Stonehaven Bay Coastal Flood Protection Study

JBA Consulting

7 November 2018

Introduction

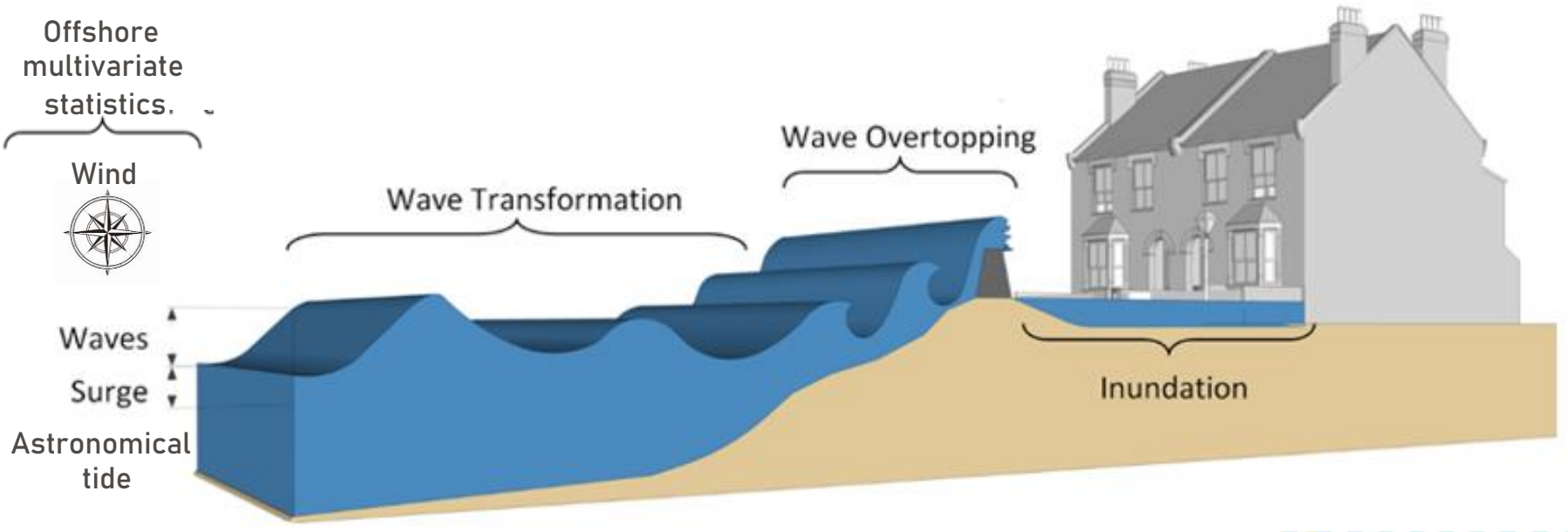
- Coastal flood and erosion protection scheme for Stonehaven and Cowie

Project timeline

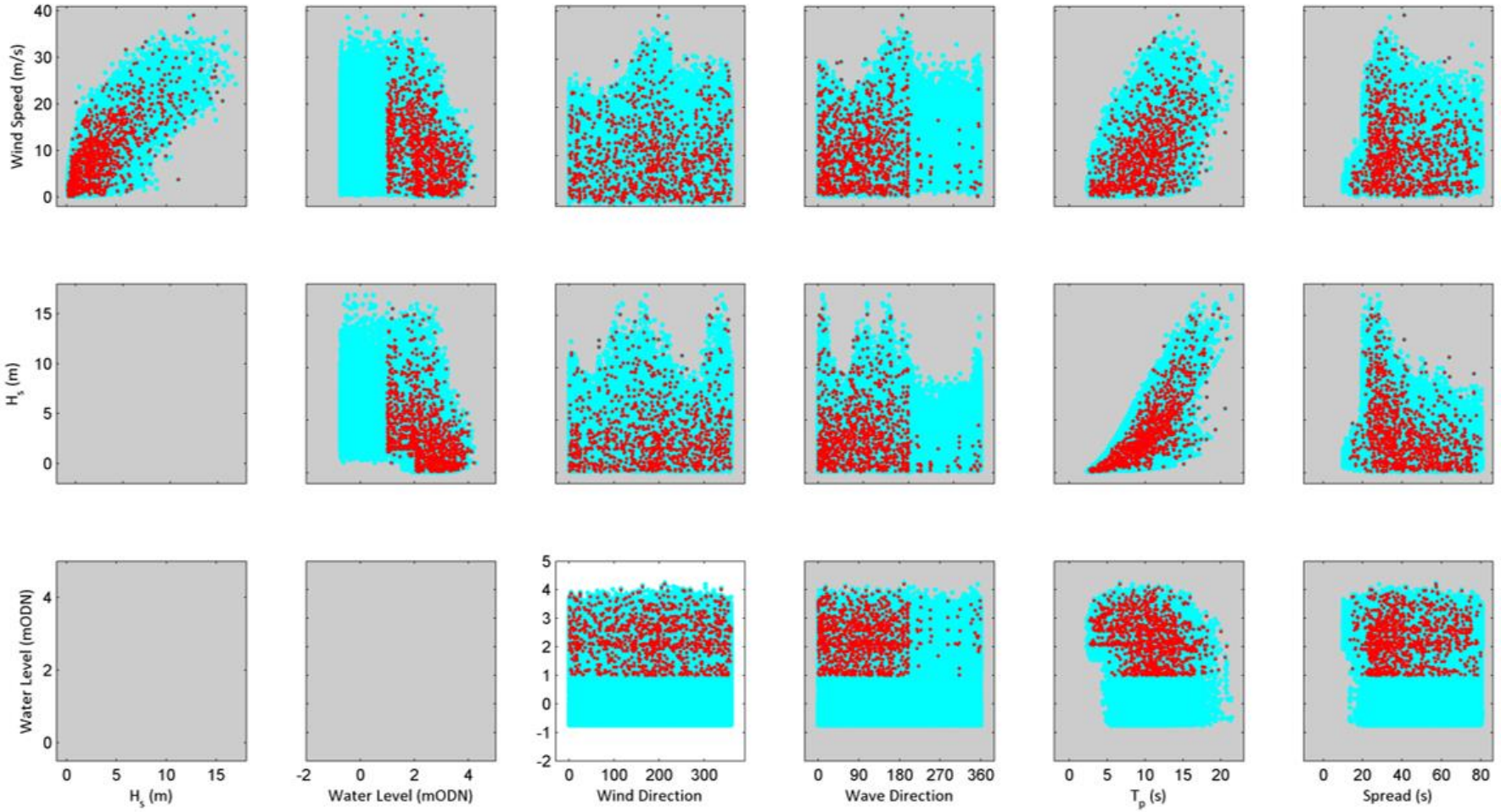
Information review report	Complete
Topographic and structural surveys	Complete
Baseline ecology/environmental, geotechnical, natural flood management, river basin management plan, landscape and built heritage studies	Complete
Flood and erosion modelling with baseline economic analysis	Discussed today!
Long list of options and multi-criteria analysis	Winter 2018
Public engagement – short list of options	Winter 2018
Options appraisal	Winter/Spring 2019
Public engagement – preferred option	Spring/Summer 2019

