Offshore Wind farm Egmond aan Zee

Benthos densities

OWEZ_R_261_T1_20080213 draft

Progress report

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This project is carried out on behalf of NoordzeeWind, through a sub contract with Wageningen-Imares

NoordzeeWind

Introduction

In 2006 an offshore wind farm has been constructed in the North Sea, at ≈7 miles off the coast near Egmond aan Zee, the Netherlands. The first years of operation of this wind farm are accompanied by an intensive monitoring and evaluation programme on the possible environmental impact of the construction of the park. This programme includes research and/or monitoring projects related to (almost) all major categories of organisms relevant to the area involved.

One of the monitoring items concerns the fate of the benthic faunal community following the construction of the energy park. Questions underlying this monitoring programme focus on the immediate effects of the presence of the park on the actual benthic community and on the long-term effects on the benthic community within the zone of the windmills. In order to obtain insight in these questions a benthic sampling programme has been started in 2007 on possible short term (<1 year after construction) effects on the benthic fauna. In this interim report the progress of this study during 2007 is presented and a planning is given of the work that still has to be executed. The final report will be available in the 4th quarter of 2008.

Progress

Fieldwork has been carried out in the period 20 - 26 March 2007 on board of the research vessel Pelagia. The field programme consisted of collecting benthic fauna samples within the area of the windmills as well as in six smaller control areas. Three of these areas were chosen north of the wind farm and the other three south of it. The benthic macrofauna was sampled with a 0.078 m^2 boxcorer and a Triple-D benthic dredge. This dredge had a cutter plate width of 20 cm and digged to a depth of 18 cm in the sediment. The net mounted on the dredge had a mesh of 7x7 mm. The dredge was adjusted to a sampling distance of 80 m, so each sample represented the fauna present under a 16 m^2 surface area. The boxcorer is used to sample the small (generally 1 to 10 mm) more or less abundant fauna species. The dredge is used to sample the less abundant and larger species, which cannot be sampled quantitatively by the boxcorer.

Boxcores were collected at 30 stations within the area of the turbines, one boxcore per station. The stations were arranged along transects running parallel to the windmill rows. In each of the control areas 15 boxcore samples were taken on three parallel transects. On board the boxcores were washed through a 1 mm mesh sieve and the residue was preserved in a 6% neutralized formaldehyde solution for later analysis in the laboratory.

Dredge hauls were made along 14 transects in the area of the windmills, and along two transects in each of the control areas. The catches were sorted and counted on board and the animals in the samples (or in subsamples) were measured. In fact all dredge sample data were collected on board. The dredge hauls were made particularly to compare its efficiency with that of the dredge used by the University of Hull in 2003 (T_0).

In the laboratory all boxcore samples were sorted. Before sorting, each sample was stained with bengal rose, which stains proteins present in animals that were caught alive with the boxcorer. In this way bengal rose creates a strong contrast between living and dead material, which facilitates sorting of the samples. The stained samples were washed over a set of nested sieves with 1 mm as the smallest mesh size to get rid of the formaldehyde. Then the various sieve fractions were examined under an illuminated magnifying lens to separate fauna from dead material, mainly shell grit. Subsequently the macrofauna was identified under a stereomicroscope. The most common groups, being the polychaetes, crustaceans, molluscs and echinoderms were generally identified to species level. Damaged animals and juveniles, which because of their small size could not be identified to species level, were recorded on a higher taxonomic level, usually the genus. Notoriously different taxa such as anthozoans, phoronids, oligochaetes and nemerteans were not further identified but counted on their taxon level.

In order to obtain biomass values for each species, the blotted wet weight of the animals present in a sample was determined on a Mettler balance. This was done for polychaetes, crustaceans and all rest groups. The biomass in g ash free dry weight (afdw) can lateron be determined by converting the wet weight into g afdw by means of known conversion factors. Molluscs and echinoderms were not weighed but the size of each individual was measured to the nearest millimeter and afdw can later be calculated by applying known length-weight relationships of the form $W = a*L^b$, where W = afdw in g and L is length in mm, and a and b are species specific constants.

