# Monitoring of pellets and mesoplastic fragments on Dutch beaches in 2021: a pilot study

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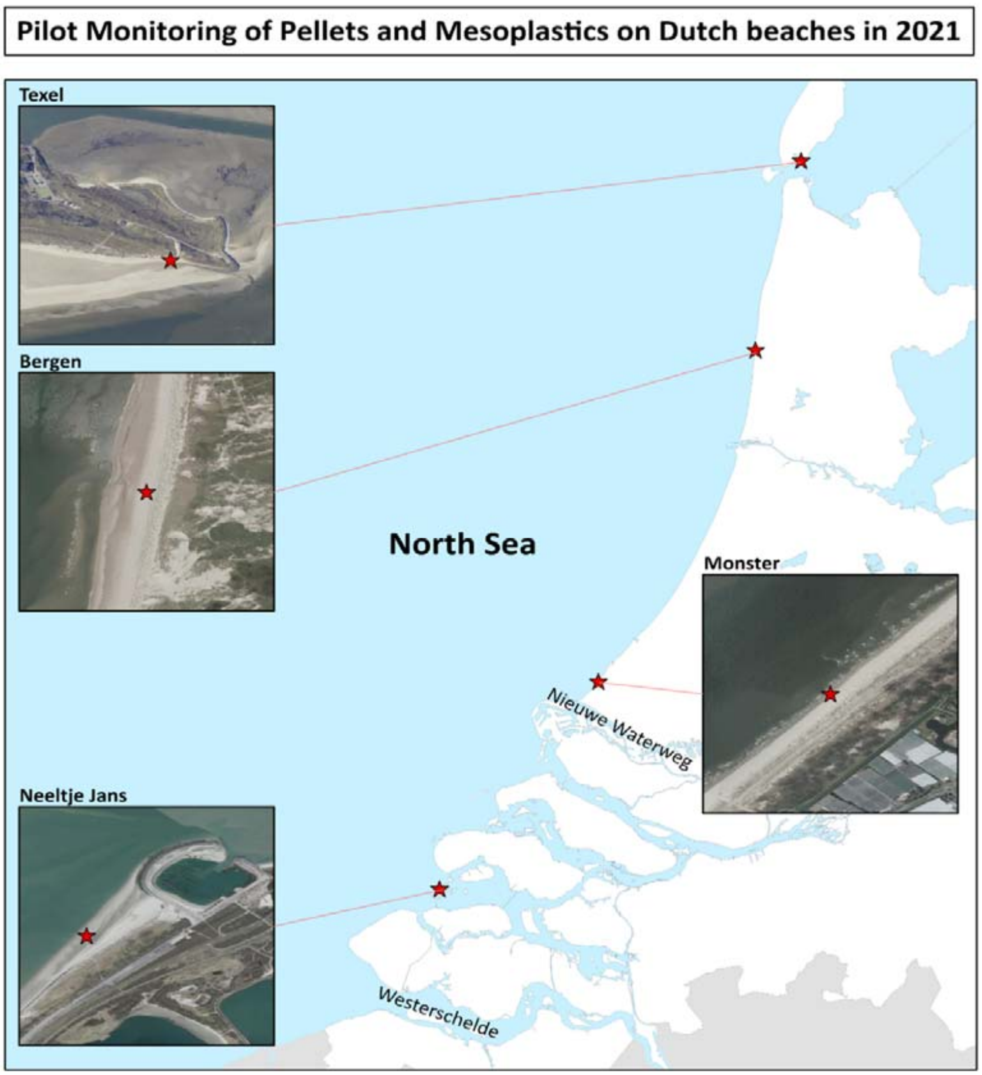

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|---|---|
| Document status | Version 13, 31-8-2022, final |
| Review by | Camille Lacroix<br>Lex Oosterbaan |
| Acknowledgements | Susanne Kuehn (WUR) and Jan Andries van Franeker are acknowledged for their expert advice. |
| Photographs | Most photos in this report were taken by Barbara Wenneker, unless indicated otherwise in the figure legend. |
| Front page figure | Map of the Dutch monitoring locations for pellets and mesoplastic fragments. |
| Citation | Please cite this report as follows:<br><br>B. Wenneker, W.M.G.M. van Loon and I. Bakker, 2022. Monitoring of pellets and mesoplastic fragments on Dutch beaches in 2021: a pilot study. |
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| Open information | This report is available on: https://puc.overheid.nl/rijkswaterstaat/<br>The monitoring data are available on: https://waterinfo-extra.rws.nl/ |

**SUMMARY**

In recent years, a clear information need has emerged within OSPAR (www.ospar.org) and the European Task Group for Marine Litter (TGML) for sufficiently reliable and comparable data on pellets on a European level. For example, OSPAR has defined a Regional Action Plan (RAP) measure to obtain zero pellet loss, the EU is working at regulation to combat pellets and the IMO has presented a draft proposal to classify plastic pellets as hazardous materials.

In addition, it is acknowledged in TGML and OSPAR that the data on mesoplastic fragments collected by European countries are probably not comparable because they are difficult to monitor accurately visually and sometimes because of their high numbers. Mesoplastic fragments are ecologically relevant because they can be ingested easily. Therefore, there is an additional need to obtain sufficiently reliable and comparable data on mesoplastic fragments.

These two information needs can well be combined into the aim for a dedicated European monitoring method for pellets and mesoplastic fragments on beaches. In this report, a first pilot monitoring method and first results for pellets and mesoplastic fragments on Dutch beaches are presented. These methods and results are intended as a stepping stone towards a harmonized European monitoring method, to be developed within the TGML.

This pilot monitoring project shows that pellets and mesoplastic fragments are present on Dutch beaches in significant amounts.

An estimated median value of 215 pellets per 100 m was found in the top layer (1-2 cm) of the Dutch beach high springtide line. This estimated value is based on a measured median 10.8 pellets per 5 m beach length (aggregation of 5 sampling units of 1 $m^2$, top layer 1-2 cm). The amount of pellets per 100 m beach is obviously larger if the full tidal zone of the beach would have been sampled. However, it is assumed that a substantial part of the pellets has accumulated and has been sampled in the high springtide zone. Pellets were found in significant amounts on all four beach locations. However, the number of pellets on the beaches of Monster (near river mouth) and Neeltje Jans (near estuarine mouth) are approx. two times higher than the more rural beaches of Bergen and Texel, respectively. A draft conversion factor of 22.2 mg per pellet was calculated from the results. These are the first quantitative monitoring results on the number of pellets on Dutch beaches.

An estimated median value of 285 mesoplastic fragments per 100 m beach was found in the top layer of the Dutch beach high springtide line. This estimated value is based on a measured median 14.3 pellets per 5 m beach length (aggregation of 5 sampling units of 1 $m^2$). The amount of mesoplastic fragments per 100 m beach is obviously larger if the full tidal zone of the beach would have been sampled. However, it is assumed that a substantial part of the pellets has accumulated and has been sampled in the high springtide zone. In the Dutch beach macrolitter monitoring report 2021, it was reported that the median number of mesoplastic fragments visually found on top of the beach for the period 2015-2020 is 15 (Boonstra et al., 2021). This shows that when the presented monitoring method, being both more precise as well as sampling within the sand (top layer 1-2 cm), much more of these ecologically relevant mesoplastic fragments are found. A draft conversion factor of 34.4 mg per fragment was calculated.

We also collected data on pellet colour and shape, which can be used by plastic researchers to search for relations with riverine and long-distance sources. This step appeared to be time-consuming and the added value of the detailed colour and shape information is unclear. Therefore,

we will limit the classification of pellet colour and shape in the coming years to four classes: black irregular (biobeads), white, yellowed and other. White pellets are assumed to be relatively fresh while yellowed pellets are assumed to have aged in the environment.

Polymer composition of pellets was measured using FT-IR for a subsample of the pellets collected. In this subsample practically all pellets were composed of polyethylene (75%), polypropylene (22%) or unknown (3%), respectively. In view of these clear results, we will not continue with FTIR measurements of pellets in the next monitoring year.

In view of the encouraging first results we will continue this monitoring the coming years. When more count and weight data have been collected, we will establish sufficiently precise conversion factors from count to weight, and possibly thereafter only monitor pellet and mesoplastic weights and estimate counts. We started a method harmonization process with France in 2022 and further harmonization with Germany is planned this year. It is envisaged that a harmonized method will be proposed to TGML in 2023.

# 1. Introduction

## 2.1 General Introduction

Pellets and mesoplastics fragments (0.5 - 2.5 cm) are a type of marine litter that are known to wash upon the shores in the OSPAR maritime area and other European countries.
Pellets, also called nurdles, pre-production pellets (OSPAR, 2018) or industrial plastics (Van Franeker et al., 2020) are small plastic particles that are used to make nearly all our plastic products. They are on average around 3 - 4 mm in size and are classified as large micro plastics (Galgani et al., 2013).
Pellet colour and shape may give information about their sources and the degree of aging of the pellets in the environment. Depending on their density, pellets may float on the sea water surface or may sink.

Pellets can be e.g. virgin pre-production pellets and recycled pellets. These particles can be lost in all steps during the production chain, from production, transport to the convertors where final plastic items are produced (Karlsson et al., 2018). The first scientific reports to document the occurrence of plastic pellets in the environment were published during the 1970's (Carpenter and Smith, 1972a; Carpenter et al., 1972b). Now pellets are found floating on surface and sea water, on riverbanks and beaches all over the world. Plastic pellets are also found on beaches that are not directly close to petrochemical or polymer industries, showing longer range transport. (Karlsson et al., 2018). When the container ship MSC Zoe lost part of its cargo early 2019 North of the Dutch-German coast, 600 kilo polyethylene-pellets and 10.000 kilo polystyrene-pellets were lost at sea (Philippart, 2021; in Dutch).

Mesoplastics, by definition in the size range 0.5-2.5 cm, include fragments of plastic items and consists of different types of plastics. In most cases these fragments are unrecognisable pieces of plastic, but e.g. cigarette butts and bottle caps may also partly fall within the mesoplastic size range. However, for this pilot project, only mesoplastic <u>fragments</u> are counted and weighted. Mesoplastics items that can be identified, like cigarette butts or bottle caps, are not included in this pilot as they are already monitored and assessed via the regular OSPAR and EU Beach Litter Monitoring Programmes (Hanke et al., 2019).

Pellets and mesoplastic fragments are also found in marine biota such as fulmars (Van Franeker et al., 2021). Mesoplastic fragments and pellets are acknowledged to be potentially harmful, because they can be ingested easily by marine biota such as birds, sea turtles and mammals, and may partially obstruct or damage the stomach and intestines of these animals (Van Franeker et al., 2011). Leachates from beached pellets (including biobeads) may contain polycyclic aromatic hydrocarbons and polychlorinated biphenyls which may be detrimental for marine organisms (Rendell-Bhatti et al., 2021).

At present a harmonized European monitoring method for pellets and mesoplastic fragments on beaches is not available. Haseler et al. (2018, 2020) has published a frame and sand rake method, respectively, which provides more extensive sampling of at least 10-20 m$^2$ of beach for beach litter >2 mm. Recoveries of this method have been reported. Sahuquet (2021) has reported a monitoring method for pellets and mesoplastic fragments using visual and manual sampling of 5 strips of 50 cm within a 100 m beach stretch, thus providing a relatively good spatial coverage. Our pilot method already uses elements of the French method, and will be upgraded using elements of the German study in 2022.

