

Frontal dune 'notching' in the United Kingdom

Some personal experiences and opinions

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Frontal dune 'notching'

- What?
- Why?
- Where?
- Has it worked?
- Was it worth it?
- Should it be done again?
- Where would the funding and justification come from?



What?

The artificial 'notch' continuum

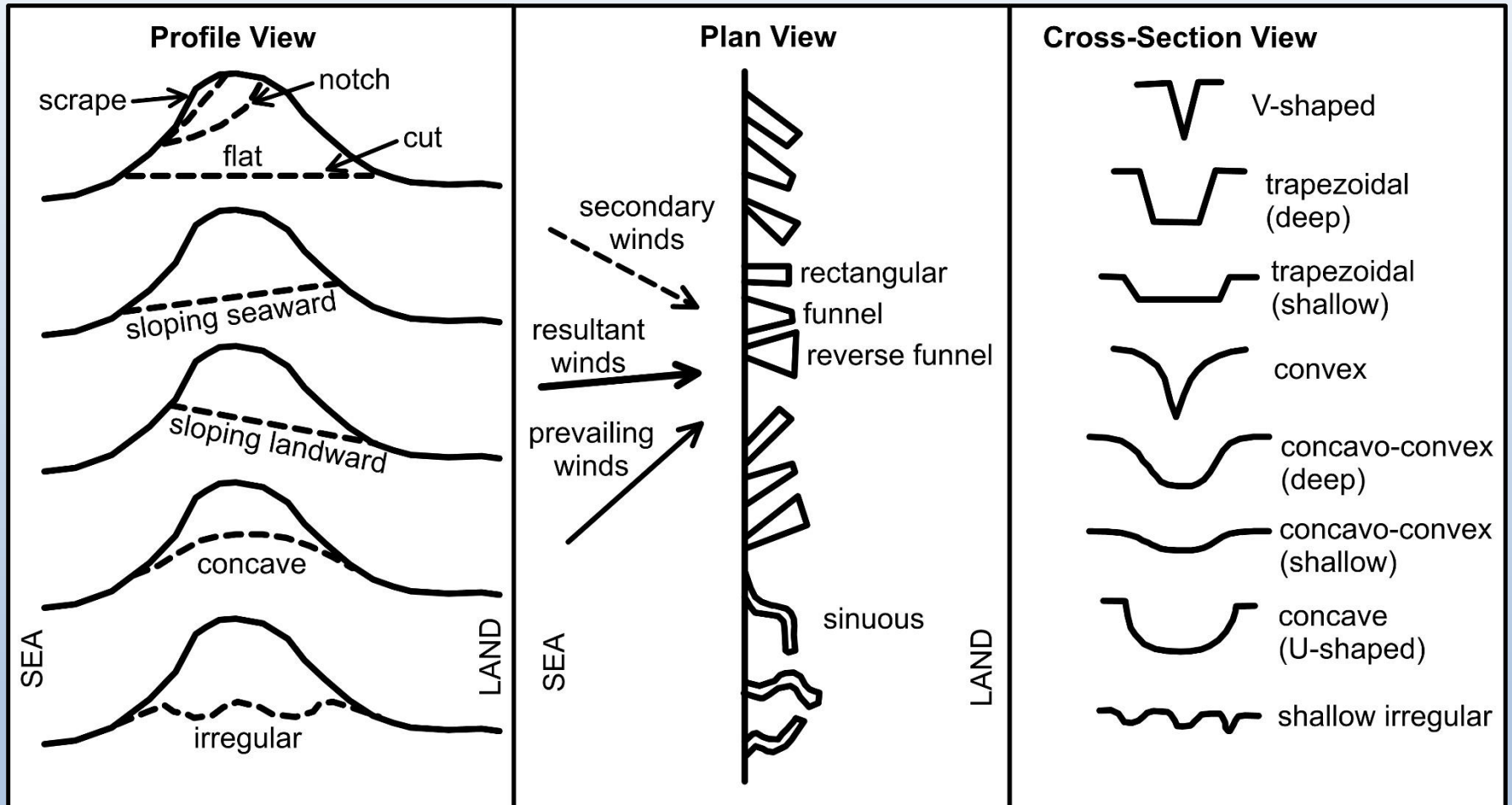
- Scrape – a shallow depression / bowl / basin
- Notch *sensu stricto* – a deeper, often elongated excavation of limited depth which does not pass through the entire width of a dune – simulates a natural blowout
- Cut – an elongated excavation which passes through the entire width of a dune and which may vary in depth from shallow to the entire height of the dune

Scrapes, notches and cuts involve movement of increasing volumes of sand and increasing cost

It is often most efficient to locate scrapes, notches and cuts at the sites of existing small blowouts or within larger stabilised blowouts, and to combine with wider scale turf stripping



Options for Scrape, Notch and Cut Design



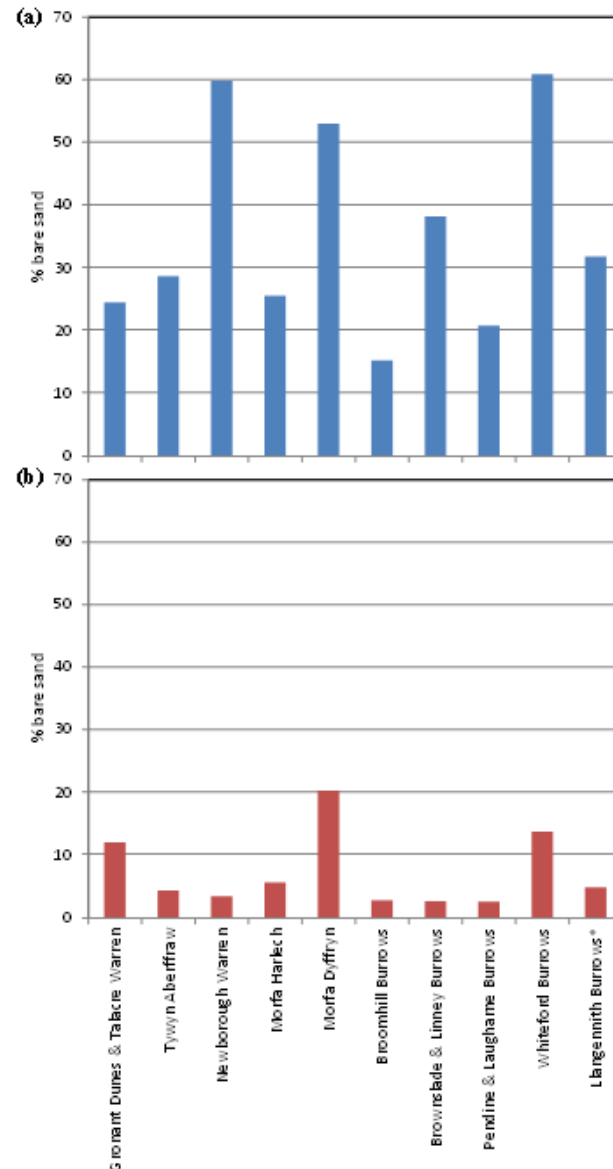
Why?

- The purpose of scrapes and notches is to create localised areas of bare sand habitat and to induce turbulence which may lead to formation or enlargement of a natural blowout and/or increase the mobility of an existing parabolic dune. They can be created in frontal or inland dunes. Scrapes can also be made in interdune areas to create pools and wet slacks
- The primary purpose of a cut is to facilitate wind and sand flow between the beach and a hind dune area in order to rejuvenate senescent yellow dune and grey dune habitats behind a frontal dune 'barrier'
- Sand excavated from a cut can be deposited on its landward side to create a lobe which may evolve into a transgressive sand sheet
- Any of the above may help in restoring or maintaining 'favourable ecological condition'

Why and Where?

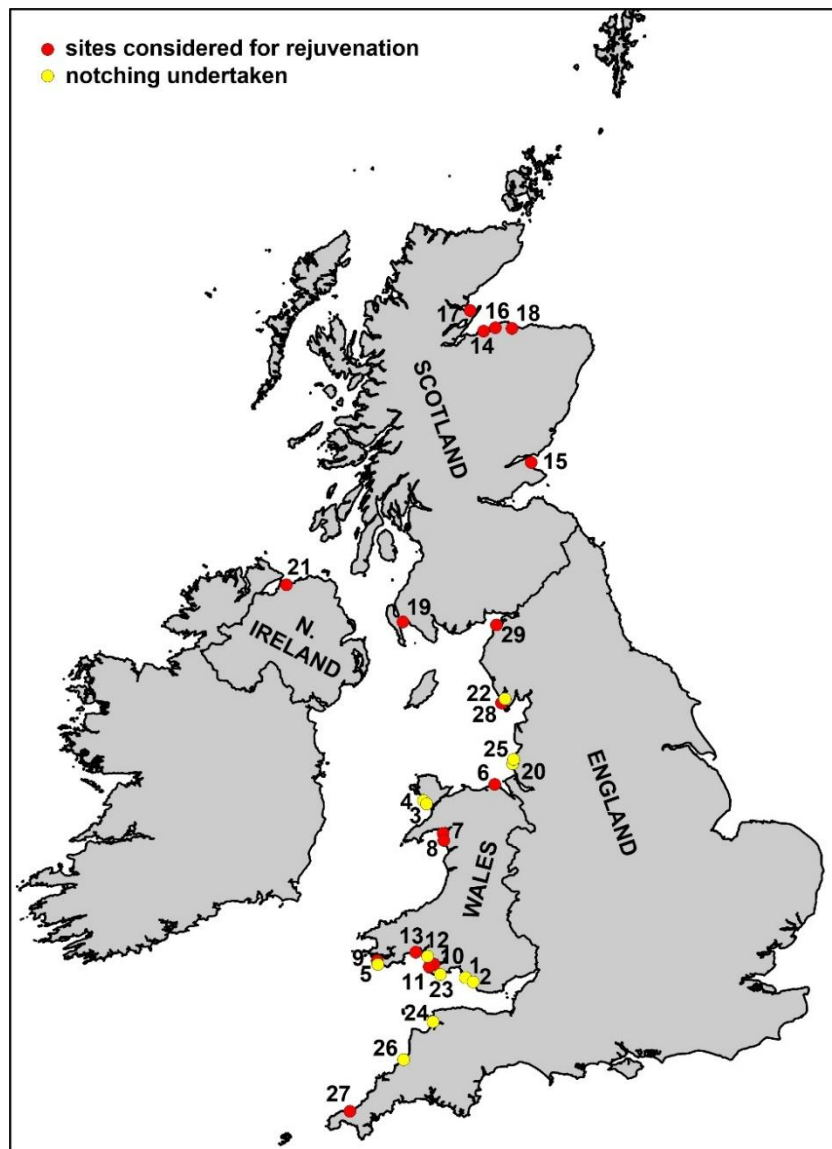
Change in percentage area of bare sand within Welsh SAC dune systems between the (a) 1940s-50s and (b) 2009 (Pye & Blott, 2012)

A desirable minimum target of 10- 15%?



