Royal Netherlands Navy

Development of the ‘NAP to Approximate LAT’ matrix for the Port of Rotterdam

NSHC TWG25 (VTC) – 07 Feb 2023

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Hydrographic Service
Geodesy and Tides

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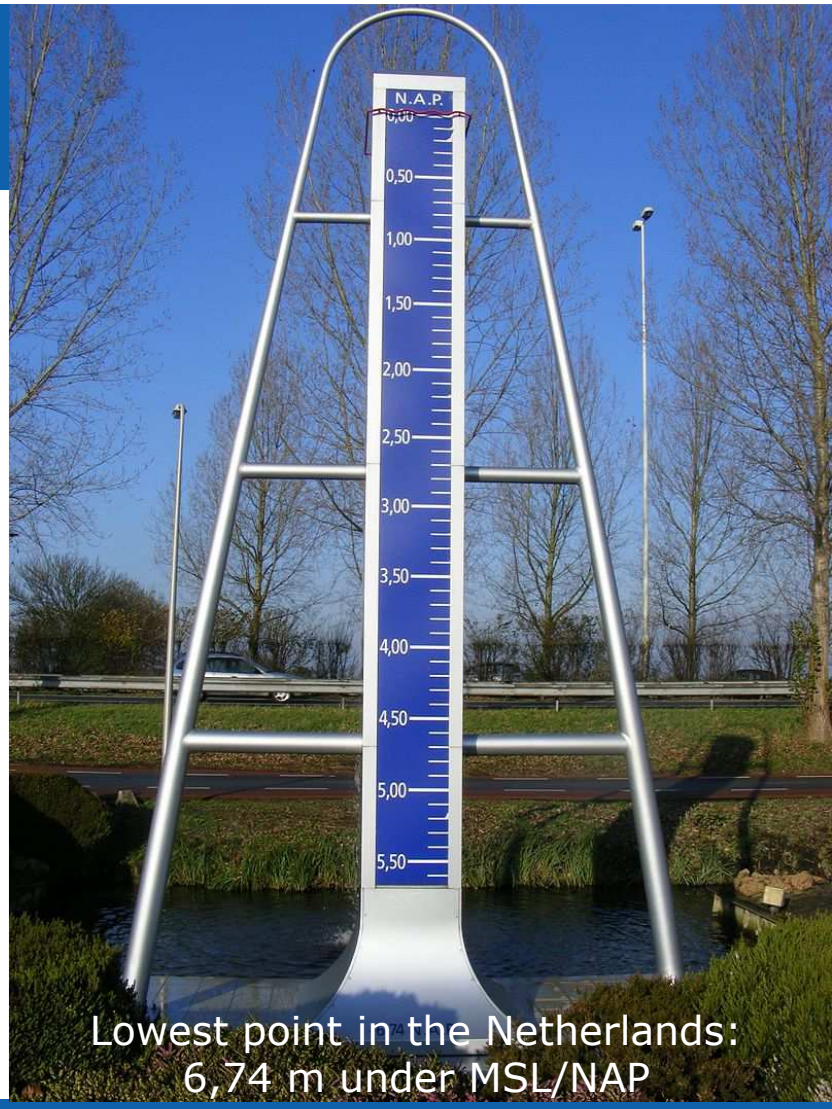
1. Rationale for the project

- NLLAT2018 is the standard at sea
- NAP (~MSL) in Rotterdam harbor (until 2022)
- Relation (Approximate)LAT-NAP needs to be known throughout the harbor.

What is available?

- NLLAT2018 on the Dutch Continental Shelf and in internal waters
- Vertical reference in Port of Rotterdam: NAP (Dutch national height reference for land)



Lowest point in the Netherlands: 6,74 m under MSL/NAP

1. Rationale for the project (2)

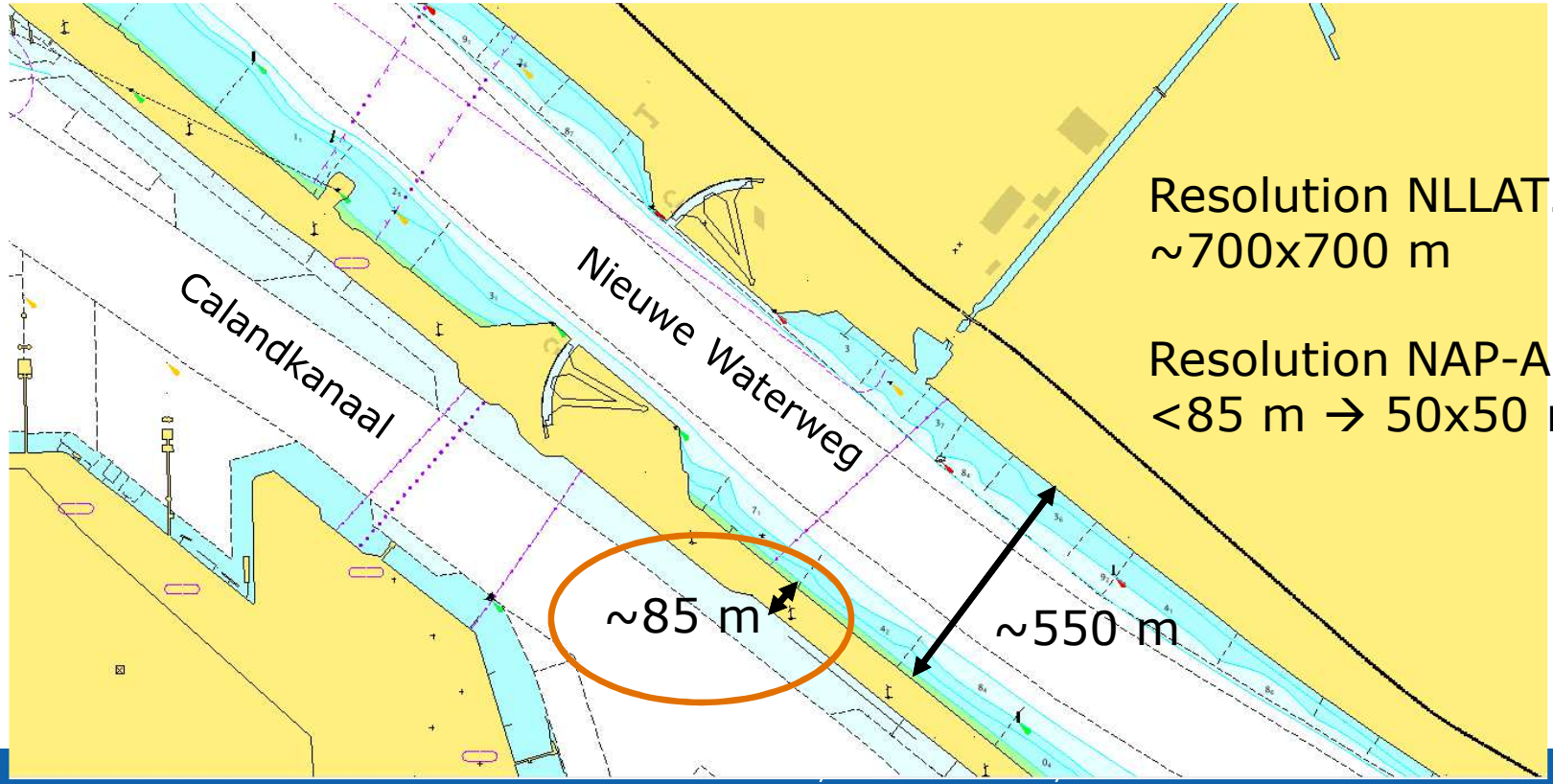
What should be the outcome?