## 1.2 Information needs

Both OSPAR and the EU recognise the need for improved monitoring of these small beach litter classes. OSPAR's Regional Action Plan Marine litter (RAP ML) sets out the policy context for work on marine litter. One of the actions that OSPAR countries worked on over the last years concerned pellets:
RAP action 52 - Zero pellet loss: promote initiatives and exchange best practice aiming at zero pellet loss along the whole plastics manufacturing chain from production to transport. Lead party for this RAP was France with participation from the Netherlands, Germany and Seas at Risk.

Currently the EU is preparing legislation to control the unwanted release of pellets into the environment. In addition, within the IMO a proposal was launched recently to classify plastic pellets as hazardous materials (IMO, 2022). These OSPAR, EU and IMO developments have created an information need for reliable data on pellets on European beaches using a harmonized or standardized European method.

In a recent EU TGML workshop (TGML, 2021), it was agreed to develop a European monitoring method for pellets. France, the Netherlands and Greece volunteered to draft a proposal for this method for TGML.

In the current OSPAR Marine Litter Beach Monitoring program, all beach litter items > 2.5 cm (macroplastics) are surveyed. Mesoplastic items (0.5 – 2.5 cm) which are clearly recognizable, such as cigarette butts and bottle caps, are also monitored as a part of macrolitter monitoring. Pellets fall in the category of large micro litter (1-5 mm) and are currently only recorded as “present” or “absent” in the OSPAR beach litter monitoring (OSPAR, 2022).

Mesoplastics fragments are counted by the Dutch monitoring organization, but are not included in the assessment of beach litter because they are monitored less comparably within the OSPAR region due to their small size and occurrence of very high numbers on some beaches (Hanke et al., 2019).

## 1.3 Monitoring aims

In view of these information needs the monitoring aims can be summarized as follows:

- The method must primarily be aimed at pellets and mesoplastic fragments.
- The monitoring method used must be suitable for state and trend assessment.
- The monitoring data must enable investigations of relationships with possible sources.
- The monitoring method must be harmonized with the beach litter macrolitter monitoring.
- The monitoring method must be (gradually) harmonized into a European method.
- The method is **no**t aimed at microplastics in the 1-2 mm range and **not** at identifiable mesoplastics (e.g. cigarette butts, bottle caps)
- Waxes are not a monitoring aim, but wax data are collected and reported as a byproduct.

## 1.4 Data analysis aims

- To estimate the total number and weight of pellets and mesoplastic fragments per 100 m beach.
- To investigate the relation between total number and total weight for pellets/mesoplastic fragments
- To aggregate these results for the four beaches as an estimation of the Dutch coastal pollution
- To calculate and present the variation of the results
- To investigate additional pellet properties colour, shape and polymer type.

## 2. METHODS

### 2.1 Sampling locations

Four Dutch beaches were chosen to test the pilot monitoring method. The beach selection criteria were taken from OSPAR (2022). In addition, the proximity to sources (harbour or estuary outlet) was used as an additional beach selection criterion. This additional criterion led to the selection of the locations Neeltje Jans (close to the outlet of the Westerschelde estuary and known as pellet hotspot) and Monster (close to the Nieuwe Waterweg and the Port of Rotterdam). The selected locations are shown on the report front page and further specified in Table 1.

*Table 1: Dutch monitoring beaches and their coordinates (see map on front page)*

| Location | Latitude | Longitude | Motivation |
|---|---|---|---|
| Texel (TXL):<br>Beach pole: 55.925 | 52.996562 | 4.770755 | Location on the Northern Dutch Wadden islands |
| Bergen (BGN):<br>Beach pole: 35.250 | 52.642145 | 4.624206 | Beach macrolitter monitoring location |
| Monster (MSR)<br>Beach pole: 112,5 | 52.022186 | 4.152487 | Near the outlet of the Nieuwe Waterweg, connected to Rotterdam harbour |
| Neeltje Jans (NJS)<br>Dune corner | 51.635109 | 3.692583 | Near the outlet of the Westerschelde estuary with harbours and industry |

### 2.2 Sampling methods

Sampling frequency is four times per year, in line with the OSPAR CEMP beach litter monitoring guidelines (OSPAR, 2022).

Sampling timing. Monitoring takes place on day 1 or 2 after springtide. At springtide, the tidal action is the strongest which gives the most recent and focused accumulation of pellets and mesoplastics (https://en.wikipedia.org/wiki/Tide#Range_variation:_springs_and_neaps; Kuehn et al. 2021). Sampling takes place at the high springtide line. Note that the sampling of historical litter, which may be present at the foot of a dune, must be prevented. (Kuehn et al., 2021).
In line with the Dutch beach litter monitoring, sampling is postponed for 2-4 weeks in case of a storm at or a few days before the sampling date, because a storm can change the beach morphology and can obscure the high tideline.

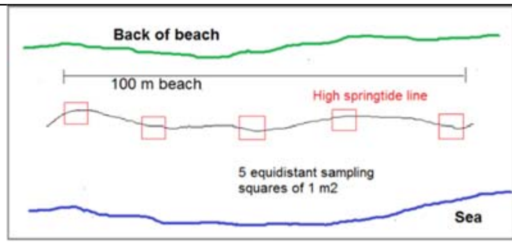
*Table 2: survey dates (1-2 days after springtide) for the four locations in 2021*

| Location | Date 1 | Date 2 | Date 3 | Date 4 |
|---|---|---|---|---|
| Texel | 2021-04-30 | 2021-07-13 | 2021-10-10 | 2021-12-23 |
| Bergen | 2021-04-30 | 2021-06-27 | 2021-10-09 | 2021-12-22 |
| Monster | 2021-05-01 | 2021-07-14 | 2021-09-25 | 2021-12-08 |
| Neeltje Jans | 2021-05-02 | 2021-06-28 | 2021-09-24 | 2021-12-07 |

Sampling units. On each of the four beaches one fixed stretch of beach of 100 meter is selected. For each 100 meters 5 sampling units (squares) of $1m^2$ are sampled at the springtide line, at a fixed distance of 25 m: 0, 25, 50, 75, 100 meters (Table 3, first figure). The squares are kept perpendicular to the backside of the beach. The Y-position varies with the position of the springtide line. Beach poles are used to locate the fixed stretch of beach. At the beach of Neeltje Jans there is no beach pole and GPS is used to sample the same location every time. A rope of 25 meters length is used to measure the distance between the sampling units.

Sampling methods. See Table 3

*Table 3: Description of sampling methods*

| Description | Illustration |
|---|---|
| 5 sampling units of 1 x 1 m are selected overlapping the high springtide line (see also description above).<br><br>Unusual circumstances at the sampling site are registered. |  |
| Example of high springtide line at the beach of the island of Texel |  |
| The sampling unit overlaps the high springtide line as well as possible |  |
| The top layer (1 - 2 cm) of beach sand is scraped off with a flat trowel and collected in a sieving bag with a mesh size of approx. 1 mm (photograph by Jan van Franeker). |  |
| With dry sand the bag can be shaken to remove the sand. When the sand is moist or wet the sand can be removed by dipping it in the sea or another water source nearby.<br>The bag with the sample is taken to the lab for further cleaning and analysis. |  |

| Description | Illustration |
| --- | --- |
| In the lab each sampling bag is emptied in a 1 mm metal laboratory sieve for final rinsing. The bag is thoroughly washed to make sure no litter  remains in the sampling bag. Once all litter items have been removed from the sample material the remainder of the sample is put into a bucket of water and stirred. Litter that was not yet spotted can also be collected in the petri dish. |  |
| All litter items are collected in a petri-dish. A sample code is given: date-location-square-number (e.g. 210627-BGN-1) and is written on the lid. Photo right: example of pellet stuck to a shell. All natural materials are closely inspected for the presence of pellets and small plastics. |  |

### 2.2 Analyses

- All litter items are categorised as follows: pellet, mesoplastic fragment, wax-like substances, macroplastics. Wax-like substance data are only reported as a byproduct of the monitoring in Annex 3. Macroplastics are not reported as they are already covered by the beach macrolitter monitoring (Boonstra et al., 2021).
- For each of these categories the number of items of one petri dish (= one sampling unit of 1 $m^2$) are counted and weighted using a laboratory weighing device.
- Next, the colour and shape of the pellets are determined and registered using a subset of EMODNET reference tables for pellet colours and shapes. In addition, the following four aggregated colour/shape classes were used as proposed by Kuehn et al. (2021) are applied: (a) White/transparent (b) Yellowed/transparant (c) Black irregular (d) Other colours. A distinction between white and yellowed pellets can provide information on the amount of time pellets have been in the environment. A distinction is made between black pellets that are irregular of shape and have a rough surface, known as biobeads, and black pellets that have a smooth surface and usually a regular shape. Biobeads are pellets used in certain sewage water treatment plants and possibly in other industrial waste water treatments (Kuehn et al., 2021; Turner et al., 2019)
- The results are photographed, see an illustration below:

**IR spectroscopy**

The IR spectra of the pellets of the second and fourth survey season (n = 36) are measured using a desktop IR spectrometer (Agilent 4500 portable FTIR spectrometer) at the RWS CIV laboratory. The pellets are squeezed flat using pliers and the FTIR spectrum is measured and compared with spectra in the spectral library. The spectral hit with the highest match, preferably $\geq$0.8 and at least $\geq$0.6, is visually checked for the presence of characteristic reference polymer peaks and is reported.

### 2.3 Data analyses

- The basic data files are: (a) Data NL pellets mesoplastics final v15-3-2022.xls and (b) Data NL pellets colour shape final v15-3-2022 (data source: Barbara Wenneker, surveyor). These datafiles are presented in Annex 1 and 2 of this report and on: https://waterinfo-extra.rws.nl/.
- The variation of the results at the beach-year level was calculated in using the Median Absolute Deviation (MAD), which is a robust measure of data variation (https://en.wikipedia.org/wiki/Median_absolute_deviation)
- Two outliers were identified in the dataset, because of their very low values for number of pellets and number of mesoplastics (<(median beach value – 2*MAD)) combined with the field observation that no clear tideline was visible. These outliers are: Bergen_09/10/2021 and Monster_08/12/2021. These outlying values are shown in Annex 1 and 2, but have been removed from the datafile on the internet.
- The counts and weights of the pellets (NPEL, WPEL) and mesoplastic fragments (NMESO, WMESO) of the five 1 $m^2$ samples per survey are added up to 1 value per beach survey before data analysis. The results of the data analysis are multiplied by 20 to obtain estimates for 100 m beach stretches, harmonized with the beach litter macrolitter monitoring.
- Data analysis is first performed at the beach level. First the ratio of the beach median and mean values were calculated. Since the median ratios were substantially lower than 1 for the beaches Neeltje Jans (0.69) and Texel (0.25), it was concluded that the data distributions are partly skewed, and that the median and MAD are correct to use. The median and the median absolute deviation (MAD, https://en.wikipedia.org/wiki/Median_absolute_deviation) are calculated in Excel. The beach results are aggregated to the national level by calculating the median values of the beach median and MAD values, respectively (Van Belle and Hughes, 1984).
- The relations between pellet count and weight, and mesoplastic count and weight, respectively, were analyzed using the aggregated 5 m data per survey (N=14).
- Four relevant colour-shape groups were analysed: black-irregular, white, yellowed, other colours, according to Kuehn et al. (2021).
- The polymer composition of pellets was analysed for all pellets from the first and fourth survey period (N = 35)
- All calculations were performed in Excel.

