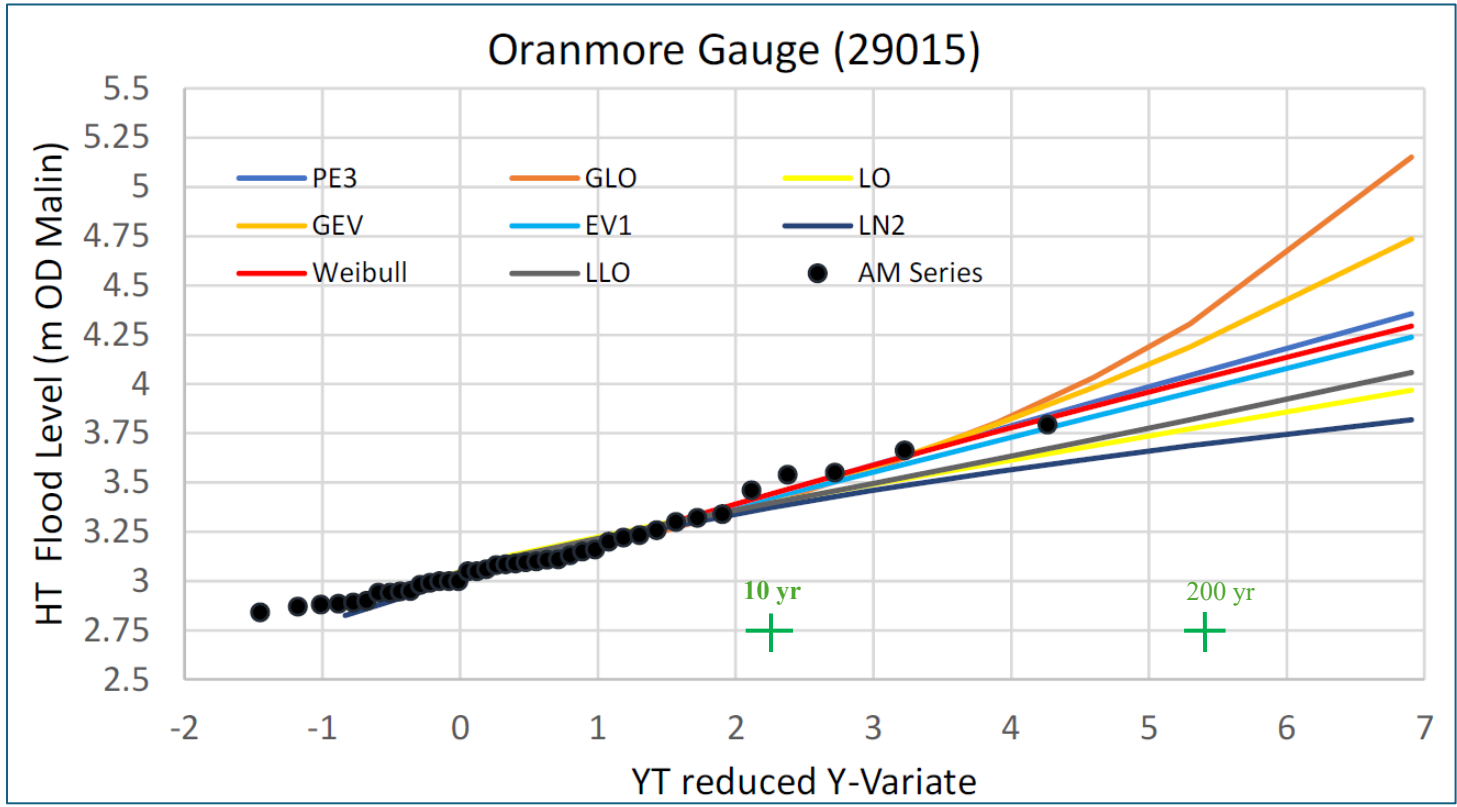
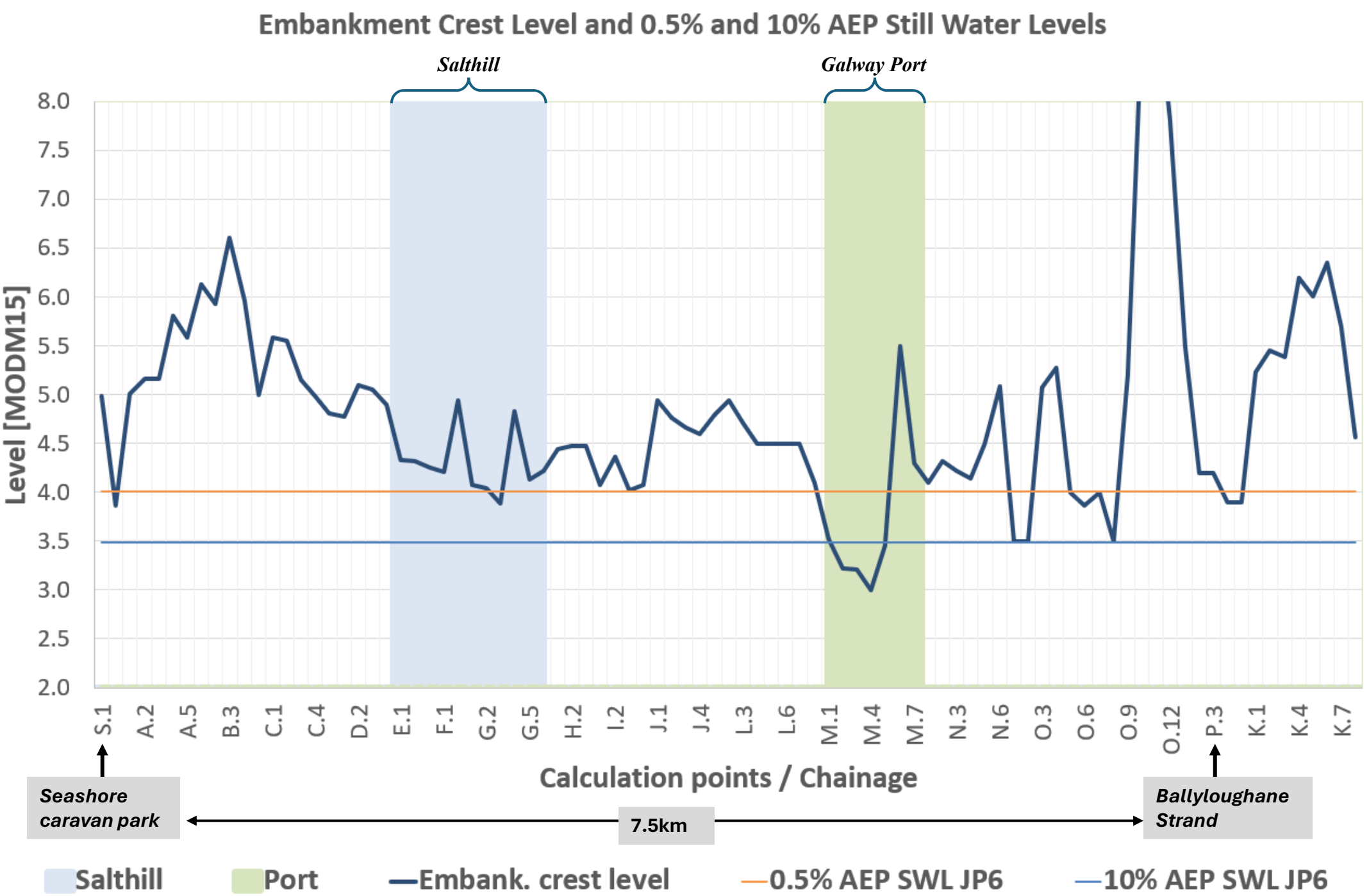
Estimating Design Tidal Water Levels