- A high resolution matrix to transform between NAP and (Approximate) LAT in the (greater) Port of Rotterdam area.

Parties involved:

- Port of Rotterdam
- Rijkswaterstaat (Ministry of Infrastructure and Water Management)
- The Netherlands Hydrographic Office

Which ‘high resolution’ is needed?



Resolution NLLAT2018:
~700x700 m

Resolution NAP-ALAT:
<85 m → 50x50 m

Smooth interpolation between tidal stations, for example Hoek van Holland and Maasslui

2. Construction of the NAP-ALAT matrix

Which input data is needed?

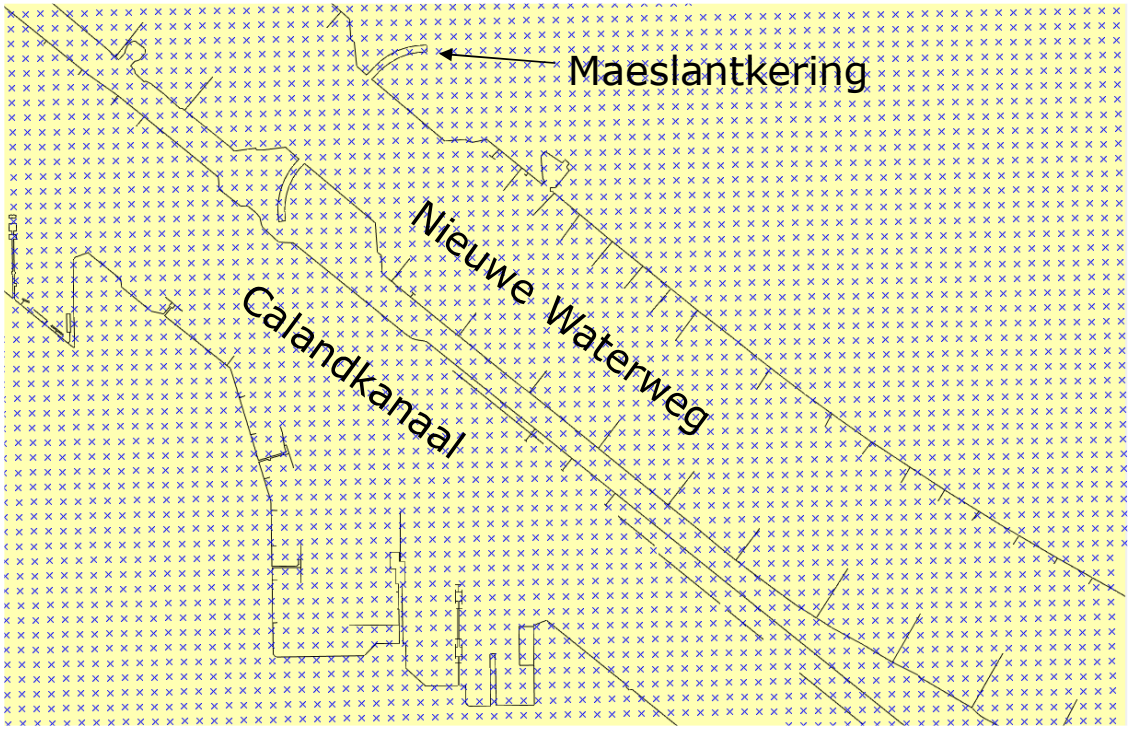
- High density grid: 50x50 meter
- NAP to ALAT values at tidal stations
- Knowledge of hydrodynamic models: how does the water behave between or beyond the tidal stations? How to interpolate?
- Location of shipping lanes, harbors and coastlines.

Coordinate system: Dutch 'RD' (projected coordinates, EPSG 28992)

- Why not ETRS89? → Special product / avoid confusion with NLLAT2018.
- Area: ca 51.7-52.0N, 3.95-4.75E (ETRS89)
  (RD x: 56300-130000; RD y: 407550-450000)