## 3 RESULTS

The main results of the pilot monitoring year are presented in Table 4 and the two relation figures below. The basic data are available in Annex 1 (two outliers included: Bergen_9/10/2021, Monster_8/12/2021) and from the website https://waterinfo-extra.rws.nl/ (two outliers excluded).

*Table 4: main results of the monitoring in 2021. The sum of the results of the five sampling squares of 1 m2 are presented, corresponding to 5 m beach length. At the bottom of the table, the estimated (extrapolated) results for 100 m are presented. The median values and the absolute median deviation (MAD) are reported. The reported indicators are: NPEL, number of pellets; WPEL, total weight of pellets (mg); NMESO, number of unidentifiable mesoplastic fragments; WMESO, total weight of unidentifiable mesoplastic fragments (mg). The aggregated results for the 4 beaches are presented at the bottom of the table.*

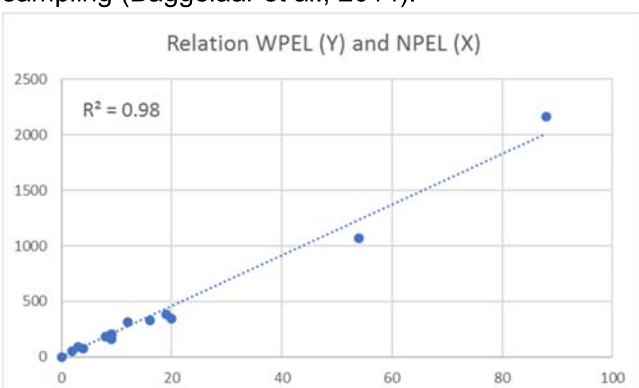
| Metric | location | date | NPEL | WPEL | NMESO | WMESO |
|---|---|---|---|---|---|---|
| | Bergen | 30/04/2021 | 4.0 | 77.1 | 10.0 | 85.8 |
| | Bergen | 27/06/2021 | 12.0 | 314.0 | 14.0 | 654.7 |
| | Bergen | 22/12/2021 | 9.0 | 161.5 | 8.0 | 415.1 |
| Median | | | **9.0** | **161.5** | **10.0** | **415.1** |
| MAD | | | **3** | **84** | **2** | **240** |
| | | | | | | |
| | Monster | 01/05/2021 | 8.0 | 183.1 | 8.0 | 404.1 |
| | Monster | 14/07/2021 | 19.0 | 387.2 | 24.0 | 719.6 |
| | Monster | 25/09/2021 | 20.0 | 343.1 | 18.0 | 388.0 |
| Median | | | **19.0** | **343.1** | **18.0** | **404.1** |
| MAD | | | **1.0** | **44.1** | **6.0** | **16.1** |
| | | | | | | |
| | Neeltje Jans | 02/05/2021 | 9.0 | 199.7 | 16.0 | 731.2 |
| | Neeltje Jans | 28/06/2021 | 54.0 | 1071.9 | 14.0 | 193.7 |
| | Neeltje Jans | 24/09/2021 | 16.0 | 332.8 | 13.0 | 1867.1 |
| | Neeltje Jans | 07/12/2021 | 3.0 | 90.0 | 13.0 | 504.1 |
| Median | | | **12.5** | **266.3** | **13.5** | **617.7** |
| MAD | | | **6.5** | **121.4** | **0.5** | **268.8** |
| | | | | | | |
| | Texel | 30/04/2021 | 0 | 0 | 1 | 44.6 |
| | Texel | 13/07/2021 | 9.0 | 204.0 | 6.0 | 74.2 |
| | Texel | 10/10/2021 | 88.0 | 2162.2 | 104.0 | 3067.2 |
| | Texel | 23/12/2021 | 2.0 | 50.1 | 24.0 | 414.6 |
| Median | | | **5.5** | **127.1** | **15.0** | **244.4** |
| MAD | | | **4.5** | **102.0** | **11.5** | **185.0** |
| | | | | | | |
| | | | | | | |
| **NL results 5m** | | | **10.8** | **213.9** | **14.3** | **409.6** |
| Median Indicator MAD (5 m) | | | 4 | 93 | 4 | 212 |
| | | | | | | |
| **NL estimates 100 m** | | | **215** | **4277.5** | **285** | **8192** |

For **pellets**, an estimated (extrapolated) median value of 215 pellets per 100 m has been found on the Dutch beach high springtide line. This estimated value is based on a measured median 10.8 pellets per 5 m beach length (5 sampling units of 1 $m^2$). The amount of pellets per 100 m beach would obviously have been larger if the full tidal zone of the beach would be sampled. However, it is assumed that a substantial part of the pellets has accumulated and has been sampled in the high springtide zone. Pellets were found in significant amounts on all four beach locations. However, the median number of pellets on the beaches of Monster (near river mouth) and Neeltje Jans (near estuarine mouth) are approx. two times higher than the more rural beach of Bergen and Texel, respectively. This is the first quantitative monitoring result on the number of pellets on Dutch beaches.

In addition, we found that pellets are found in 87% of the beach surveys. Pellets were not found in 2 out of 16 surveys.

The estimated median total weight of the pellets found is 4278 mg (4.3 gram) per 100 m beach length. This estimated value is based on a measured median value of 214 mg of pellets per 5 m beach length (5 sampling units of 1 $m^2$). The total weight of pellets per 100 m beach would obviously have been larger if the full tidal zone of the beach would be sampled. However, it is assumed that a major part of the pellets has accumulated and has been sampled in the high springtide zone.

Note that this aggregated value is representative for the set of 4 locations, but not for the entire Dutch coast because the location selection was not performed using stratified random sampling (Baggelaar et al., 2014).

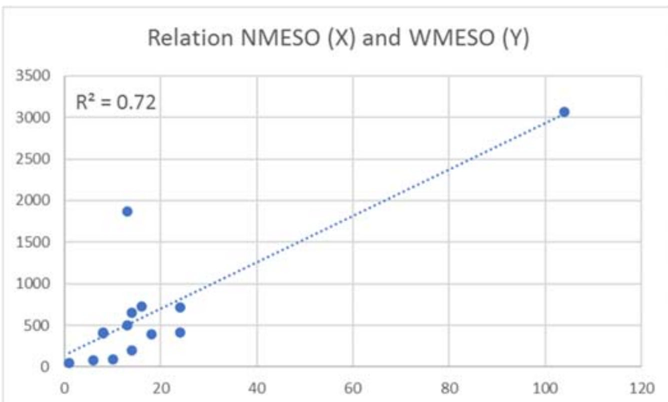



For pellets a good correlation ($R^2$ = 0.98, N=14) between the pellet count and the pellet weight is observed (see Figure above). This can be explained by the small size and shape range of pellets (3-4 mm). The mean and median weight per pellet are both 22.2 mg. Because of this good correlation, it is possible to only monitor the pellet total weight, and estimate the number of pellets using this conversion factor. This would simplify the monitoring process. However, we will first collect 2 additional monitoring data years to obtain a more precise conversion factor based on 46 surveys. This is in line with the use of $\geq$40 surveys for a beach litter threshold value assessment (Van Loon et al., 2020).

For **mesoplastics** an estimated (extrapolated) median value of 285 mesoplastic fragments per 100 m beach are found on the Dutch beach high springtide line. This estimated value is based on a measured median 14.3 mesoplastic fragments per 5 m beach length (5 sampling units of 1 $m^2$). The amount of mesoplastic fragments per 100 m beach is obviously larger if the full tidal zone of the beach would be sampled. However, it is assumed that a substantial part of the mesoplastic fragments has accumulated and has been sampled in the high springtide zone.

In the Dutch beach macrolitter monitoring report 2021, it was reported that the median number of mesoplastic fragments found on top of the beach sand for the period 2015-2020 is 15 (Boonstra et al., 2021). This shows that when the presented more precise monitoring method is used much more of these ecologically relevant mesoplastic fragments are measured. Note however that this result does not disqualify the macrolitter monitoring results, which only surveys mesoplastic fragments on top of the beach sand.

This corresponds with an estimated median weight of 8192 mg (8.2 g) mesoplastic fragments per 100 m beach. The weight of mesoplastic fragments per 100 m beach is obviously larger if the full tidal zone of the beach would have been sampled. However, it is assumed that a substantial part of the mesoplastic fragments has accumulated and has been sampled in the high springtide zone.




For mesoplastics, a reasonable relation between the number of mesoplastic fragments and the weight is observed (see figure above; $R^2$ = 0.72, N=14). The mean and median weight of a mesoplastic fragment are 39.6 and 34.4 mg, respectively. Because of this reasonable correlation, and in view of comparability with the beach macrolitter count data, it is possible to only monitor the total weight of mesoplastic fragments, and to estimate the corresponding total number using the median conversion factor of 34.4 mg/fragment. This would simplify the monitoring process. However, we will first collect 2 additional monitoring data years to obtain a more precise conversion factor based on 46 surveys.

### 3.4 Colour/shape and polymer types of pellets

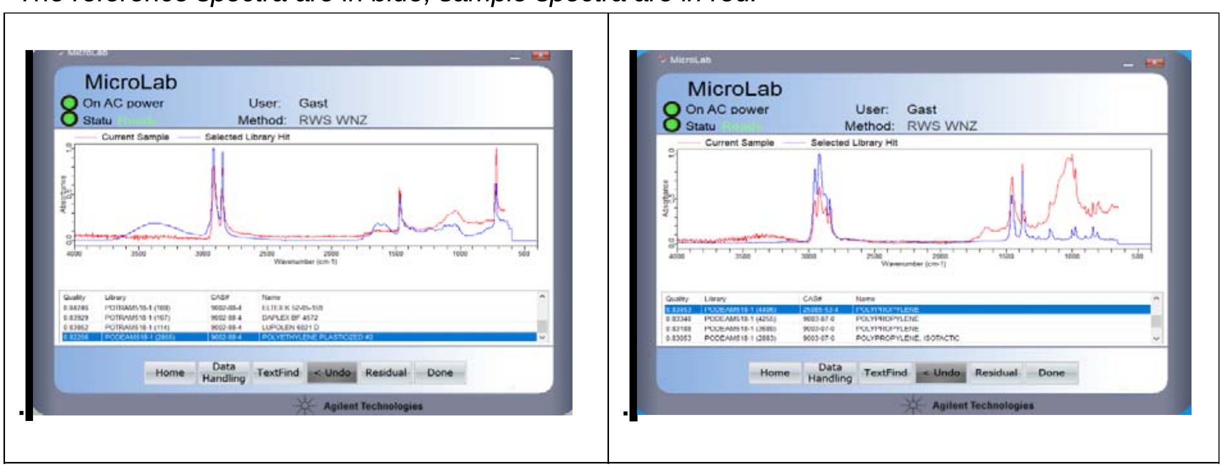
The aggregated colours/shape of 251 pellets are presented at the beach level in Table 5. The basic data are presented in Annex 2 and will be published on: https://waterinfo-extra.rws.nl/
These results do not show remarkable differences between different colour/shape groups measured at the four beach locations. For example, no remarkable difference in occurrence of black irregular pellets, related to water purification plants, is observed for the four locations. However, more data are needed to make more reliable location difference analyses and trend analysis using these data.