Flood modelling

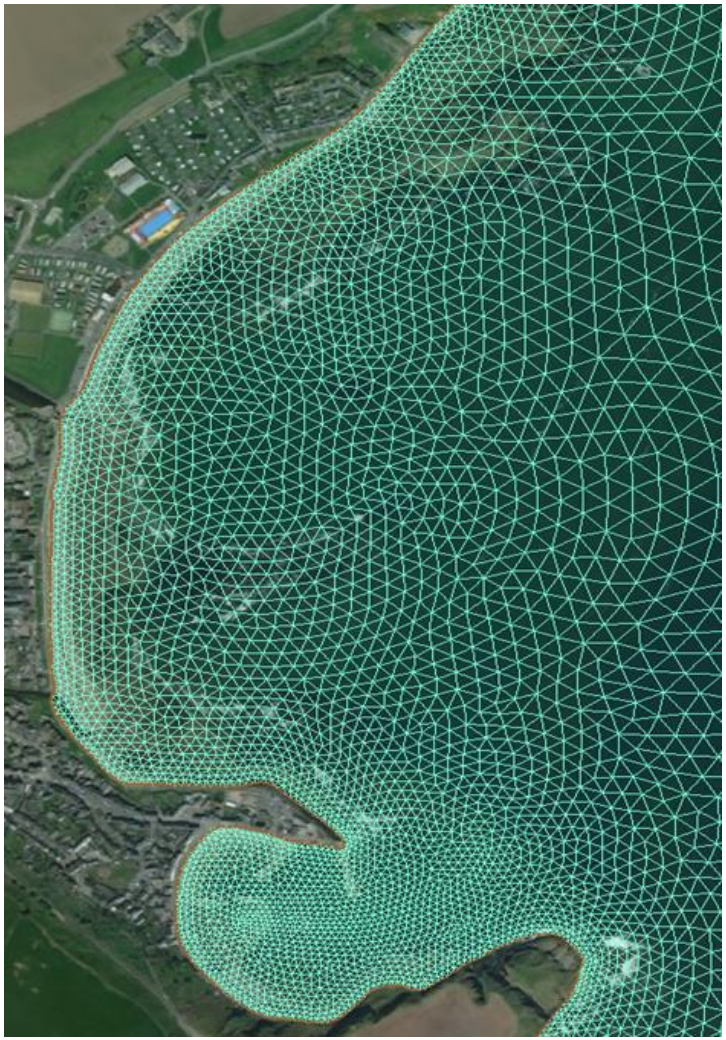
Flood modelling

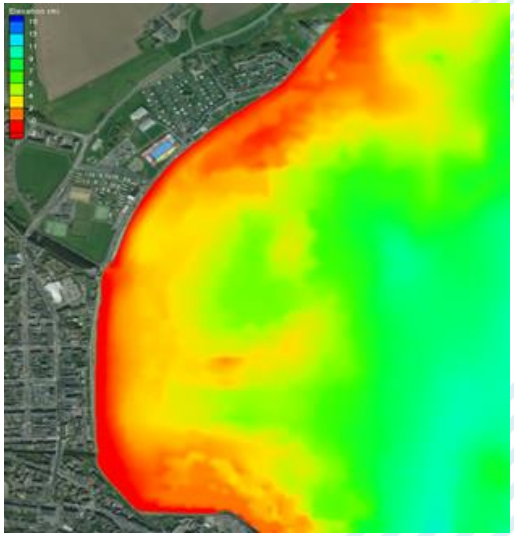


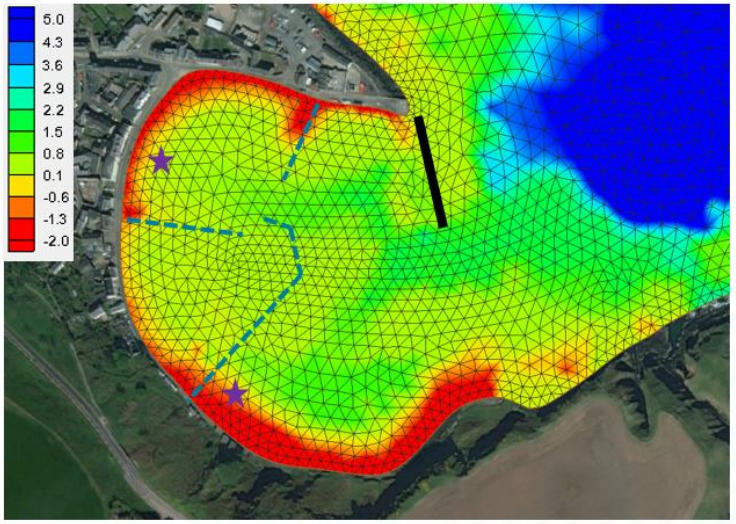
Multivariate statistics



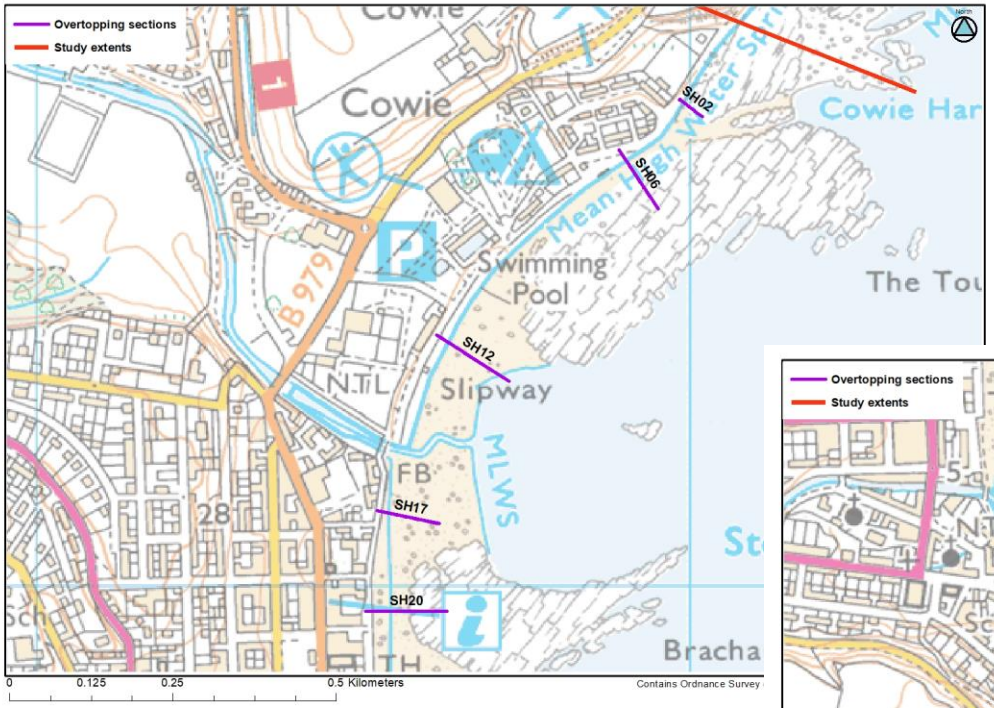
Wave transformation

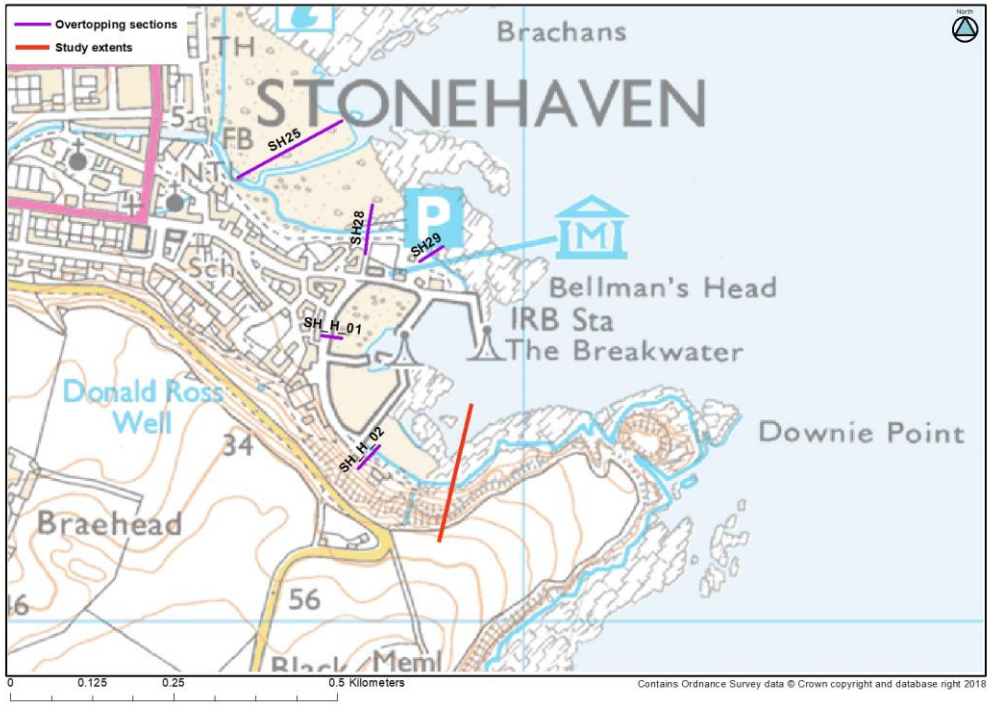






Wave overtopping





Wave overtopping

Wave overtopping calibration

- Overtopping rates at each cross section for 13 recorded events:
  - Cowie: SH_12 consistently has higher rates, SH_02 and SH_06 are similar.
  - Central wall: SH_20 lower rates than SH_17 due to rock platform.
  - Bellman's Head: moderate levels of overtopping at both sections.
  - Harbour: SH_H_01 lower rates than SH_H_02 due to sheltering from harbour walls.