- EVA of the Amax timeseries at 3 gauges:
  - *Oranmore (40+ years)*
  - *Galway Port (15+ years)*
  - *Wolfe Tone Bridge (30+ years)*
- Variety of statistical distributions were fitted to the Amax series by the method of L-moments.
- 2-parameter EV1 distribution adopted
- Levels validated against findings of the **Galway City Coastal Wave & Water Level Modelling Study** 2020 (CWWS)
- Tidal curve fitted to the peaks to generate a tidal time series



Return Period years	Gauged Oranmore HT mOD Malin OGSM15	ICWWS W6 HT mOD Malin OGSM15
2	3.09	3.29
5	3.29	3.44
10	3.42	3.55
20	3.55	3.66
50	3.71	3.80
100	3.83	3.90
200	3.96	4.01
1000	4.24	4.26


Embankment Crest Level and 0.5% and 10% AEP Still Water Levels
Salthill
Galway Port
Level [MODM15]
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
S.1
A.2
A.5
B.3
C.1
C.4
D.2
E.1
F.1
G.2
G.5
H.2
I.2
J.1
J.4
L.3
L.6
M.1
M.4
M.7
N.3
N.6
O.3
O.6
O.9
O.12
P.3
K.1
K.4
K.7
Calculation points / Chainage
Seashore caravan park
7.5km
Ballyloughane Strand
Salthill
Port
Embank. crest level
0.5% AEP SWL JP6
10% AEP SWL JP6

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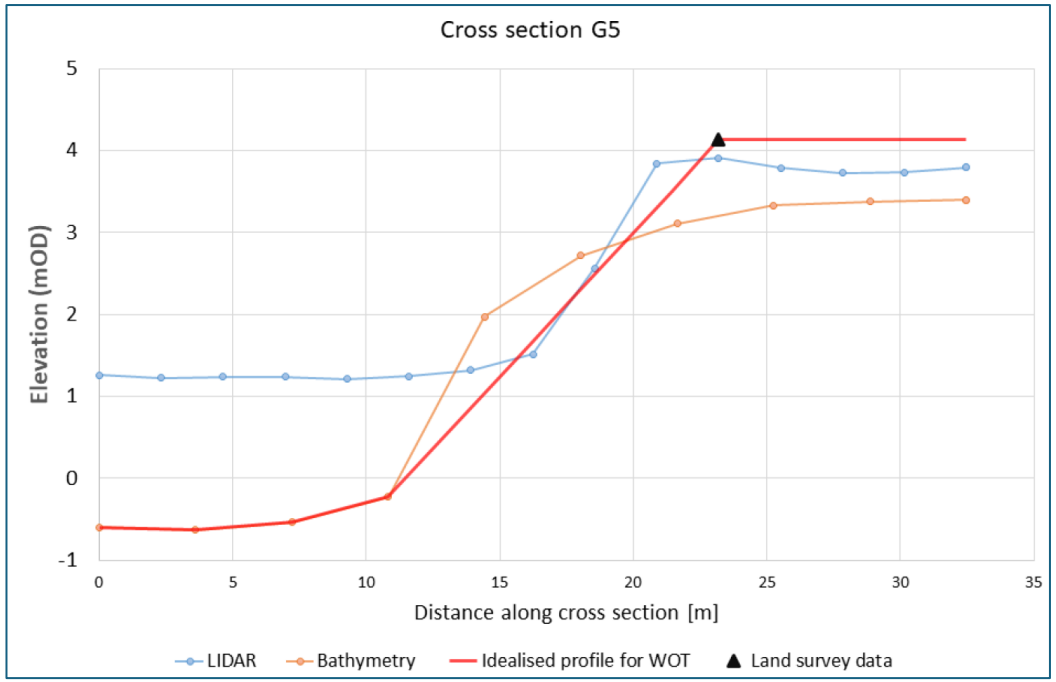
Galway City Flood Relief Scheme