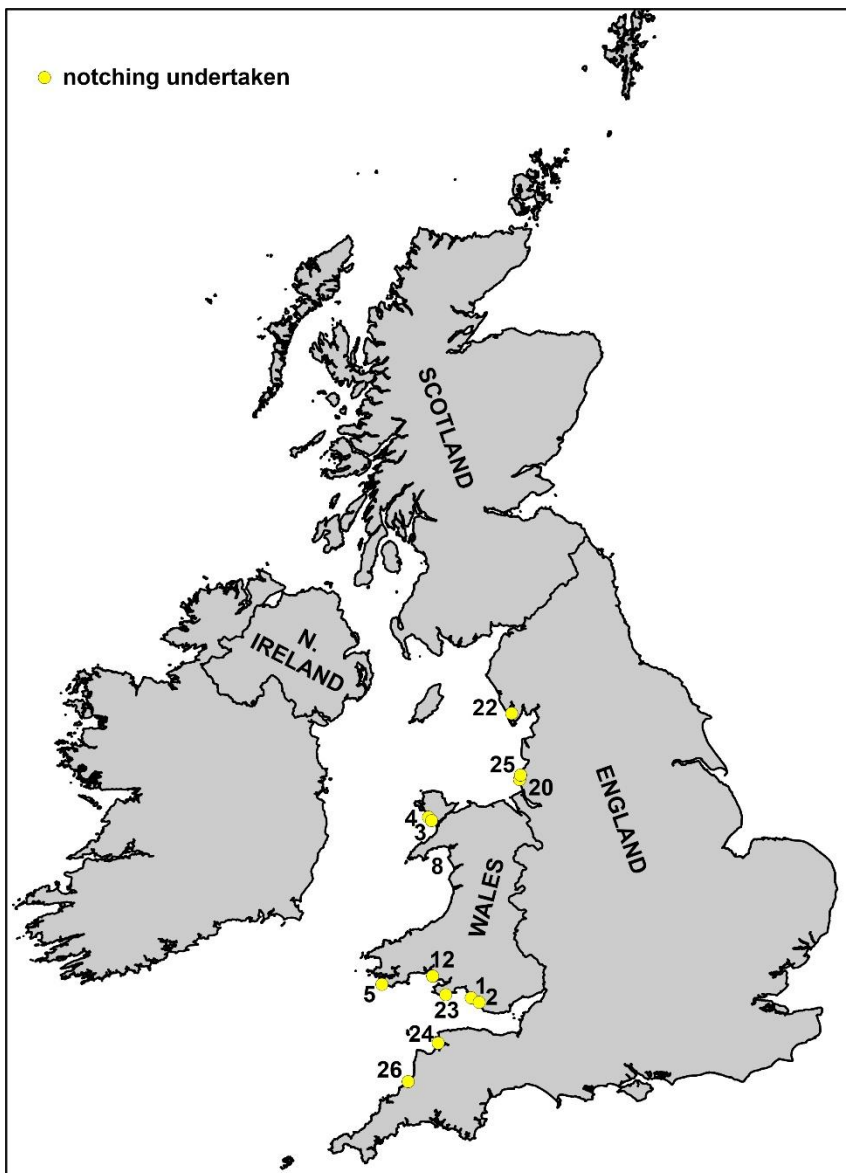
UK sites considered for dune rejuvenation works by KPAL

2011-2023



Site	Name	Location	Proposed	Notching	Details
1	Kenfig	Wales	2011	2011 onwards	10 notches
2	Merthyr Mawr	Wales	2011	2013 onwards	4 notches
3	Newborough	Wales	2012	2013 onwards	10 notches
4	Aberffraw	Wales	2012	2022 onwards	1 notch
5	Castlemartin (Brownsdale)	Wales	2012	2016 onwards	2 notches
6	Talacre & Gronant	Wales	2012	none	
7	Harlech	Wales	2012	none	
8	Dyffryn	Wales	2012	none	
9	Broomhill	Wales	2012	none	
10	Whiteford	Wales	2012	none	
11	Llangennith	Wales	2012	none	
12	Pembrey	Wales	2012	2022 onwards	3 notches
13	Pendine & Laugharne	Wales	2014	none	
14	Culbin	Scotland	2014	none	
15	Tentsmuir	Scotland	2014	none	
16	Roseisle	Scotland	2014	none	
17	Morrich More	Scotland	2014	none	
18	Lossie	Scotland	2014	none	
19	Torrs Warren	Scotland	2014	none	
20	Formby	England	2015	2021 onwards	2 notches
21	Magilligan	Northern Ireland	2015	none	
22	Sandscale Haws	England	2016	2022 onwards	4 notches
23	Oxwich	Wales	2018	2022 onwards	1 notch
24	Braunton	England	2018	2022 onwards	4 notches
25	Ainsdale	England	2018	2022 onwards	4 notches
26	Penhale	England	2018	2023 onwards	3 notches
27	Gwithian to Mexico	England	2018	none	
28	North Walney	England	2023	none	
29	Grune Point	England	2023	none	

UK sites where frontal dune 'notching' has been done



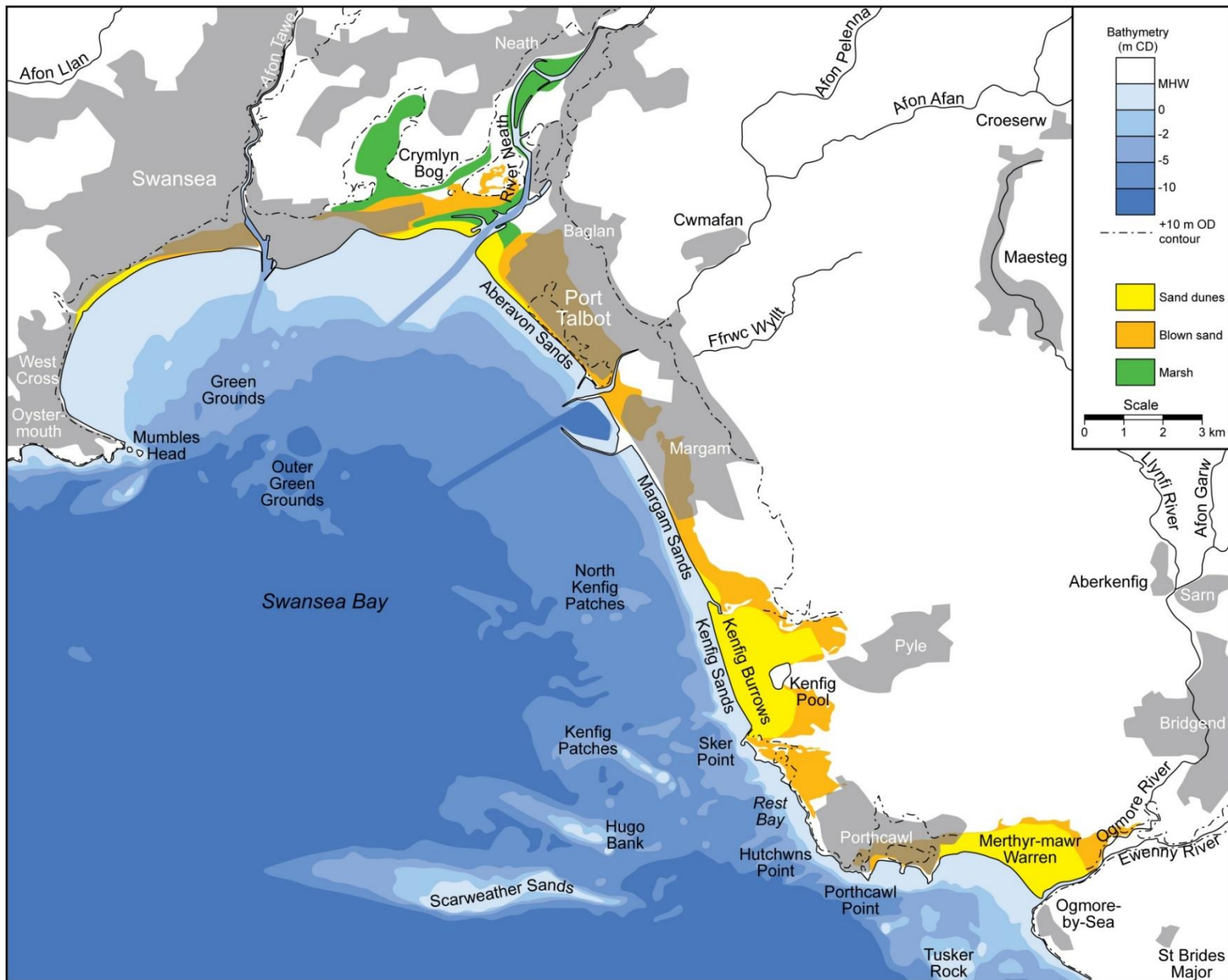
Conservation designations

Site	Name	Date	Notches	SAC	SPA	SSSI	NNR	Biosphere	AONB	NP	GCR	Heritage Coast
1	Kenfig	2011-	10	X		X	X					
2	Merthyr Mawr	2013-	4	X		X	X					X
3	Newborough	2013-	10	X		X	X		X		X	
4	Aberffraw	2022-	1	X		X			X		X	X
5	Castlemartin	2016-	2	X	X	X				X	X	X
12	Pembrey	2022-	3	X		X					X	
20	Formby	2021-	2									
22	Sandscale Haws	2022-	4									
23	Oxwich	2022-	1			X	X		X		X	X
24	Braunton	2022-	4	X		X		X	X		X	X
25	Ainsdale	2022-	4	X		X	X				X	
26	Penhale	2023-	3	X		X						

Principal sponsors

Site	Name	Date	Notches	CCW/NRW	Welsh Government	Defence Infrastructure Organization	National Trust	Natural England	Cornwall Wildlife Trust	Plant Life	Sands of Life	Dynamic Dunescapes and National Lottery
1	Kenfig	2011-	10	X								X
2	Merthyr Mawr	2013-	4	X								X
3	Newborough	2013-	10	X	X							X
4	Aberffraw	2022-	1	X								X
5	Castlemartin	2016-	2			X						
12	Pembrey	2022-	3									
20	Formby	2021-	2				X					X
22	Sandscale Haws	2022-	4				X					X
23	Oxwich	2022-	1	X								X
24	Braunton	2022-	4							X		X
25	Ainsdale	2022-	4					X				X
26	Penhale	2023-	3						X			X

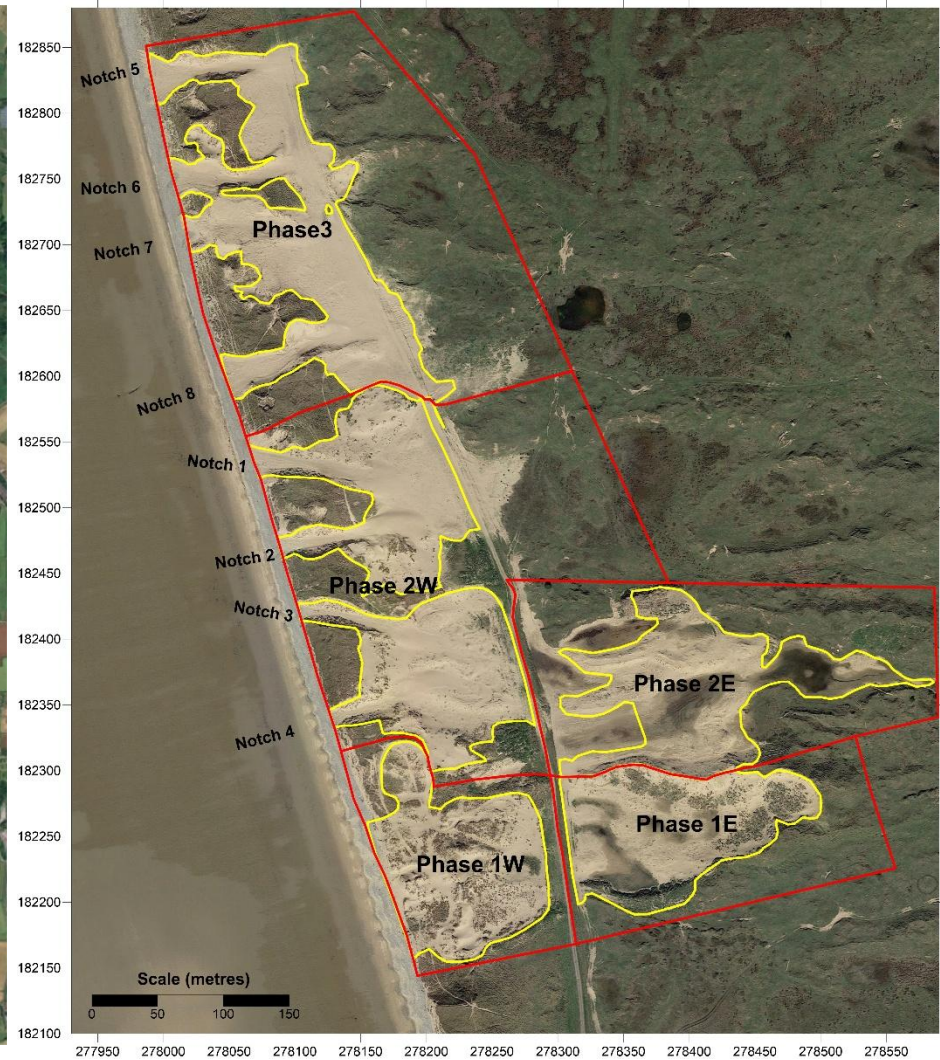
Example 1: Kenfig Burrows, Swansea Bay



Dune rejuvenation works at Kenfig Burrows



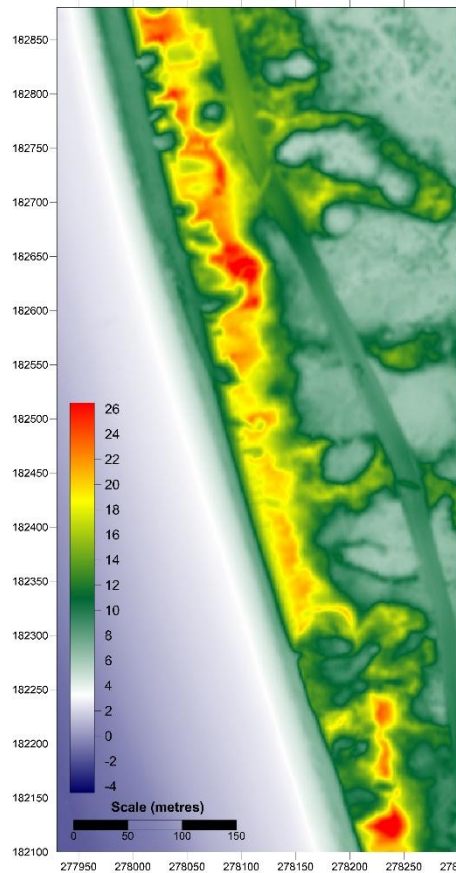
**Whole site,
16/06/2024
(Google Earth)**