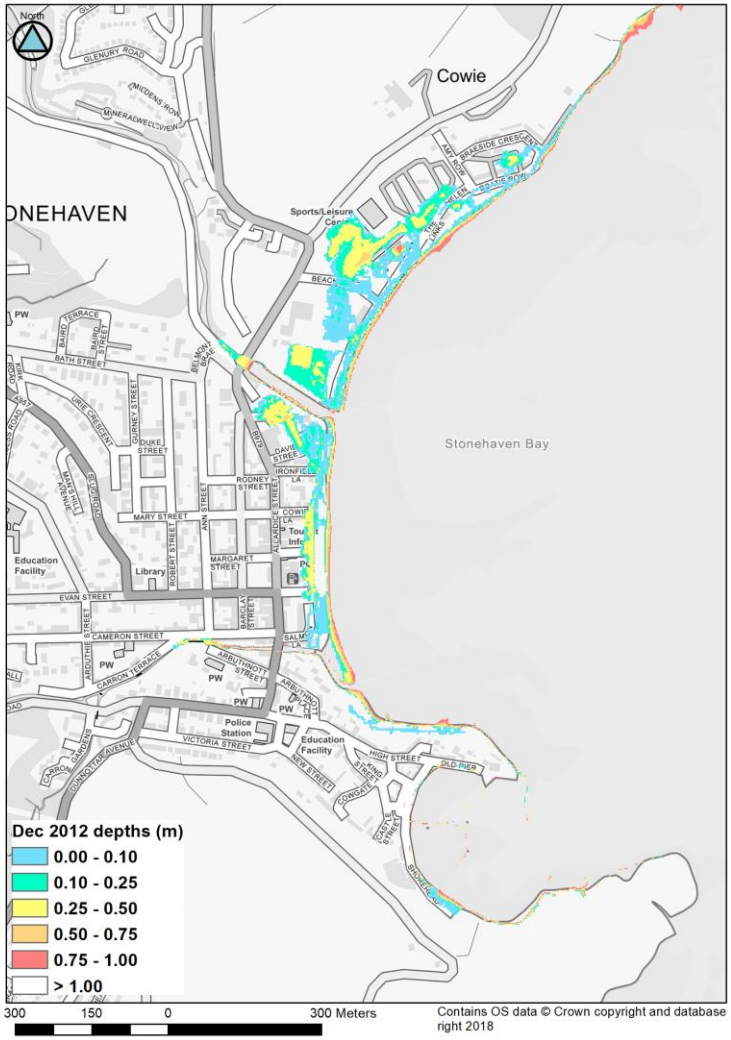
Wave overtopping frequency analysis

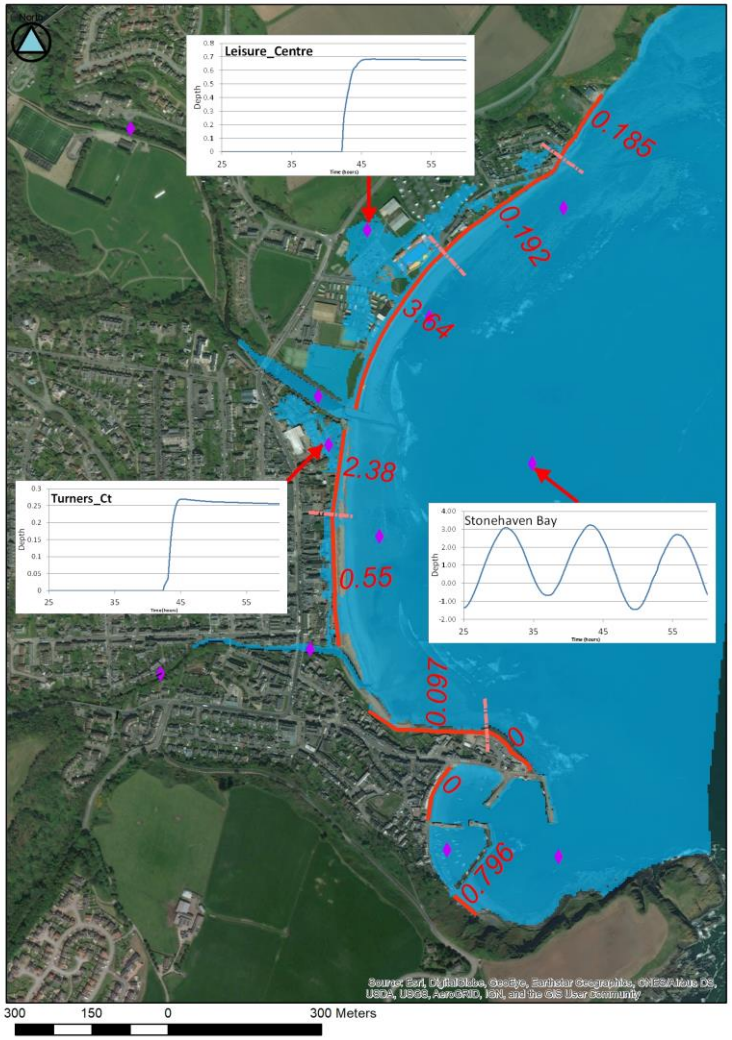
SH_25	River Carron rock armour
SH_12	Cowie promenade
SH_17	Central wall – north
SH_06	Cowie recurve wall
SH_28	Boardwalk
SH_02	Cowie wall
SH_29	Bellman's head rock armour
SH_20	Central wall – south
SH_H_02	Harbour – south
SH_H_01	Harbour – Shorehead

Inundation

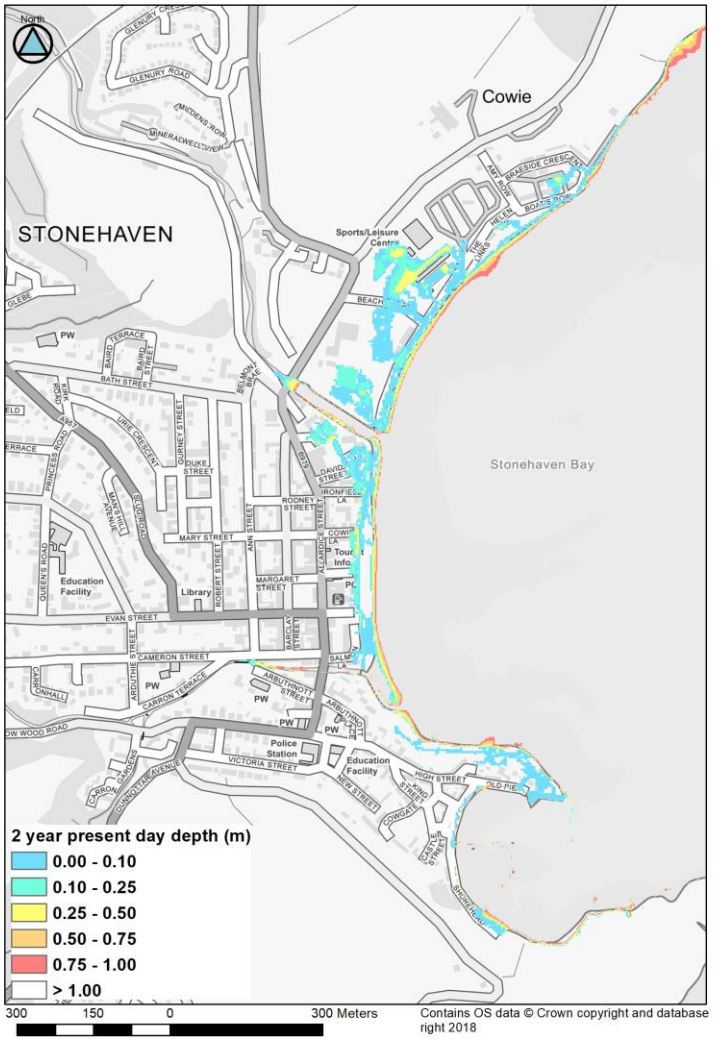
- TUFLOW model
- Tidal graph and wave overtopping inflows
- Digital terrain model with defence crests stamped on.
- Surveyed threshold levels of buildings.
- Roughness values varied according to land use.
- Calibrated to Dec 2012 event.