Regarding polymer type, 36 pellets were analysed using FTIR. It appears that 75 % (27) of the polymers is polyethylene, 22 % (8) is polypropylene and 1 pellet (3 %) is unidentified. The FTIR reference and some sample spectra of PE and PP are shown in Figure 3. In many cases a match factor of ≥80% was obtained. In some cases lower match factors (60-80%) were obtained, which can be explained by the presence of chemical additives in the pellets or the use of insufficiently flattened pellet measurement surfaces. In all cases, the presence of characteristic IR-peaks of PE and PP was checked for positive identification as PE or PP.

*Table 5: aggregated colours/shapes of pellets (N = 251).*

| location_code | group_code | mean % |
|---|---|---|
| Texel | black_irregular | 25.8 |
| Bergen | black_irregular | 19.2 |
| Monster | black_irregular | 10.9 |
| Neeltje Jans | black_irregular | 14.6 |
| | | |
| Texel | white_transparant | 28.9 |
| Bergen | white_transparant | 15.4 |
| Monster | white_transparant | 13.0 |
| Neeltje Jans | white_transparant | 32.9 |
| | | |
| Texel | Yellowed | 22.7 |
| Bergen | Yellowed | 30.8 |
| Monster | Yellowed | 26.1 |
| Neeltje Jans | Yellowed | 31.7 |
| | | |
| Texel | other_colour | 22.7 |
| Bergen | other_colour | 34.6 |
| Monster | other_colour | 50.0 |
| Neeltje Jans | other_colour | 20.7 |

*Figure 3: FTIR spectra of a polyethylene (PE, left) and polypropylene (PP, right) pellet, respectively. The reference spectra are in blue, sample spectra are in red.*




Wax data, which are seen as a byproduct of this monitoring, are listed in Annex 3. These data may be useful in the future for researchers looking at waxes in the marine environment.

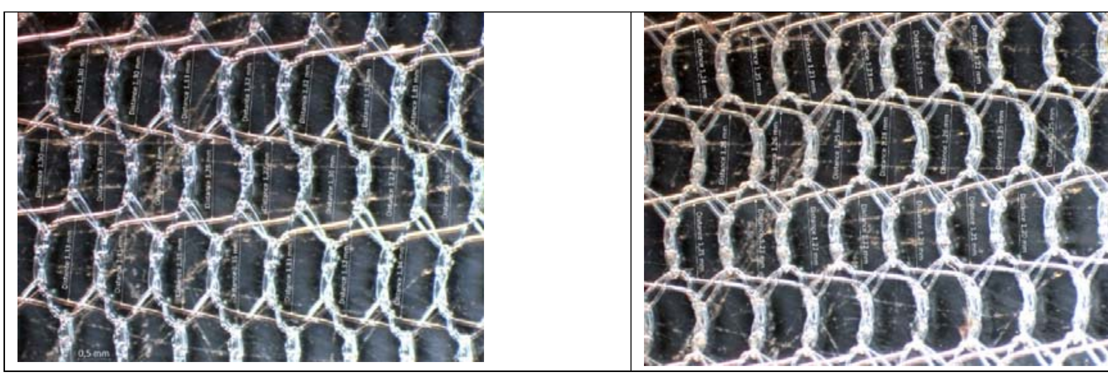
# 4 DISCUSSION AND CONCLUSIONS

## 4.1 Methods

Tidelines (accumulation zones) are expected to have accumulated most pellets and mesoplastics. If present, it is highly recommended to sample at least these tidelines within the transects. A clear high springtide line (accumulation zone) is important in this method to obtain reliable data. This high springtide line is usually present and easily observed on our Dutch beaches, and therefore the proposed method could usually be applied well. During this pilot project 3 out of the 16 surveys were performed without a clear springtide line. Another option is to expand the spatial coverage of the monitoring, as discussed below.

The method with the sieving bag appears to be very practical and easy to perform, and avoids sample transfer, and possible target plastic losses, in the field. The bags have a mesh of an average of 1.315 x 0.723 mm (see photos below). As the focus of this research is for pellets and mesoplastic fragments this mesh size meets the requirements.
The bag sieving method was tested during the first try outs. The samples collected in the sieving bag were “shaken” above the metal sieve and it was found that no litter was lost from the sieving bags. Before use the bags were checked for wear and damage. After being used several times the mesh was measured and appeared to be slightly smaller (on average is 1.24*0.67 mm. Courtesy to Susanne Kuehn, WUR). This could be due to frayed rope due to wear and tear, resulting in smaller net openings. The mesh size after being used several times. We therefore conclude that new sieving bags have to be used for every survey.

The combination of sieving in the field using the sieving bags and the laboratory sieve resulted in an accurate and reliable separation of pellets and mesoplastics from the sandy samples. We estimate that this method, although a bit more time consuming, may have slightly higher recoveries than the use of density extraction using sea water, as used by Sahuquet (2021). In addition, we found that the use of sample extraction and washing methods on the beach could be difficult to perform under cold and windy conditions. The use of the pre-sieving of sandy samples on the beach using the sieving bags, combined with final sieving at the laboratory, in our experience appeared to be a practical and accurate method.



*Photos: mesh size measurements of new bag (left) and used bag (right) (Susanne Kuehn, WUR).*

The results obtained using the presented monitoring method are qualitatively comparable with the (plastics in stomachs of) fulmars monitoring results regarding the litter size range detected (large microplastics and mesoplastics). It is possible to investigate in the future if correlations between the Dutch fulmar results (Van Franeker et al., 2020). and these beach pellet/mesoplastic monitoring results can be found.

The French method (Sahuquet, 2021) which uses five transects (50 cm wide) from the seaside to the duneside was considered and the good spatial coverage is a strong point of this method. However, we think that taking sand samples based on visual observation can be misleading. In addition, we estimate that the density separation of pellets and mesoplastics using sea water can be incomplete, and was found to be impractical under cold and windy survey conditions.

The German method (Haseler et al., 2018, 2020) using the frame method and sand rake also has an improved spatial coverage (10 or 20 $m^2$) and recoveries were determined and reported. However the report states that the rake method is not very suitable when the sand is wet. In addition, these two methods also using mechanical sieving, which we consider to be a good analytical method.

In view of these two methods, we propose to increase the sampling area of the Dutch method presented here to at least 10 $m^2$ as used by Haseler (2018), by adding one rows of 5 sampling units of 1 $m^2$, respectively. This additional row of sampling units should preferably cover a second high tideline (if present), or otherwise be situated at the average distance of the second tideline to the springtide line. This will clearly improve the spatial coverage of the method, and may make it less dependent of the precise sampling data shortly after spring tide. At present, we prefer the use of sampling units over the use of the sand rake (2 mm sieving) in view of the practicality of using sieving bags and the analytical precision of these bags combined with analytical sieving (1 mm), respectively.

### 4.2 Results

The results of this pilot project firstly show that the number of pellets can be monitored accurately on the springtide line, and that pellets are present in most of the samples (87%) in significant amounts.

The sampling strategy requires accurate timing, 1 or 2 days after springtide (after full moon or new moon). Although the method we used by sampling shortly after springtide appears to work, it may be a bit vulnerable due to the limited number of sampling units (French report, German papers). According to Haseler et al. (2018), at least 10 sampling units of 1 $m^2$ in three rows at the beach are needed. Therefore, we plan to add an additional row of 5 sampling squares at (a) a possible second high tideline if observed or (b) at an average measured distance from the springtide line at which second tidelines have been observed. This will (a) expand the spatial coverage of the monitoring, (b) improve the robustness of the results in line with German and French methods, and (c) will make the monitoring less dependent of a precise planning of the surveys and (d) validate our assumption that most litter accumulates in the high springtide line.

The results secondly show that mesoplastic fragments can be monitored accurately on the high springtide line, and are almost always present in the samples (94%). The detected amounts are much higher than found in the macrolitter monitoring, showing the benefit of this precise monitoring method. The use of visual macrolitter monitoring clearly underestimates the number of mesoplastic fragments. The use of the top layer of 1-2 cm clearly increases the number of detected mesoplastic fragments, compared to visually detecting mesoplastic fragments on top of the sand. These results do not disqualify the beach results, which is targeted at litter on top of the beach sand. However, when the top layer of 1-2 cm is sampled, a much better quantitative picture of both pellets and mesoplastics is obtained. For example, pellets are often not visually detected on top of the

Dutch beaches, but only found when the top layer is sampled and sieved. This clearly illustrates the advantage of this precise sampling method. Furthermore, this precise method will probably produce results which will be comparable at a European level.

The first data analysis of the four pellet colour and shape classes did not show clear differences between locations. More data are needed to find possible differences between locations and possible relations with pellet and macrolitter reduction measures. We will continue with a simplified and more efficient data collection using only the four pellet classes reported here.

However, since their does not appear to be a European need for these data, partly because this analysis is time-consuming and partly subjective, we do not plan to invest in this type of analyses. We will only report pictures of pellet samples in our next annual report; and the samples are available for inspection in our sampling archive for Dutch plastic researchers.

### 4.3 Harmonization with French and German methods

In March 2022 a first harmonization meeting was held with Camille Lacroix, Cedre, France. It appeared that the French method is especially suitable for more highly polluted beaches, such as the French Atlantic coast. The Dutch method is more tailored for less polluted beach such as the Dutch North Sea coast. Therefore, it is necessary for the Dutch method to sample a few days after spring tide, to get the necessary accumulation of pellets and mesoplastics at the high springtide line. The French beaches do not need this specific timing of the monitoring, because pellets are in most cases easily found in several tidelines. Both methods are only suitable for sandy beaches.

It is however necessary to improve the spatial coverage of the Dutch sampling from 5 to 10 $m^2$, as recommended by Haseler et al. (2017). These 5 additional sampling squares of 1 $m^2$ will be selected at (a) a second observed high tideline or, if no second high tideline is observed, (b) halfway between the high tideline and the low tideline. This will bring the spatial coverage also more in line with that of the French method, which uses 5 transects of 50 cm wide. This improved spatial coverage is currently tested in the Dutch monitoring for 2022.

In a field meeting with France in June 2022, the following points were agreed:

- use 5 vertical transects of fixed distances 20 m: at 10, 30, 50, 70 and 90 m
- sample transects of 50 cm wide (highly polluted) or 100 cm wide (low pollution level)
- sample every visible tideline by scraping the top 1 cm layer. Inspect visually in between. The basic assumption is that the pellets and mesoplastic fragments accumulate in these tidelines
- the scraped samples can be washed in bucket with seawater on the beach or sieved with bag and metal sieve. Recovery of these two methods is expected to be comparable for pellets at higher levels. At lower levels sieving may be more accurate. Heavy mesoplastic fragments may be lost in the washing method.
- France will attempt to also use the springtide sampling and sieving bags.

Furthermore, a harmonization meeting with Germany was held in august 2022.
Germany now also cooperates in this project to design a draft harmonized European method for pellets and mesoplastic fragments.

## 6. RECOMMENDATIONS

It is recommended to continue the current monitoring with an improved and more harmonized method (see 4.3). This will give a good baseline dataset for pellets and mesoplastic fragments for further Dutch monitoring and assessment, and for contribution to a desired harmonized EU and OSPAR monitoring and assessment of pellets.

It is recommended to discuss this method with the EU TGML group for consideration as a part of a European harmonized monitoring method for pellets and mesoplastic fragments.

We will improve the spatial coverage of our method and investigate the distribution of pellets and mesoplastic fragments over the several tidelines (when present) within the five strata, and by sampling at least 10 $m^2$ of beach surface.

We will improve the data support for the conversion factors from number to weight for pellets and mesoplastics using two additional years of monitoring data.