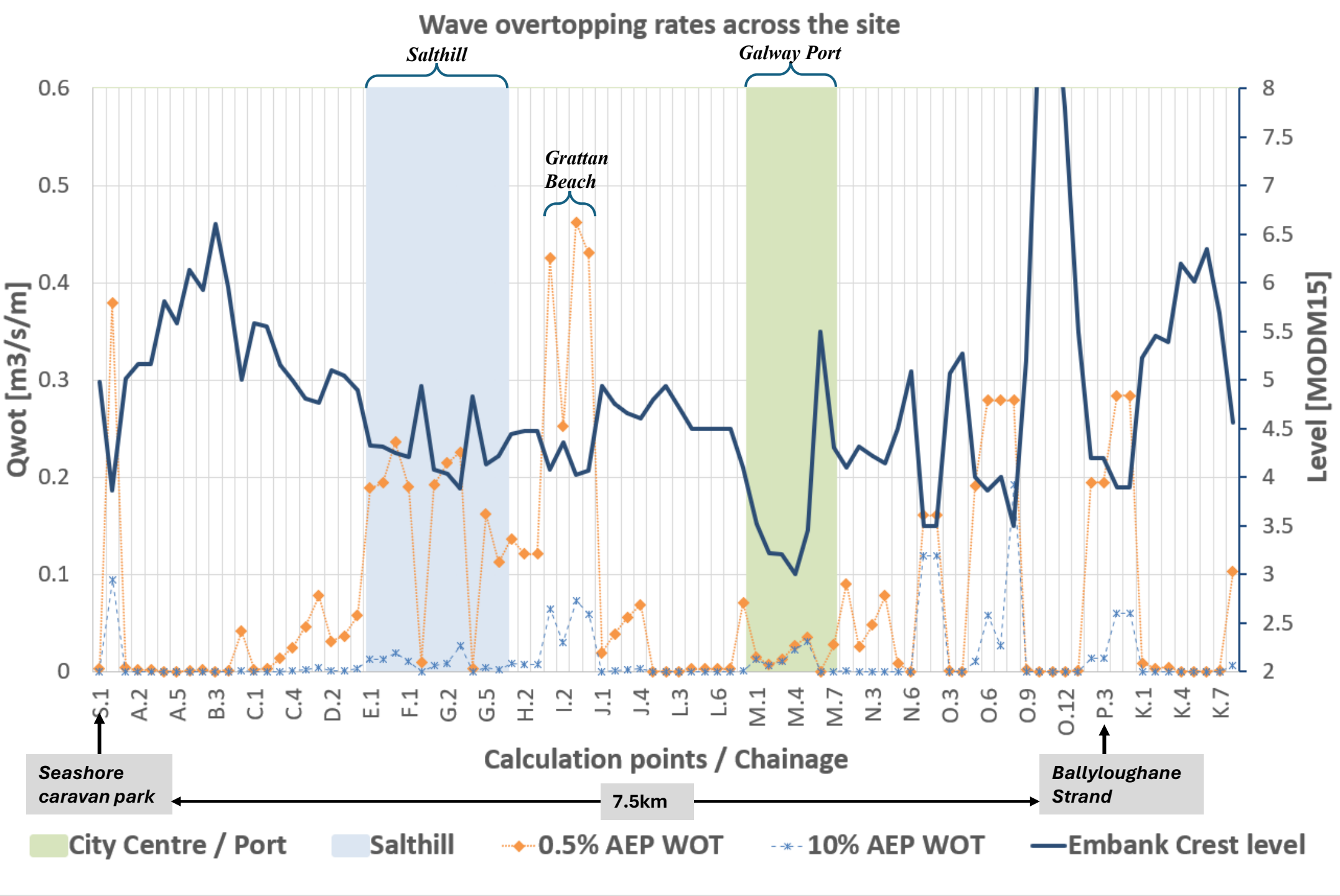
Wave Overtopping Analysis

Three separate methods considered:

- ***Eurotop*** *Artificial Neural Network (ANN)*
- ***Eurotop*** *Empirical Equations (EE)*
- ***Bayonet*** *GPE Overtopping*

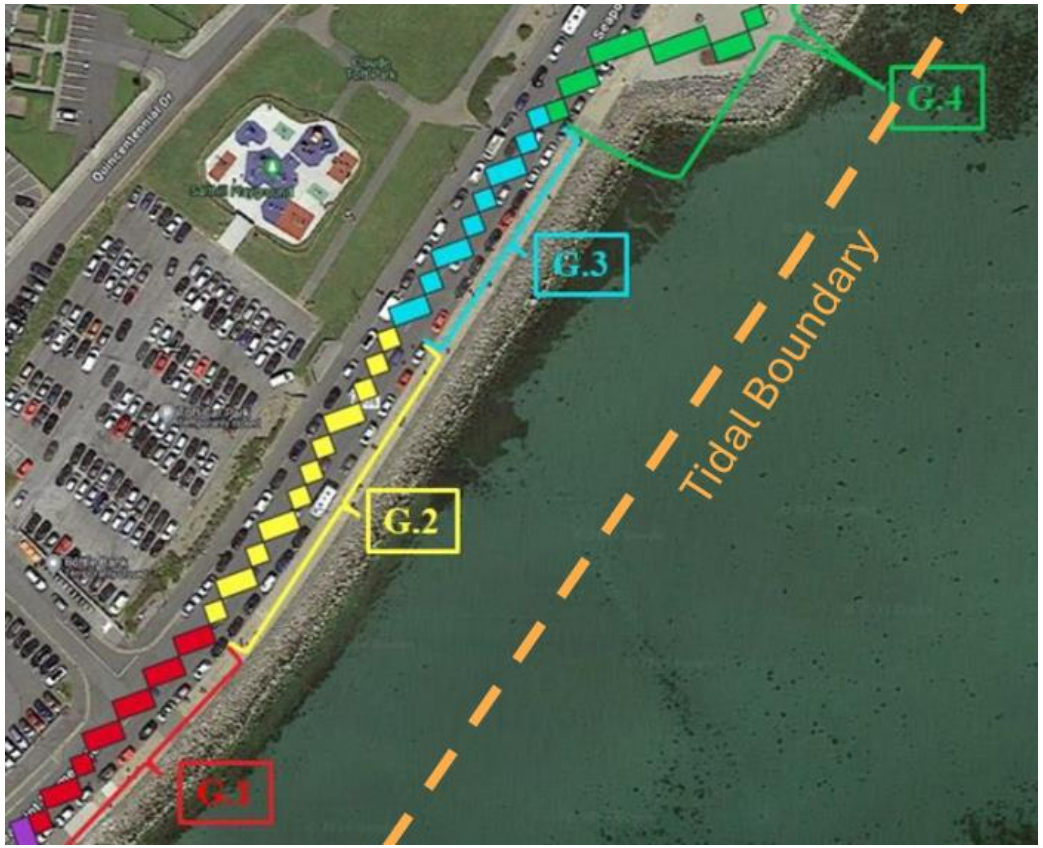
- Approach:
  - Define the WOT calc points (89 pts across 7.5km)
  - Construct an idealised profile geometry at each pt
  - Apply Wave Climate data at each pt (CWWS)
  - Python scripting:
    - *assembles all the input data,*
    - *perform the calculations*
    - *writes the WOT hydrograph results to excel*