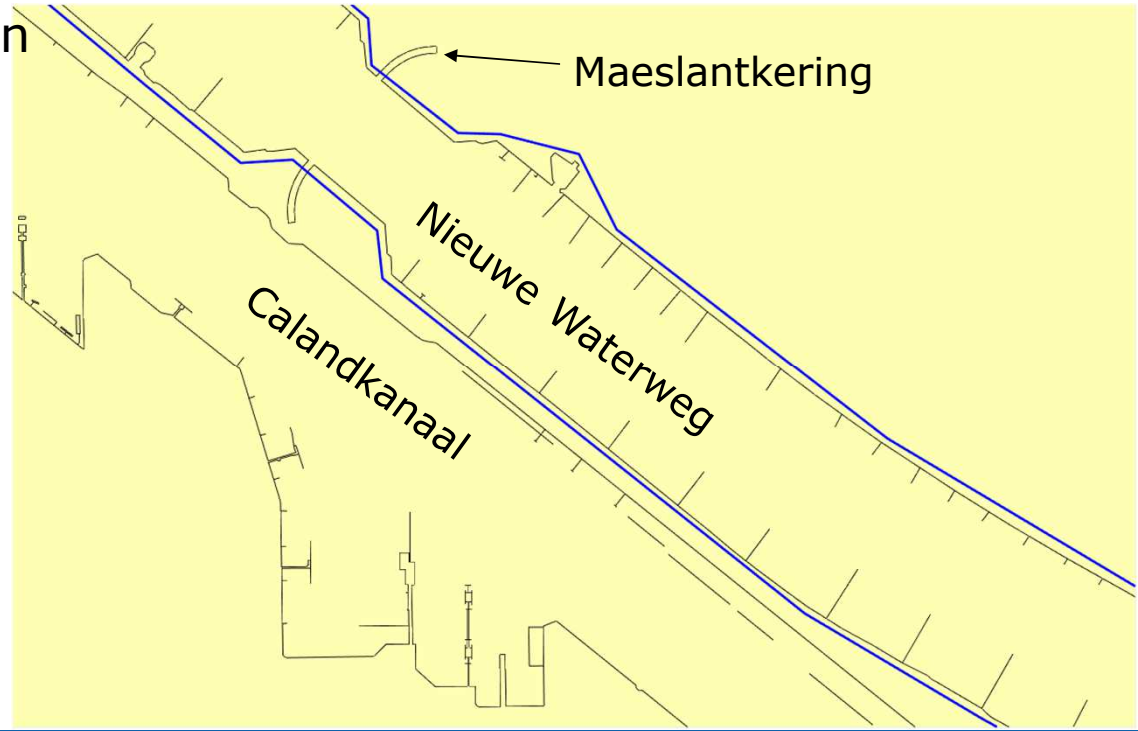
2. Construction of the NAP-ALAT matrix

- Step 1: create high density grid



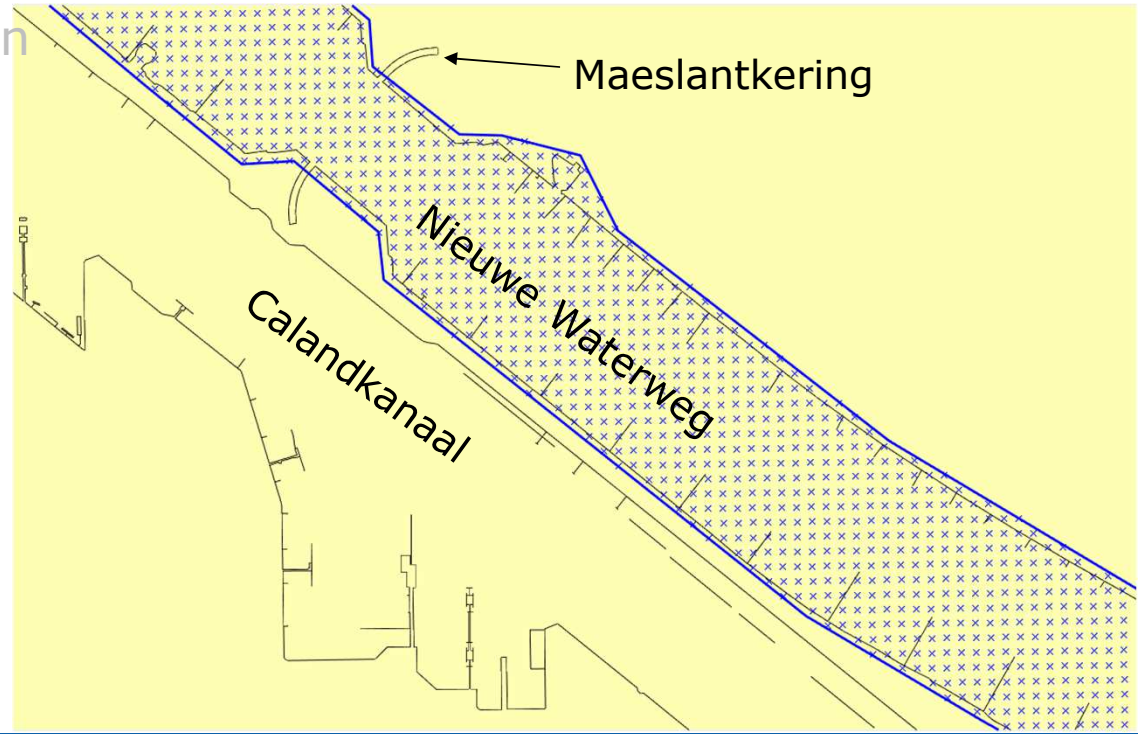
2. Construction of the NAP-ALAT matrix

- Step 1: create high density grid
- Step 2: define polygons between tidal stations (source: NLHO ENC's)



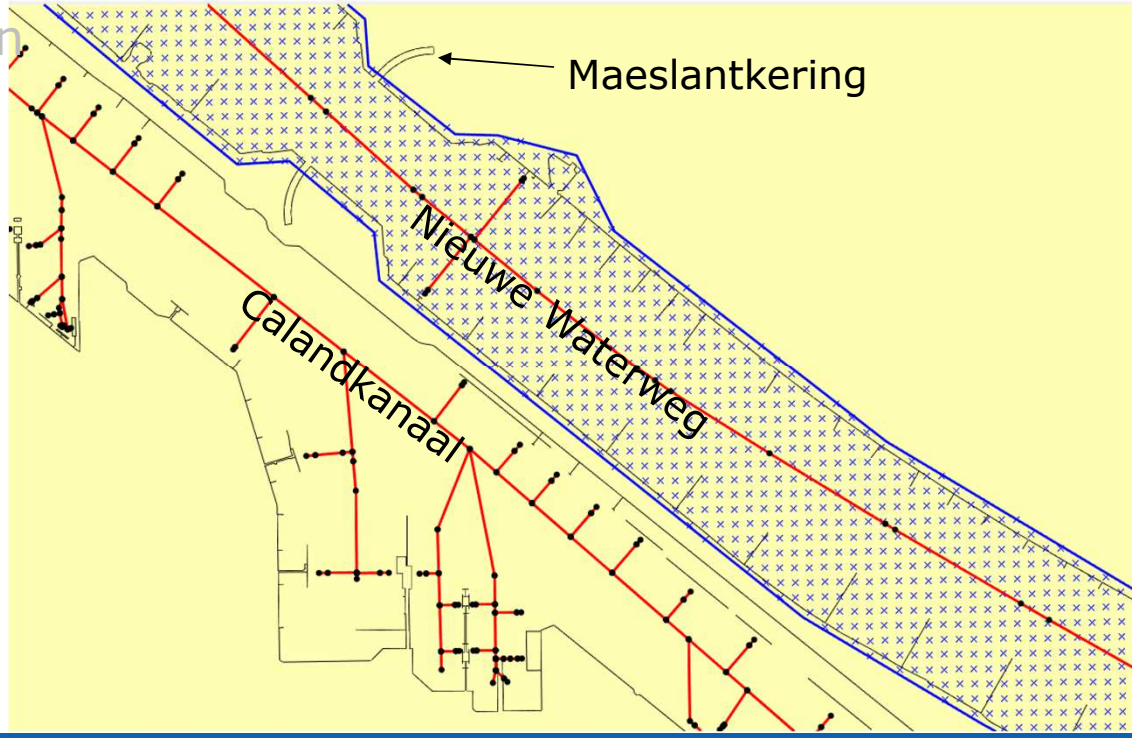
2. Construction of the NAP-ALAT matrix

- Step 1: create high density grid
- Step 2: define polygons between tidal stations (source: NLHO ENC's)
- Step 3: find grid points within each polygon



2. Construction of the NAP-ALAT matrix

- Step 1: create high density grid
- Step 2: define polygons between tidal stations (source: NLHO ENC's)
- Step 3: find grid points within each polygon
- Step 4: find fairway axis within each polygon