The boxcore samples were all sorted in 2007. Identification and determination of basic biomass values were completed for about 70 % of the samples. It is foreseen that this work will be finished in the first quarter of 2008. In

this same period the basic data will be imported in a data file and analysis of the data will start. The data analysis will be finished in the second trimester of 2008 and the final report will be available in the 4th quarter of 2008.

All triple-D dredge data have been imported in data files. Further the major data analyses were completed. Differences and resemblances between the fauna composition in the various areas were quantified by calculating Bray-Curtis indexes for percentage similarity. In order to prevent that a few abundant species would disproportionally dominate the between station similarities, the method was applied to squareroot transformed abundance data of the individual species. The results of the calculations showed that there was generally 'rather good' (between 60 and 80%) similarity between the areas. The similarity between the windmill area and the control areas was generally not lower than the similarity between the various control areas themselves. This indicates that in terms of faunal similarity there was no measurable effect on the 'dredge fauna' in the wind farm.

Relative fauna abundance was calculated for each pair of stations in the control areas and for seven pairs of stations in the area of the windmills. Differences in relative abundance were tested for statistical significance by applying analysis of variance. This was done separately for the macrobenthos and for the fish that was caught by the dredge. Further the diversity of the fauna in the dredge hauls was quantified in terms of species richness and by calculating the Shannon-Weaver index. The latter was calculated for each pair of stations in the control areas and for seven pairs of stations in the area of the windmills.

A comparison of the triple D-dredge data (see attached table) with those collected in 2003 by the University of Hull (T_0) showed that the total macrofauna abundance (expressed as numbers of individuals per m^2) was generally higher in 2007 than in 2003. Only in one reference area (R1) north of the windpark fauna abundance was higher in 2003. This was principally due to a very dense population of *Spisula subtruncata* in that area in 2003. This population had completely disappeared in 2007, which was not surprising since *S. subtruncata* has strongly decreased in the whole Dutch coastal zone in recent years. When *S. subtruncata* is excluded from the comparison the total fauna density was higher in 2007 in all areas. Species richness too seemed to be higher in 2007 than in 2003. This indicates that the triple-D dredge worked more efficiently than the dredge used by Hull University. It is possible however, that their dredge was less efficient only with respect to a limited number of species or that they did not include all species caught in their data analysis. Therefore a further data comparison will be done at the species level. This will be performed in the first quarter of 2008. In the same

period graphic illustrations will be prepared of the data collected. The report will be available in the 4th quarter of 2008.