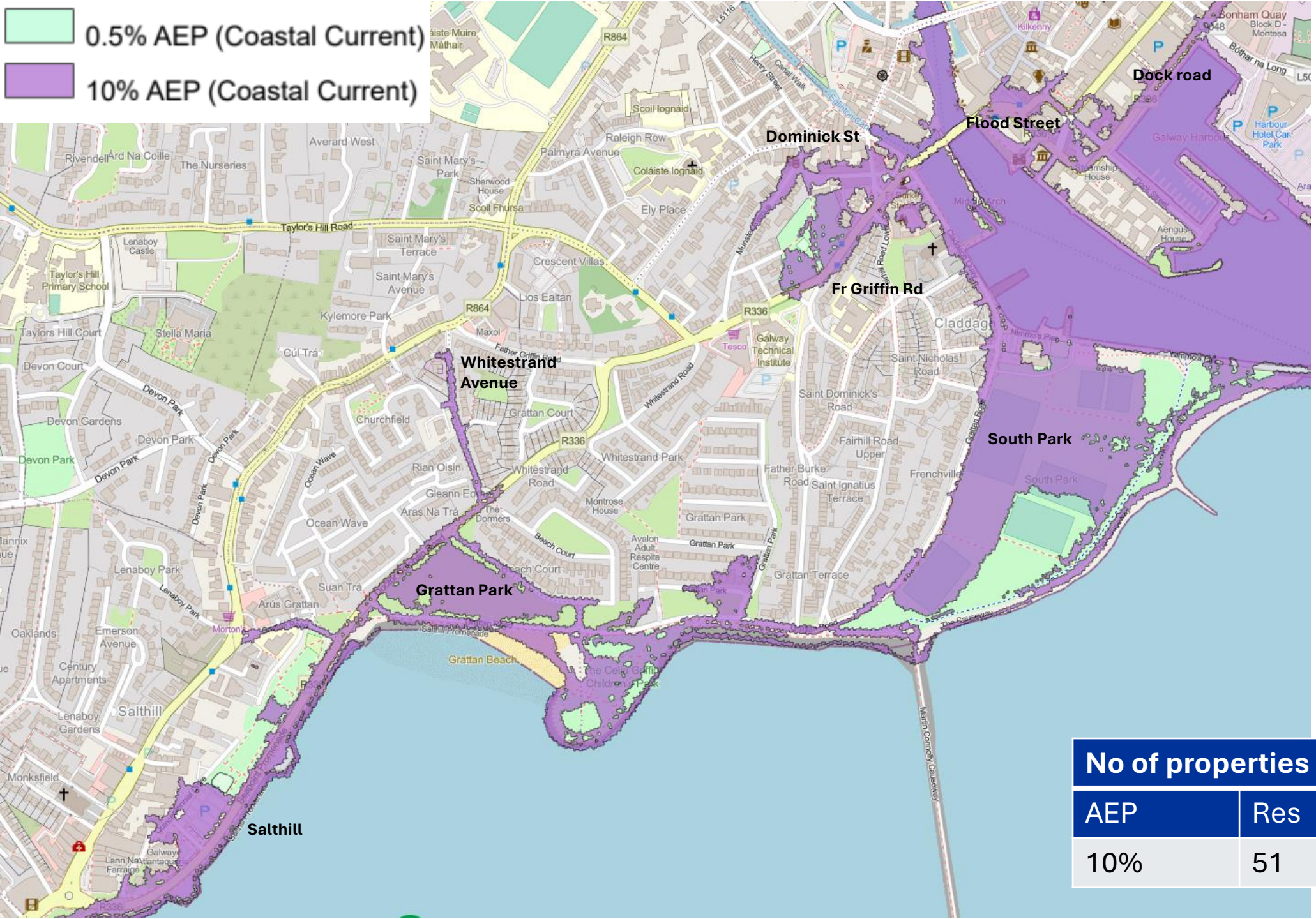



Wave overtopping rates across the site
Salthill
Galway Port
Grattan Beach
Qwot [m3/s/m]
Level [MODM15]
0.6
0.5
0.4
0.3
0.2
0.1
0
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
S.1
A.2
A.5
B.3
C.1
C.4
D.2
E.1
F.1
G.2
G.5
H.2
I.2
J.1
J.4
L.3
L.6
M.1
M.4
M.7
N.3
N.6
O.3
O.6
O.9
O.12
P.3
K.1
K.4
K.7
Calculation points / Chainage
Seashore caravan park
7.5km
Ballyloughane Strand
City Centre / Port
Salthill
0.5% AEP WOT
10% AEP WOT
Embank Crest level