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- Step 1: create high density grid
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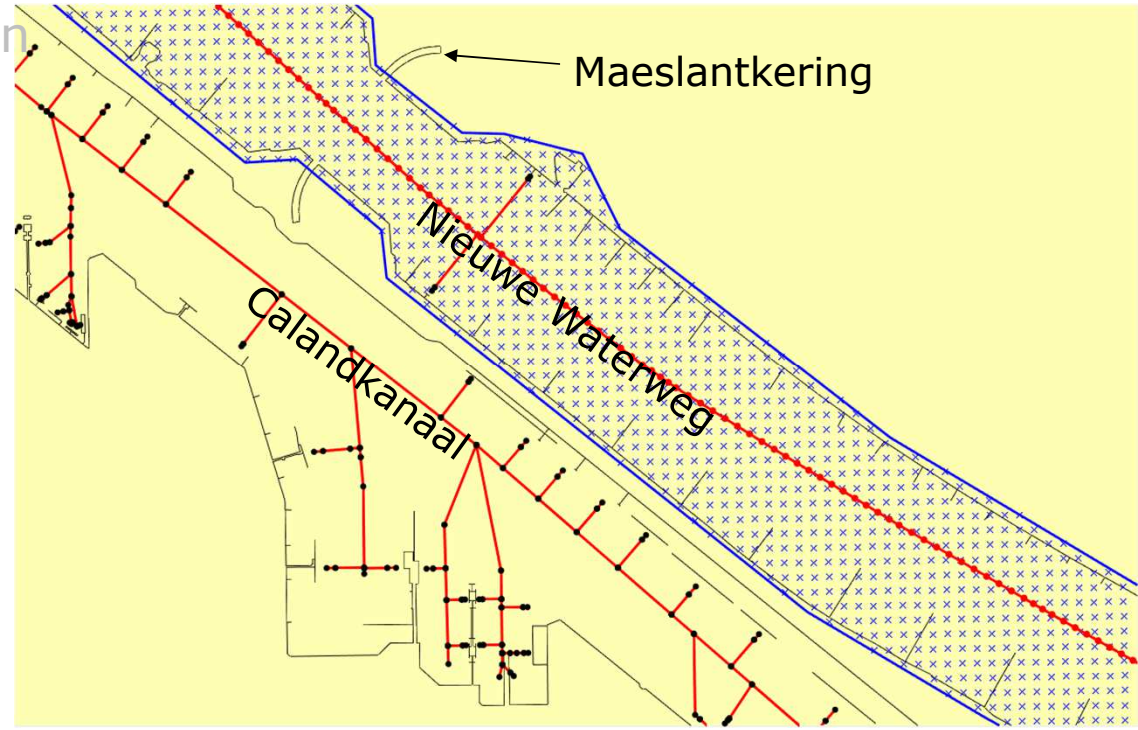
- Step 3: find grid points within each polygon
- Step 4: find fairway axis within each polygon
- Step 5: densify points along fairway axis (1x per max. 50 meter)



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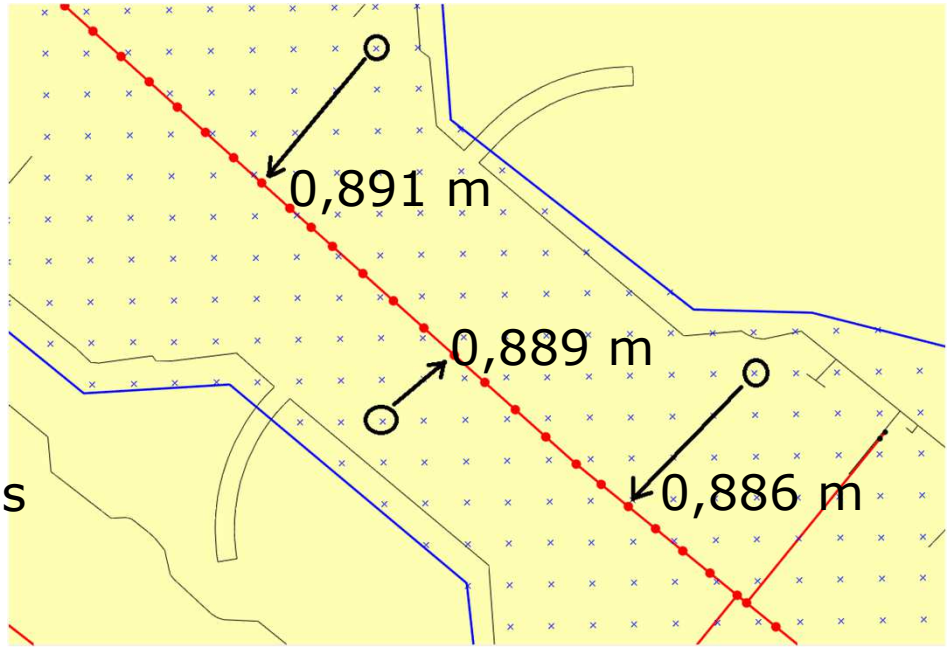
- Step 6: for each point in polygon, find nearest point on (densified) fairway axis and take according NAP-ALAT value.