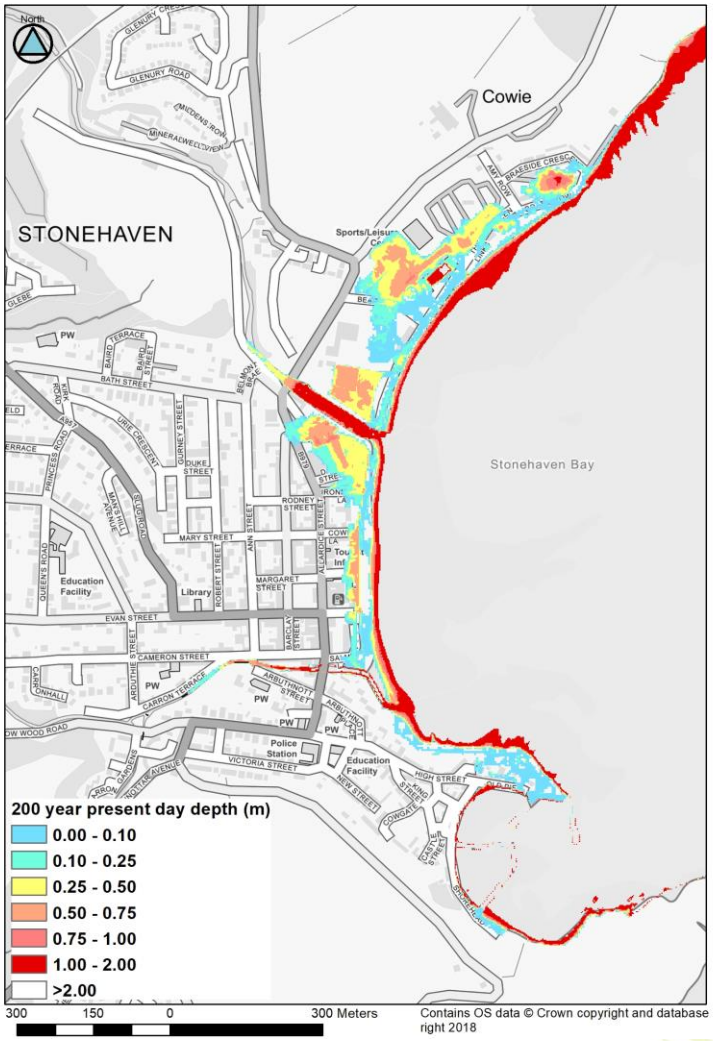
Inundation calibration





Outputs


North
STONEHAVEN
Cowie
Stonehaven Bay
Sports/Leisure Centre
Education Facility
Library
Police Station
Education Facility
2 year present day depth (m)
0.00 - 0.10
0.10 - 0.25
0.25 - 0.50
0.50 - 0.75
0.75 - 1.00
> 1.00
300 150 0 300 Meters
Contains OS data © Crown copyright and database right 2018


North
STONEHAVEN
Cowie
Stonehaven Bay
Education Facility
Library
Police Station
Education Facility
200 year present day depth (m)
0.00 - 0.10
0.10 - 0.25
0.25 - 0.50
0.50 - 0.75
0.75 - 1.00
1.00 - 2.00
>2.00
300 150 0 300 Meters
Contains OS data © Crown copyright and database right 2018

Flood modelling maps

Erosion modelling

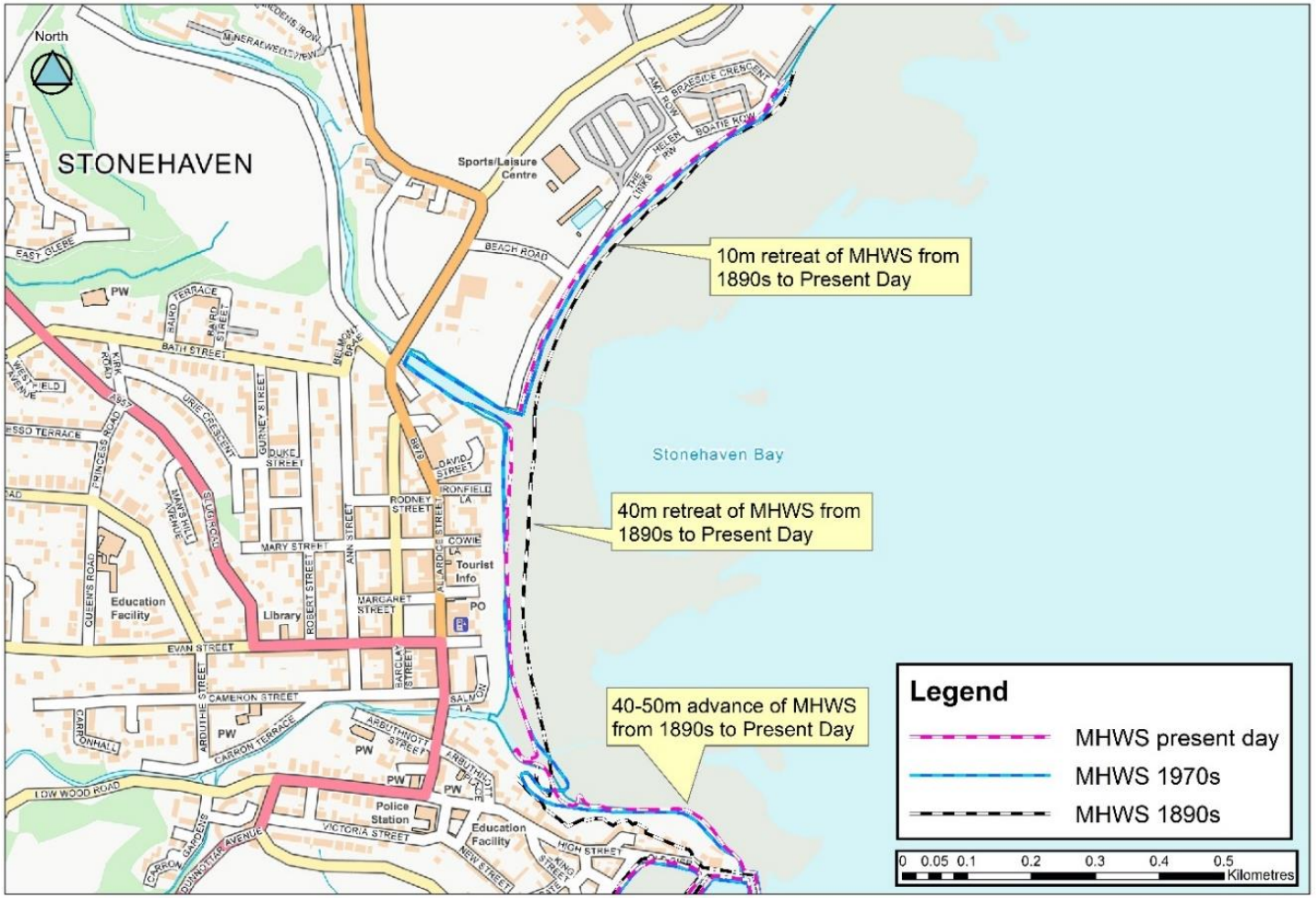
Erosion modelling

- Understanding of processes within the bay and how they contribute to flood risk.

- **Historical trends** – shoreline position, beach volume and sediment management practices.