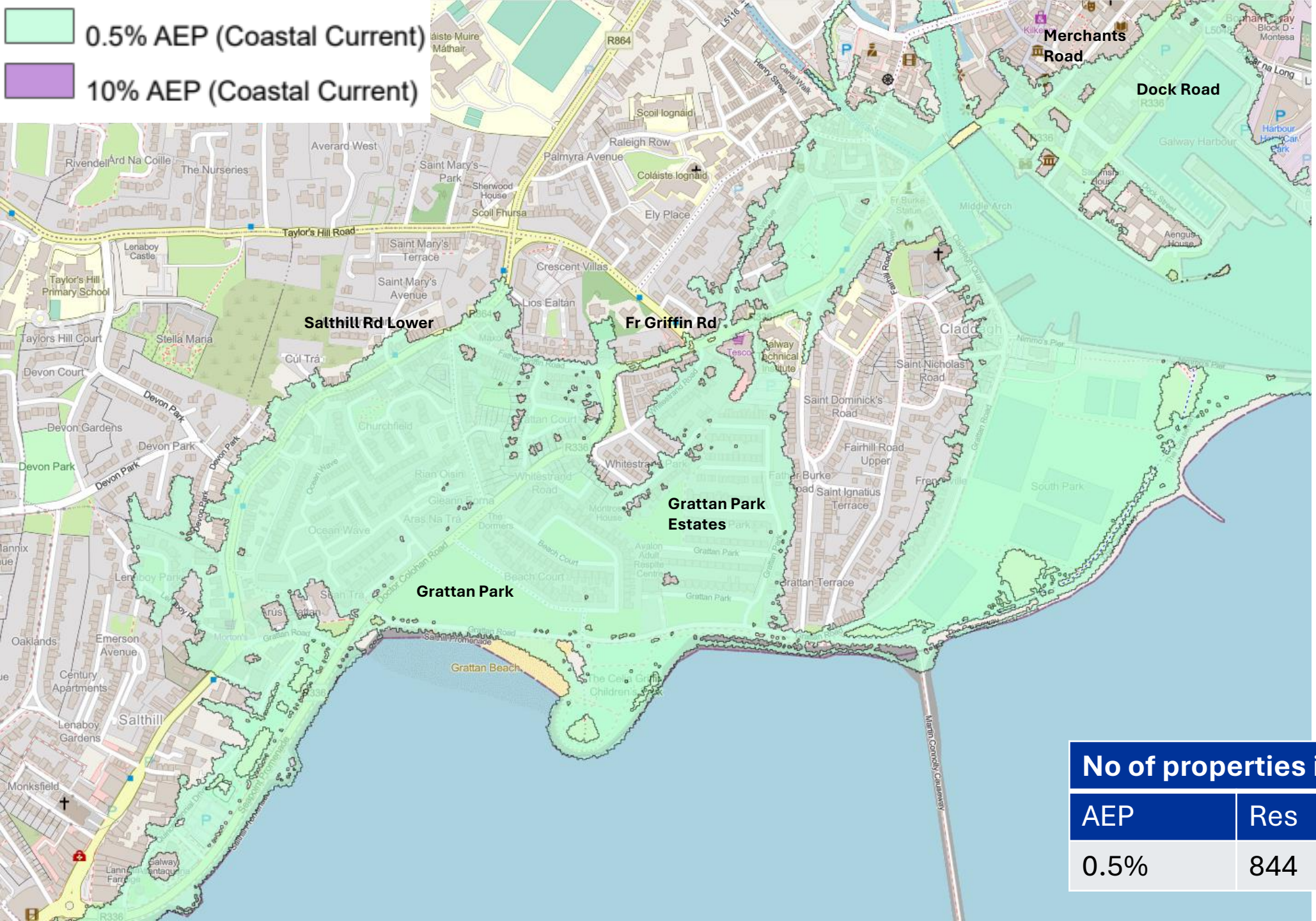
Hydraulic modelling

- Coastal floodplain nested grid model developed in Tuflow HPC (4m and 2m grids)
- WOT boundary:
  - *WOT flow estimated for a single point (m3/s/m)*
  - *Deemed to be representative for a length with similar geometry*
- Tidal boundary applied separately





No of properties inundated (10 yr)			
AEP	Res	Comm	Total
10%	51	37	**88**



No of properties inundated (200 yr)			
AEP	Res	Comm	Total
0.5%	844	235	**1079**

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Galway City Flood Relief Scheme

Requirements of the Flood Scheme for Galway:

- *Technically viable scheme to the required SoP*
- *Engineering solutions need to be sensitive to (1) the rich **cultural heritage** of the existing streetscape, and (2) the high **social amenity value** of the coastal areas*
- *Residual risks with **allowable WOT** to be manageable*
- *Cost-effective*
- *Environmentally sustainable (Galway Bay: **SAC, SPA)***
- *Adaptable to climate change and/or assumptive allowance*
- *Integration with other infrastructure projects*

Optioneering Process:

- *Initial screening assessment*
- *Assessment of technically viable options*
- *Public/Stakeholder engagement, MCA, CBA, CCAP*
- *Emerging Preferred Option*
- *EIAR and Planning Application*

Initial Screening Assessment

Measures considered	Outcome
Direct Defenses Walls and/or Embankments Flood gates / demountables	**Viable** Brought Forward for Further Technical Assessment
Conveyance Improvements Channel deepening/widening & Dredging	**Not Viable** No impact on the design tidal water level or WOT volumes
Coastal Defense Structures (Large scale) Tidal Barrier Tidal Barrage Offshore Breakwaters	**Not Viable** - Hugely significant costs - Significant environmental Impact on an SAC, SPA - IROPI exemption not applicable - Breakwater not viable against tidal flood risk
Nature Based Solutions Fluvial & Coastal	- **Viable:** Climate Change adaption measure for the upstream catchment - **Not viable in isolation:** The *Living Lab NBS* approach adopted by GCC and community groups for Grattan Beach
Salmon Weir Barrage gate operation modification	**Not Viable** - Limited impact on the fluvial risk - May be considered for climate change adaptation