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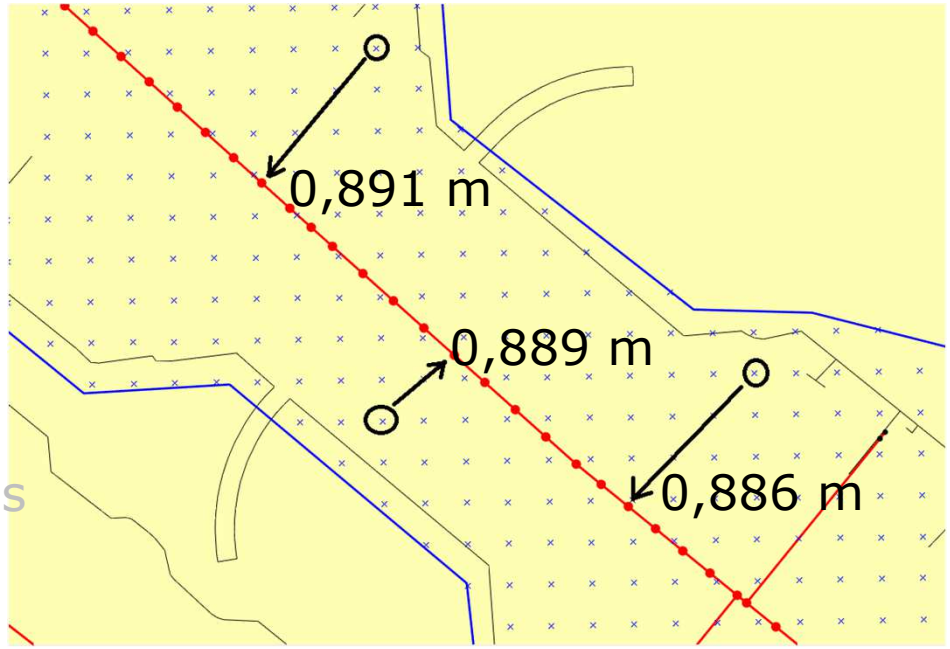
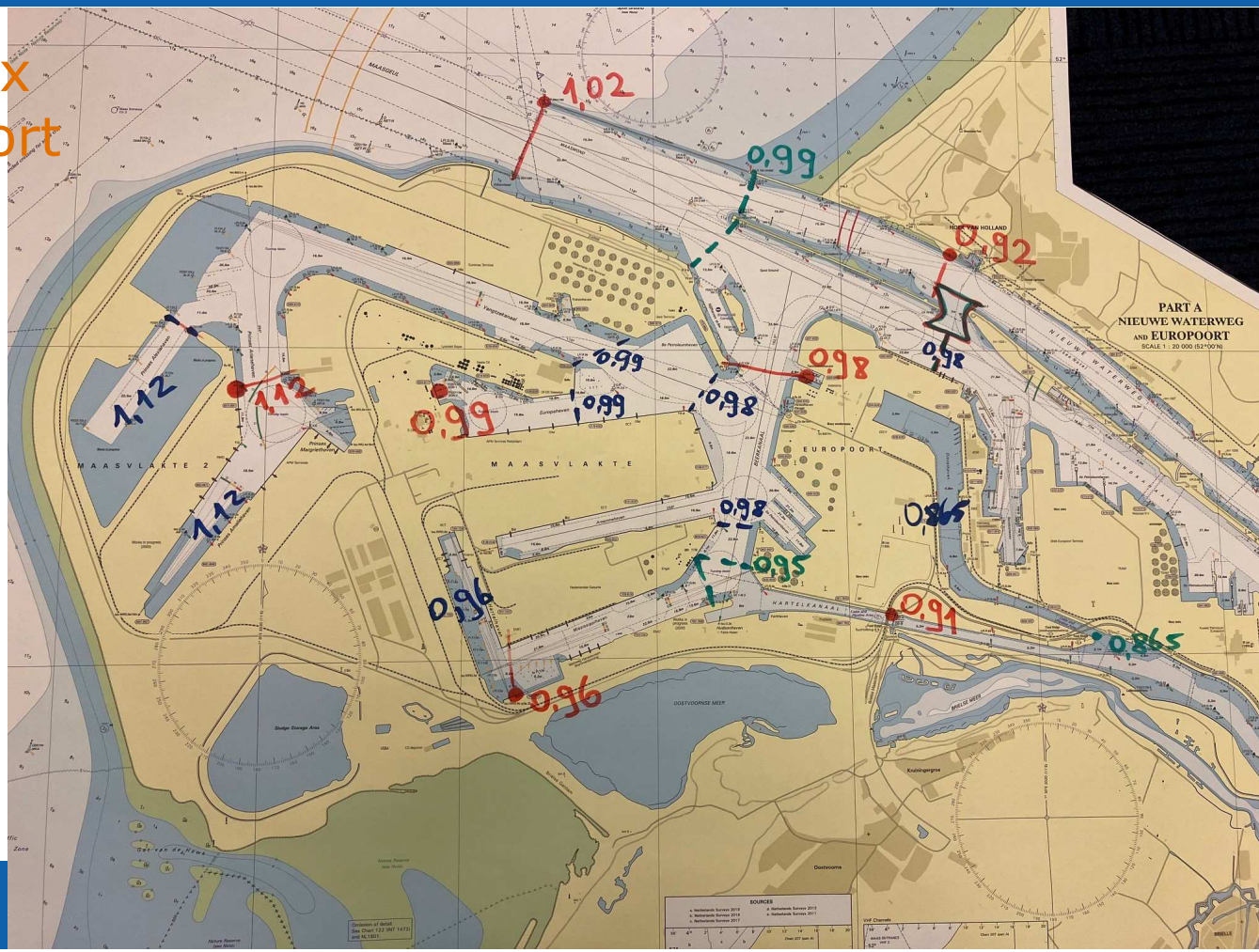
- Repeat for each polygon and combine.



Input values for matrix (Maasvlakte / Europoort area shown)

- Red = known value at tidal station
- Green = derived by interpolation
- Blue = constant value in harbor bassin