We will simplify the reporting of pellet colour and shape by only classifying and reporting pellets as black irregular (biobeads), white, yellowed and other. White pellets are assumed to be relatively fresh while yellowed pellets are assumed to have aged in the environment.

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**Annex 1: Results for pellets and mesoplastic fragments on Dutch beaches 2021**

*The detailed results of the individual sampling squares of 1 m2 per survey are presented. The reported indicators are: NPEL, number of pellets; WPEL, total weight of pellets (mg); NMESO, number of unidentifiable mesoplastic fragments; WMESO, total weight of unidentifiable mesoplastic fragments (mg).*

| country | location | sample_code | date | NPEL | WPEL | NMESO | WMESO | Remarks |
|---|---|---|---|---|---|---|---|---|
| NL | Bergen | 210430-BGN-1 | 30/04/2021 | 0 | 0 | 5 | 18.6 | |
| NL | Bergen | 210430-BGN-2 | 30/04/2021 | 1 | 16.7 | 2 | 25.7 | |
| NL | Bergen | 210430-BGN-3 | 30/04/2021 | 2 | 20.3 | 1 | 13.1 | |
| NL | Bergen | 210430-BGN-4 | 30/04/2021 | 0 | 0 | 1 | 10 | |
| NL | Bergen | 210430-BGN-5 | 30/04/2021 | 1 | 40.1 | 1 | 18.4 | |
| NL | Texel | 210430-TXL-1 | 30/04/2021 | 0 | 0 | 0 | 0 | |
| NL | Texel | 210430-TXL-2 | 30/04/2021 | 0 | 0 | 0 | 0 | |
| NL | Texel | 210430-TXL-3 | 30/04/2021 | 0 | 0 | 1 | 44.6 | |
| NL | Texel | 210430-TXL-4 | 30/04/2021 | 0 | 0 | 0 | 0 | |
| NL | Monster | 210501-MSR-1 | 01/05/2021 | 2 | 35.3 | 3 | 67 | |
| NL | Monster | 210501-MSR-2 | 01/05/2021 | 2 | 62.2 | 1 | 81.7 | |
| NL | Monster | 210501-MSR-3 | 01/05/2021 | 1 | 12.9 | 0 | 0 | |
| NL | Monster | 210501-MSR-4 | 01/05/2021 | 1 | 22.8 | 1 | 159.6 | |
| NL | Monster | 210501-MSR-5 | 01/05/2021 | 2 | 49.9 | 3 | 95.8 | |
| NL | Neeltje Jans | 210502-NTJ-1 | 02/05/2021 | 1 | 20.6 | 2 | 38.9 | |
| NL | Neeltje Jans | 210502-NTJ-2 | 02/05/2021 | 2 | 47.5 | 6 | 443 | |
| NL | Neeltje Jans | 210502-NTJ-3 | 02/05/2021 | 0 | 0 | 0 | 0 | |
| NL | Neeltje Jans | 210502-NTJ-4 | 02/05/2021 | 4 | 78.3 | 6 | 230.9 | |
| NL | Neeltje Jans | 210502-NTJ-5 | 02/05/2021 | 2 | 53.3 | 2 | 18.4 | |
| NL | Bergen | 210627-BGN-1 | 27/06/2021 | 1 | 24.1 | 0 | 0 | no clear tideline |
| NL | Bergen | 210627-BGN-2 | 27/06/2021 | 1 | 29.6 | 0 | 0 | no clear tideline |
| NL | Bergen | 210627-BGN-3 | 27/06/2021 | 0 | 0 | 0 | 0 | no clear tideline |
| NL | Bergen | 210627-BGN-4 | 27/06/2021 | 9 | 237.9 | 13 | 290.7 | no clear tideline |
| NL | Bergen | 210627-BGN-5 | 27/06/2021 | 1 | 22.4 | 1 | 364 | no clear tideline |
| NL | Neeltje Jans | 210628-NTJ-1 | 28/06/2021 | 5 | 66.8 | 2 | 19.5 | |
| NL | Neeltje Jans | 210628-NTJ-2 | 28/06/2021 | 1 | 16.1 | 0 | 0 | |
| NL | Neeltje Jans | 210628-NTJ-3 | 28/06/2021 | 1 | 17.1 | 0 | 0 | |
| NL | Neeltje Jans | 210628-NTJ-4 | 28/06/2021 | 46 | 951.3 | 12 | 174.2 | |
| NL | Neeltje Jans | 210628-NTJ-5 | 28/06/2021 | 1 | 20.6 | 0 | 0 | |
| NL | Texel | 210713-TXL-1 | 13/07/2021 | 1 | 22.1 | 2 | 3.3 | |
| NL | Texel | 210713-TXL-2 | 13/07/2021 | 2 | 42.3 | 2 | 13.2 | |
| NL | Texel | 210713-TXL-3 | 13/07/2021 | 2 | 29.7 | 0 | 0 | |
| NL | Texel | 210713-TXL-4 | 13/07/2021 | 3 | 95.7 | 2 | 57.7 | |
| NL | Texel | 210713-TXL-5 | 13/07/2021 | 1 | 14.2 | 0 | 0 | |
| NL | Monster | 210714-MSR-1 | 14/07/2021 | 5 | 118.8 | 6 | 111.4 | |
| NL | Monster | 210714-MSR-2 | 14/07/2021 | 8 | 159.1 | 3 | 496.8 | |
| NL | Monster | 210714-MSR-3 | 14/07/2021 | 4 | 60.1 | 0 | 0 | |
| NL | Monster | 210714-MSR-4 | 14/07/2021 | 2 | 49.2 | 4 | 27 | |
| NL | Monster | 210714-MSR-5 | 14/07/2021 | 0 | 0 | 11 | 84.4 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| NL | Neeltje Jans | 210924-NTJ-1 | 24/09/2021 | 6 | 94.4 | 6 | 1575.7 | |
| NL | Neeltje Jans | 210924-NTJ-2 | 24/09/2021 | 2 | 52.3 | 0 | 0 | |
| NL | Neeltje Jans | 210924-NTJ-3 | 24/09/2021 | 3 | 65.8 | 0 | 0 | |
| NL | Neeltje Jans | 210924-NTJ-4 | 24/09/2021 | 3 | 70.1 | 5 | 258.3 | |
| NL | Neeltje Jans | 210924-NTJ-5 | 24/09/2021 | 2 | 50.2 | 2 | 33.1 | |
| NL | Monster | 210925-MSR-1 | 25/09/2021 | 2 | 46 | 3 | 23.5 | |
| NL | Monster | 210925-MSR-2 | 25/09/2021 | 6 | 101 | 6 | 51.3 | |
| NL | Monster | 210925-MSR-3 | 25/09/2021 | 9 | 160 | 3 | 179.6 | |
| NL | Monster | 210925-MSR-4 | 25/09/2021 | 2 | 25.4 | 3 | 51.1 | |
| NL | Monster | 210925-MSR-5 | 25/09/2021 | 1 | 10.7 | 3 | 82.5 | |
| NL | Texel | 211010-TXL-1 | 10/10/2021 | 13 | 303.2 | 26 | 473 | |
| NL | Texel | 211010-TXL-2 | 10/10/2021 | 23 | 574.9 | 21 | 893.8 | |
| NL | Texel | 211010-TXL-3 | 10/10/2021 | 19 | 508 | 18 | 371.7 | |
| NL | Texel | 211010-TXL-4 | 10/10/2021 | 19 | 437.6 | 15 | 724.5 | |
| NL | Texel | 211010-TXL-5 | 10/10/2021 | 14 | 338.5 | 24 | 604.2 | |
| NL | Bergen | 211009-BGN-1 | 09/10/2021 | 0 | 0 | 0 | 0 | no clear tideline |
| NL | Bergen | 211009-BGN-2 | 09/10/2021 | 0 | 0 | 0 | 0 | no clear tideline |
| NL | Bergen | 211009-BGN-3 | 09/10/2021 | 0 | 0 | 0 | 0 | no clear tideline |
| NL | Bergen | 211009-BGN-4 | 09/10/2021 | 0 | 0 | 0 | 0 | no clear tideline |
| NL | Bergen | 211009-BGN-5 | 09/10/2021 | 1 | 9.4 | 0 | 0 | no clear tideline |
| NL | Neeltje Jans | 211207-NTJ-1 | 07/12/2021 | 0 | 0 | 1 | 21.3 | |
| NL | Neeltje Jans | 211207-NTJ-2 | 07/12/2021 | 0 | 0 | 3 | 57.3 | |
| NL | Neeltje Jans | 211207-NTJ-3 | 07/12/2021 | 0 | 0 | 3 | 260.5 | |
| NL | Neeltje Jans | 211207-NTJ-4 | 07/12/2021 | 3 | 90 | 4 | 131.1 | |
| NL | Neeltje Jans | 211207-NTJ-5 | 07/12/2021 | 0 | 0 | 2 | 33.9 | |
| NL | Monster | 211208-MSR-1 | 08/12/2021 | 0 | 0 | 0 | 0 | no clear tideline |
| NL | Monster | 211208-MSR-2 | 08/12/2021 | 0 | 0 | 2 | 27.1 | no clear tideline |
| NL | Monster | 211208-MSR-3 | 08/12/2021 | 0 | 0 | 0 | 0 | no clear tideline |
| NL | Monster | 211208-MSR-4 | 08/12/2021 | 0 | 0 | 0 | 0 | no clear tideline |
| NL | Monster | 211208-MSR-5 | 08/12/2021 | 0 | 0 | 3 | 6.1 | no clear tideline |
| NL | Bergen | 211222-BGN-1 | 22/12/2021 | 0 | 0 | 0 | 0 | |
| NL | Bergen | 211222-BGN-2 | 22/12/2021 | 3 | 49.1 | 2 | 316 | |
| NL | Bergen | 211222-BGN-3 | 22/12/2021 | 6 | 112.4 | 3 | 38.9 | |
| NL | Bergen | 211222-BGN-4 | 22/12/2021 | 0 | 0 | 1 | 50.5 | |
| NL | Bergen | 211222-BGN-5 | 22/12/2021 | 0 | 0 | 2 | 9.7 | |
| NL | Texel | 211223-TXL-1 | 23/12/2021 | 0 | 0 | 3 | 27.5 | |
| NL | Texel | 211223-TXL-2 | 23/12/2021 | 0 | 0 | 2 | 187.2 | |
| NL | Texel | 211223-TXL-3 | 23/12/2021 | 1 | 25.3 | 14 | 174.6 | |
| NL | Texel | 211223-TXL-4 | 23/12/2021 | 1 | 24.8 | 4 | 19.4 | |
| NL | Texel | 211223-TXL-5 | 23/12/2021 | 0 | 0 | 1 | 5.9 | |