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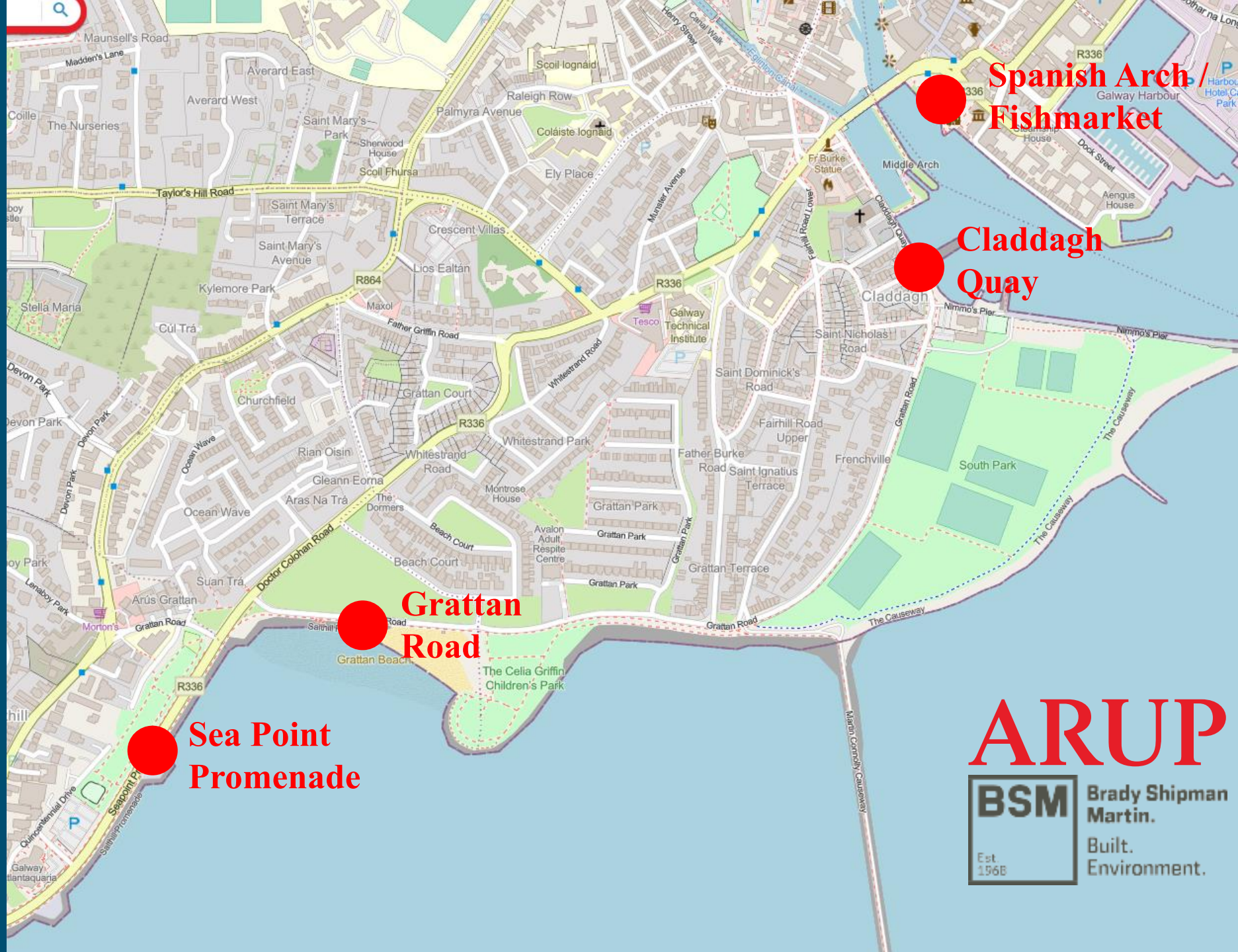
Flood Cells

Areas

- Upper Salthill – from Caravan Park to Salthill car park
- Salthill – Seapoint Promenade
- Salthill – Grattan Road
- South Park and Nimmo's Pier
- Claddagh Quay and Raven Terrace
- City Centre
  - Eglinton Canal
  - Fishmarket / Spanish Arch
  - Long Walk
  - Docks area
  - Lough Atalia
- Menlo
- Terryland
- Rowing and Yacht Club
- Harbour Enterprise Park
- Ballyloughane Beach



Example area

Options for Spanish Arch / Fishmarket area

Option 1 - Rear Wall

Option 2 - Demountable Defences

Option 3 - River Steps

Option 4 - Quay Wall

Option 1 - Rear Wall

Option 2 - Demountable Defences

Option 3 - River Steps

Option 4 - Quay Wall

Example area

Seapoint Promenade

Option 1 - Sea-side Wall, Road and Promenade Raising

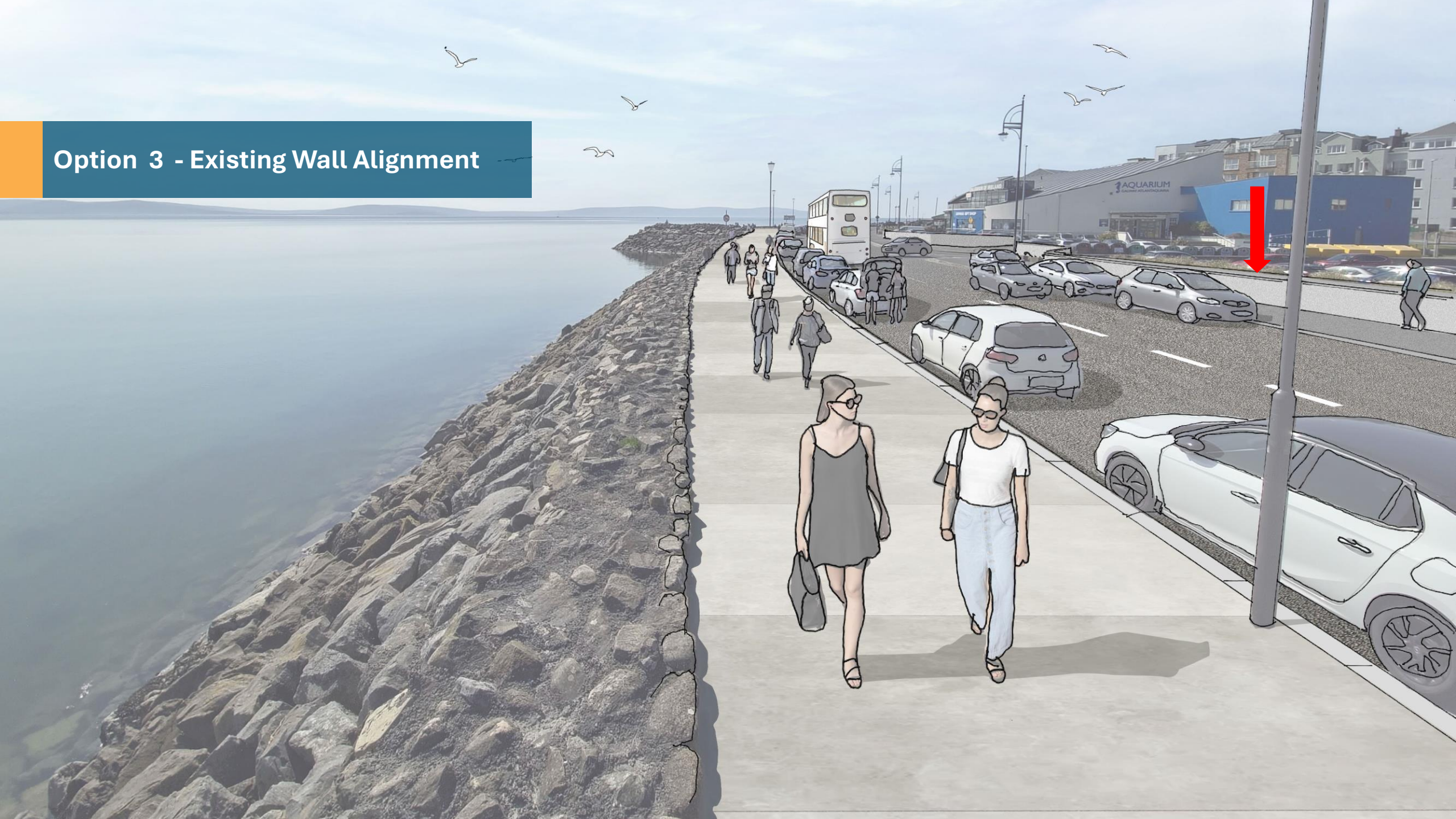
Option 2 - Promenade Raising with Wall at Back of Promenade