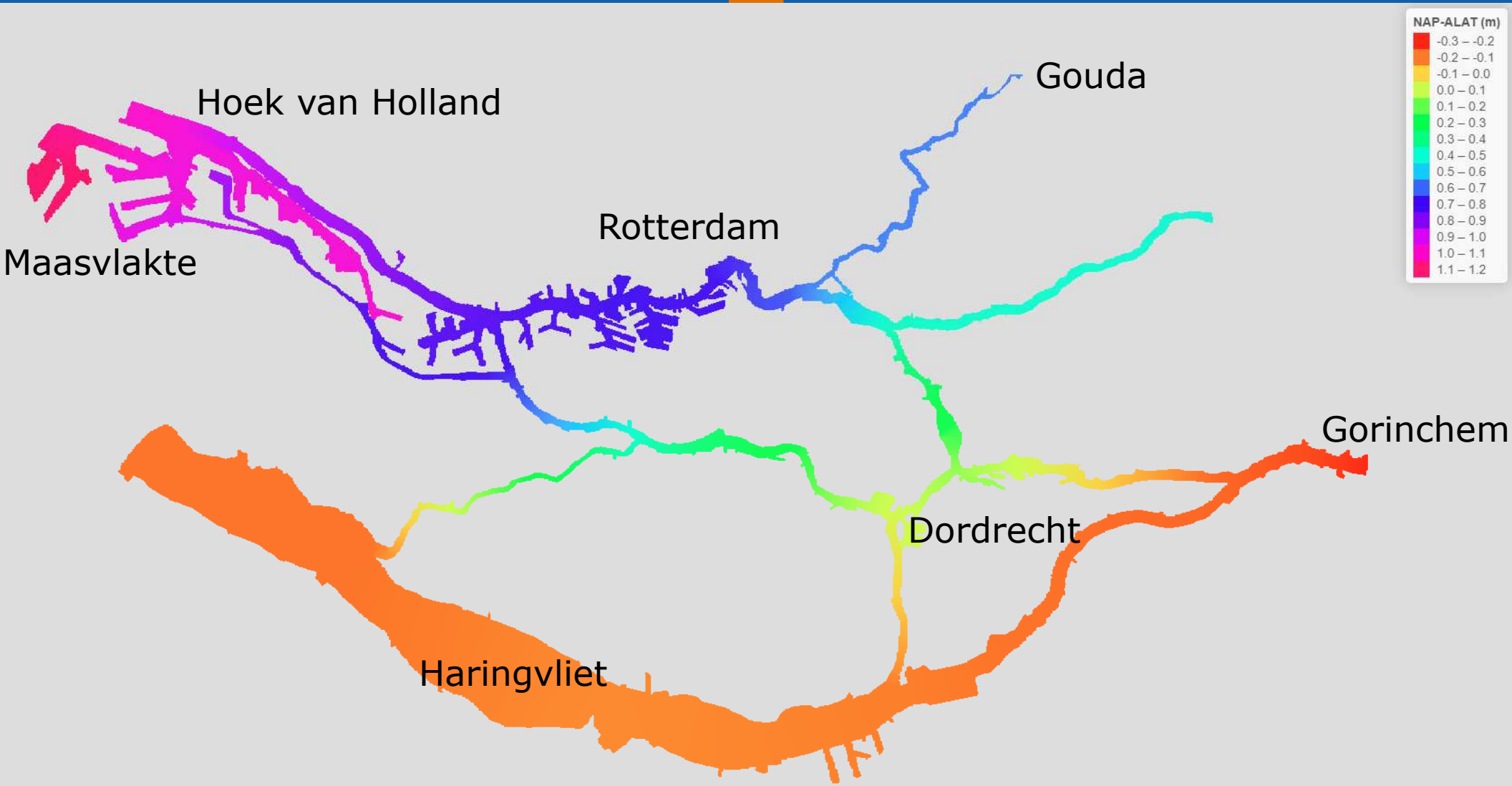


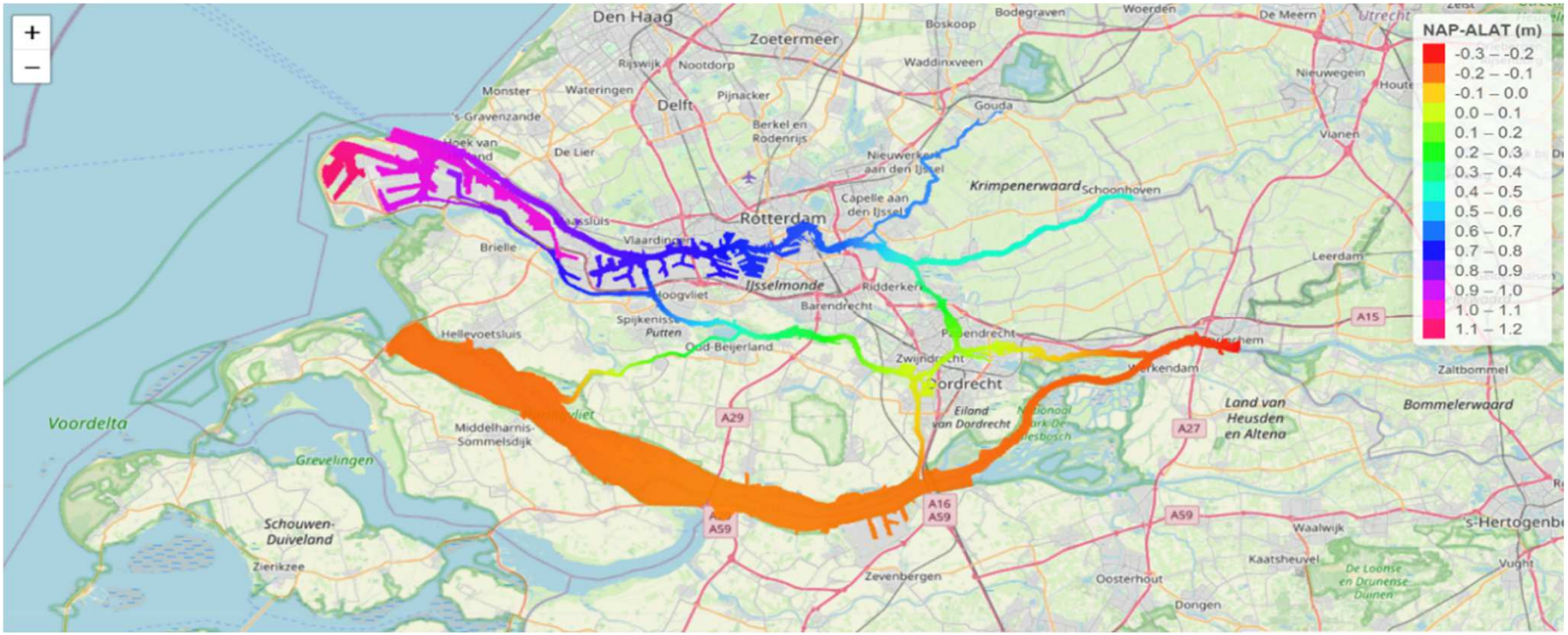
ALAT-NAP matrix (first lines)