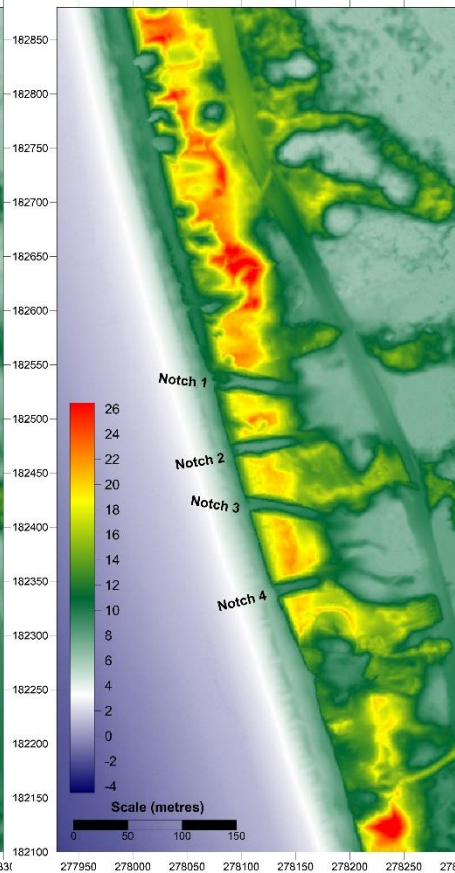
**Original site (Phases 1-3),
18/04/2015
(Google Earth)**

LiDAR Surveys of Phases 1 – 3 at Kenfig 2009-2022

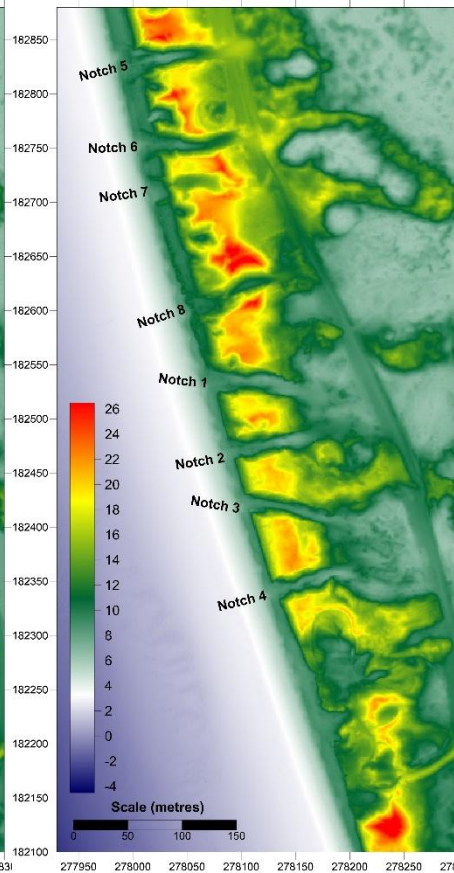
12/05/2009



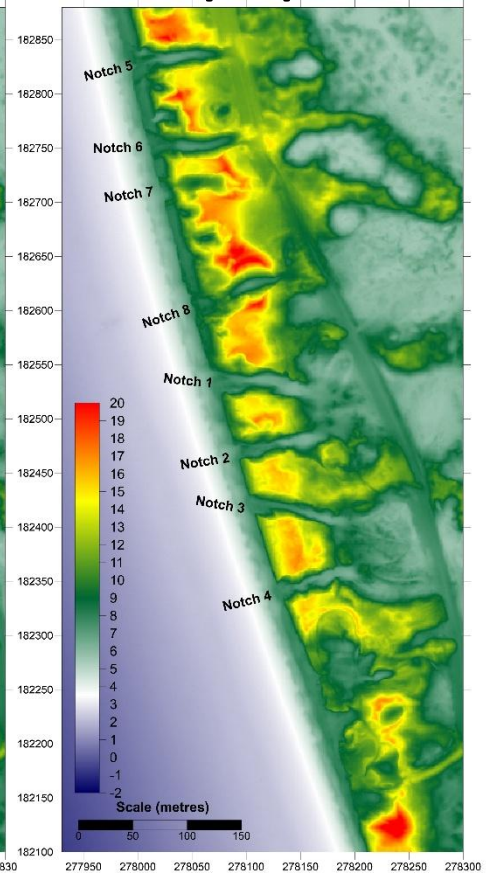
12/03/2014



13/09/2019



03/04/2022



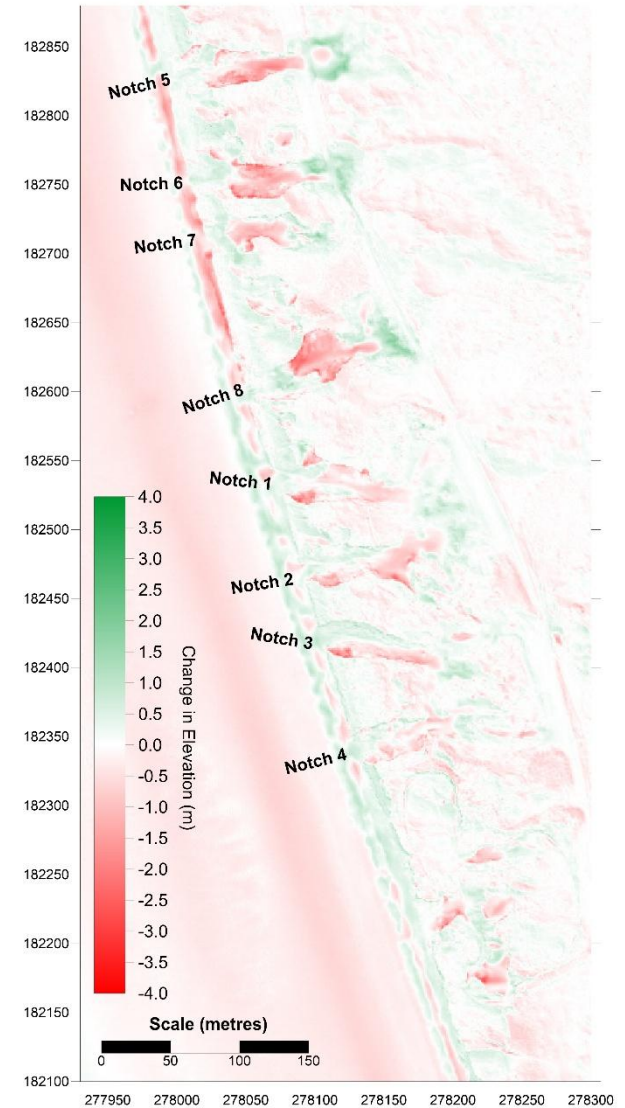
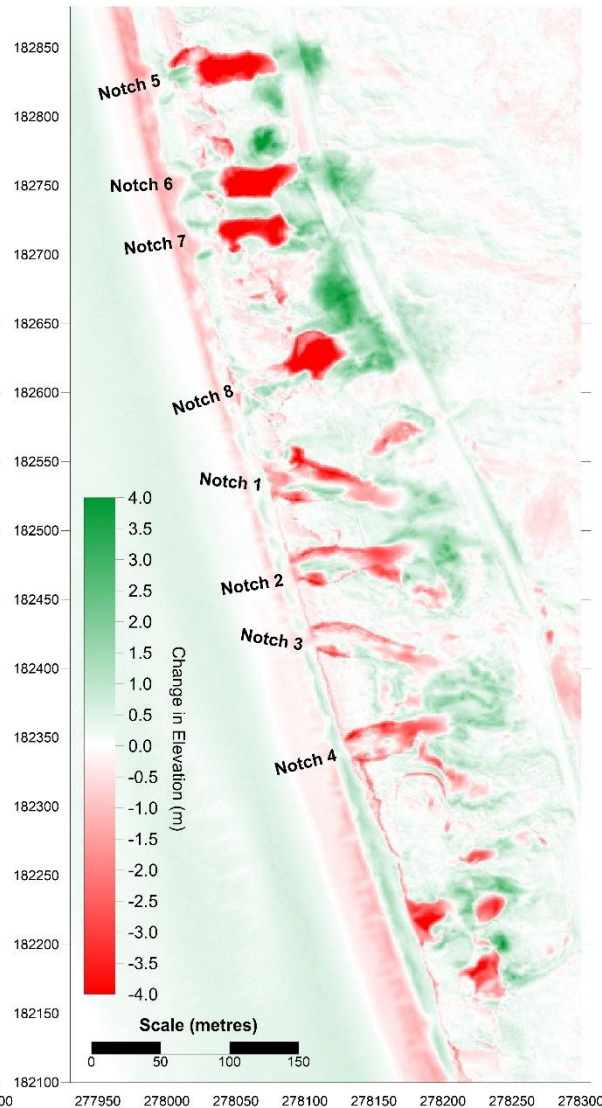
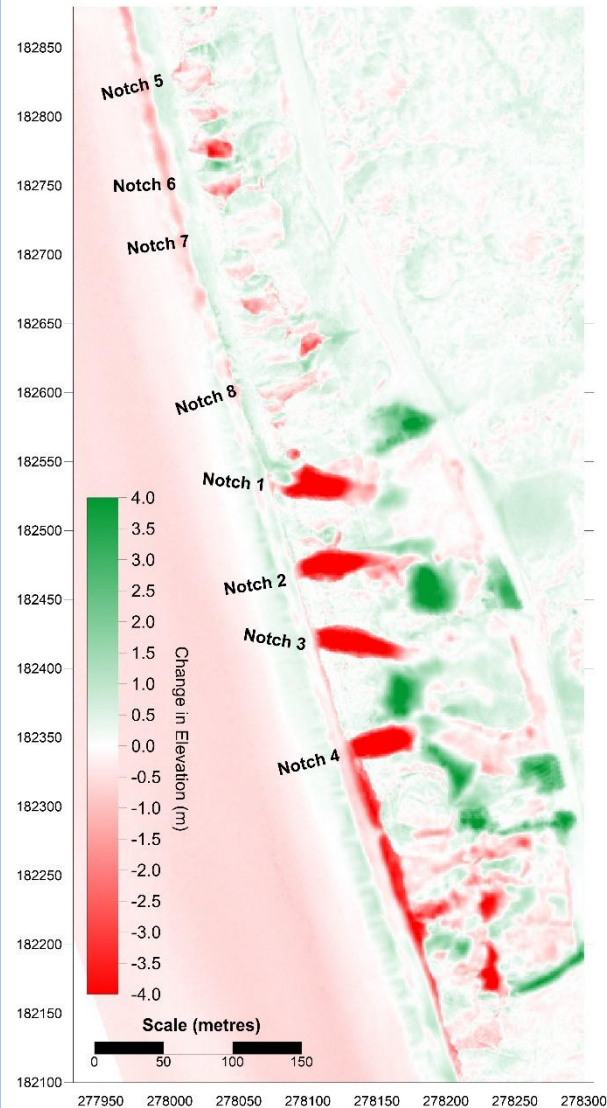
Elevation change at Kenfig Phases 1 – 3 since 2009