Option 3 - Existing Wall Alignment

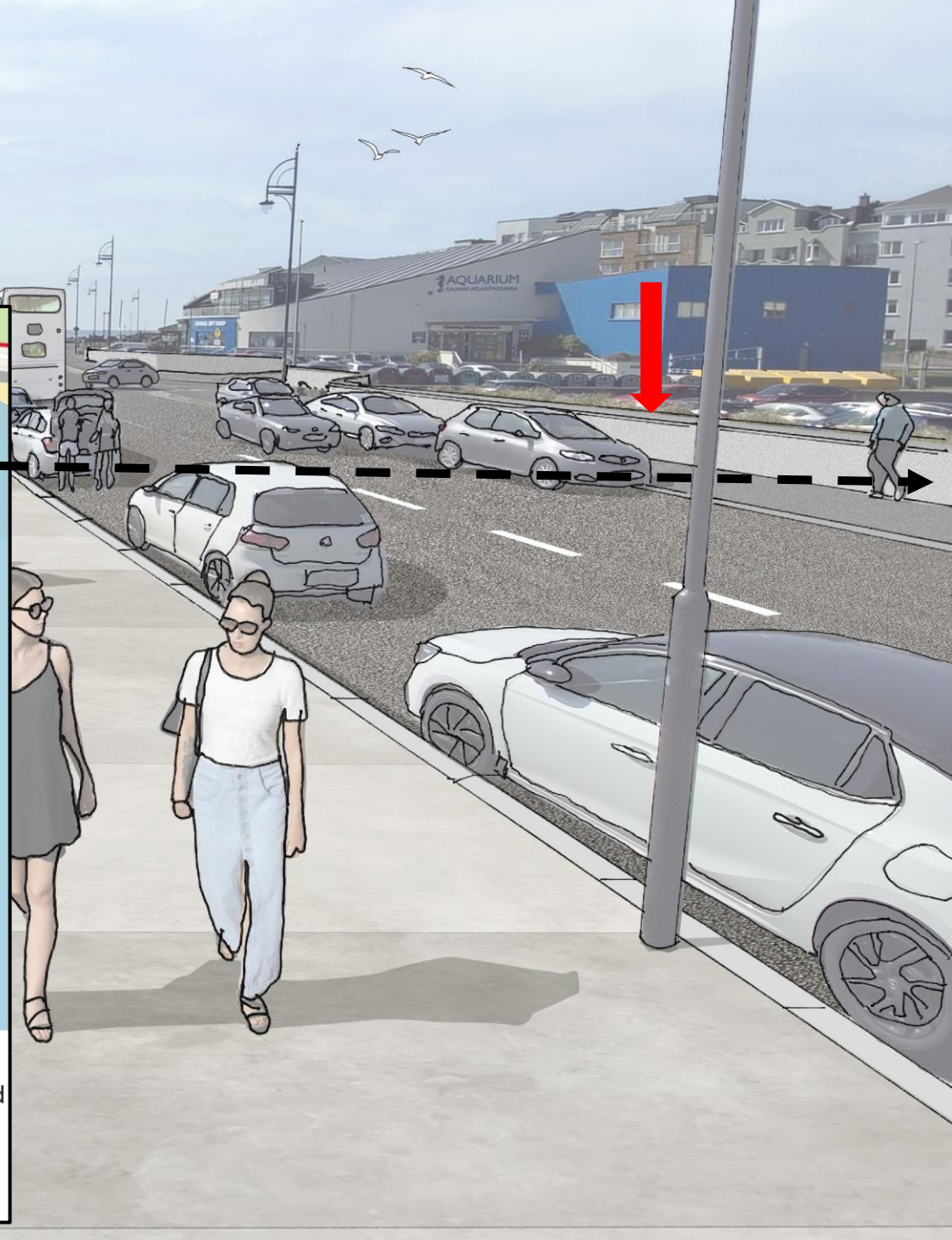
Option 1 - Sea-side Wall, Road and Promenade Raising