ALAT_HBR_RD_2021.txt - Kladblok

Bestand Bewerken Opmaak Beeld Help

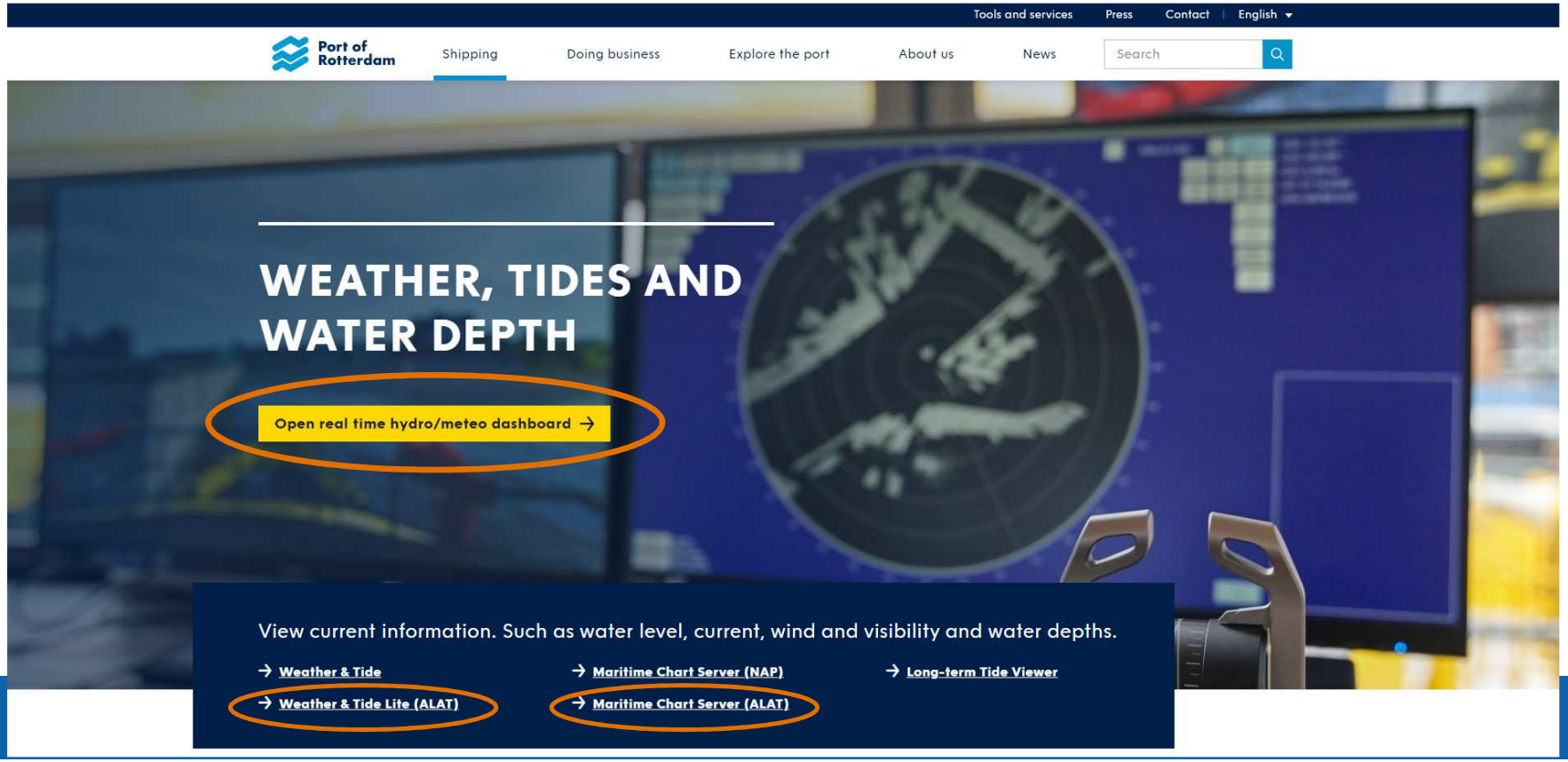
```
column 1: x_coordinate_RD_(meters)
column 2: y_coordinate_RD_(meters)
column 3: NAP_quasi_geoid_height_above_Lowest_astronomical_tide_height_(m)
column 4: NAP_quasi_geoid_height_above_ETRS89_ellipsoid_(m)
column 5: Lowest_astronomical_tide_height_above_ETRS89_ellipsoid_(m)
 57400   441850   1.120   43.614   42.495
 57400   441900   1.120   43.614   42.494
 57400   441950   1.120   43.613   42.493
 57400   442000   1.120   43.612   42.492
 57400   442050   1.120   43.612   42.492
 57400   442100   1.120   43.611   42.491
 57400   442150   1.120   43.610   42.490
 57400   442200   1.120   43.610   42.490
 57400   442250   1.120   43.609   42.489
 57400   442300   1.120   43.608   42.488
 57450   441700   1.120   43.617   42.497
 57450   441750   1.120   43.616   42.496
 57450   441800   1.120   43.615   42.495
 57450   441850   1.120   43.614   42.495
 57450   441900   1.120   43.614   42.494
 57450   441950   1.120   43.613   42.493
 57450   442000   1.120   43.612   42.492
 57450   442050   1.120   43.612   42.492
 57450   442100   1.120   43.611   42.491
 57450   442150   1.120   43.610   42.490
 57450   442200   1.120   43.610   42.490
```


NAP-ALAT (m)
-0.3 – -0.2
-0.2 – -0.1
-0.1 – 0.0
0.0 – 0.1
0.1 – 0.2
0.2 – 0.3
0.3 – 0.4
0.4 – 0.5
0.5 – 0.6
0.6 – 0.7
0.7 – 0.8
0.8 – 0.9
0.9 – 1.0
1.0 – 1.1
1.1 – 1.2
Gouda
Hoek van Holland
Rotterdam
Maasvlakte
Gorinchem
Dordrecht
Haringvliet


NAP-ALAT (m)
-0.3 – -0.2
-0.2 – -0.1
-0.1 – 0.0
0.0 – 0.1
0.1 – 0.2
0.2 – 0.3
0.3 – 0.4
0.4 – 0.5
0.5 – 0.6
0.6 – 0.7
0.7 – 0.8
0.8 – 0.9
0.9 – 1.0
1.0 – 1.1
1.1 – 1.2
Den Haag
Zoetermeer
Delft
Rotterdam
Dordrecht
Krimpenerwaard
IJsselmonde
Voordelta
Grevelingen
Schouwen-Duiveland
Land van Heusden en Altena
Bommelerwaard
Eiland van Dordrecht
Gouda
Schoonhoven
Brielle
Hellevoetsluis
Middelharnis-Sommelsdijk
Zierikzee
Zevenbergen
Oosterhout
Dongen
Waalwijk
Kaatsheuvel
Vianen
Leerdam
Zaltbommel
Nieuwegein
Waddinxveen
Boskoop
Bodegraven
Woerden
De Meern
Utrecht
Monster
Wateringen
Pijnacker
Berkel en Rodenrijs
Nootdorp
Rijswijk
Barendrecht
Ridderkerk
Spijkenisse
Putten
Oud-Beijerland
Hoogvliet
Vlaardingen
Capelle aan den IJssel
Nieuwerkerk aan den IJssel
De Lier
A29
A59
A16
A27
A15
Vught
De Loonse en Drunense Duinen

3. Publicity / visibility at the Port of Rotterdam

https://www.portofrotterdam.com/en/up-to-date-information/weather-tides-and-water-depth