Triple-D data: Densities of macrobenthos in OWEZ and 6 control areas

			densities (n per 100 m2)						
MACROBENTHOS		area→	OWEZ	R1	R2	R3	R4	R5	R6
Anthozoa	zeeanemoon		1.8	34.4		28.1			3.1
Callianassa tyrrhena			0.4	9.4		6.3	9.4		3.1
Corystes cassivelaunus	helmkrab		2.7	3.1	6.3		3.1	6.3	
Crangon almanni			4.0						
Crangon crangon	garnaal		557.6	200.0	278.1	343.8	300.0	509.4	290.6
Diogenes pugilator			6.3				3.1	9.4	
Liocarcinus arcuatus	gewimperde zwemkrab		1.3			9.4	3.1		3.1
Liocarcinus depurator	blauwpootzwemkrab		3.1	3.1					
Liocarcinus holsatus	gewone zwemkrab		71.4	15.6	21.9	21.9	31.3	59.4	18.8
Liocarcinus marmoratus	gemarmerde zwemkrab		6.3	12.5		40.6	6.3	9.4	9.4
Macropodia spec.			0.4						
Pagurus bernhardus	heremietkreeft		5.4	6.3	9.4	40.6	28.1	15.6	15.6
Pontophilus spec.			71.9	71.9	96.9	75.0	62.5	40.6	21.9
Portumnus latipes	breedpootkrab		0.9						
Processa spec.			3.1			6.3	3.1		12.5
Thia scutellata	nagelkrabbetje		30.4		56.3	9.4	46.9	6.3	28.1
Chamelea striatula	venusschelp		31.3	25.0	34.4	28.1	28.1	93.8	25.0
Donax vittatus	zaagje		23.2	12.5	50.0	21.9	21.9	25.0	6.3
Ensis americanus	amerikaanze zwaardschede		370.5	75.0	25.0	1037.5	28.1	284.4	68.8
Ensis arcuatus	grote zwaardschede		4.5						
Ensis ensis	kleine zwaardschede		0.9		3.1				
Euspira nitida	glanzende tepelhoren		2.7	9.4		12.5			
Nassarius reticulatus	gevlochten fuikhoren								9.4
Laevicardium norvegicum	noorse hartschelp		0.4						
Lutraria lutraria	otterschelp		23.7			21.9	3.1	3.1	12.5
Mactra corallina	grote strandschelp		0.9						6.3
Natica catena	tepelhoren		1.3	3.1				6.3	
Spisula elliptica	ovale strandschelp						3.1	3.1	
Spisula solida	stevige strandschelp		2.2		6.3			9.4	12.5
Spisula subtruncata	halfgeknotte strandschelp		8.5	9.4		6.3	37.5	21.9	
Tellina fabula	rechtsgestreepte platschelp		1.3	187.5			3.1		
Tellina tenuis	tere platschelp		1.3		3.1				
Asterias rubens	zeester		1.3						
Echinocardium cordatum	zeeklit		8.5	6.3	9.4	12.5	109.4	3.1	6.3
Ophiura albida			43.8	12.5			18.8	34.4	159.4
Ophiura texturata			158.5	78.1	59.4	218.8	131.3	168.8	62.5
Total fauna abundance			1451.8	775.0	659.4	1940.6	881.3	1309.4	775.0
Number of species			34.0	19.0	14.0	18.0	21.0	19.0	20.0