Option 2 - Promenade Raising with Wall at Back of Promenade

Option 3 - Existing Wall Alignment



Option 3 - Existing Wall Alignment



Example area

Grattan Road

Option 1 - Sea Side Wall

Option 2 - Road Raising

Option 3 - Backside Wall

Option 1 - Sea Side Wall

Option 2 - Road Raising

Option 3 - *Backside Wall*

Example area

Claddagh Quay

Option 1 - Quay side wall

Option 2 - Set back wall and one way traffic

Option 3 - Set back wall and two way traffic

Option 1 - Quay side wall

Option 2 - Set back wall and one way traffic

Option 3 - Set back wall and two way traffic

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Developing the Emerging Preferred Option

- Emerging preferred option is presently being developed from the various technically viable options presented in June 2025
- The design is informed by:
  - *Public/stakeholder feedback from the consultation*
  - *Multi Criteria Analysis on the various options*
  - *Heritage, Environmental, and Social Amenity constraints*
  - *Managing the residual risk of "allowable" WOT flooding*
  - *Traffic Impact assessment*
  - *Climate Change adaptability*
  - *Long term maintenance and operation*
- Preferred Option to be presented before the Summer

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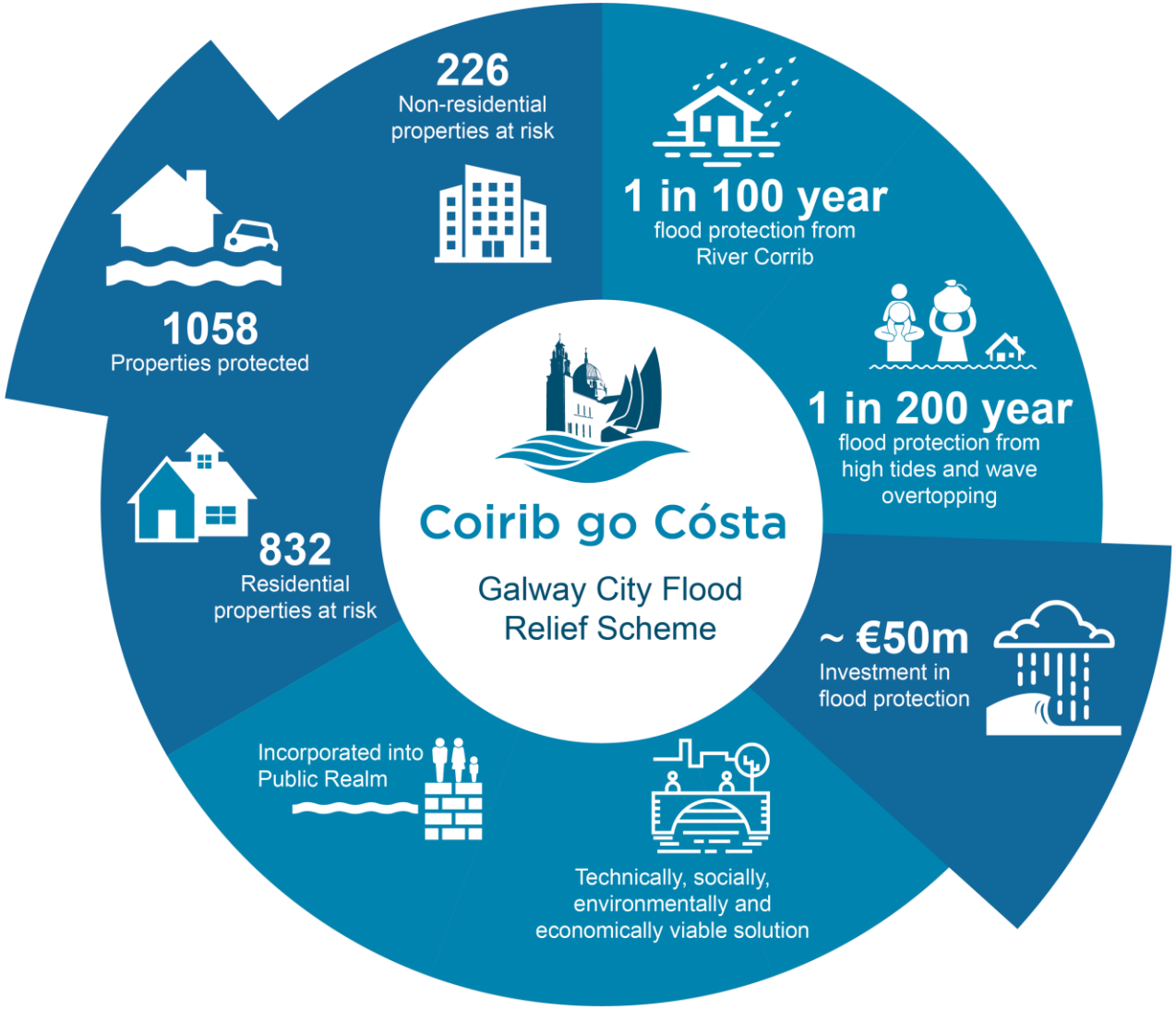
Benefits of the Scheme

- **800+ homes** and **220+ businesses** defended
- **Protection** of a significant number of **heritage assets** from future flooding
- **Improved public realm spaces,** e.g. Spanish Arch area in collaboration with Galway City Council
- **Climate change allowance** included upfront in wall heights



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Outline Delivery Programme

Stage	Description	Key dates
Stage 1 – Development of flood defence options and identification of a Preferred Flood Relief Scheme	Review available data. Identify constraints. Collect additional data required to inform the scheme development. Hydrological study and Hydraulic modelling to inform flood extent mapping. Preliminary assessment of nature-based opportunities.	Complete
	Development of viable flood defence options. Identification of the Preferred Scheme Option to provide flood defence for Galway city. Non-statutory public engagement processes. Ground Investigation across the scheme area.	Ongoing
	Completion of required reports to progress the Preferred Scheme to Stage 2	Commence in Q2 2026
Stage 2 – Planning Consent Process	Planning Consent design and preparation (NIS/EIAR/AA)	Commence in Q1 2027
	Planning Consent Submission	Q4 2028
Stage 3	Detailed Design and Tender	Commence in 2029
Stages 4 and 5	Construction and Handover of the Scheme	Commence in 2030

Thank you