12/05/2009 to
12/03/2014

12/03/2014 to
13/09/2019

13/09/2019 to
03/04/2022



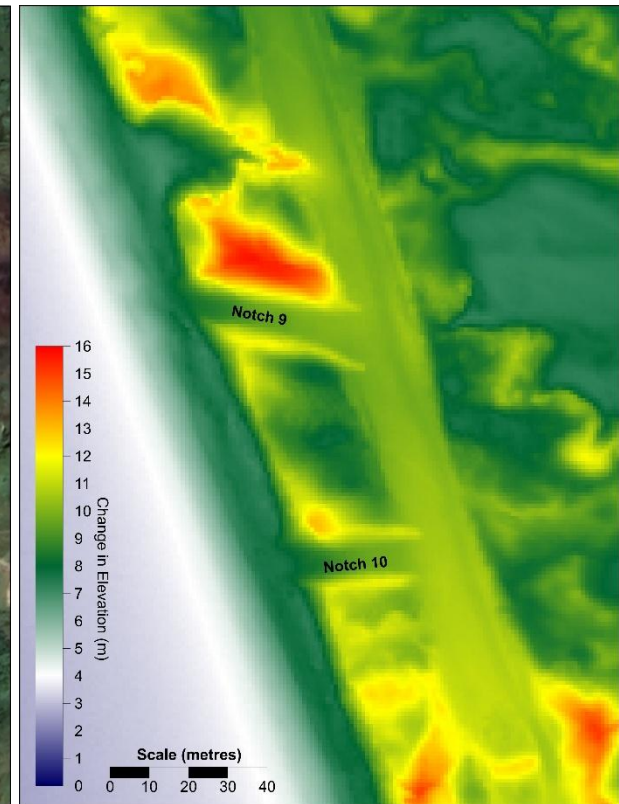
'Notching' and turf stripping at Kenfig Burrows in 2022-23



07/07/2023
(Google Earth)



16/06/2024
(Google Earth)



03/04/2022
(LiDAR DTM)

Photographs of Kenfig Phase 1, undertaken winter 2011-2012

(a) March 2012



(b) July 2012



(c) February 2013

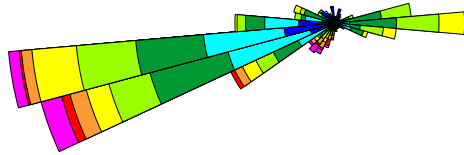


(d) March 2013

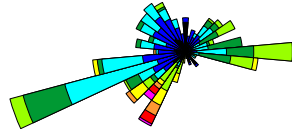


Monthly wind roses at Mumbles, 2012-2013

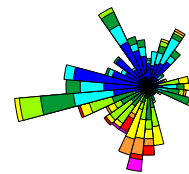
(a) Jan 2012



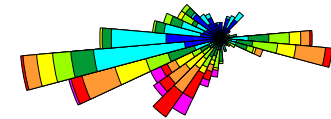
(b) Feb 2012



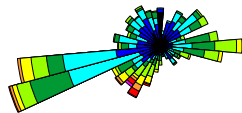
(k) Nov 2012



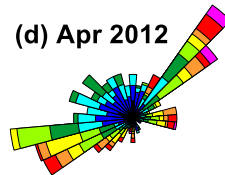
(l) Dec 2012



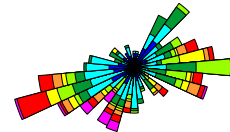
(c) Mar 2012



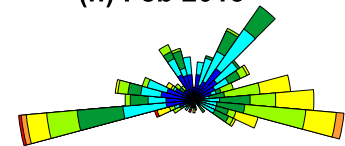
(d) Apr 2012



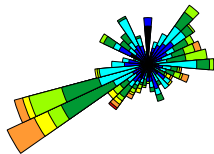
(m) Jan 2013



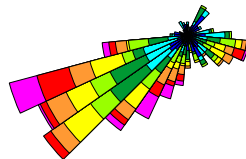
(n) Feb 2013



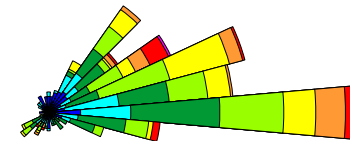
(e) May 2012



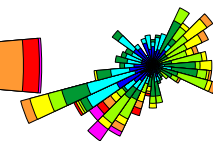
(f) Jun 2012



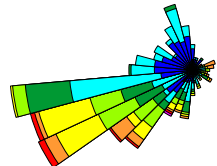
(o) Mar 2013



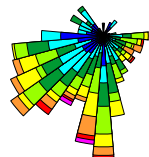
(p) Apr 2013



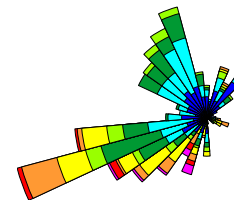
(g) Jul 2012



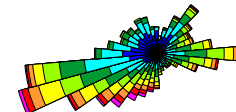
(h) Aug 2012



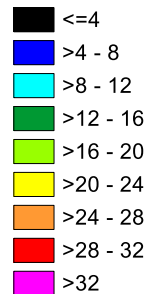
(q) May 2013



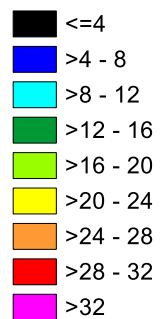
(r) Jan 2012 to May 2013



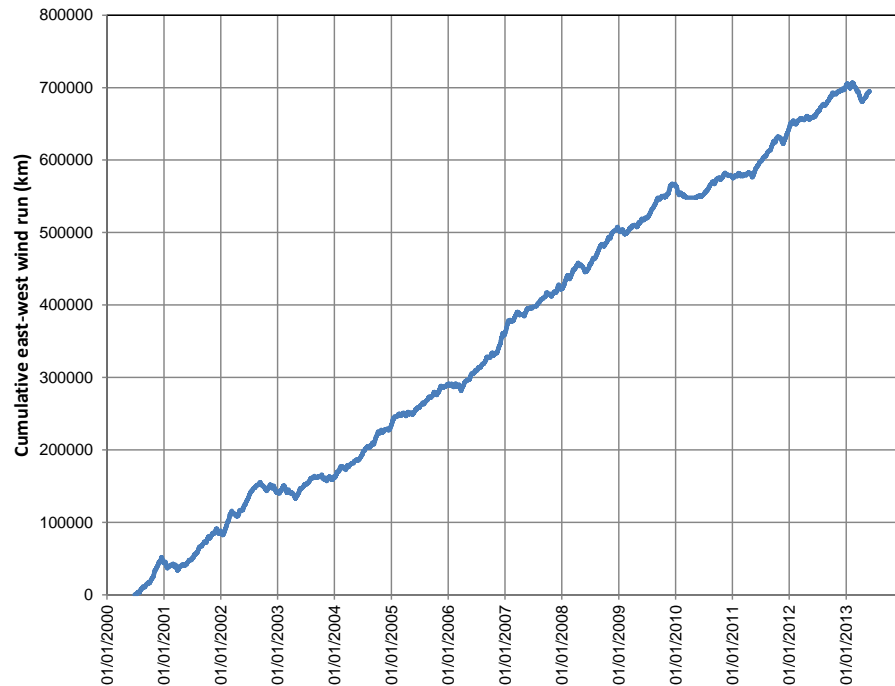
Mean wind speed (knots)



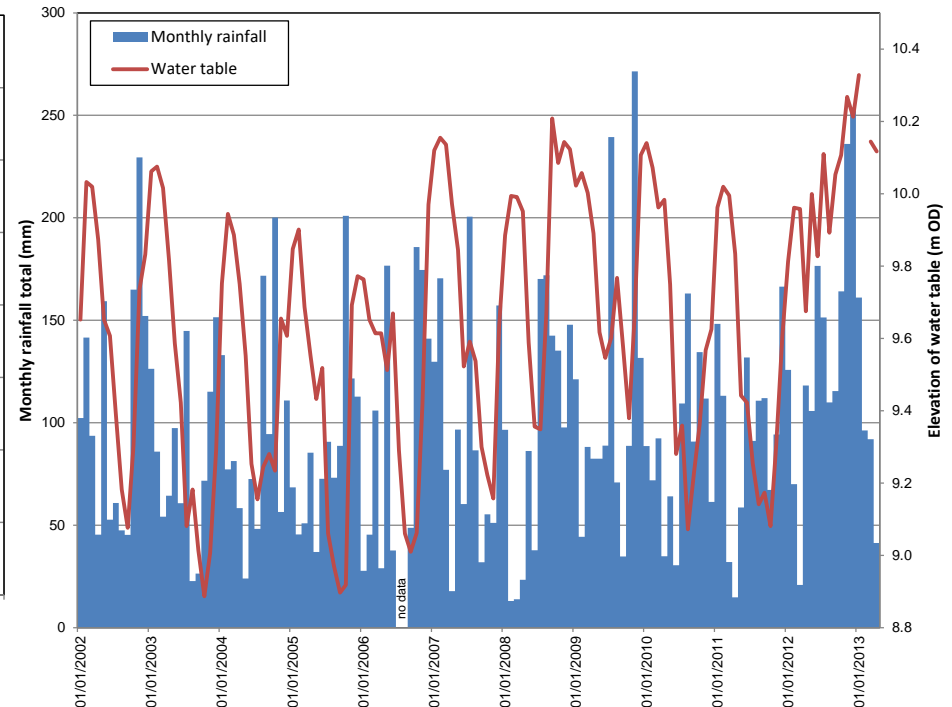
Mean wind speed (knots)