Triple-D data: Densities of fish in OWEZ and 6 control areas

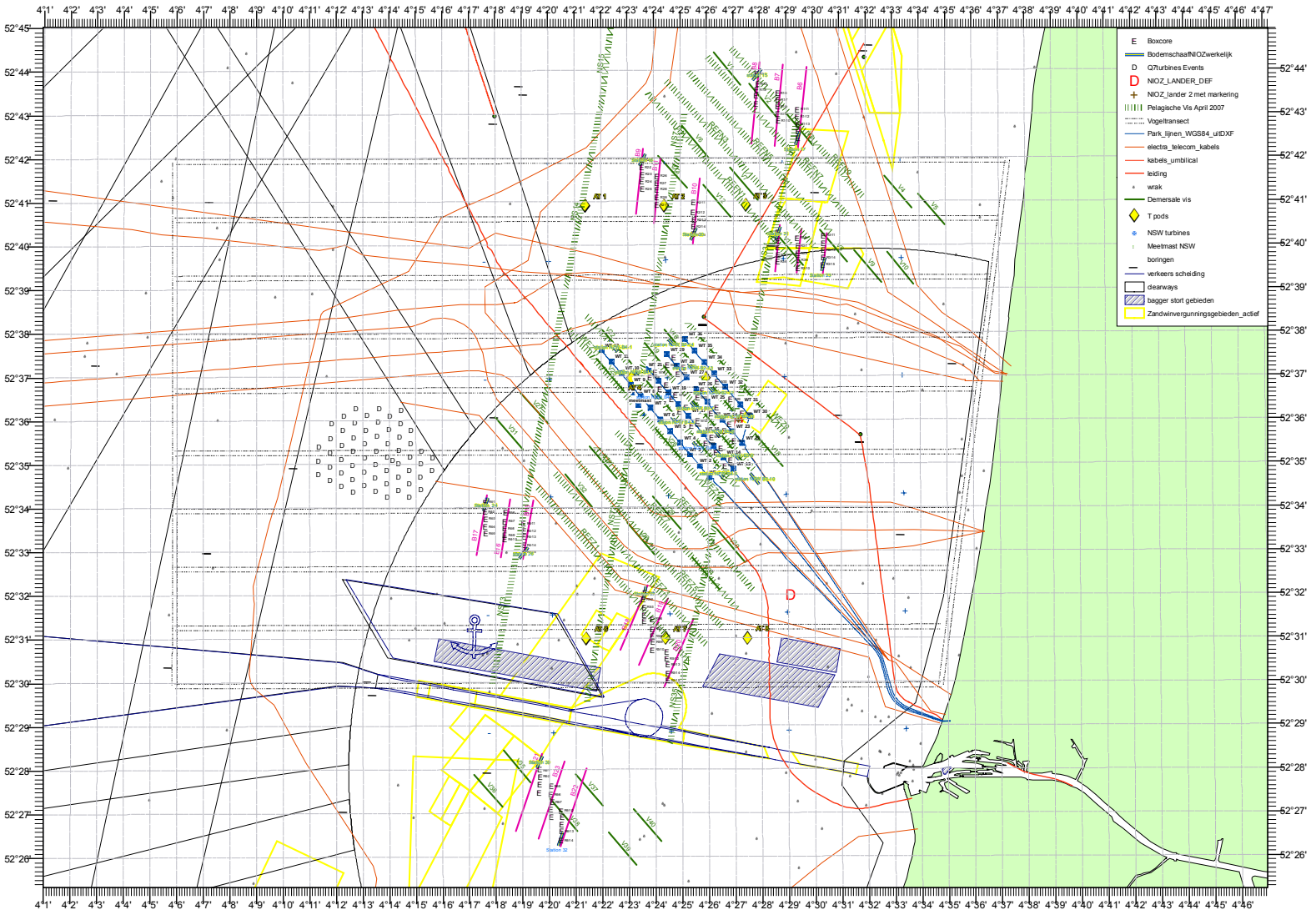
		densities (n per 100 m2)						
FISH	area→	OWEZ	R1	R2	R3	R4	R5	R6
Agonus cataphractus	harnasmannetje		3.1					
Ammodytes tobianus	zandspiering	21.4	18.8	156.3	18.8		21.9	40.6
Arnoglossus laterna	schurftvis	4.5	3.1		3.1	3.1	9.4	6.3
Buglossidium luteum	dwergtong	17.0	46.9	50.0	46.9	28.1	56.3	40.6
Callionymus lyra	pitvis	3.6		9.4		28.1	6.3	21.9
Ciliata mustela	meun	0.4						
Hyperoplus lanceolatus	smelt	3.1						31.3
Limanda limanda	schar	17.4			6.3	37.5	12.5	12.5
Merlangius merlangus	wijting	0.4						
Myoxocephalus scorpius	knorhaan	1.3						
Pleuronectes platessa	schol	7.6	9.4	9.4	6.3	9.4	3.1	3.1
Pomatoschistus spec.	grondel	223.7	56.3	78.1	237.5	287.5	140.6	312.5
Solea solea	tong	4.5			3.1	3.1		3.1
Sprattus sprattus	sprot	1.8						
Syngnathus spec.	zeenaald	3.6	3.1				15.6	6.3
Total abundance		310.3	140.6	303.1	321.9	396.9	265.6	478.1
Number of species		14.0	7.0	5.0	7.0	7.0	8.0	10.0