**Annex 2: Results for colours and shapes of pellets**

*The detailed results of the individual sampling squares of 1 m2 per survey are presented.*
*The data format of the pellet_code is: date-locationcode-squarenr-pelletnr*

| location | pellet_code | date | colour | shape | colour_shape | transparancy |
|---|---|---|---|---|---|---|
| Monster | 210501-MSR-4-1 | 01/05/2021 | black | irregular | black_irregular | non-transparent |
| Monster | 210501-MSR-5-2 | 01/05/2021 | black | irregular | black_irregular | non-transparent |
| Monster | 210501-MSR-2-1 | 01/05/2021 | black | discoid | other_colour | non-transparent |
| Monster | 210501-MSR-2-2 | 01/05/2021 | black | ball | other_colour | non-transparent |
| Monster | 210501-MSR-3-1 | 01/05/2021 | black | discoid | other_colour | non-transparent |
| Monster | 210501-MSR-1-2 | 01/05/2021 | white | ovoid | white | transparent |
| Monster | 210501-MSR-1-1 | 01/05/2021 | yellowed | discoid | yellowed | transparent |
| Monster | 210501-MSR-5-1 | 01/05/2021 | yellowed | ovoid | yellowed | transparent |
| Neeltje Jans | 210502-NTJ-2-1 | 02/05/2021 | black | irregular | black_irregular | non-transparent |
| Neeltje Jans | 210502-NTJ-4-2 | 02/05/2021 | black | irregular | black_irregular | non-transparent |
| Neeltje Jans | 210502-NTJ-5-1 | 02/05/2021 | black | irregular | black_irregular | non-transparent |
| Neeltje Jans | 210502-NTJ-1-1 | 02/05/2021 | grey | cylinder | other_colour | non-transparent |
| Neeltje Jans | 210502-NTJ-4-1 | 02/05/2021 | black | ovoid | other_colour | non-transparent |
| Neeltje Jans | 210502-NTJ-2-2 | 02/05/2021 | yellowed | ball | yellowed | non-transparent |
| Neeltje Jans | 210502-NTJ-4-3 | 02/05/2021 | yellowed | other | yellowed | transparent |
| Neeltje Jans | 210502-NTJ-4-4 | 02/05/2021 | yellow | donut | other_colour | non-transparent |
| Neeltje Jans | 210502-NTJ-5-2 | 02/05/2021 | yellow | ovoid | other_colour | non-transparent |
| Neeltje Jans | 211207-NTJ-4-1 | 07/12/2021 | black | cylinder | other_colour | non-transparent |
| Neeltje Jans | 211207-NTJ-4-2 | 07/12/2021 | black | discoid | other_colour | non-transparent |
| Neeltje Jans | 211207-NTJ-4-3 | 07/12/2021 | white | discoid | white | non-transparent |
| Bergen | 211009-BGN-5-1 | 09/10/2021 | black | cubical | other_colour | non-transparent |
| Texel | 211010-TXL-1-1 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-1-2 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-1-3 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-1-4 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-1-5 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-2-1 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-2-2 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-2-3 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-2-4 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-3-1 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-3-2 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-3-3 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-3-4 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-3-5 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-4-1 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-4-2 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-4-3 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-4-4 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-5-1 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-5-2 | 10/10/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211010-TXL-1-6 | 10/10/2021 | black | discoid | other_colour | non-transparent |
| Texel | 211010-TXL-1-7 | 10/10/2021 | black | cylinder | other_colour | non-transparent |
| Texel | 211010-TXL-2-18 | 10/10/2021 | black | cubical | other_colour | non-transparent |

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|---|---|---|---|---|---|---|
| Texel | 211010-TXL-2-19 | 10/10/2021 | black | other | other_colour | non-transparent |
| Texel | 211010-TXL-2-20 | 10/10/2021 | black | discoid | other_colour | non-transparent |
| Texel | 211010-TXL-2-21 | 10/10/2021 | black | donut | other_colour | non-transparent |
| Texel | 211010-TXL-2-5 | 10/10/2021 | red | discoid | other_colour | transparent |
| Texel | 211010-TXL-2-6 | 10/10/2021 | grey | discoid | other_colour | non-transparent |
| Texel | 211010-TXL-2-7 | 10/10/2021 | grey | cylinder | other_colour | non-transparent |
| Texel | 211010-TXL-2-9 | 10/10/2021 | brown | ovoid | other_colour | transparent |
| Texel | 211010-TXL-3-10 | 10/10/2021 | brown | ovoid | other_colour | transparent |
| Texel | 211010-TXL-3-19 | 10/10/2021 | grey | cylinder | other_colour | non-transparent |
| Texel | 211010-TXL-3-6 | 10/10/2021 | black | discoid | other_colour | non-transparent |
| Texel | 211010-TXL-3-7 | 10/10/2021 | black | ovoid | other_colour | non-transparent |
| Texel | 211010-TXL-3-8 | 10/10/2021 | black | cylinder | other_colour | non-transparent |
| Texel | 211010-TXL-3-9 | 10/10/2021 | brown | ovoid | other_colour | transparent |
| Texel | 211010-TXL-4-5 | 10/10/2021 | red | cubicalal | other_colour | non-transparent |
| Texel | 211010-TXL-4-6 | 10/10/2021 | black | other | other_colour | non-transparent |
| Texel | 211010-TXL-4-8 | 10/10/2021 | brown | cylinder | other_colour | transparent |
| Texel | 211010-TXL-5-3 | 10/10/2021 | black | other | other_colour | non-transparent |
| Texel | 211010-TXL-5-4 | 10/10/2021 | brown | donut | other_colour | transparent |
| Texel | 211010-TXL-5-5 | 10/10/2021 | grey | cylinder | other_colour | non-transparent |
| Texel | 211010-TXL-1-10 | 10/10/2021 | white | other | white | transparent |
| Texel | 211010-TXL-1-11 | 10/10/2021 | white | other | white | transparent |
| Texel | 211010-TXL-1-12 | 10/10/2021 | white | other | white | transparent |
| Texel | 211010-TXL-1-14 | 10/10/2021 | white | cylinder | white | non-transparent |
| Texel | 211010-TXL-2-11 | 10/10/2021 | white | cylinder | white | transparent |
| Texel | 211010-TXL-2-12 | 10/10/2021 | white | discoid | white | transparent |
| Texel | 211010-TXL-2-14 | 10/10/2021 | white | discoid | white | transparent |
| Texel | 211010-TXL-2-15 | 10/10/2021 | white | ovoid | white | transparent |
| Texel | 211010-TXL-2-16 | 10/10/2021 | white | other | white | transparent |
| Texel | 211010-TXL-2-17 | 10/10/2021 | white | other | white | transparent |
| Texel | 211010-TXL-2-8 | 10/10/2021 | white | ovoid | white | non-transparent |
| Texel | 211010-TXL-3-14 | 10/10/2021 | white | other | white | transparent |
| Texel | 211010-TXL-3-15 | 10/10/2021 | white | discoid | white | transparent |
| Texel | 211010-TXL-3-16 | 10/10/2021 | white | discoid | white | transparent |
| Texel | 211010-TXL-3-17 | 10/10/2021 | white | other | white | transparent |
| Texel | 211010-TXL-4-10 | 10/10/2021 | white | ball | white | non-transparent |
| Texel | 211010-TXL-4-11 | 10/10/2021 | white | other | white | transparent |
| Texel | 211010-TXL-4-12 | 10/10/2021 | white | cylinder | white | non-transparent |
| Texel | 211010-TXL-4-13 | 10/10/2021 | white | cylinder | white | non-transparent |
| Texel | 211010-TXL-4-14 | 10/10/2021 | white | ovoid | white | transparent |
| Texel | 211010-TXL-4-9 | 10/10/2021 | white | cylinder | white | non-transparent |
| Texel | 211010-TXL-5-10 | 10/10/2021 | white | ovoid | white | transparent |
| Texel | 211010-TXL-5-11 | 10/10/2021 | white | ovoid | white | transparent |
| Texel | 211010-TXL-5-12 | 10/10/2021 | white | cylinder | white | transparent |
| Texel | 211010-TXL-5-13 | 10/10/2021 | white | cylinder | white | transparent |
| Texel | 211010-TXL-1-13 | 10/10/2021 | yellowed | other | yellowed | transparent |
| Texel | 211010-TXL-1-8 | 10/10/2021 | yellow | other | other_colour | non-transparent |
| Texel | 211010-TXL-1-9 | 10/10/2021 | yellow | discoid | other_colour | transparent |
| Texel | 211010-TXL-2-10 | 10/10/2021 | yellow | other | other_colour | transparent |
| Texel | 211010-TXL-2-13 | 10/10/2021 | yellowed | cylinder | yellowed | transparent |

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|---|---|---|---|---|---|---|
| Texel | 211010-TXL-3-11 | 10/10/2021 | yellowed | ovoid | yellowed | transparent |
| Texel | 211010-TXL-3-12 | 10/10/2021 | yellowed | other | yellowed | transparent |
| Texel | 211010-TXL-3-13 | 10/10/2021 | yellowed | cylinder | yellowed | transparent |
| Texel | 211010-TXL-3-18 | 10/10/2021 | yellowed | cylinder | yellowed | transparent |
| Texel | 211010-TXL-4-15 | 10/10/2021 | yellowed | discoid | yellowed | transparent |
| Texel | 211010-TXL-4-16 | 10/10/2021 | yellowed | cylinder | yellowed | transparent |
| Texel | 211010-TXL-4-17 | 10/10/2021 | yellowed | cylinder | yellowed | transparent |
| Texel | 211010-TXL-4-18 | 10/10/2021 | yellowed | cylinder | yellowed | transparent |
| Texel | 211010-TXL-4-19 | 10/10/2021 | yellowed | cylinder | yellowed | transparent |
| Texel | 211010-TXL-4-7 | 10/10/2021 | yellowed | beam | yellowed | transparent |
| Texel | 211010-TXL-5-6 | 10/10/2021 | yellowed | ball | yellowed | non-transparent |
| Texel | 211010-TXL-5-7 | 10/10/2021 | yellowed | ball | yellowed | non-transparent |
| Texel | 211010-TXL-5-8 | 10/10/2021 | yellowed | ovoid | yellowed | transparent |
| Texel | 211010-TXL-5-9 | 10/10/2021 | yellowed | ovoid | yellowed | transparent |
| Texel | 210713-TXL-2-2 | 13/07/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 210713-TXL-3-2 | 13/07/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 210713-TXL-4-3 | 13/07/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 210713-TXL-1-1 | 13/07/2021 | white | other | white | transparent |
| Texel | 210713-TXL-3-1 | 13/07/2021 | white | ovoid | white | non-transparent |
| Texel | 210713-TXL-5-1 | 13/07/2021 | white | cylinder | white | transparent |
| Texel | 210713-TXL-2-1 | 13/07/2021 | yellowed | ovoid | yellowed | non-transparent |
| Texel | 210713-TXL-4-1 | 13/07/2021 | yellowed | other | yellowed | non-transparent |
| Texel | 210713-TXL-4-2 | 13/07/2021 | yellowed | cylinder | yellowed | non-transparent |
| Monster | 210714-MSR-1-5 | 14/07/2021 | black | irregular | black_irregular | non-transparent |
| Monster | 210714-MSR-1-2 | 14/07/2021 | black | irregular | black_irregular | non-transparent |
| Monster | 210714-MSR-1-3 | 14/07/2021 | black | irregular | black_irregular | non-transparent |
| Monster | 210714-MSR-1-1 | 14/07/2021 | green | ovoid | other_colour | non-transparent |
| Monster | 210714-MSR-2-2 | 14/07/2021 | blue | cubical | other_colour | non-transparent |
| Monster | 210714-MSR-2-4 | 14/07/2021 | brown | donut | other_colour | transparent |
| Monster | 210714-MSR-2-5 | 14/07/2021 | brown | other | other_colour | non-transparent |
| Monster | 210714-MSR-2-6 | 14/07/2021 | brown | cylinder | other_colour | transparent |
| Monster | 210714-MSR-2-7 | 14/07/2021 | brown | other | other_colour | transparent |
| Monster | 210714-MSR-3-1 | 14/07/2021 | brown | cubical | other_colour | transparent |
| Monster | 210714-MSR-3-3 | 14/07/2021 | brown | ovoid | other_colour | transparent |
| Monster | 210714-MSR-3-4 | 14/07/2021 | brown | cylinder | other_colour | transparent |
| Monster | 210714-MSR-4-1 | 14/07/2021 | brown | other | other_colour | transparent |
| Monster | 210714-MSR-4-2 | 14/07/2021 | black | ovoid | other_colour | non-transparent |
| Monster | 210714-MSR-2-8 | 14/07/2021 | white | ovoid | white | non-transparent |
| Monster | 210714-MSR-1-4 | 14/07/2021 | yellowed | discoid | yellowed | transparent |
| Monster | 210714-MSR-2-1 | 14/07/2021 | yellowed | ovoid | yellowed | transparent |
| Monster | 210714-MSR-2-3 | 14/07/2021 | yellowed | discoid | yellowed | transparent |
| Monster | 210714-MSR-3-2 | 14/07/2021 | yellowed | ovoid | yellowed | non-transparent |
| Bergen | 211222-BGN-3-1 | 22/12/2021 | black | discoid | other_colour | non-transparent |
| Bergen | 211222-BGN-3-2 | 22/12/2021 | grey | cylinder | other_colour | non-transparent |
| Bergen | 211222-BGN-2-1 | 22/12/2021 | white | discoid | white | transparent |
| Bergen | 211222-BGN-3-5 | 22/12/2021 | white | other | white | non-transparent |
| Bergen | 211222-BGN-2-2 | 22/12/2021 | yellowed | cylinder | yellowed | transparent |
| Bergen | 211222-BGN-2-3 | 22/12/2021 | yellowed | discoid | yellowed | transparent |
| Bergen | 211222-BGN-3-3 | 22/12/2021 | yellowed | discoid | yellowed | transparent |