Cumulative wind run and monthly rainfall at Mumbles, 2000-2013

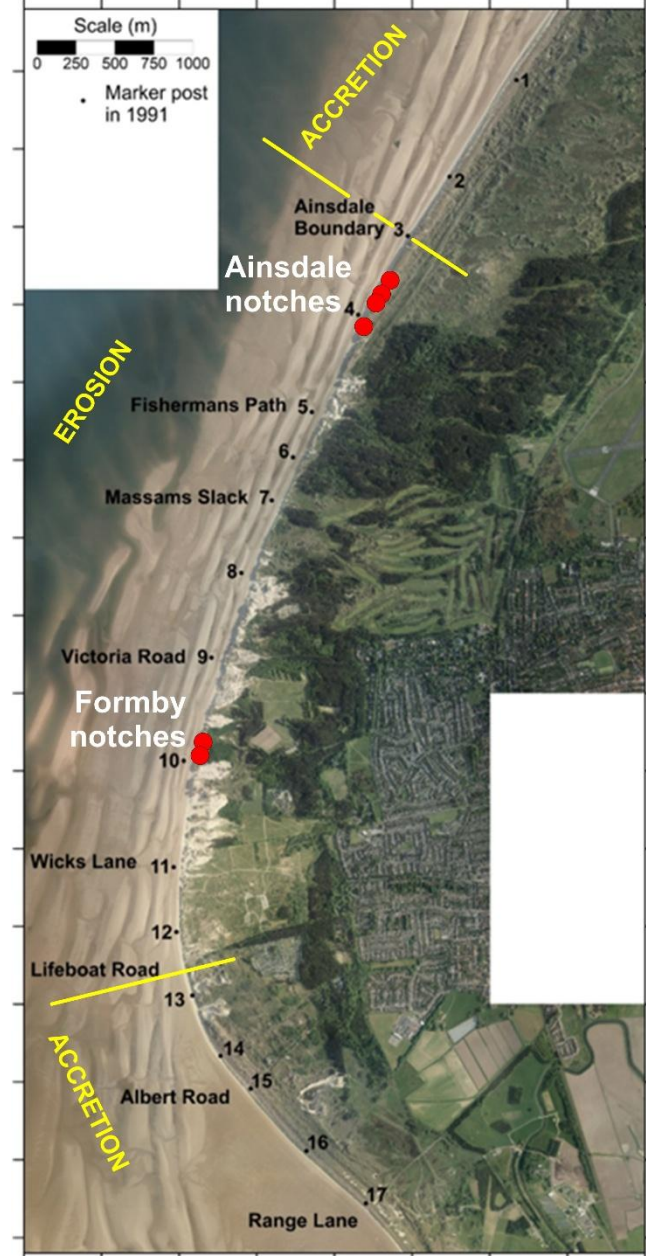
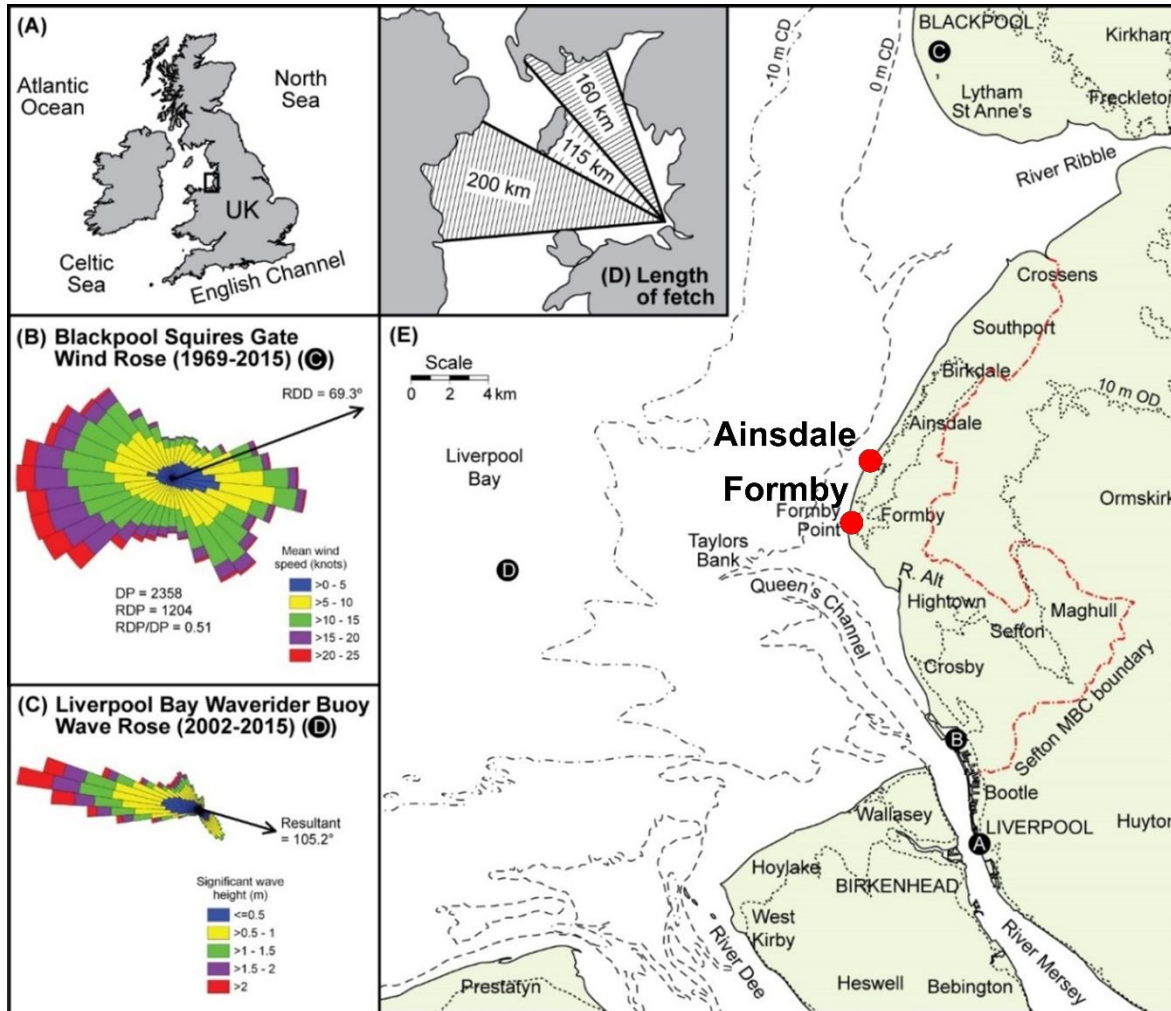


**Cumulative wind run,
2000-2013**



Monthly rainfall 2002-2013

Examples 2 & 3: 'Notching' at Ainsdale and Formby, NW England



Satellite Images of Ainsdale before and after the works (Google Earth)

27/03/2022



04/07/2023



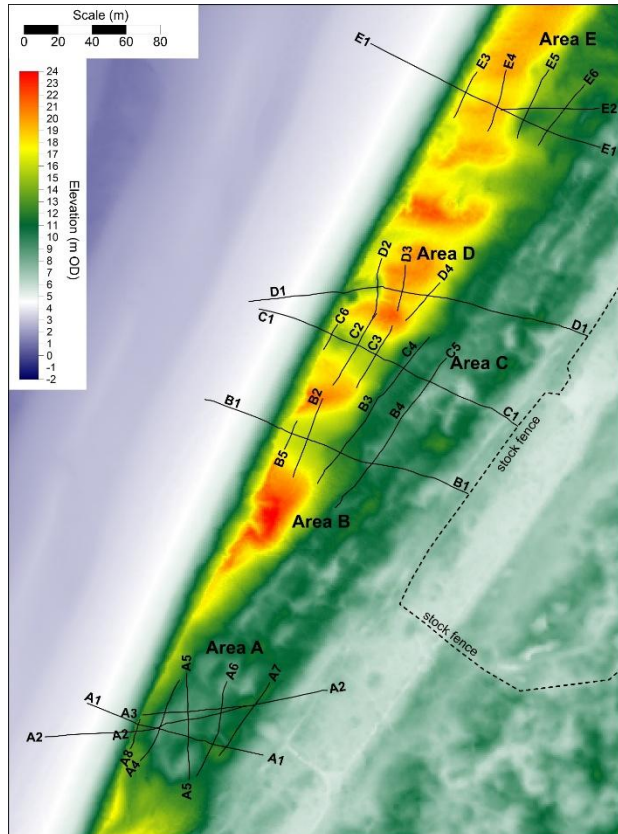
22/06/2024



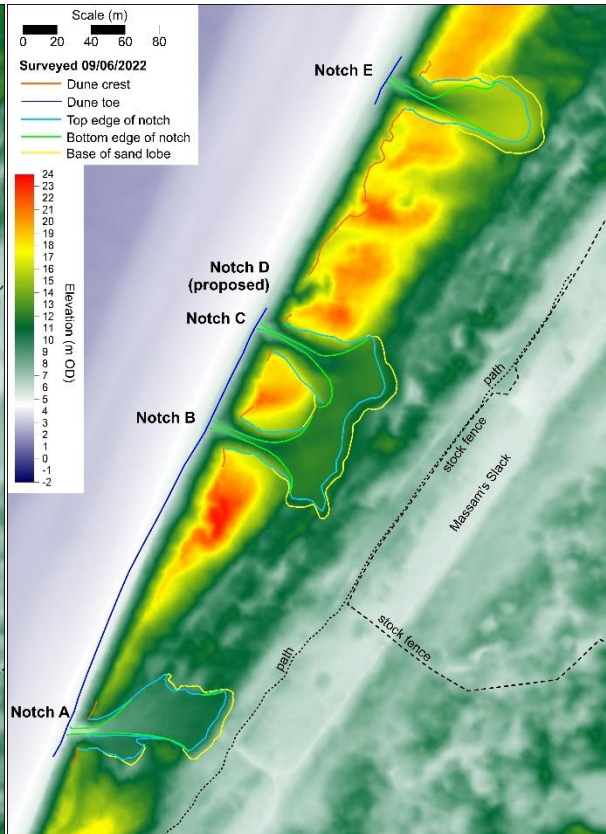
LiDAR Surveys of part of Ainsdale NNR 2020 – 2024

(Natural England, Dynamic Dunescapes project)