- **Future erosion risk** – numerical modelling to consider risk to critical assets should the current defences fail.

Historical trends



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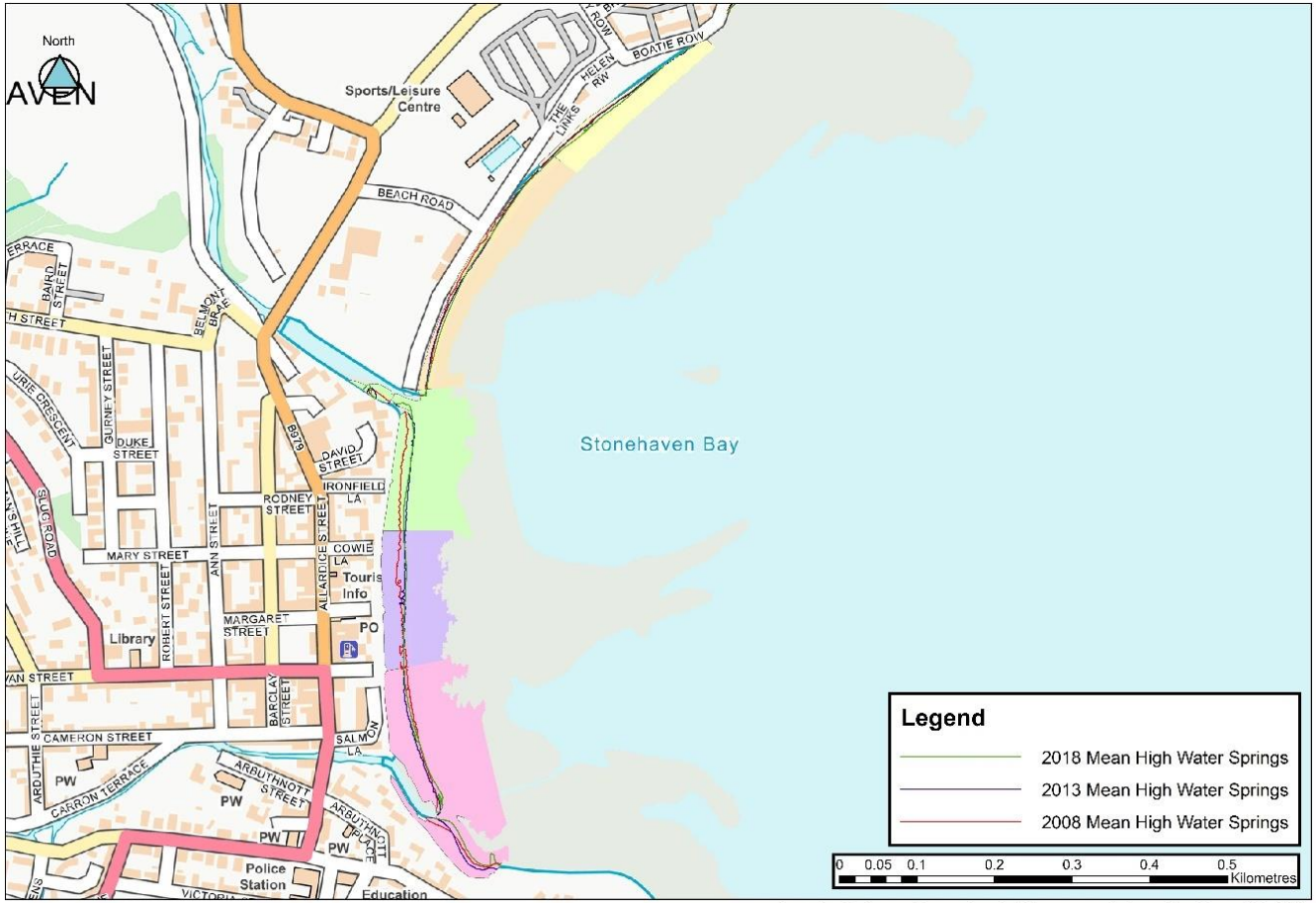
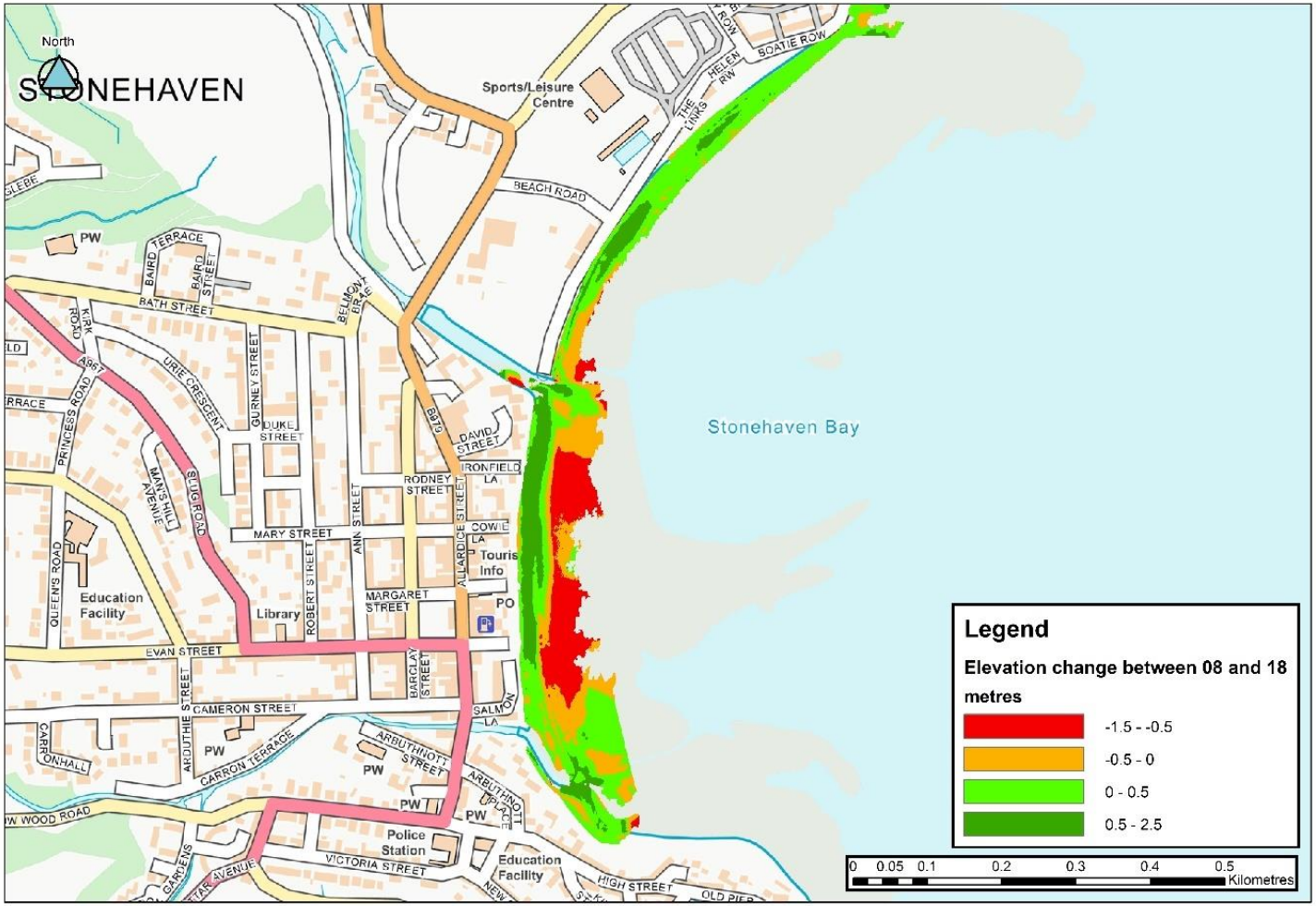
Volumetric analysis