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|---|---|---|---|---|---|---|
| Bergen | 211222-BGN-3-4 | 22/12/2021 | yellowed | cylinder | yellowed | transparent |
| Bergen | 211222-BGN-3-6 | 22/12/2021 | yellowed | other | yellowed | transparent |
| Texel | 211223-TXL-3-1 | 23/12/2021 | black | irregular | black_irregular | non-transparent |
| Texel | 211223-TXL-4-1 | 23/12/2021 | black | irregular | black_irregular | non-transparent |
| Neeltje Jans | 210924-NTJ-1-1 | 24/09/2021 | black | irregular | black_irregular | non-transparent |
| Neeltje Jans | 210924-NTJ-1-5 | 24/09/2021 | black | irregular | black_irregular | non-transparent |
| Neeltje Jans | 210924-NTJ-3-2 | 24/09/2021 | black | irregular | black_irregular | non-transparent |
| Neeltje Jans | 210924-NTJ-1-6 | 24/09/2021 | brown | discoid | other_colour | transparent |
| Neeltje Jans | 210924-NTJ-2-2 | 24/09/2021 | grey | ovoid | other_colour | non-transparent |
| Neeltje Jans | 210924-NTJ-4-3 | 24/09/2021 | black | other | other_colour | non-transparent |
| Neeltje Jans | 210924-NTJ-1-2 | 24/09/2021 | white | discoid | white | transparent |
| Neeltje Jans | 210924-NTJ-1-3 | 24/09/2021 | white | discoid | white | transparent |
| Neeltje Jans | 210924-NTJ-2-1 | 24/09/2021 | white | ovoid | white | transparent |
| Neeltje Jans | 210924-NTJ-3-1 | 24/09/2021 | white | ovoid | white | transparent |
| Neeltje Jans | 210924-NTJ-3-3 | 24/09/2021 | white | discoid | white | transparent |
| Neeltje Jans | 210924-NTJ-4-1 | 24/09/2021 | white | other | white | transparent |
| Neeltje Jans | 210924-NTJ-1-4 | 24/09/2021 | yellowed | discoid | yellowed | transparent |
| Neeltje Jans | 210924-NTJ-4-2 | 24/09/2021 | yellowed | donut | yellowed | transparent |
| Neeltje Jans | 210924-NTJ-5-1 | 24/09/2021 | yellowed | ovoid | yellowed | non-transparent |
| Neeltje Jans | 210924-NTJ-5-2 | 24/09/2021 | yellowed | cylinder | yellowed | transparent |
| Monster | 210925-MSR-1-2 | 25/09/2021 | brown | beam | other_colour | transparent |
| Monster | 210925-MSR-2-1 | 25/09/2021 | brown | cylinder | other_colour | transparent |
| Monster | 210925-MSR-2-2 | 25/09/2021 | brown | discoid | other_colour | transparent |
| Monster | 210925-MSR-2-3 | 25/09/2021 | green | ovoid | other_colour | non-transparent |
| Monster | 210925-MSR-3-2 | 25/09/2021 | brown | ovoid | other_colour | non-transparent |
| Monster | 210925-MSR-3-4 | 25/09/2021 | brown | cubical | other_colour | transparent |
| Monster | 210925-MSR-3-6 | 25/09/2021 | brown | cubical | other_colour | transparent |
| Monster | 210925-MSR-3-7 | 25/09/2021 | brown | ovoid | other_colour | transparent |
| Monster | 210925-MSR-3-8 | 25/09/2021 | black | ovoid | other_colour | non-transparent |
| Monster | 210925-MSR-2-4 | 25/09/2021 | white | other | white | transparent |
| Monster | 210925-MSR-2-5 | 25/09/2021 | white | ovoid | white | transparent |
| Monster | 210925-MSR-3-3 | 25/09/2021 | white | other | white | transparent |
| Monster | 210925-MSR-5-1 | 25/09/2021 | white | other | white | transparent |
| Monster | 210925-MSR-1-1 | 25/09/2021 | yellowed | cylinder | yellowed | transparent |
| Monster | 210925-MSR-3-1 | 25/09/2021 | yellowed | discoid | yellowed | non-transparent |
| Monster | 210925-MSR-3-5 | 25/09/2021 | yellowed | other | yellowed | transparent |
| Monster | 210925-MSR-3-9 | 25/09/2021 | yellowed | cylinder | yellowed | non-transparent |
| Monster | 210925-MSR-4-1 | 25/09/2021 | yellowed | discoid | yellowed | non-transparent |
| Monster | 210925-MSR-4-2 | 25/09/2021 | yellowed | ovoid | yellowed | non-transparent |
| Bergen | 210627-BGN-4-5 | 27/06/2021 | black | irregular | black_irregular | non-transparent |
| Bergen | 210627-BGN-4-6 | 27/06/2021 | black | irregular | black_irregular | non-transparent |
| Bergen | 210627-BGN-4-7 | 27/06/2021 | black | irregular | black_irregular | non-transparent |
| Bergen | 210627-BGN-4-8 | 27/06/2021 | black | irregular | black_irregular | non-transparent |
| Bergen | 210627-BGN-1-1 | 27/06/2021 | brown | discoid | other_colour | transparent |
| Bergen | 210627-BGN-4-3 | 27/06/2021 | black | ovoid | other_colour | non-transparent |
| Bergen | 210627-BGN-4-4 | 27/06/2021 | black | ovoid | other_colour | non-transparent |
| Bergen | 210627-BGN-5-1 | 27/06/2021 | black | ovoid | other_colour | non-transparent |
| Bergen | 210627-BGN-4-2 | 27/06/2021 | white | discoid | white | transparent |
| Bergen | 210627-BGN-4-9 | 27/06/2021 | white | ovoid | white | non-transparent |

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|---|---|---|---|---|---|---|
| Bergen | 210627-BGN-2-1 | 27/06/2021 | yellowed | cylinder | yellowed | transparent |
| Bergen | 210627-BGN-4-1 | 27/06/2021 | yellowed | other | yellowed | transparent |
| Neeltje Jans | 210628-NTJ-4-1 | 28/06/2021 | black | irregular | black_irregular | non-transparent |
| Neeltje Jans | 210628-NTJ-4-2 | 28/06/2021 | black | irregular | black_irregular | non-transparent |
| Neeltje Jans | 210628-NTJ-4-3 | 28/06/2021 | black | irregular | black_irregular | non-transparent |
| Neeltje Jans | 210628-NTJ-4-4 | 28/06/2021 | black | irregular | black_irregular | non-transparent |
| Neeltje Jans | 210628-NTJ-4-5 | 28/06/2021 | black | irregular | black_irregular | non-transparent |
| Neeltje Jans | 210628-NTJ-4-6 | 28/06/2021 | black | irregular | black_irregular | non-transparent |
| Neeltje Jans | 210628-NTJ-1-1 | 28/06/2021 | brown | cubical | other_colour | transparent |
| Neeltje Jans | 210628-NTJ-4-10 | 28/06/2021 | black | donut | other_colour | non-transparent |
| Neeltje Jans | 210628-NTJ-4-11 | 28/06/2021 | brown | other | other_colour | transparent |
| Neeltje Jans | 210628-NTJ-4-12 | 28/06/2021 | brown | other | other_colour | transparent |
| Neeltje Jans | 210628-NTJ-4-13 | 28/06/2021 | brown | other | other_colour | transparent |
| Neeltje Jans | 210628-NTJ-4-14 | 28/06/2021 | brown | cylinder | other_colour | transparent |
| Neeltje Jans | 210628-NTJ-4-7 | 28/06/2021 | black | discoid | other_colour | non-transparent |
| Neeltje Jans | 210628-NTJ-4-8 | 28/06/2021 | black | other | other_colour | non-transparent |
| Neeltje Jans | 210628-NTJ-4-9 | 28/06/2021 | black | donut | other_colour | non-transparent |
| Neeltje Jans | 210628-NTJ-5-1 | 28/06/2021 | black | cylinder | other_colour | non-transparent |
| Neeltje Jans | 210628-NTJ-1-2 | 28/06/2021 | white | cylinder | white | transparent |
| Neeltje Jans | 210628-NTJ-1-3 | 28/06/2021 | white | other | white | transparent |
| Neeltje Jans | 210628-NTJ-2-1 | 28/06/2021 | white | ovoid | white | transparent |
| Neeltje Jans | 210628-NTJ-3-1 | 28/06/2021 | white | ovoid | white | transparent |
| Neeltje Jans | 210628-NTJ-4-18 | 28/06/2021 | white | discoid | white | non-transparent |
| Neeltje Jans | 210628-NTJ-4-19 | 28/06/2021 | white | ovoid | white | non-transparent |
| Neeltje Jans | 210628-NTJ-4-20 | 28/06/2021 | white | ovoid | white | non-transparent |
| Neeltje Jans | 210628-NTJ-4-21 | 28/06/2021 | white | ovoid | white | non-transparent |
| Neeltje Jans | 210628-NTJ-4-22 | 28/06/2021 | white | ovoid | white | non-transparent |
| Neeltje Jans | 210628-NTJ-4-28 | 28/06/2021 | white | cylinder | white | transparent |
| Neeltje Jans | 210628-NTJ-4-31 | 28/06/2021 | white | discoid | white | transparent |
| Neeltje Jans | 210628-NTJ-4-32 | 28/06/2021 | white | discoid | white | transparent |
| Neeltje Jans | 210628-NTJ-4-33 | 28/06/2021 | white | discoid | white | transparent |
| Neeltje Jans | 210628-NTJ-4-34 | 28/06/2021 | white | other | white | transparent |
| Neeltje Jans | 210628-NTJ-4-35 | 28/06/2021 | white | other | white | transparent |
| Neeltje Jans | 210628-NTJ-4-36 | 28/06/2021 | white | other | white | transparent |
| Neeltje Jans | 210628-NTJ-4-43 | 28/06/2021 | white | cylinder | white | transparent |
| Neeltje Jans | 210628-NTJ-4-44 | 28/06/2021 | white | cylinder | white | transparent |
| Neeltje Jans | 210628-NTJ-4-45 | 28/06/2021 | white | cylinder | white | transparent |
| Neeltje Jans | 210628-NTJ-4-46 | 28/06/2021 | white | cylinder | white | transparent |
| Neeltje Jans | 210628-NTJ-1-4 | 28/06/2021 | yellowed | cylinder | yellowed | transparent |
| Neeltje Jans | 210628-NTJ-1-5 | 28/06/2021 | yellowed | ovoid | yellowed | transparent |
| Neeltje Jans | 210628-NTJ-4-15 | 28/06/2021 | yellow | ovoid | other_colour | non-transparent |
| Neeltje Jans | 210628-NTJ-4-16 | 28/06/2021 | yellowed | donut | other_colour | non-transparent |
| Neeltje Jans | 210628-NTJ-4-17 | 28/06/2021 | yellowed | donut | yellowed | non-transparent |
| Neeltje Jans | 210628-NTJ-4-23 | 28/06/2021 | yellowed | cylinder | yellowed | transparent |
| Neeltje Jans | 210628-NTJ-4-24 | 28/06/2021 | yellowed | cylinder | yellowed | transparent |
| Neeltje Jans | 210628-NTJ-4-25 | 28/06/2021 | yellowed | discoid | yellowed | transparent |
| Neeltje Jans | 210628-NTJ-4-26 | 28/06/2021 | yellowed | discoid | yellowed | transparent |
| Neeltje Jans | 210628-NTJ-4-27 | 28/06/2021 | yellowed | cylinder | yellowed | transparent |
| Neeltje Jans | 210628-NTJ-4-29 | 28/06/2021 | yellowed | discoid | yellowed | transparent |