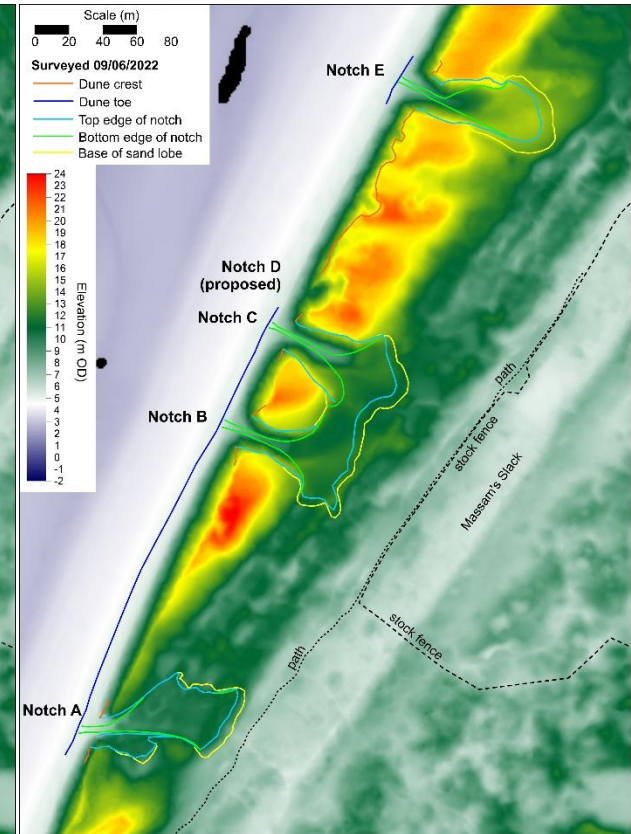
15/10/2020



07/12/2022



19/09/2024



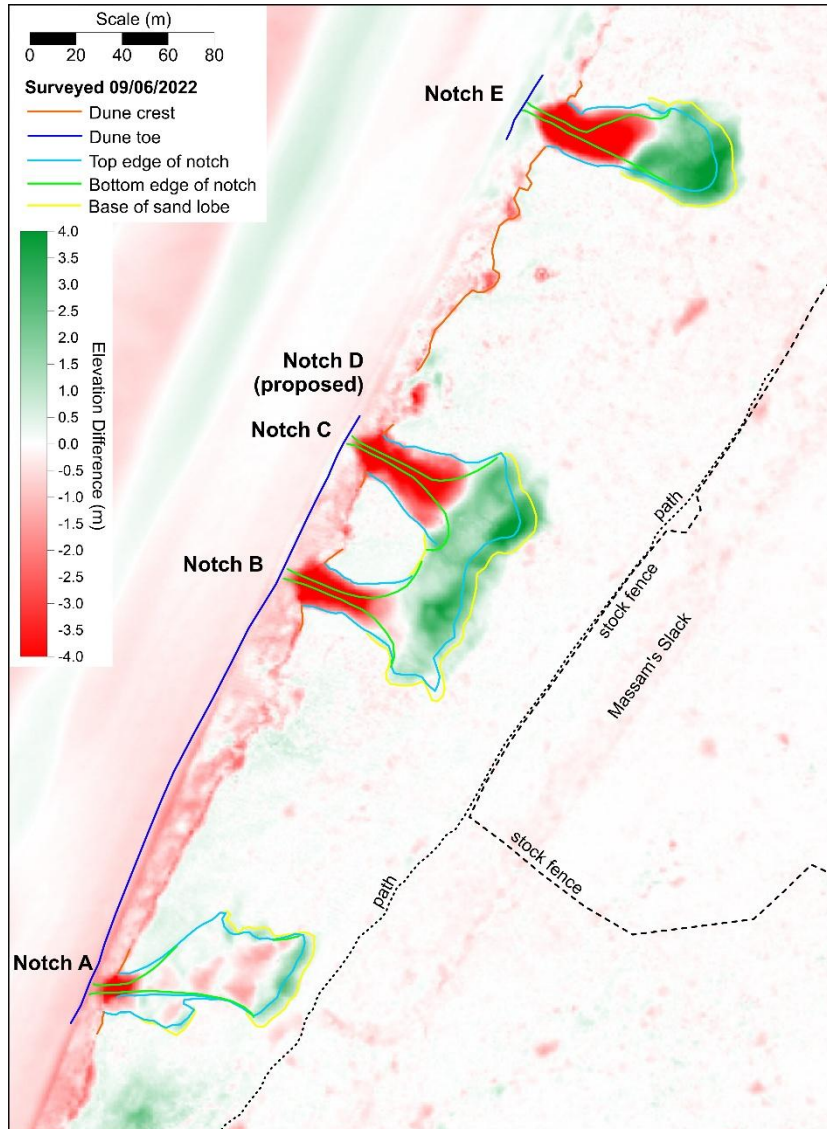
Notching at Ainsdale, taken 2022



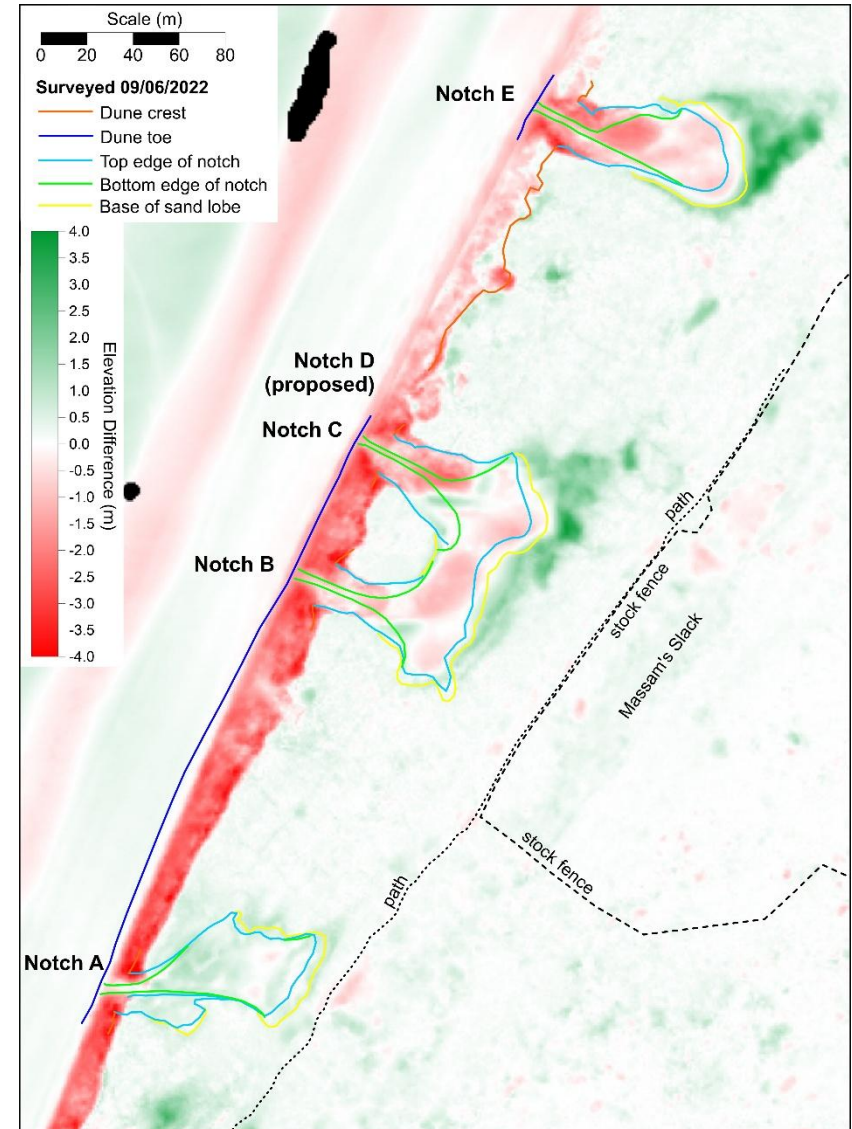
Elevation change at Ainsdale 2020 - 2024



Change 15/10/2020 to 07/12/2022



Change 07/12/2022 to 19/09/2024

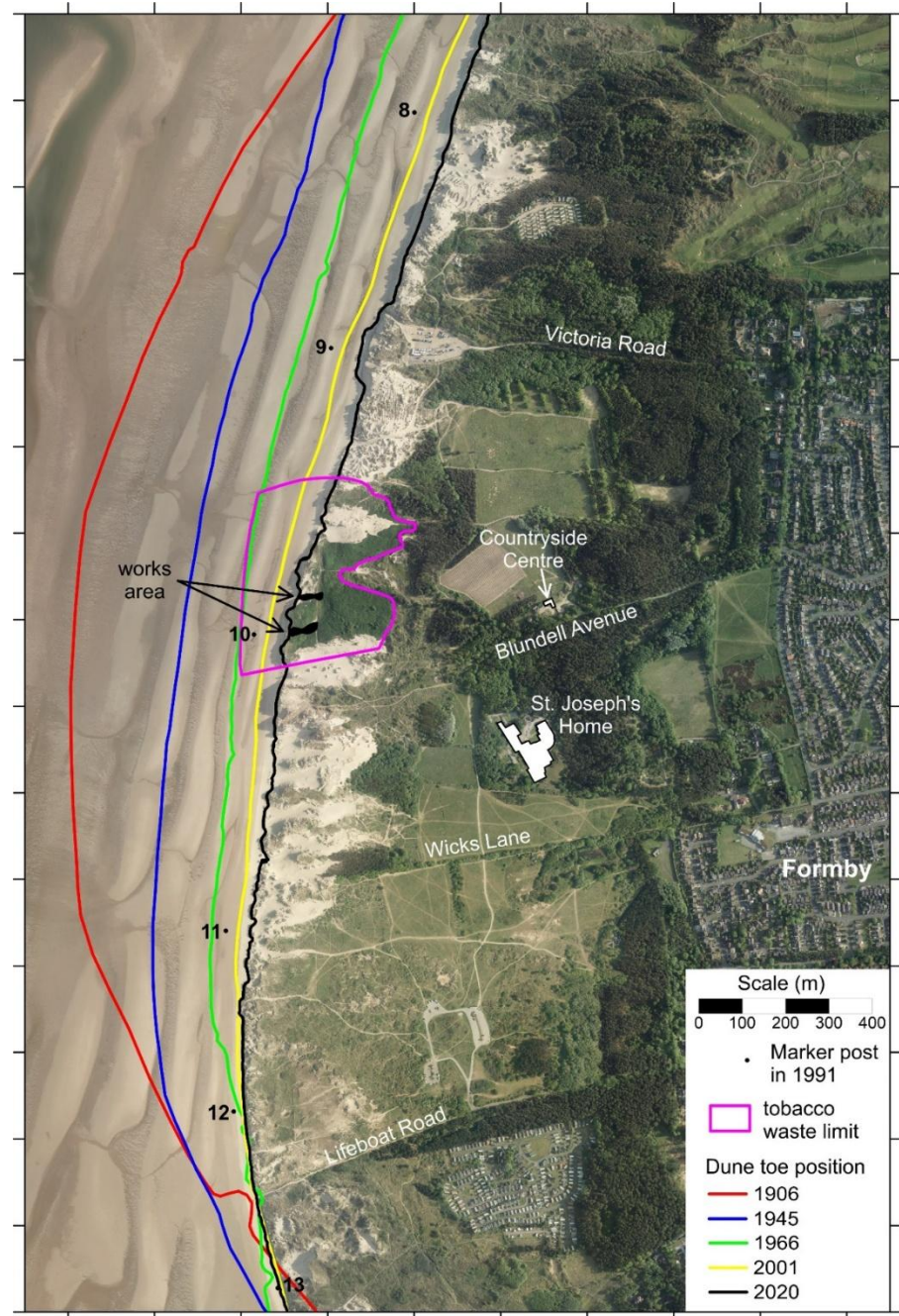


'Notching' at Formby in January 2022

(National Trust, Dynamic Dunescapes project)



Aerial photography
flown 17/05/2018
(EA) with proposed
notches and historical
dune toe positions



'Notching' at Formby in January 2022

Tobacco waste site

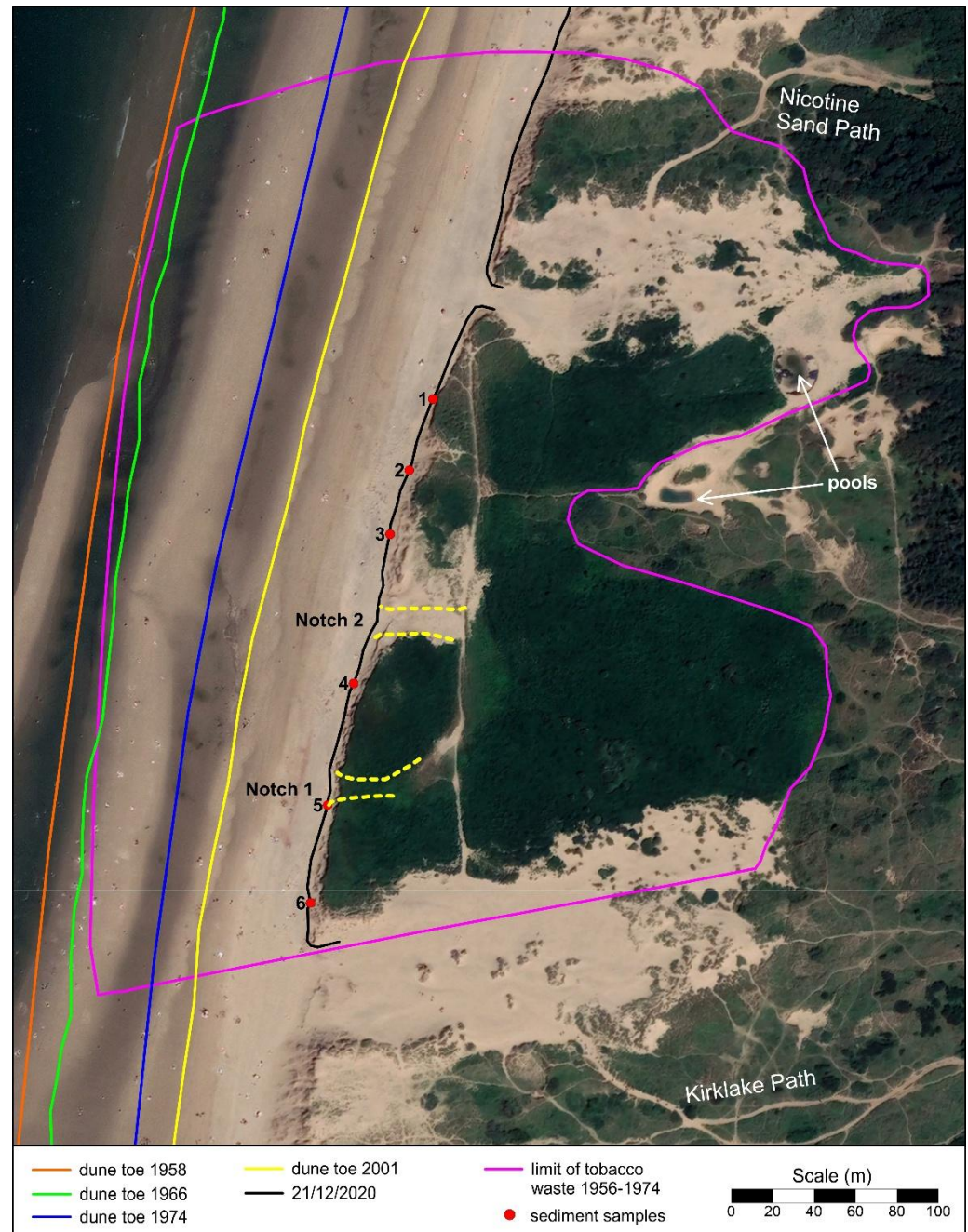
Aerial photography
flown 1966 with
historical dune toe
positions and sediment
sample locations