Hydro/meteo dashboard

real-time info, referred to NAP…

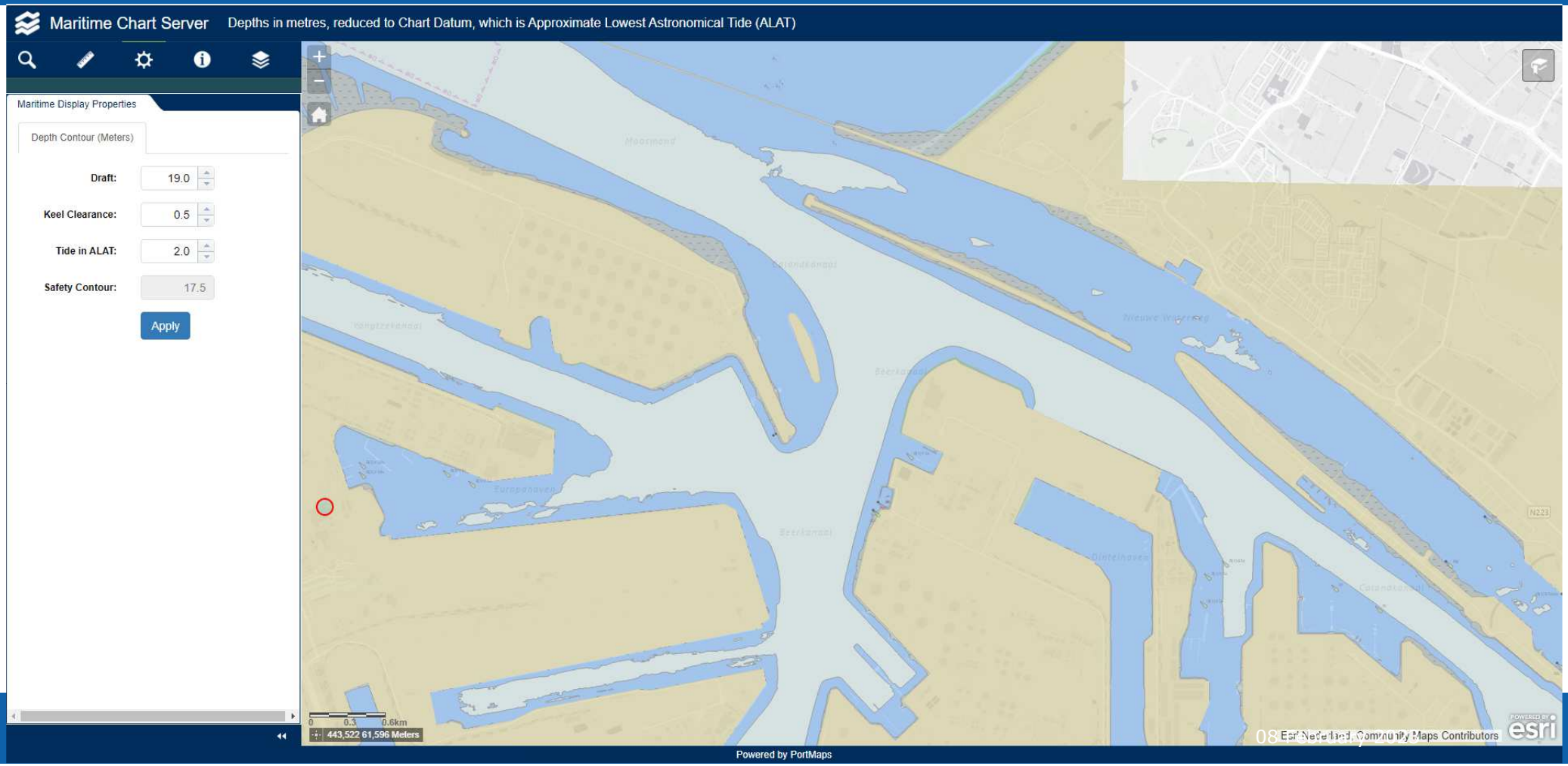
08 February 2023

Hydro/meteo dashboard

real-time info, referred to ALAT

Maritime Chart Server

real-time safety contours, referred to ALAT



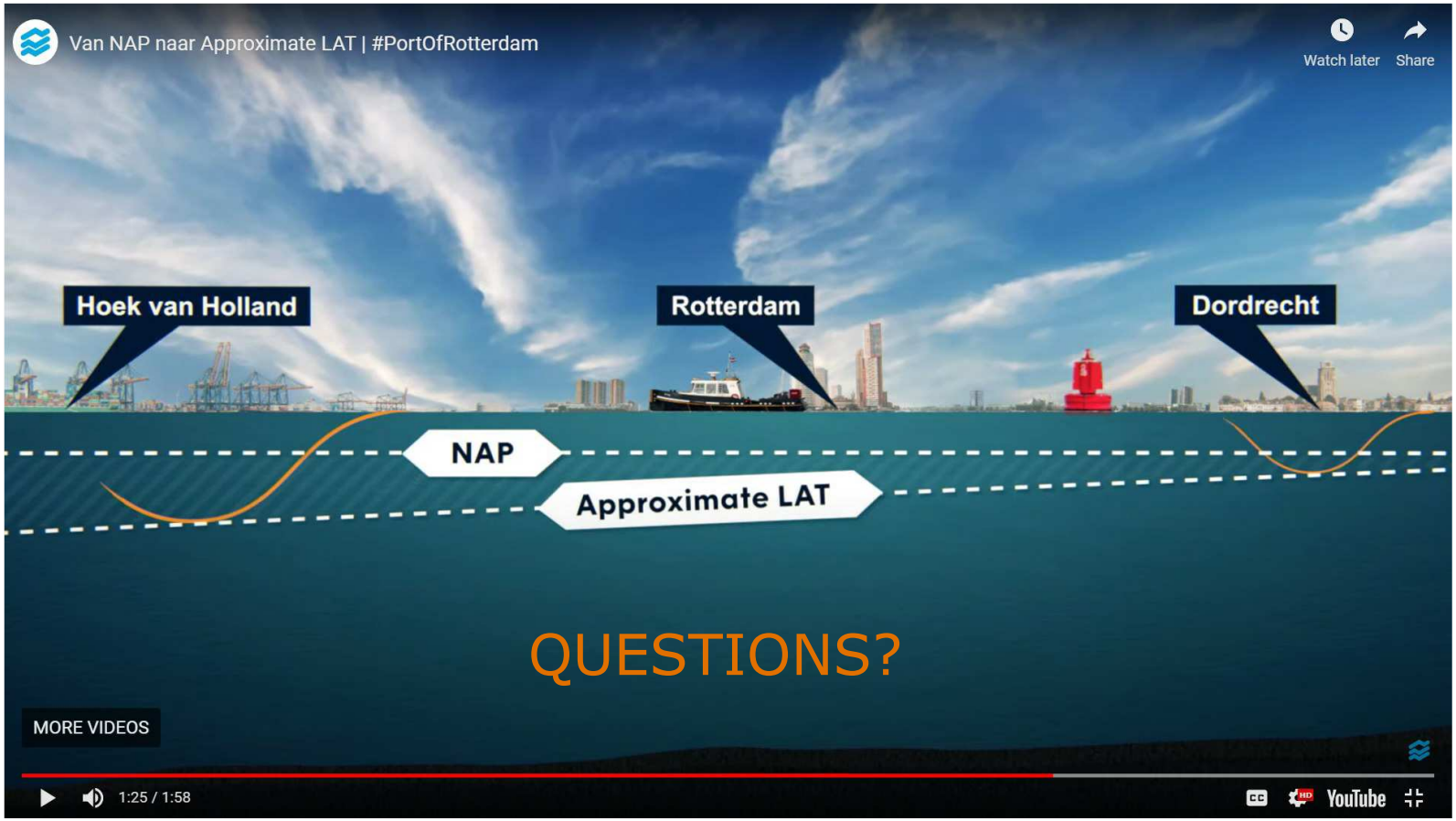
4. Future maintenance

Yearly heads-up between the parties involved:

- Port of Rotterdam
- Rijkswaterstaat (Ministry of Infrastructure and Water Management)
- The Netherlands Hydrographic Office

Questions to be answered:

- Changes / extensions in harbors?
- NAP-ALAT values at tidal stations still valid?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QUESTIONS?