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|---|---|---|---|---|---|---|
| Neeltje Jans | 210628-NTJ-4-30 | 28/06/2021 | yellowed | discoid | yellowed | transparent |
| Neeltje Jans | 210628-NTJ-4-37 | 28/06/2021 | yellowed | cylinder | yellowed | transparent |
| Neeltje Jans | 210628-NTJ-4-38 | 28/06/2021 | yellowed | cylinder | yellowed | transparent |
| Neeltje Jans | 210628-NTJ-4-39 | 28/06/2021 | yellowed | cylinder | yellowed | transparent |
| Neeltje Jans | 210628-NTJ-4-40 | 28/06/2021 | yellowed | cylinder | yellowed | transparent |
| Neeltje Jans | 210628-NTJ-4-41 | 28/06/2021 | yellowed | cylinder | yellowed | transparent |
| Neeltje Jans | 210628-NTJ-4-42 | 28/06/2021 | yellowed | cylinder | yellowed | transparent |
| Bergen | 210430-BGN-5-1 | 30/04/2021 | black | irregular | black_irregular | non-transparent |
| Bergen | 210430-BGN-3-1 | 30/04/2021 | black | ovoid | other_colour | non-transparent |
| Bergen | 210430-BGN-3-2 | 30/04/2021 | black | cylinder | other_colour | non-transparent |
| Bergen | 210430-BGN-2-1 | 30/04/2021 | yellowed | donut | yellowed | transparent |

**Annex 3: Results for wax-like substances**

*The detailed results of the individual sampling squares of 1 m$^2$ per survey are presented. The reported indicators are: NWAX, number of wax-like items and WWAX, total weight of wax-like items (mg).*

| location | sample_code | date | NWAX | GWAX | Remarks |
|---|---|---|---|---|---|
| Bergen | 210430-BGN-1 | 30/04/2021 | 0 | 0 | |
| Bergen | 210430-BGN-2 | 30/04/2021 | 0 | 0 | |
| Bergen | 210430-BGN-3 | 30/04/2021 | 0 | 0 | |
| Bergen | 210430-BGN-4 | 30/04/2021 | 0 | 0 | |
| Bergen | 210430-BGN-5 | 30/04/2021 | 0 | 0 | |
| Texel | 210430-TXL-1 | 30/04/2021 | 0 | 0 | |
| Texel | 210430-TXL-2 | 30/04/2021 | 0 | 0 | |
| Texel | 210430-TXL-3 | 30/04/2021 | 0 | 0 | |
| Texel | 210430-TXL-4 | 30/04/2021 | 0 | 0 | |
| Monster | 210501-MSR-1 | 01/05/2021 | 0 | 0 | |
| Monster | 210501-MSR-2 | 01/05/2021 | 0 | 0 | |
| Monster | 210501-MSR-3 | 01/05/2021 | 0 | 0 | |
| Monster | 210501-MSR-4 | 01/05/2021 | 0 | 0 | |
| Monster | 210501-MSR-5 | 01/05/2021 | 0 | 0 | |
| Neeltje Jans | 210502-NTJ-1 | 02/05/2021 | 0 | 0 | |
| Neeltje Jans | 210502-NTJ-2 | 02/05/2021 | 1 | 8 | |
| Neeltje Jans | 210502-NTJ-3 | 02/05/2021 | 1 | 353.5 | |
| Neeltje Jans | 210502-NTJ-4 | 02/05/2021 | 0 | 0 | |
| Neeltje Jans | 210502-NTJ-5 | 02/05/2021 | 0 | 0 | |
| Bergen | 210627-BGN-1 | 27/06/2021 | 6 | 786.4 | no clear tideline |
| Bergen | 210627-BGN-2 | 27/06/2021 | 0 | 0 | no clear tideline |
| Bergen | 210627-BGN-3 | 27/06/2021 | 1 | 56 | no clear tideline |
| Bergen | 210627-BGN-4 | 27/06/2021 | 1 | 56.1 | no clear tideline |
| Bergen | 210627-BGN-5 | 27/06/2021 | 3 | 41.1 | no clear tideline |
| Neeltje Jans | 210628-NTJ-1 | 28/06/2021 | 0 | 0 | |
| Neeltje Jans | 210628-NTJ-2 | 28/06/2021 | 1 | 342.1 | |
| Neeltje Jans | 210628-NTJ-3 | 28/06/2021 | 0 | 0 | |
| Neeltje Jans | 210628-NTJ-4 | 28/06/2021 | 1 | 15.8 | |
| Neeltje Jans | 210628-NTJ-5 | 28/06/2021 | 0 | 0 | |
| Texel | 210713-TXL-1 | 13/07/2021 | 0 | 0 | |
| Texel | 210713-TXL-2 | 13/07/2021 | 1 | 108.8 | |
| Texel | 210713-TXL-3 | 13/07/2021 | 0 | 0 | |
| Texel | 210713-TXL-4 | 13/07/2021 | 5 | 20.3 | |
| Texel | 210713-TXL-5 | 13/07/2021 | 0 | 0 | |
| Monster | 210714-MSR-1 | 14/07/2021 | 0 | 0 | |
| Monster | 210714-MSR-2 | 14/07/2021 | 0 | 0 | |
| Monster | 210714-MSR-3 | 14/07/2021 | 0 | 0 | |
| Monster | 210714-MSR-4 | 14/07/2021 | 0 | 0 | |
| Monster | 210714-MSR-5 | 14/07/2021 | 0 | 0 | |
| Neeltje Jans | 210924-NTJ-1 | 24/09/2021 | 0 | 0 | |
| Neeltje Jans | 210924-NTJ-2 | 24/09/2021 | 0 | 0 | |
| Neeltje Jans | 210924-NTJ-3 | 24/09/2021 | 0 | 0 | |
| Neeltje Jans | 210924-NTJ-4 | 24/09/2021 | 5 | 196 | |

| | | | | | |
|---|---|---|---|---|---|
| Neeltje Jans | 210924-NTJ-5 | 24/09/2021 | 0 | 0 | |
| Monster | 210925-MSR-1 | 25/09/2021 | 1 | 436.1 | |
| Monster | 210925-MSR-2 | 25/09/2021 | 0 | 0 | |
| Monster | 210925-MSR-3 | 25/09/2021 | 1 | 4.3 | |
| Monster | 210925-MSR-4 | 25/09/2021 | 1 | 9.2 | |
| Monster | 210925-MSR-5 | 25/09/2021 | 0 | 0 | |
| Texel | 211010-TXL-1 | 10/10/2021 | 1 | 26 | |
| Texel | 211010-TXL-2 | 10/10/2021 | 3 | 61.4 | |
| Texel | 211010-TXL-3 | 10/10/2021 | 4 | 651.1 | |
| Texel | 211010-TXL-4 | 10/10/2021 | 0 | 0 | |
| Texel | 211010-TXL-5 | 10/10/2021 | 2 | 247.5 | |
| Bergen | 211009-BGN-1 | 09/10/2021 | 0 | 0 | no clear tideline |
| Bergen | 211009-BGN-2 | 09/10/2021 | 0 | 0 | no clear tideline |
| Bergen | 211009-BGN-3 | 09/10/2021 | 0 | 0 | no clear tideline |
| Bergen | 211009-BGN-4 | 09/10/2021 | 0 | 0 | no clear tideline |
| Bergen | 211009-BGN-5 | 09/10/2021 | 0 | 0 | no clear tideline |
| Neeltje Jans | 211207-NTJ-1 | 07/12/2021 | 48 | 793.9 | incident East Schelde |
| Neeltje Jans | 211207-NTJ-2 | 07/12/2021 | 11 | 181.2 | incident East Schelde |
| Neeltje Jans | 211207-NTJ-3 | 07/12/2021 | 27 | 138.7 | incident East Schelde |
| Neeltje Jans | 211207-NTJ-4 | 07/12/2021 | 44 | 469.5 | incident East Schelde |
| Neeltje Jans | 211207-NTJ-5 | 07/12/2021 | 35 | 712.5 | incident East Schelde |
| Monster | 211208-MSR-1 | 08/12/2021 | 0 | 0 | no clear tideline |
| Monster | 211208-MSR-2 | 08/12/2021 | 0 | 0 | no clear tideline |
| Monster | 211208-MSR-3 | 08/12/2021 | 0 | 0 | no clear tideline |
| Monster | 211208-MSR-4 | 08/12/2021 | 0 | 0 | no clear tideline |
| Monster | 211208-MSR-5 | 08/12/2021 | 0 | 0 | no clear tideline |
| Bergen | 211222-BGN-1 | 22/12/2021 | 0 | 0 | |
| Bergen | 211222-BGN-2 | 22/12/2021 | 0 | 0 | |
| Bergen | 211222-BGN-3 | 22/12/2021 | 2 | 87.9 | |
| Bergen | 211222-BGN-4 | 22/12/2021 | 0 | 0 | |
| Bergen | 211222-BGN-5 | 22/12/2021 | 0 | 0 | |
| Texel | 211223-TXL-1 | 23/12/2021 | 0 | 0 | |
| Texel | 211223-TXL-2 | 23/12/2021 | 0 | 0 | |
| Texel | 211223-TXL-3 | 23/12/2021 | 0 | 0 | |
| Texel | 211223-TXL-4 | 23/12/2021 | 0 | 0 | |
| Texel | 211223-TXL-5 | 23/12/2021 | 0 | 0 | |