boxcorer

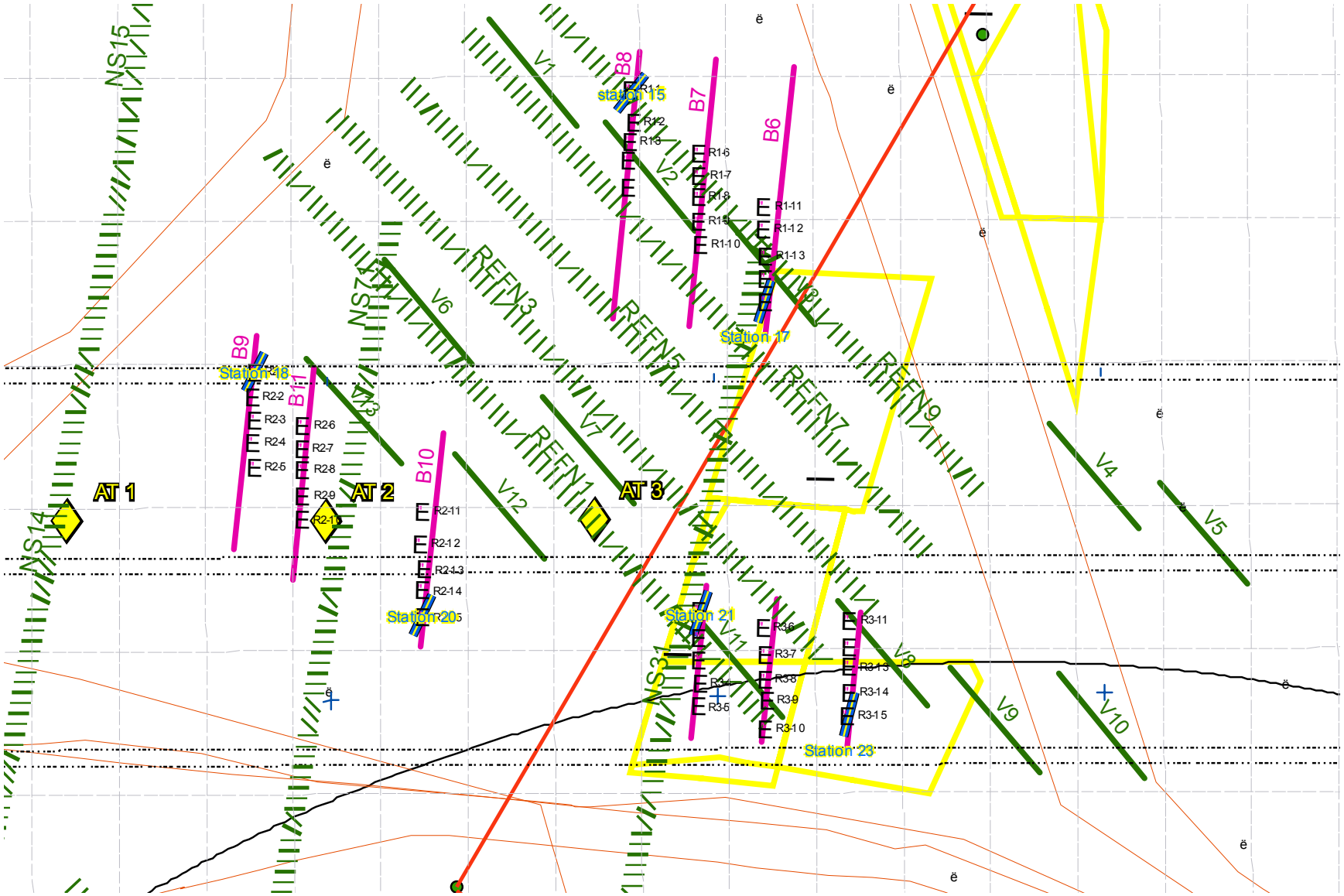
Triple-D dredge

Dredge catch

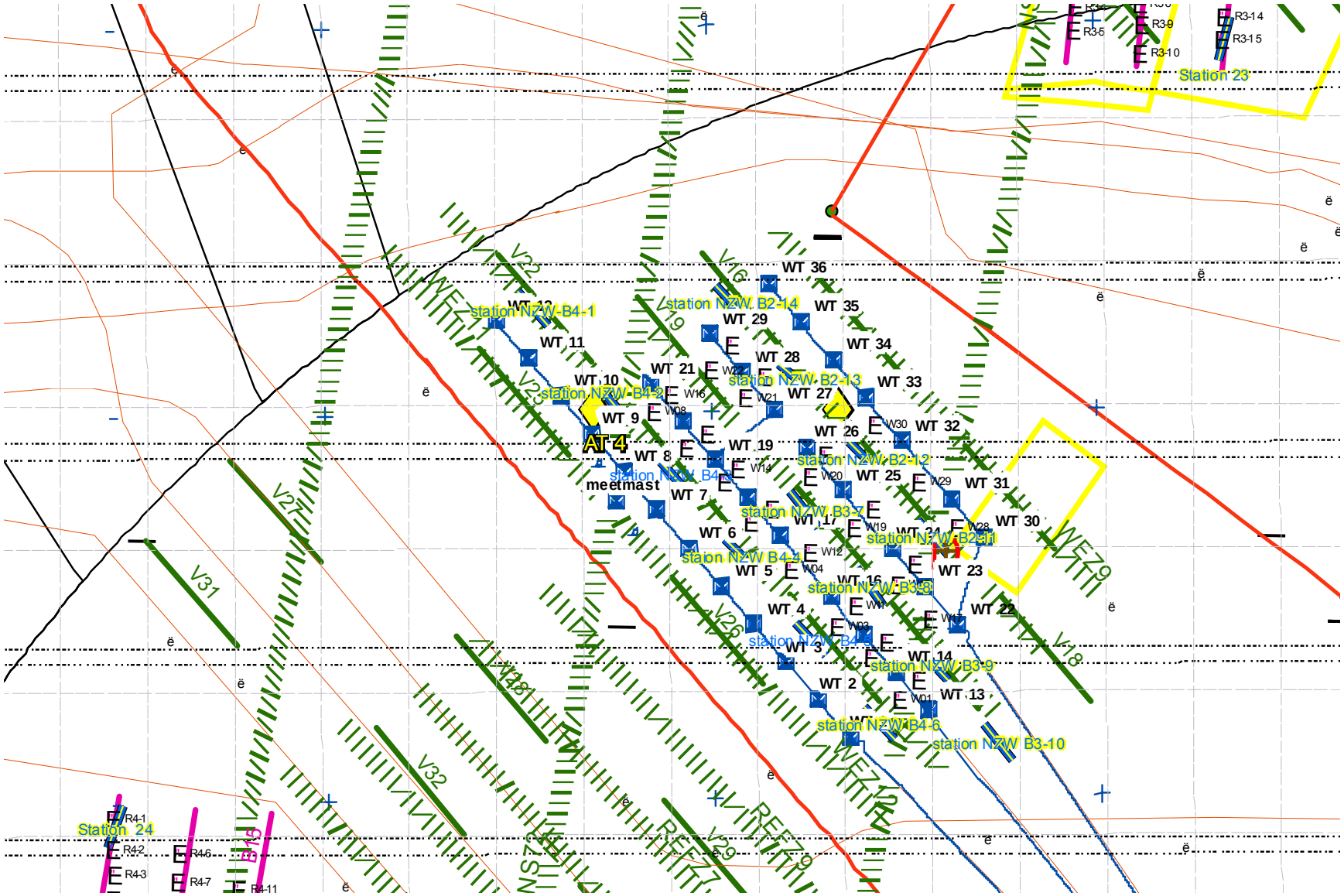
Overview OWEZ and reference area's



Reference area North (detail)



OWEZ area (detail)



Reference area south (detail)