'Notching' at Formby in January 2022



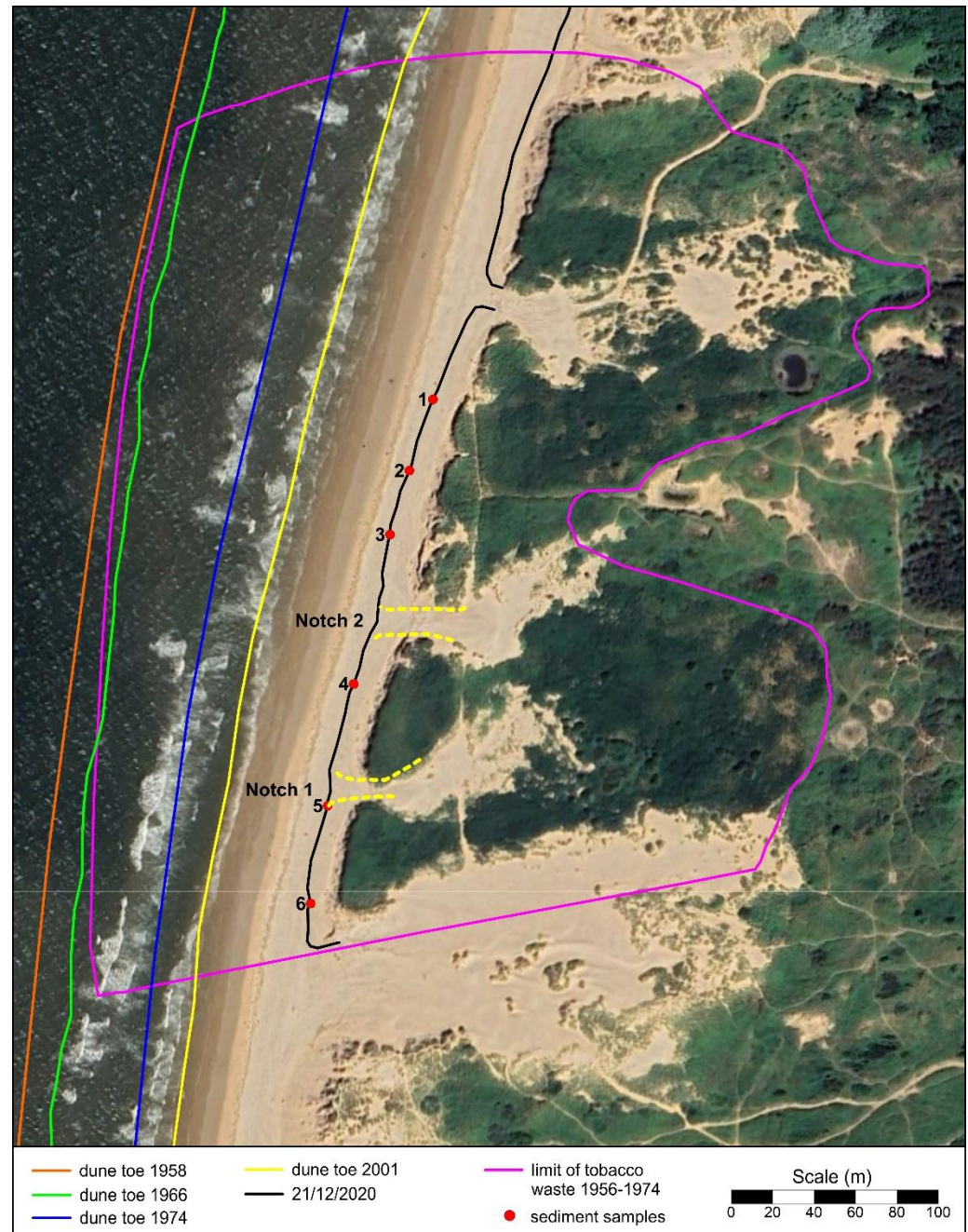
Satellite imagery taken 25/06/2020 with historical dune toe positions and sediment sample locations



Notching at Formby in January 2022



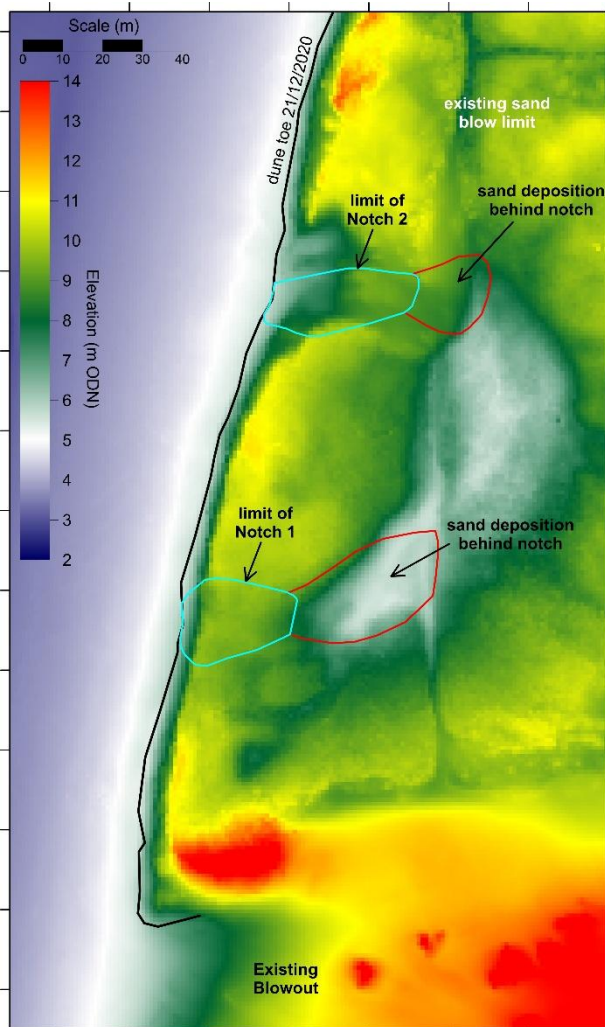
Satellite imagery taken
22/06/2024 with
historical dune toe
positions and sediment
sample locations



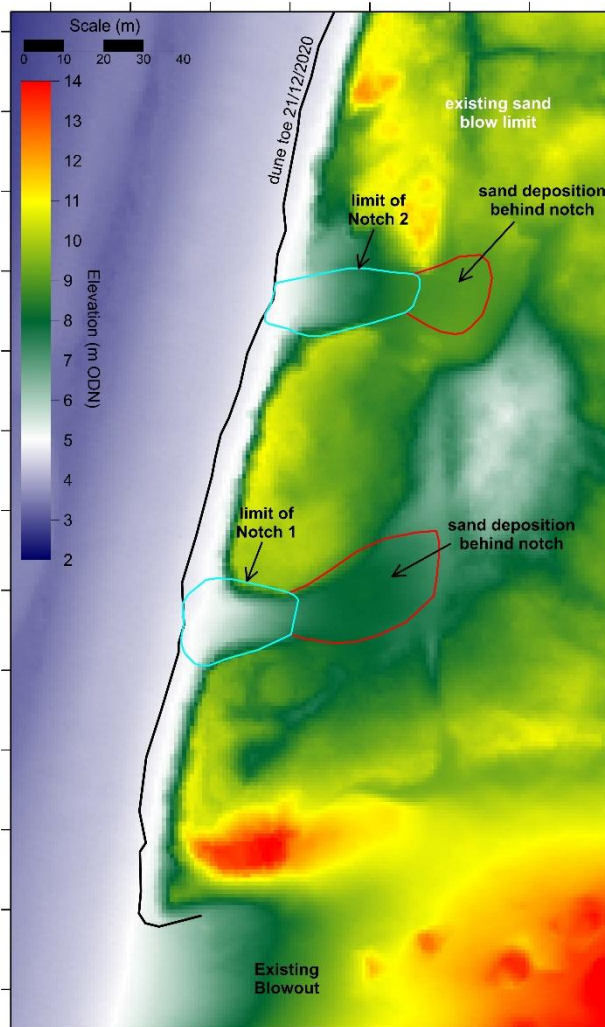
LiDAR Surveys of Formby (1 metre DTMs)