- Survey from Dec 2008, May 2013 and May 2018



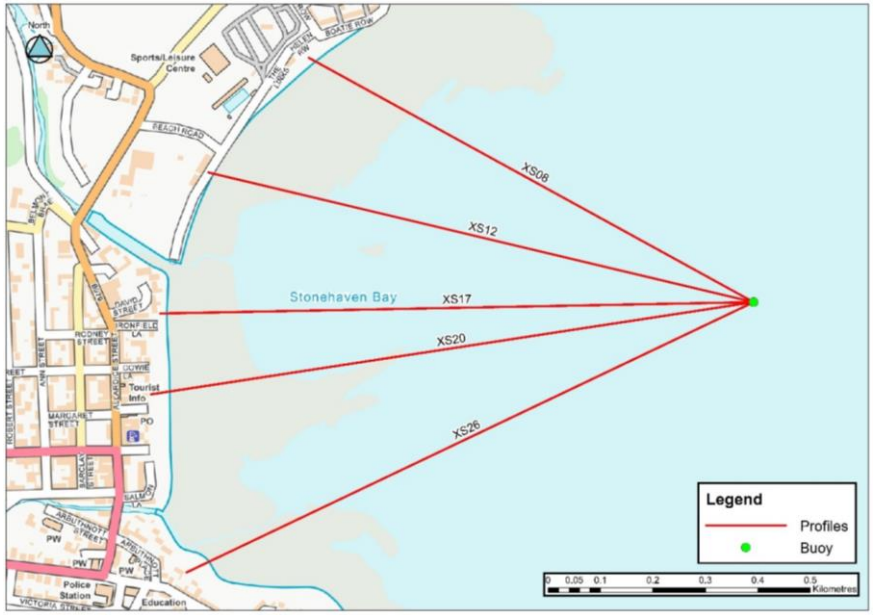
Volumetric analysis



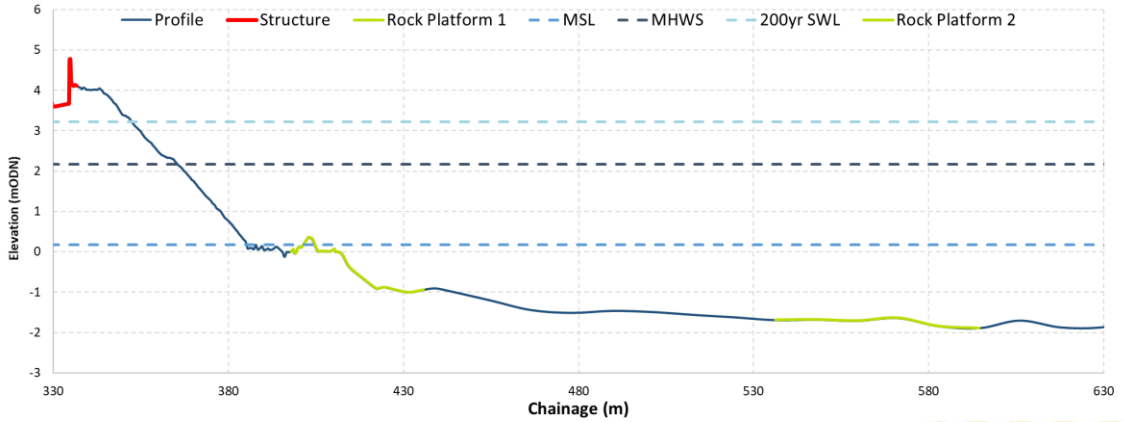
Volumetric analysis

- Trend for increase in volume in upper beach and decrease in lower beach – results in steepening of the beach.
- Greater variations between 2008 and 2013 than between 2013 and 2018 – similar number of ‘storm events’, so likely to be due to differences in seasonality of the surveys.
- Cowie training wall: sediment bypasses the wall and builds up in the Cowie channel and to the south.

Erosion modelling



- Calibrated against 2017 event recorded at buoy.
- Used to assess response with hard defences removed.



Erosion modelling

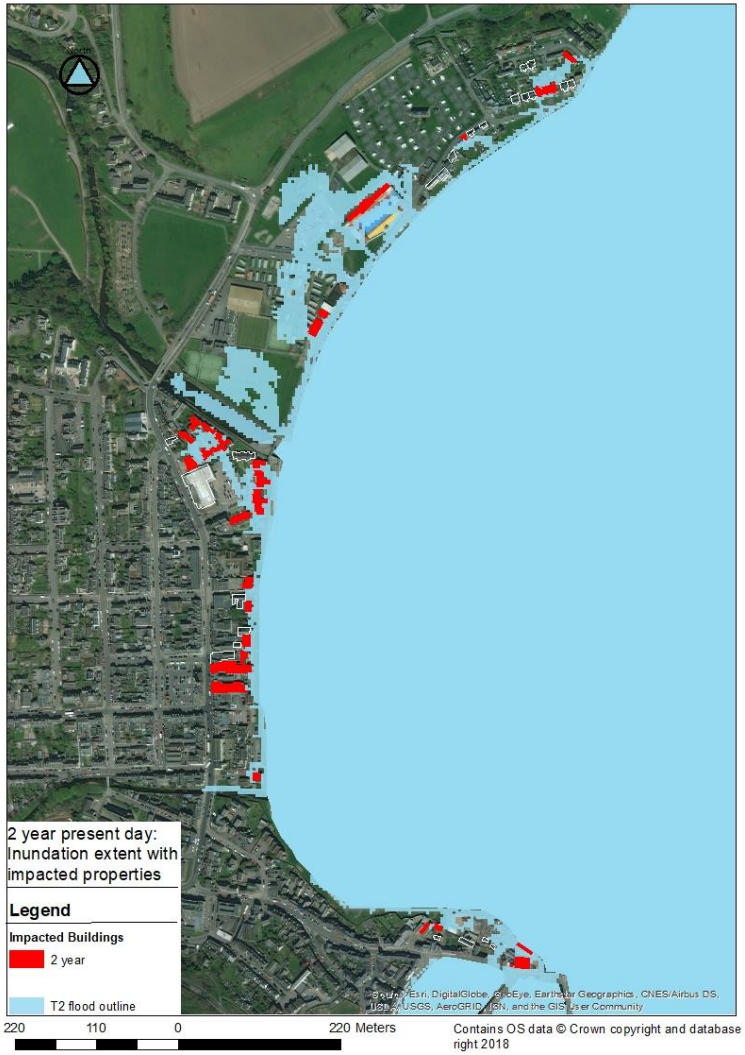
Erosion modelling maps

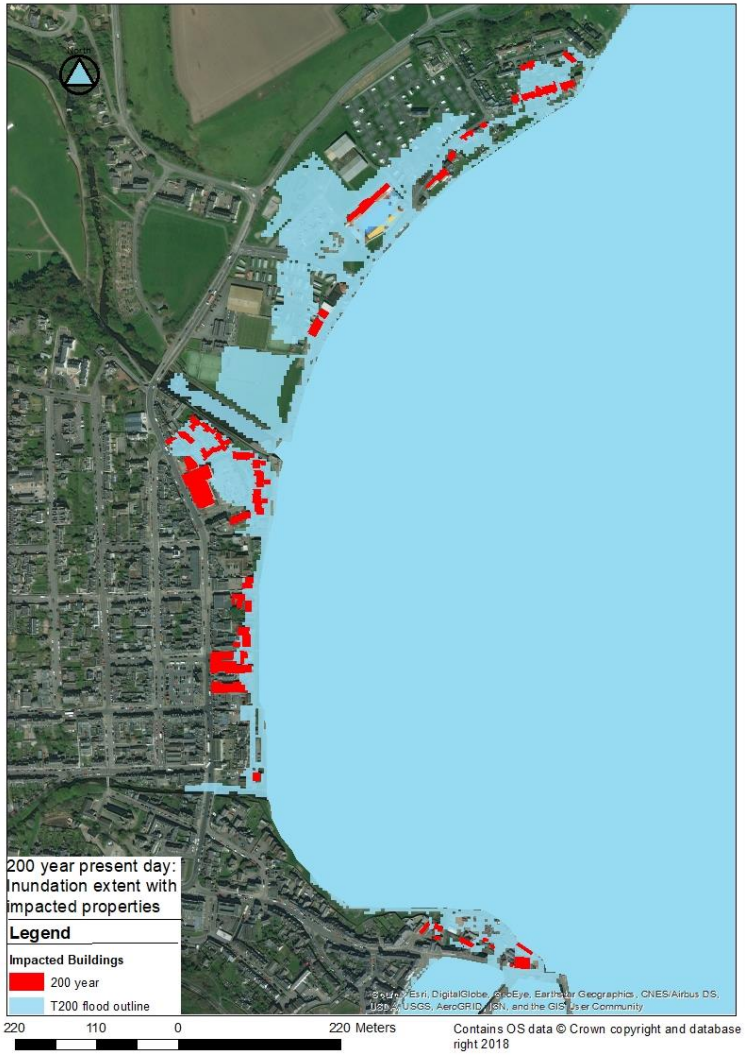
Baseline economic assessment

Baseline economic assessment

- SEPA's receptor database property points
- Water depths from inundation modelling
- Depth-damage curves from Multi-Coloured Manual (MCM) for wave action water
- Building threshold levels
- Direct/indirect and tangible/intangible damages

Properties inundated

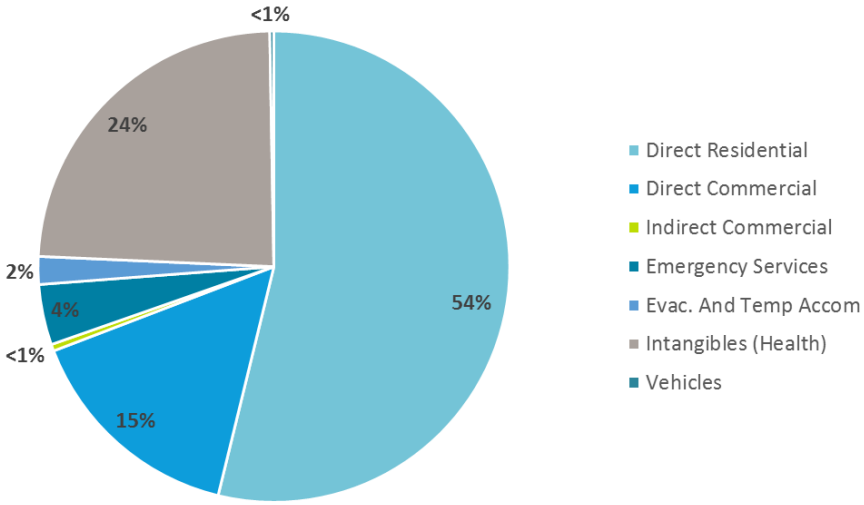




Present day damages

Event	2yr	5yr	10yr	30yr	50yr	100yr	200yr	1000 yr
Residential	25	29	34	46	55	62	65	77
Commercial	4	4	4	10	11	14	15	23
Total	29	33	38	56	66	76	80	100

Component	AAD (£k)	PvD (£k)
Direct Residential	£163.77	£4,882.57
Direct Commercial	£46.81	£1,395.54
Indirect Commercial	£1.40	£41.87
Emergency Services	£12.63	£376.69
Evac. And Temp Accom	£5.79	£172.72
Intangibles (Health)	£73.14	£2,180.58
Vehicles	£0.84	£25.04
Total	**£304.40**	**£9,074.99**



Economic assessment questions

Next steps?

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- Modelling reviewed by Aberdeenshire Council and SEPA
- Feedback from stakeholder consultation – today!
- Finalise modelling and appraisal
- Move on to engineering phase