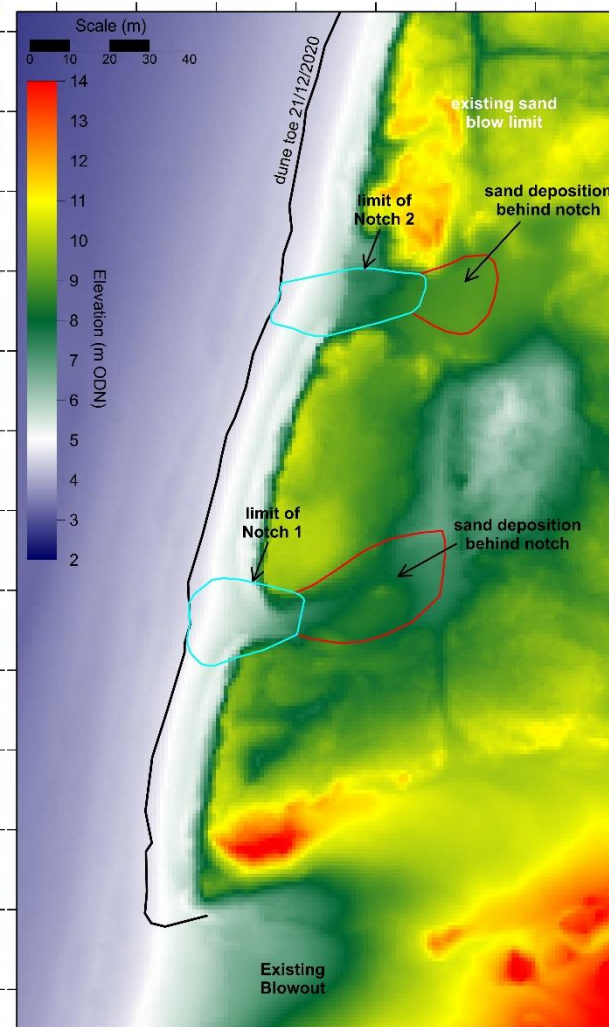
14/10/2020



07/12/2022

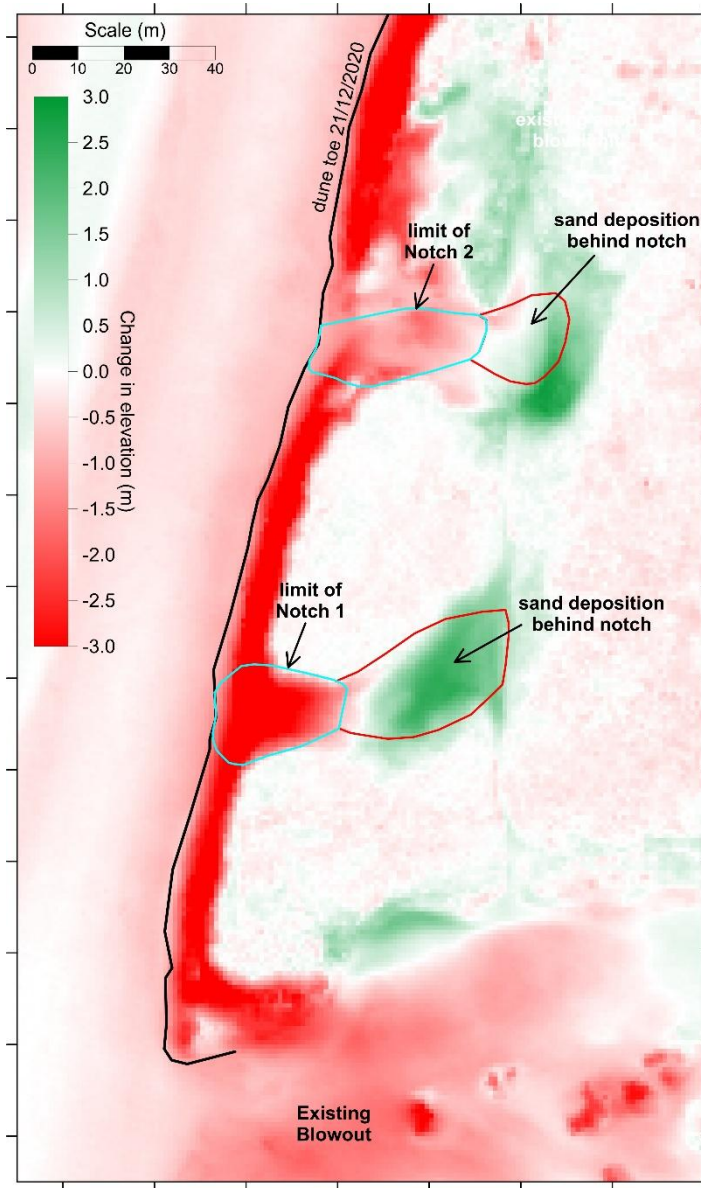


19/09/2024

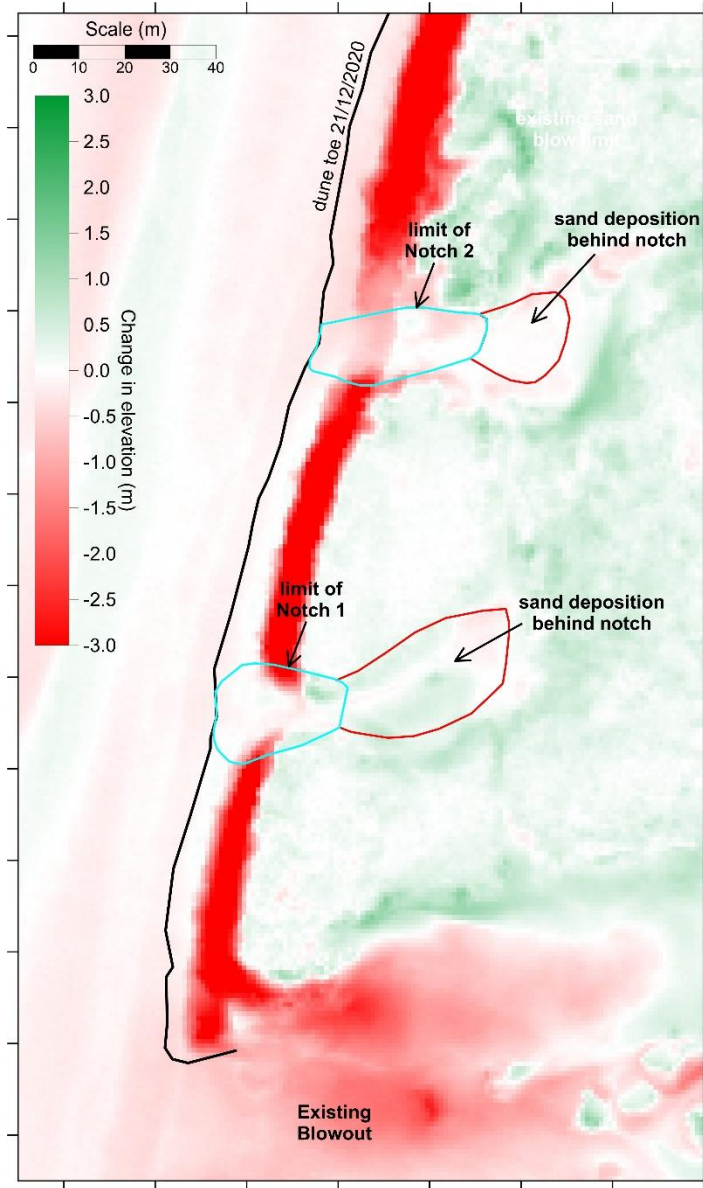


LiDAR Surveys of Formby (1 metre DTMs)

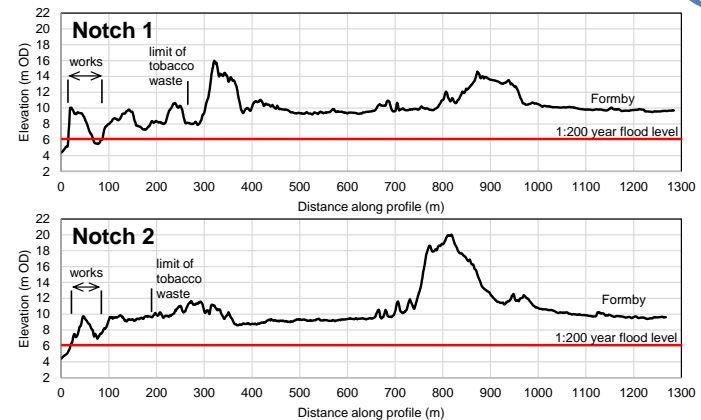
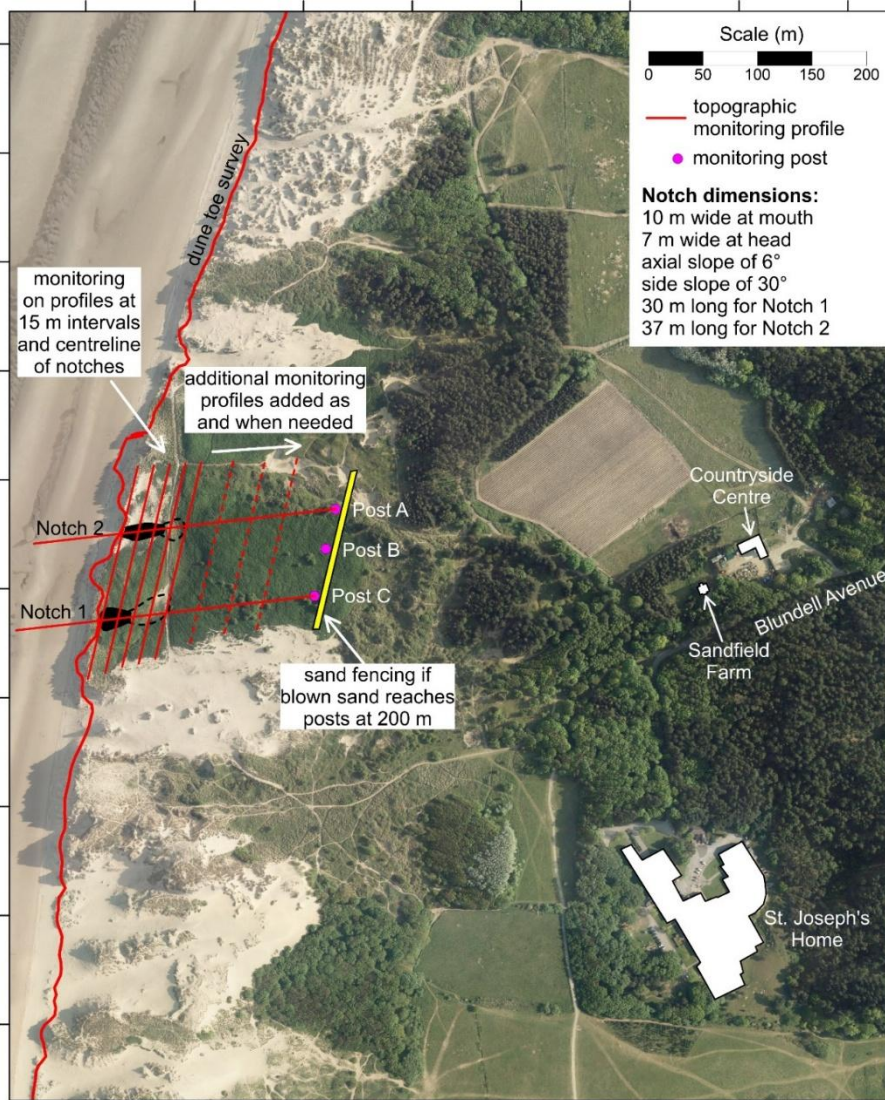
Change 14/10/2020 to 07/12/2022



Change 07/12/2022 to 19/09/2024



Formby Tobacco Waste Notching – Proposed Monitoring Plan



Risk assessment, triggers and mitigation

Identified Risk	Mitigation Measures	Monitoring	Intervention Trigger	Intervention Measures
Coastal erosion	Notches excavated above 1:200 flood level, maximum width at 'mouth' limited to 10 m, spaced 80 m apart with intervening and bordering tobacco waste cliffs acting to maintain erosion rate at current rate	Annual RTK GNSS surveys of the dune toe to assess any change in the long term rate of coastal erosion; upper beach levels and the width and cross-sectional area of each notch to be monitored annually	Recession rate of the dune toe exceeds 2.26 m per year (2005-2019 historical rate plus two standard errors), averaged over a 3 yr period	Erection of sand fencing at the mouth of the notches to limit further wind erosion and movement of beach sand inland through the notches
Coastal flooding	Notches excavated above the extreme 1:200 year flood level of 6.1 m, with sand deposited immediately behind the notch to fill depressions behind	Annual topographic surveys along fixed profiles along and perpendicular to the axes of the notches	Elevation drops below the extreme flood level of 6.1 m OD	Re-profiling of sand to fill low areas using sand deposited from the excavation of the notches
Windblown sand migration onto adjacent property / infrastructure	Notches designed to be narrow (7 m wide at the head) and sloping upwards to limit the amount of sand transported from the beach. Natural high ground 300 m inland (above 12 m ODN) and woodland will prevent sand migrating further than 300 m inland for at least 50 years	Periodic (at least annual) measurement of the landward limit of blown sand relative to 3 fixed posts to be installed 200 m inland of the present cliff edge. Additional annual topographic surveying along fixed profiles along and perpendicular to the axes of the notches. Examination of available aerial photography and LiDAR data at yearly intervals	If significant amounts of blown sand extent within 10 m of the three marker posts, located 200 m inland of the present cliff edge, the requirement for possible intervention measures will be assessed.	Erection of a line of sand fencing behind the marker posts to limit further spread of sand inland. Possible erection of further sand fences across the notches or intervening sand sheets. Possible placement of brushwood and marram planting to stabilize the surface.

Conclusions 1

Has it worked and was it worth it?

- Need a period of at least 10 years for adequate assessment
- Need to define multiple assessment criteria (bare sand area, sand volume, invertebrate numbers, rare plants, effects on shoreline erosion)
- Attempt to separate effects of 'notching' from turf stripping & inland scrapes - assess what would likely to have occurred without 'notching'
- In terms of bare / partially mobile sand area: need to quantify pre-works situation and current position – with qualitative description high to low)
- Overall effect of combined works
- Kenfig Phases 1-3 Moderate to low, declining – still more dynamic than pre-intervention, but significant revegetation
- Merthyr Mawr as above
- Newborough
- Traeth Llanddwyn as above
- Traeth Penrhos as above

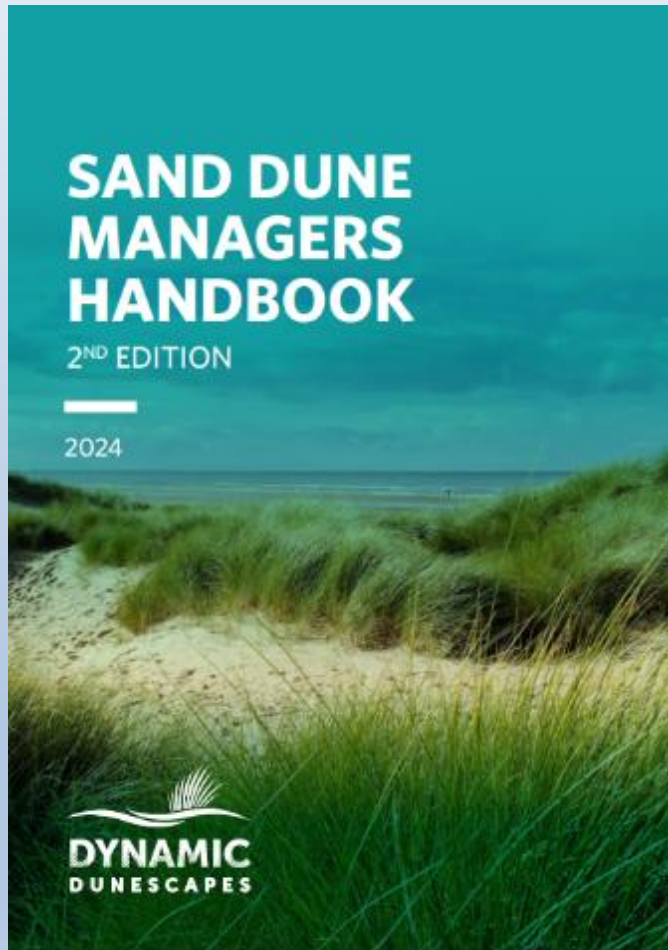
Conclusions 2

Should it be done again and where would the funding come from?

- **Only in selected areas where geomorphological and climatic conditions favour it**
- **Only where there is no increase in coastal flood risk and mobile sand is likely to present a threat to assets**
- **Large scale project funding no longer available from EU and UK Government has other priorities**
- **Possible opportunities from future coast risk management adaptive management funding**
- **Small-scale interventions may be possible with funding from Reserve management budgets and Agri-Environment schemes**



Further information and references




Kenneth Pye Associates Ltd.
Scientific Research, Consultancy and Investigations

Home Research Consultancy Investigations Analysis Services Publications

KPAL is an independent UK-based consultancy company providing a range of specialist survey, analysis, research and investigation services relating to sediments, soils, and earth surface processes.

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Laboratory analyses:



Applications
We undertake work for a number of sectors, including:

