Annex 1 – Mussel Survey and Inspection Reports

Solway Subtidal Mussels Sonar Survey June 2024

1. Background

Historically there was a subtidal dredge mussel fishery in the Silloth Channel in the Solway, and although the fishery is not regular, when it has occurred it has been important for local boats who prosecute a range of fisheries. In the past this fishery was managed by Cumbria Sea Fisheries Committee.

In 2013 the approach to managing fisheries within European Marine Sites (EMS) changed. Due to the area being designated as an EMS and lying within the Solway Firth Special Area of Conservation (SAC), Upper Solway Flats and Marshes Special Protection Area (SPA) and more recently designated Solway Firth SPA (SPA), the NWIFCA is legally bound to carry out robust Habitats Regulations Assessments (HRA) on all fishing activities. For the Solway subtidal mussel, this requires sound evidence and data, not only on the stock to be fished, but also the functionality of this mussel to identify whether it can be classed as Annex I reef. Understanding the nature and longevity of the mussel resource and the changing surrounding habitats will inform decisions on whether to a fishery would be possible in the future.

In 2019 NWIFCA developed a methodology which includes using side scan sonar (SSS) and the use of a Hamon grab to ground-truth imagery. The aim is to assign substrate types to specific signals of SSS data with high levels of confidence to reduce the necessity to ground-truth by grab sampling and assign habitat types to a large area. This will enable rapid and effective evidence gathering in an area that is particularly problematic to survey sub-tidally (due to turbidity, currents and shallow water). Surveys have been completed between 2019-2021 and this year. It is expected that a number of surveys will be required over a longer timeframe to build the evidence required to complete a HRA on any potential dredge fishery.

2. Methodology

Equipment Used

- Tritech Seaking Towfish SSS with the data acquisition through Tritech Seanet Pro Software (version 2.24)
- Hamon Grab - 0.1m² sample area

Tide Selection

Data collection took place on the 19th June 2024 onboard the NWIFCA patrol and survey vessel North Western Protector. Neap tides were chosen to ensure the best chance of the least amount of current. This coincided with low wind speeds giving calm seas to give the best chance of collecting higher quality data.

To get the most from the limited amount of time and good weather conditions, work was carried out throughout the tides over low and high tides on the survey day.

Survey Plan

Based on previous work with the SSS between 2019 and 2021, an 80m range and 160m swathe at 675Khz would be used. This would require a towfish altitude of approximately 8m from the seabed (10% of range). The transect line plan is shown in Annex A. Each transects is 1km in length with a spacing of 80m. When setting up the equipment the test showed there was too much loss of data and the range was reduced to 50m and transects adjusted manually on the vessel. The location was based on historical knowledge of where mussel has known to be present and was previously surveyed.

Data Collection

SSS data was collected approximately 1-2 hours either side of high and low tide, and as the grab can operate in higher current speeds than the SSS, samples were taken during periods when SSS transects could not be completed.

i. Side Scan Sonar

During deployment the vessel maintained a speed over ground (SOG) of 0.8 – 2.5 knots. The tidal current speed varied between 0 and 3 knots. The tidal current speed was recorded at the start of each tow and likely varied throughout the tow. When current speed was higher the SOG of the vessel was reduced. The majority of the data was collected towing into the tide to ensure the towfish was straight, one transect was completed with the tide due to wave/swell action and the tide turning prior to the completion of a transect. Unfortunately, sea state was not a calm as predicted which affect some of the quality of data. The antenna for the GPS hemisphere is located on the centre line of the vessel above the wheelhouse. The layback was calculated to be negligible due to the towfish being setup on the bow of the vessel, the length of the cable and the location of the GPS hemisphere antenna. Data collection was not recorded until the start location of each tow line had been reached and the towfish was fully deployed and collecting data, which was fed directly through to a laptop set up in the dry lab onboard the vessel.

The settings within Seanet Pro for the data acquisition remained the same for each of the tows and are as follows:

- Sonar Gain – 25%
- Contrast – 47dB
- Range – 50m
- Resolution - Ult
- Frequency - 675kHz

Five tows (nineteen transects) were completed with details provided at Annex A. A number of transects were completed in one tow to make the best use of time. Four transects (1F – 4F) were not completed due to time restraints and due to the lack of mussel in the rest of the survey and covering the main area where mussel has previously been present in the past.

ii. Hamon Grab Sampling

As SSS data was collected, target locations for the hamon grab were identified from the live SSS waterfall data feed. Target areas were picked based on texture and hardness, with officers selecting a range of different textures and hardness from across the survey area.

The vessel was positioned over each target location. Due to the current speed a hand held GPS positioned at the stern of the vessel was used to record the location of the grab once it had hit the bottom. On retrieval the sample was assessed to see whether a full sample had been collected. A number of repeats were completed at each station to ensure a representative number of samples were collected. The number of repetitions depended on observations of the contents of the sample. If samples were similar in sediment and faunal types, fewer repeat samples were completed compared to those with differing sediment and fauna, or where the Hamon grab was not full. If the grab failed a number of times it was recorded as unknown and the vessel moved to the next target area.

The sediment type and fauna present was recorded for each sample, with mussel, *Sabellaria* ssp. and starfish presence being highlighted. A labelled photograph of each sample was taken.

Data Handling and Analysis

The data was processed using Coda Octopus GeoSurvey (version 7.3.2). Seanet Pro .V4LOG files were converted into .xtf format using Tritech Seanet DumpLog (version 2.29) for processing in Coda.

The .xft files were loaded into Geosurvey. The first tow was played back in the waterfall display. Image enhancement was applied inverting the grey scale to give white as high and black as low backscatter. The data was scaled using auto scale to achieve the best image. Time varying gain was applied to increase the gain at the outer edges of the swathe. Once the best image was achieved the settings were saved and applied to each of the tows. Seabed detection (identification of the seabed from imagery) was completed manually for each of the tows.

All the tows were loaded into the Mosaic window. Navigation smoothing was applied to all tows. The tows were layered from land in a north-westerly direction giving the best image. The image was exported as a geotiff, at a resolution of 2 pixels per geographical metre. The geotiff was loaded into mapping software Qgis with the geotiff being georeferenced.

Data Acquisition

Nineteen transects were completed in six tows and eighty grab samples were completed from twenty-five target areas.

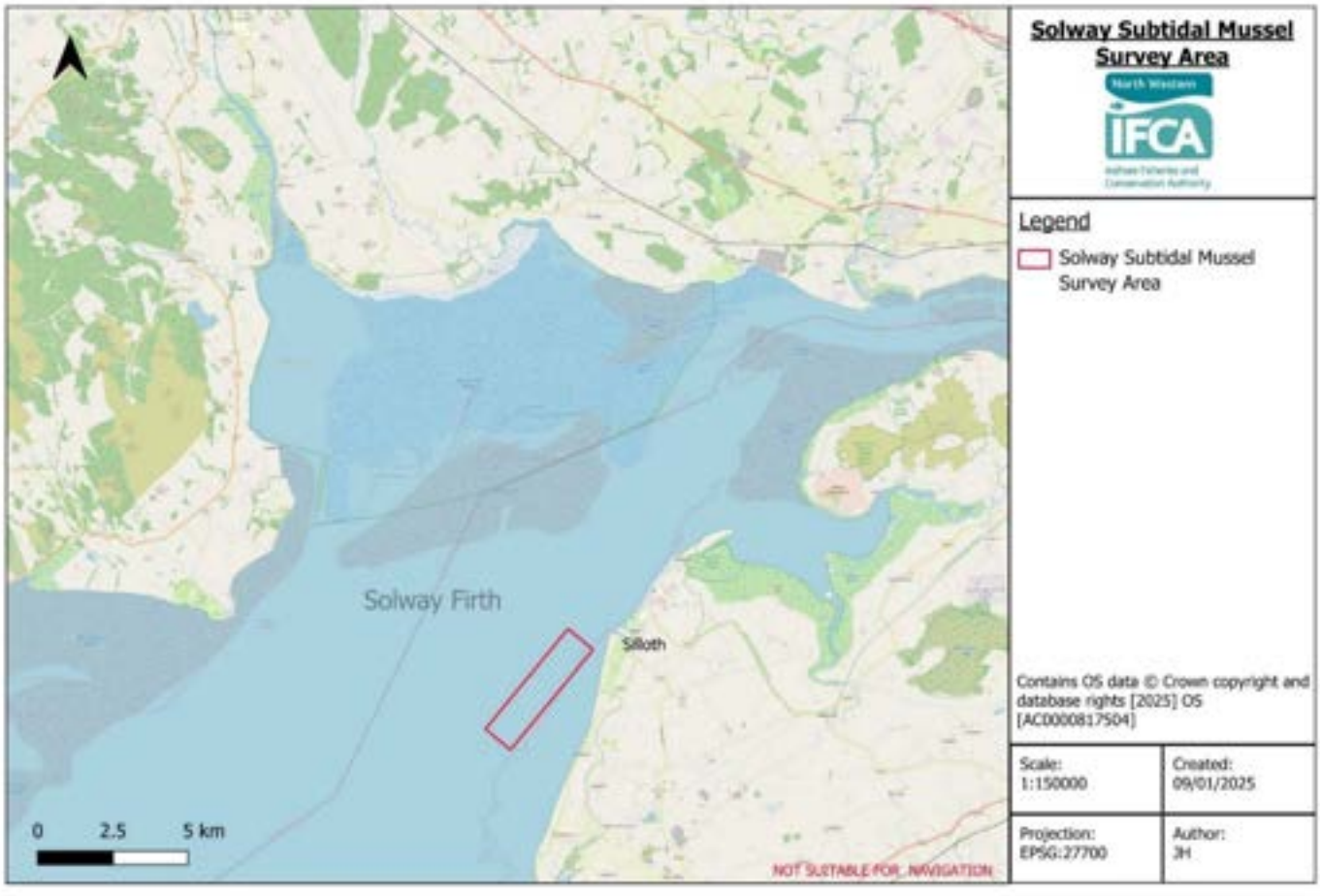

Figure 1 – Overview of the Solway subtidal mussel survey area June 2024.

3. Results

Figure 1 shows the area surveyed and its location in relation to coastal features within the Solway Firth. Figures 2 to 4 show images of the SSS data collected. From the SSS data several target areas were selected to ground-truth (figure 2). Figure 3 overlays the sediment type from the grab samples onto the SSS data and

figure 4 highlights the presence of live and dead Sabellaria spp. in the grab samples. Dead Sabellaria spp. is classed as the presence of historic sabellaria ssp. tubes.

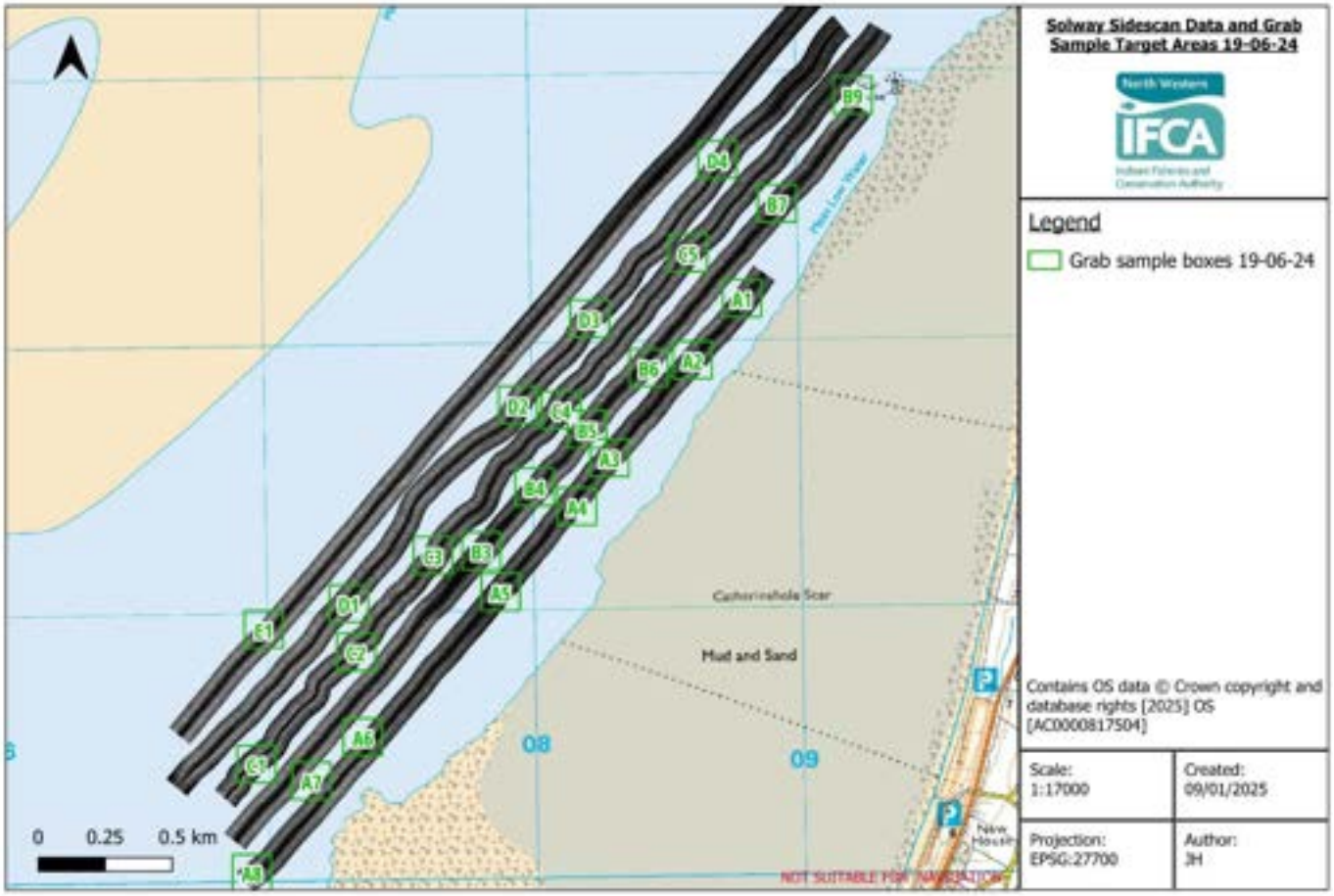

Figure 2 – Image of SSS data showing the location of the target areas June 2024.

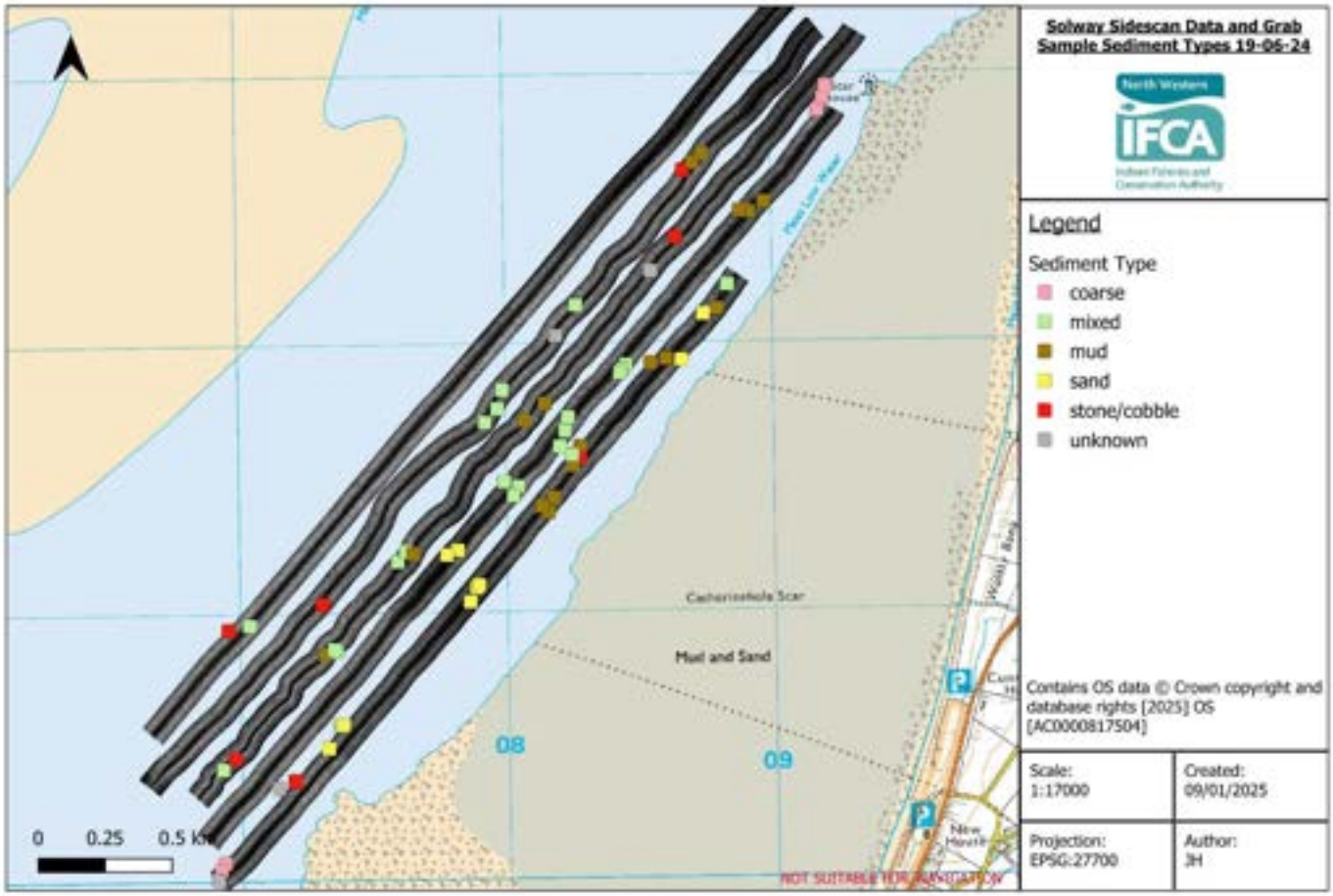

Figure 3 – Image of SSS data and the sediment type taken from the grab samples June 2024.

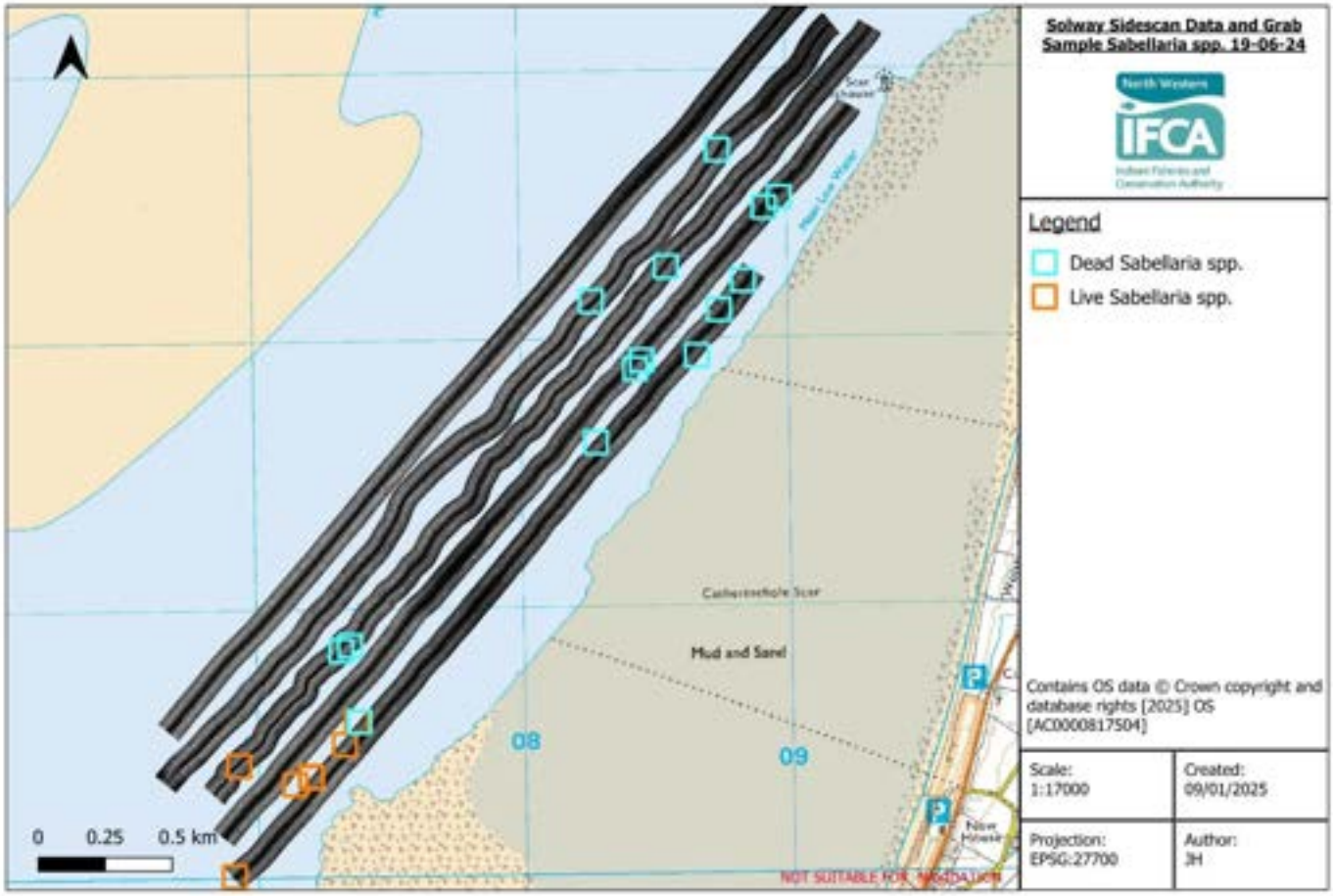

Figure 4 – Image of SSS data and the presence of live and dead *Sabellaria spp*. In the grab samples June 2024.

SSS Data

The data collected was of good quality with definition between hardness and texture with twenty-four target areas chosen for ground-truthing from the data. There was some loss in the clarity of data when converting file format from .V4LOG to .xtf. Some imagery has been impacted by swell with stretching of data, for example in area C5 and the formation of ripples within the data. 100% coverage was not achieved due to the reduction in range to 50m but data was collected across the full swarth.

Grab samples

The grab samples contained a range of broad sediment types including mud, sand, coarse, mixed and stone/cobble (figure 2). Figures 5 to 52 show the location and content of the grabs at each target location. No mussel was recorded in any of the grab samples. If grab samples only contained *Sabellaria spp.* the sediment type was marked as unknown, although it is likely that the *Sabellaria spp.* would have been attached to harder compacted sediment types. There were a number of failed grabs which were either due to equipment not working in high tidal currents or the grab being on hard compacted sediment. These grabs have been omitted from the data due to low confidence. A summary of the grabs with *Sabellaria spp*. is provided in Table 1. Where *Sabellaria* spp. has been classified as historic (dead) this is due to the tube structures being very degraded and worn, black in colour, appear to have been dead for some time and likely to have been under sediment. Thirteen of the target areas contained *Sabellaria* spp*.* tubes with twenty-one grab samples containing *Sabellaria* spp*.* tubes; fourteen were historic tubes with no live S*abellaria* spp. polychaetes present and seven samples contained live specimens. All live specimens were located in the South of the survey area.

Table 1 - Summary of the substrate, condition of *Sabellaria* spp. and if mussel present.

Area	Sample	Sediment	*Sabellaria spp.*
A1	A1-2	Mixed	Dead
	A1-3	Sand	Dead
A2	A2-2	Sand	Dead
A3	A3-1	Mud	Dead
A6	A6-1	Mixed	Live
	A6-2	Sand	Live
	A6-4	Sand	Dead
A7	A7-1	Sand	Live
	A7-2	Unknown	Live
	A7-3	Stone/Cobble	Live
A8	A8-3	Unknown	Live
B6	B6-1	Mixed	Dead
	B6-3	Mixed	Dead
B7	B7-1	Mud	Dead
	B7-2	Mud	Dead
C1	C1-1	Mixed	Live
C2	C2-1	Mud	Dead
	C2-3	Mixed	Dead
C5	C5-4	Unknown	Dead
D3	D3-3	Mixed	Dead
D4	D4-3	Mud	Dead

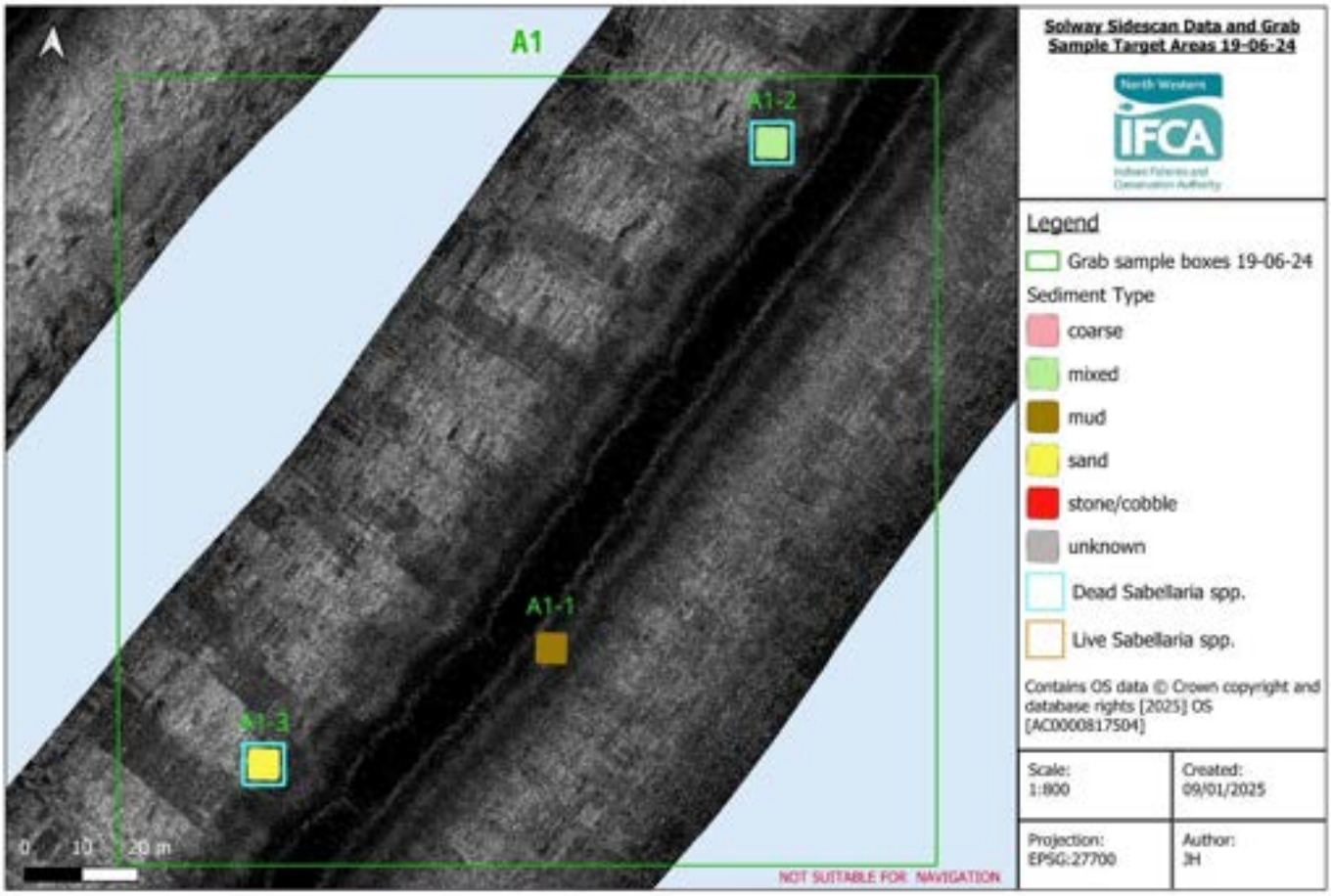

Figure 5 – Higher magnification of SSS data from target area A1 and grab sample contents for ground-truthing

Figure 6 – Hamon Grab samples taken from A1.

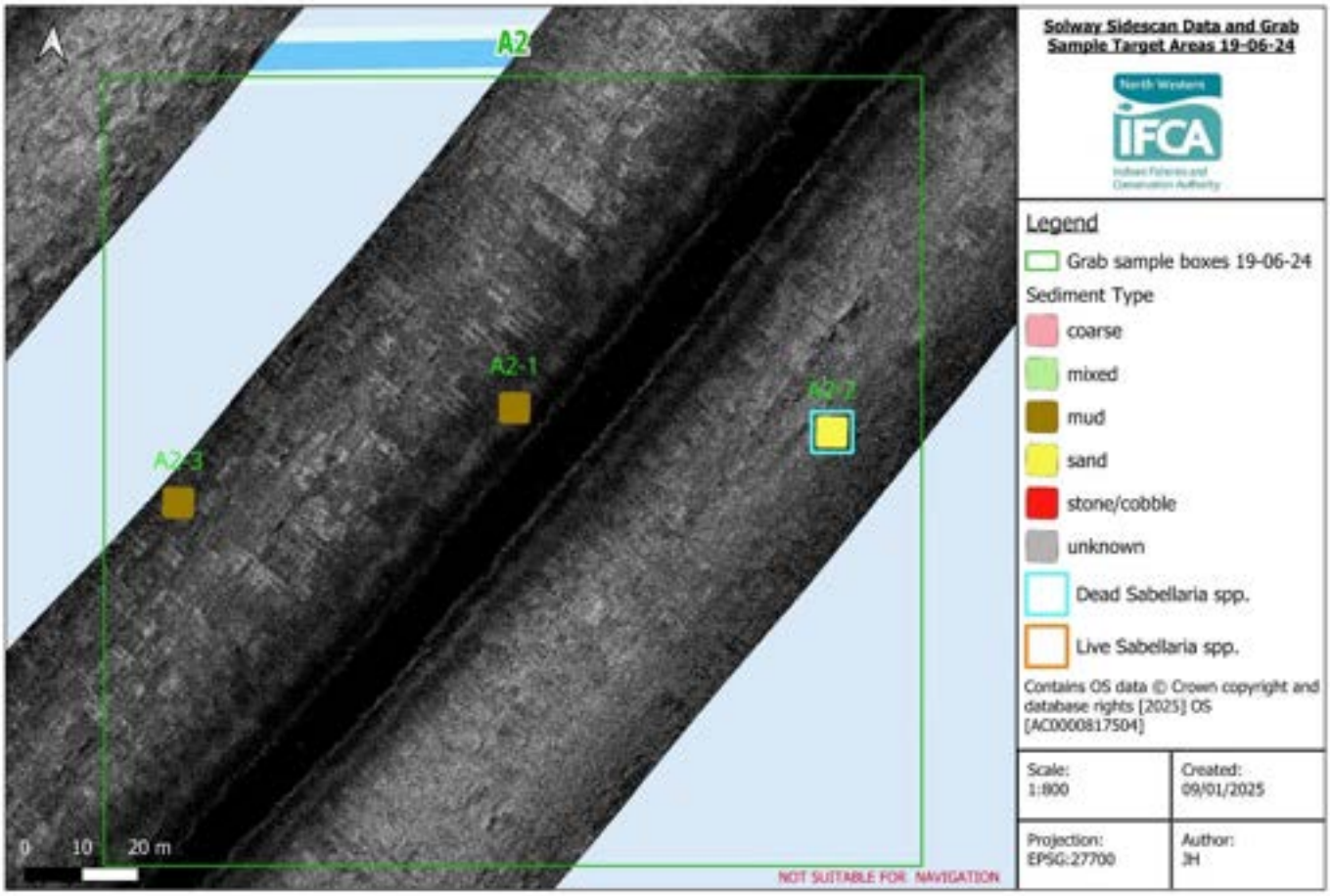

Figure 7 – Higher magnification of SSS data from target area A2 and grab sample contents for ground-truthing.

Figure 8 – Hamon Grab samples taken from A2.

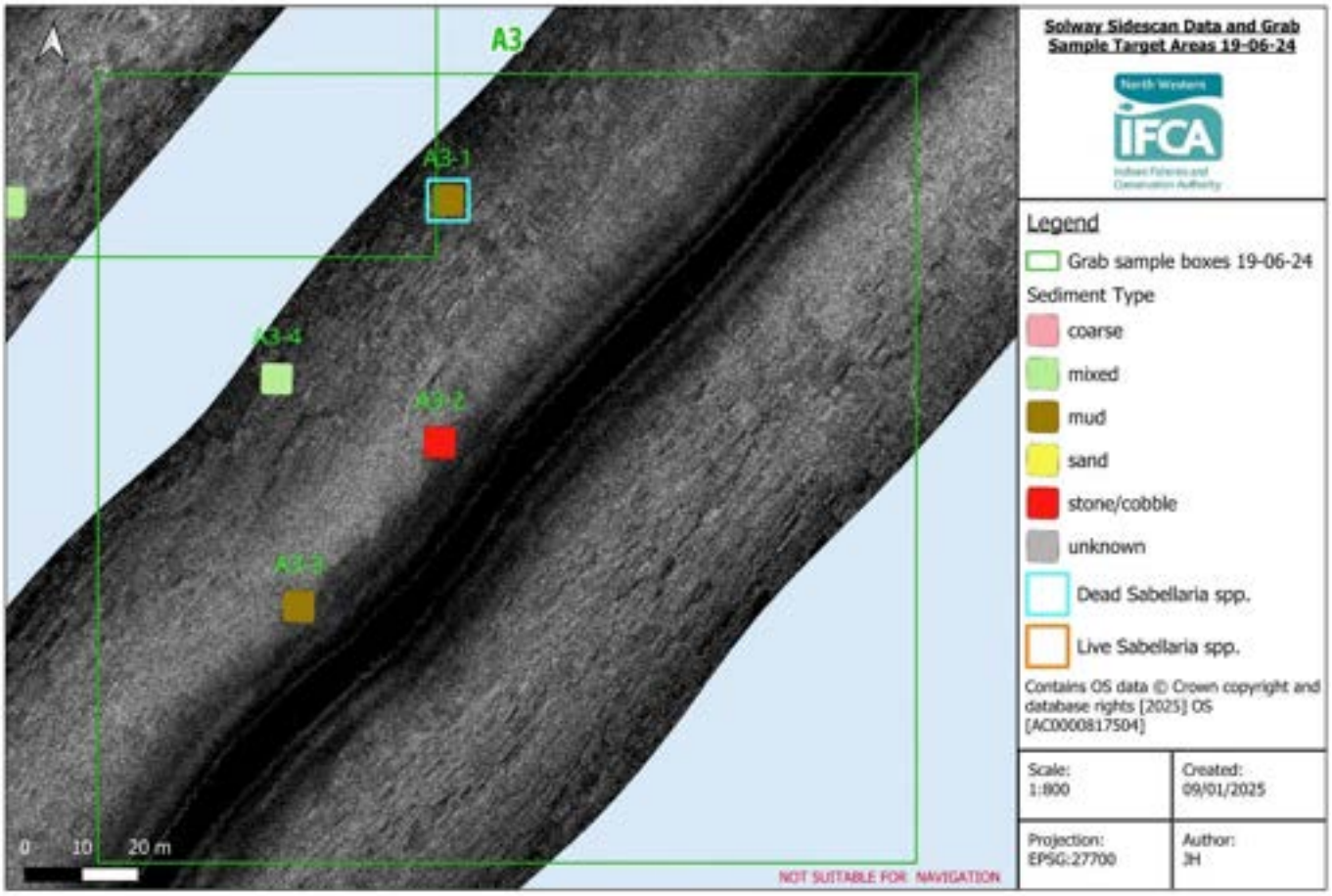

Figure 9 – Higher magnification of SSS data from target area A3 and grab sample contents for ground-truthing.

Figure 10 – Hamon Grab samples taken from A3.

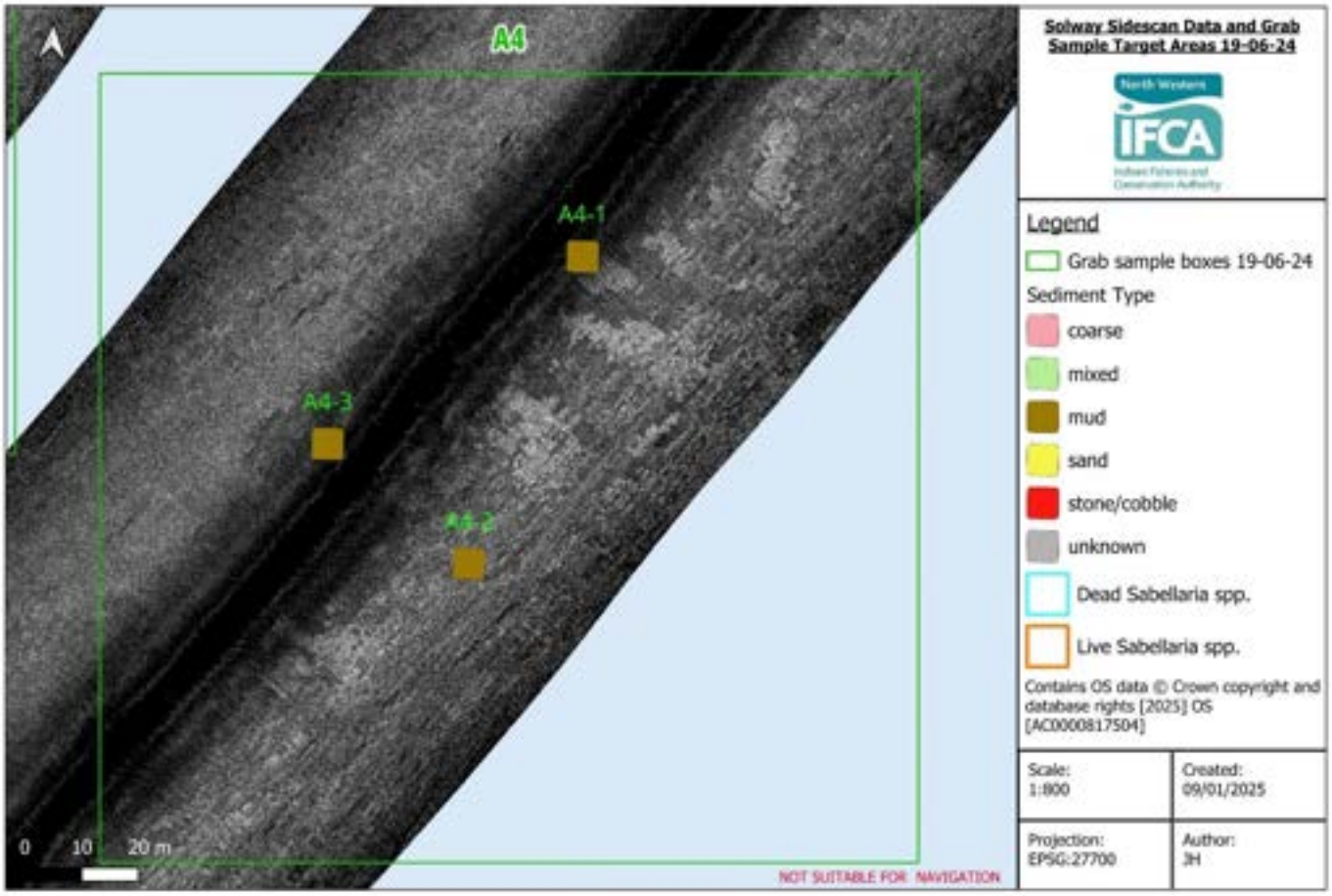

Figure 11 – Higher magnification of SSS data from target area A4 and grab sample contents for ground-truthing.

Figure 12 – Hamon Grab samples taken from A4.

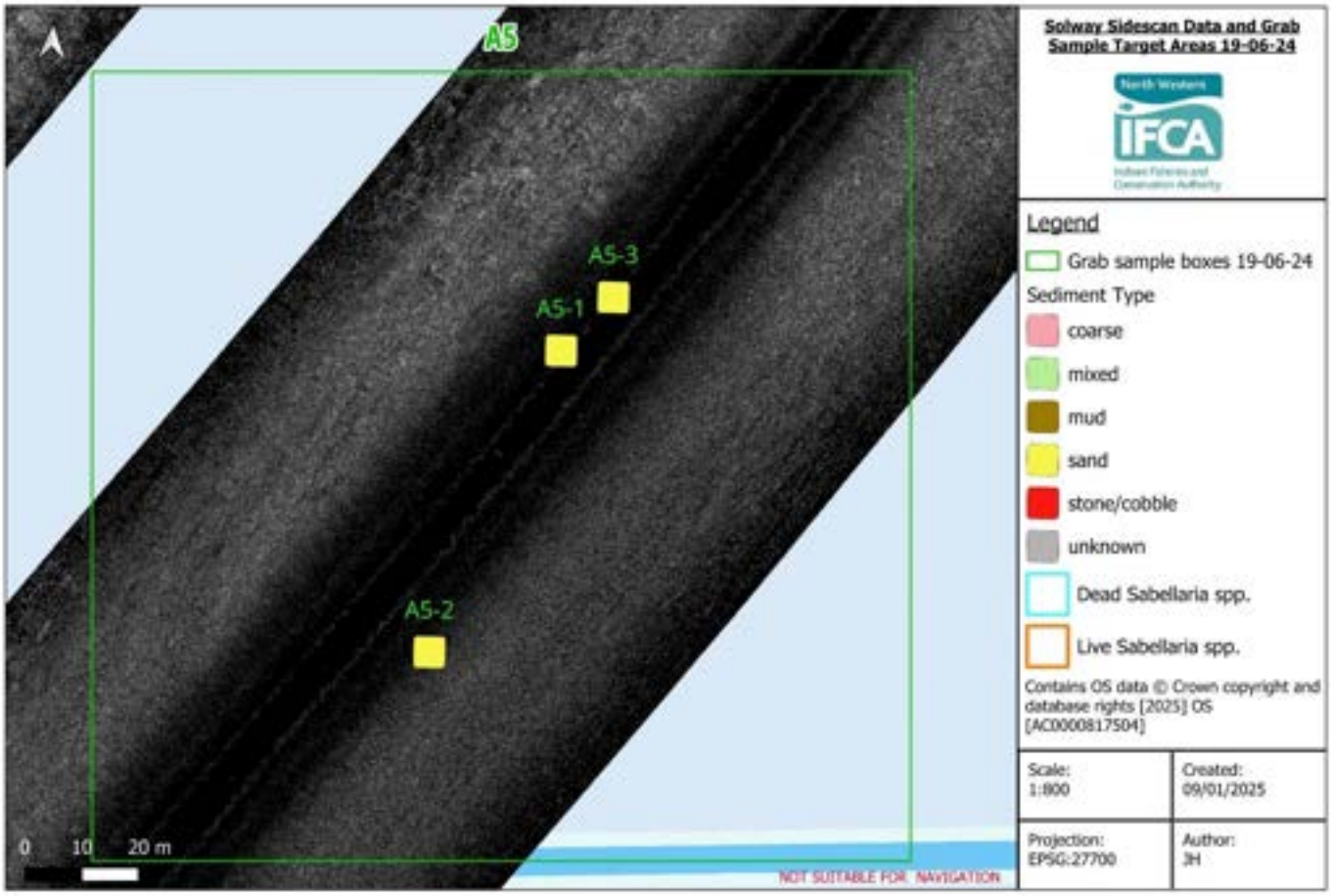

Figure 13 – Higher magnification of SSS data from target area A5 and grab sample contents for ground-truthing.

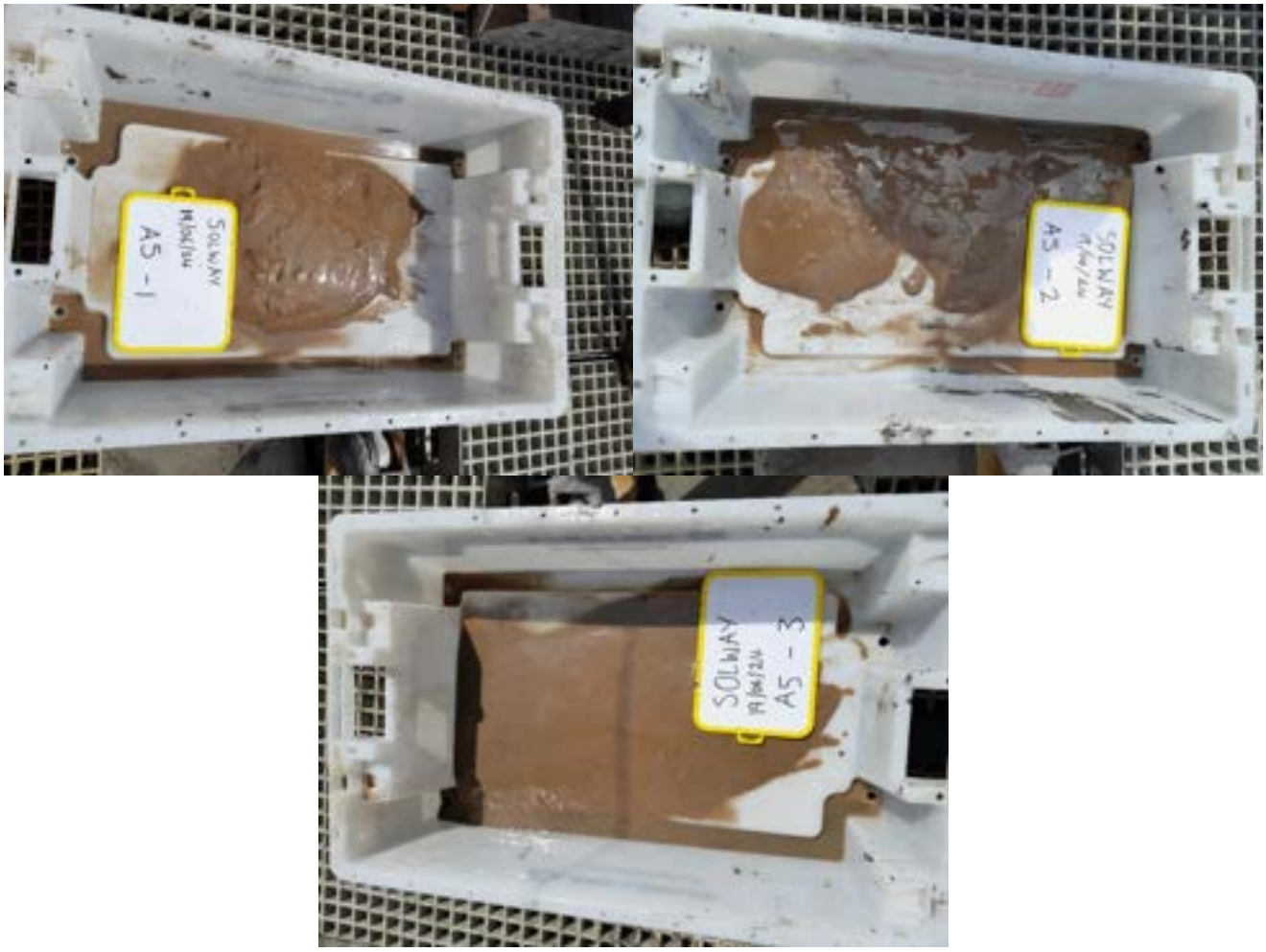

Figure 14 – Hamon Grab samples taken from A5.

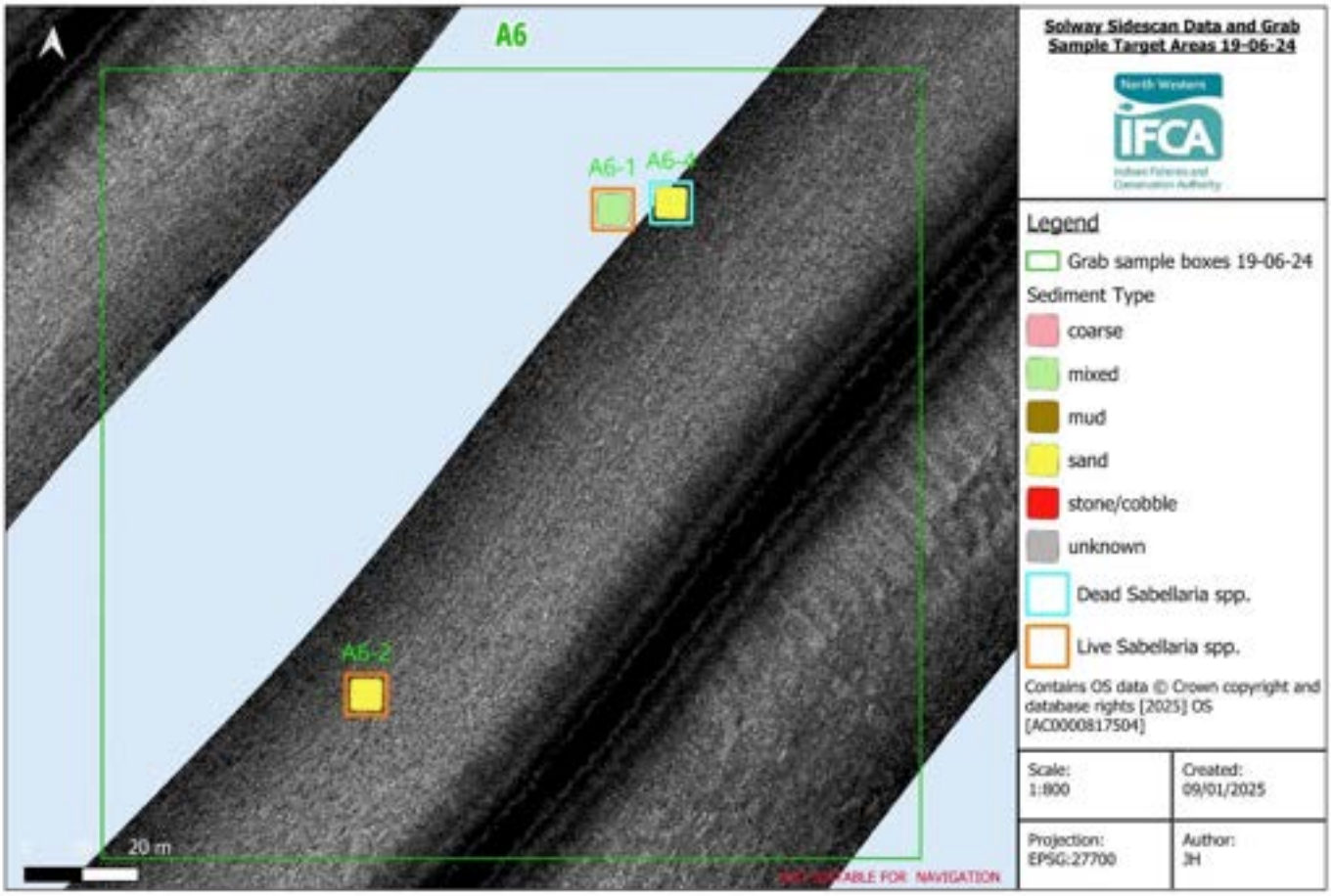

Figure 15 – Higher magnification of SSS data from target area A6 and grab sample contents for ground-truthing.

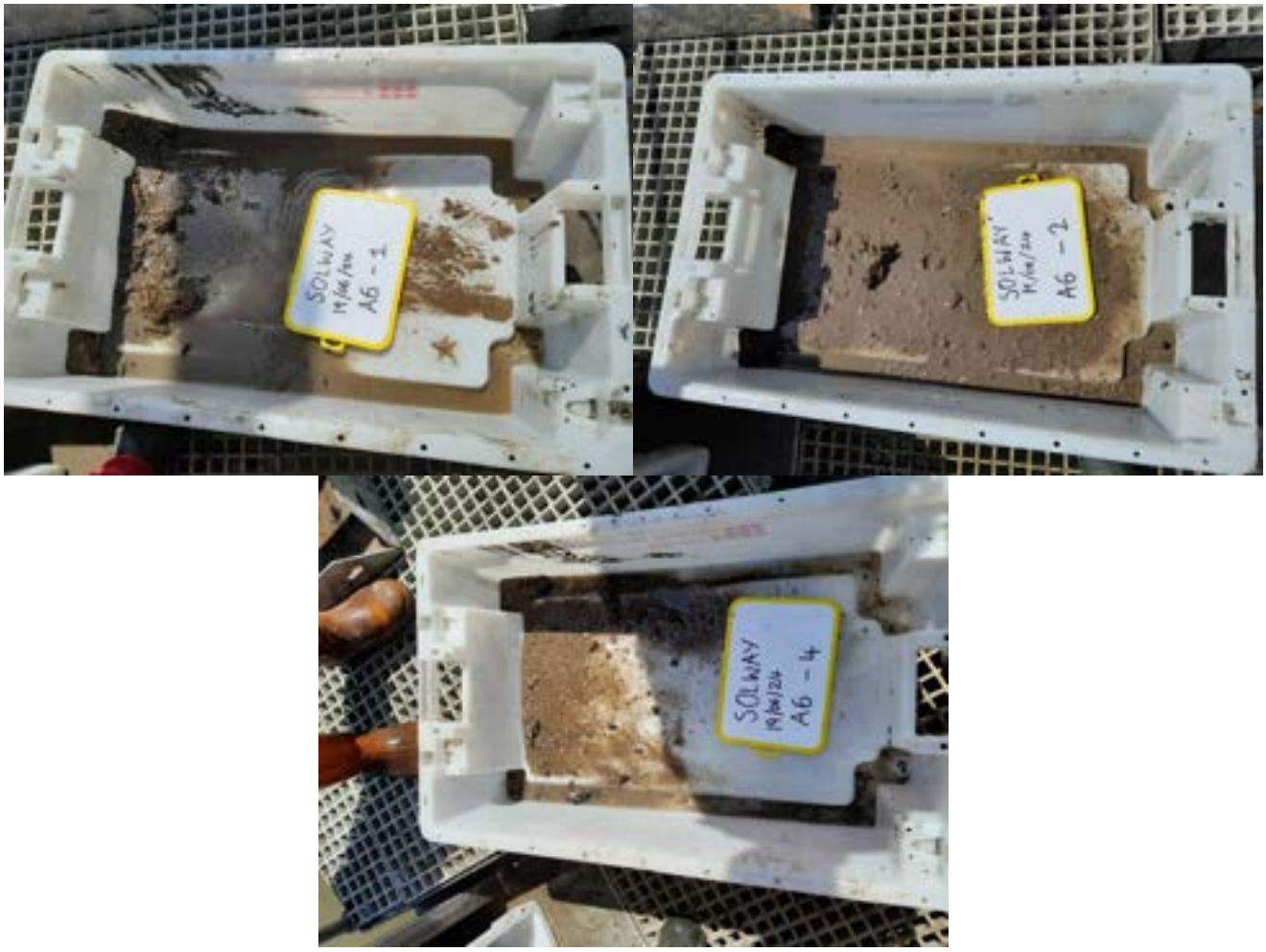

Figure 16 – Hamon Grab samples taken from A6.

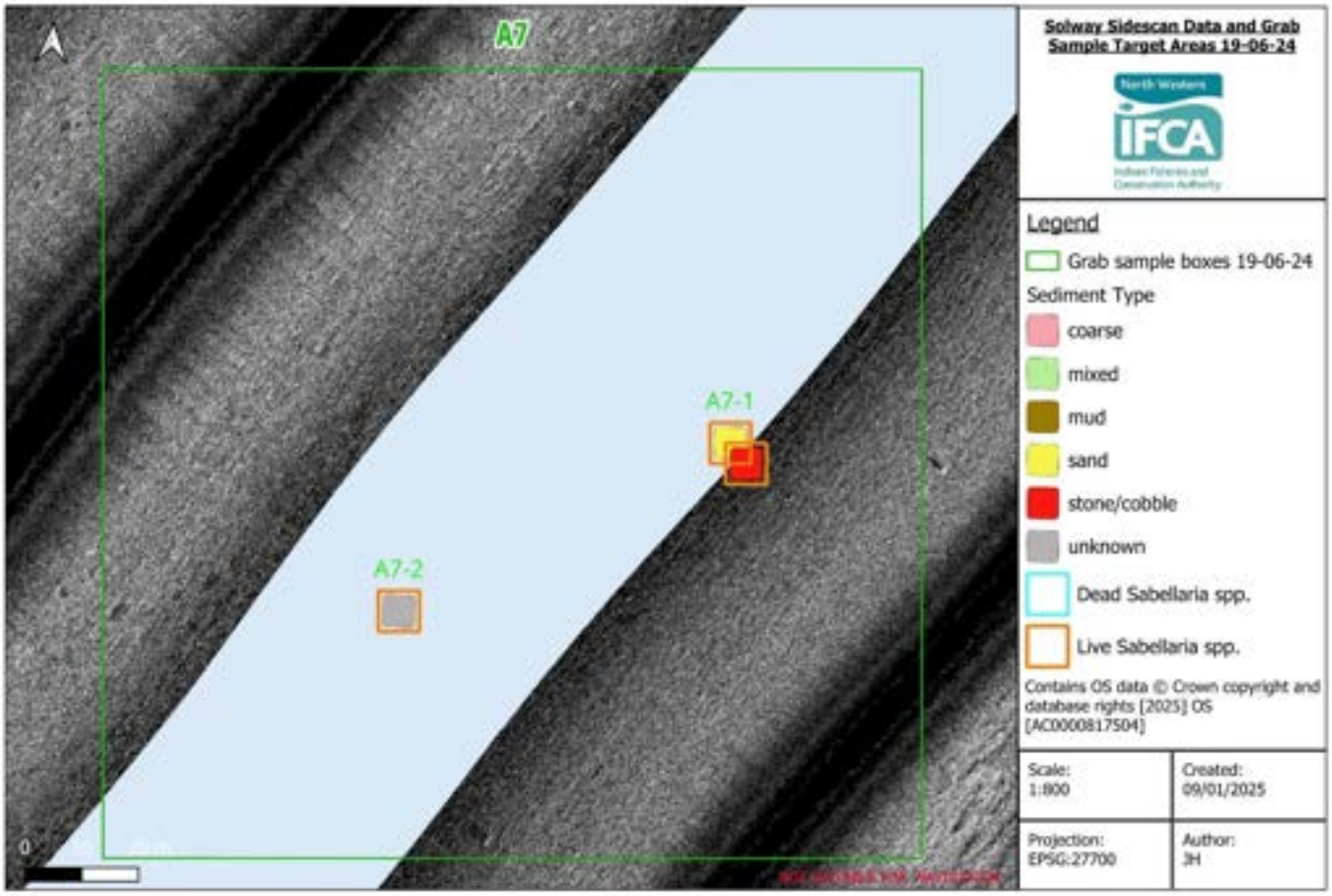

Figure 17 – Higher magnification of SSS data from target area A7 and grab sample contents for ground-truthing.

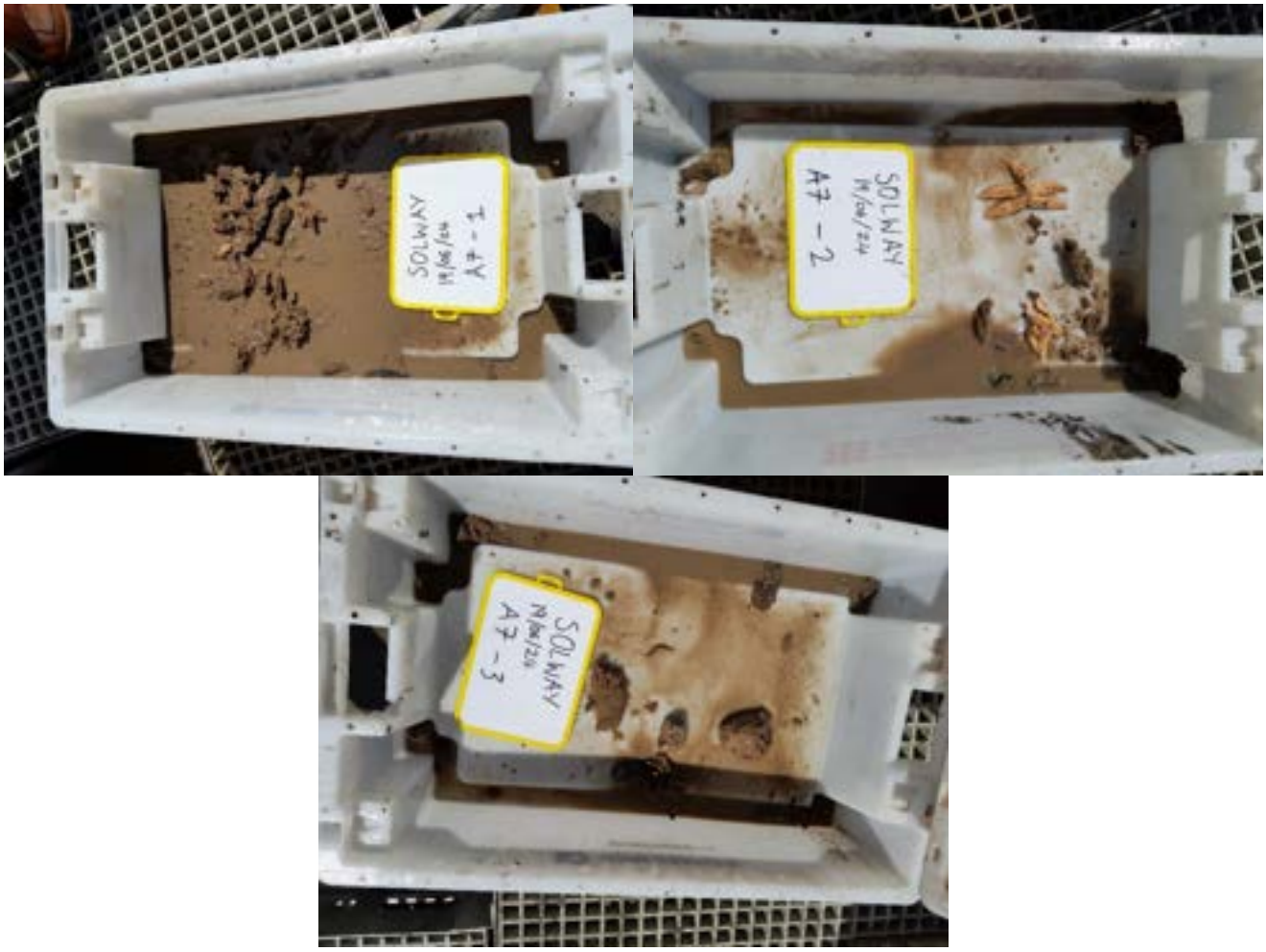

Figure 18 – Hamon Grab samples taken from A7.

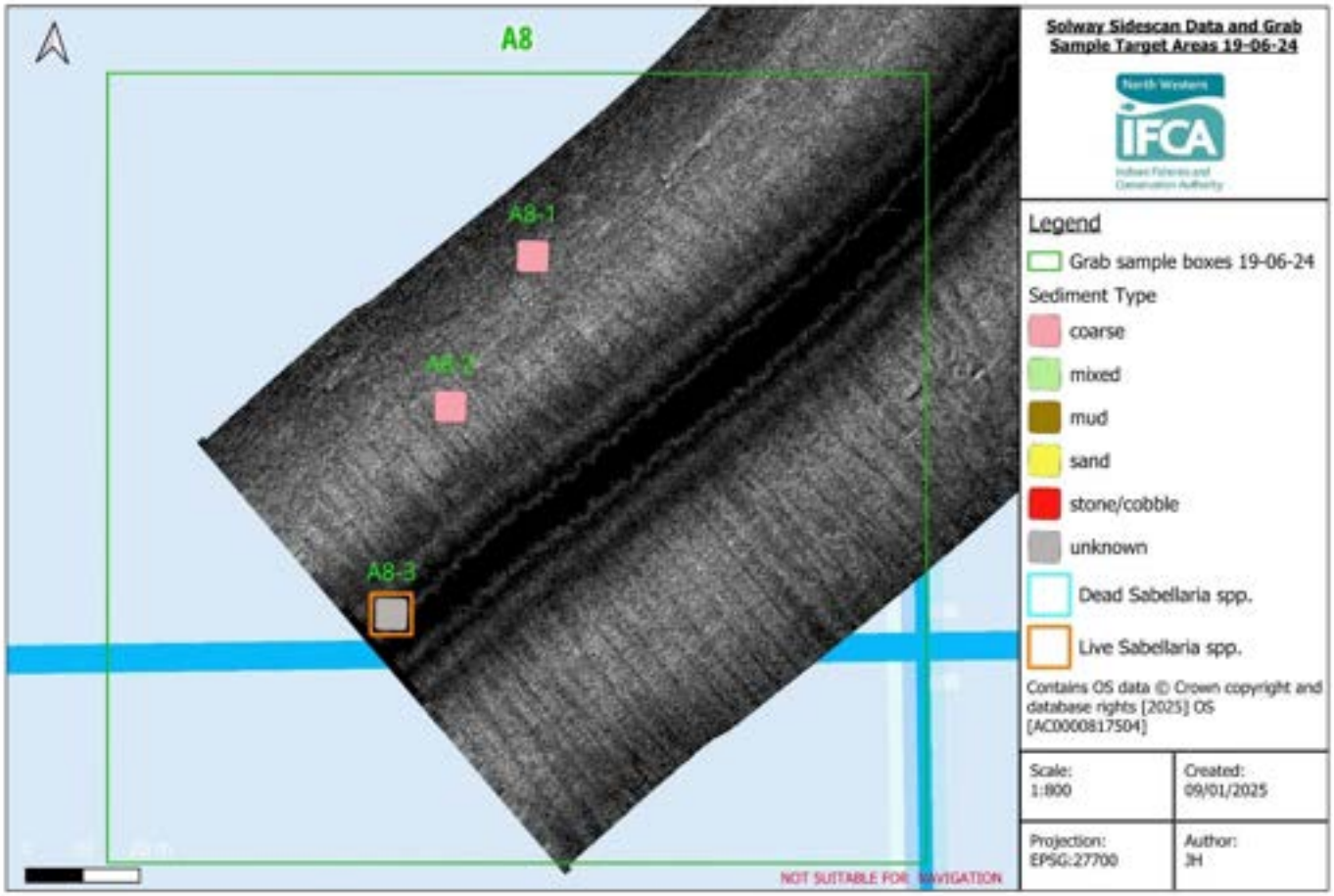

Figure 19 – Higher magnification of SSS data from target area A8 and grab sample contents for ground-truthing.

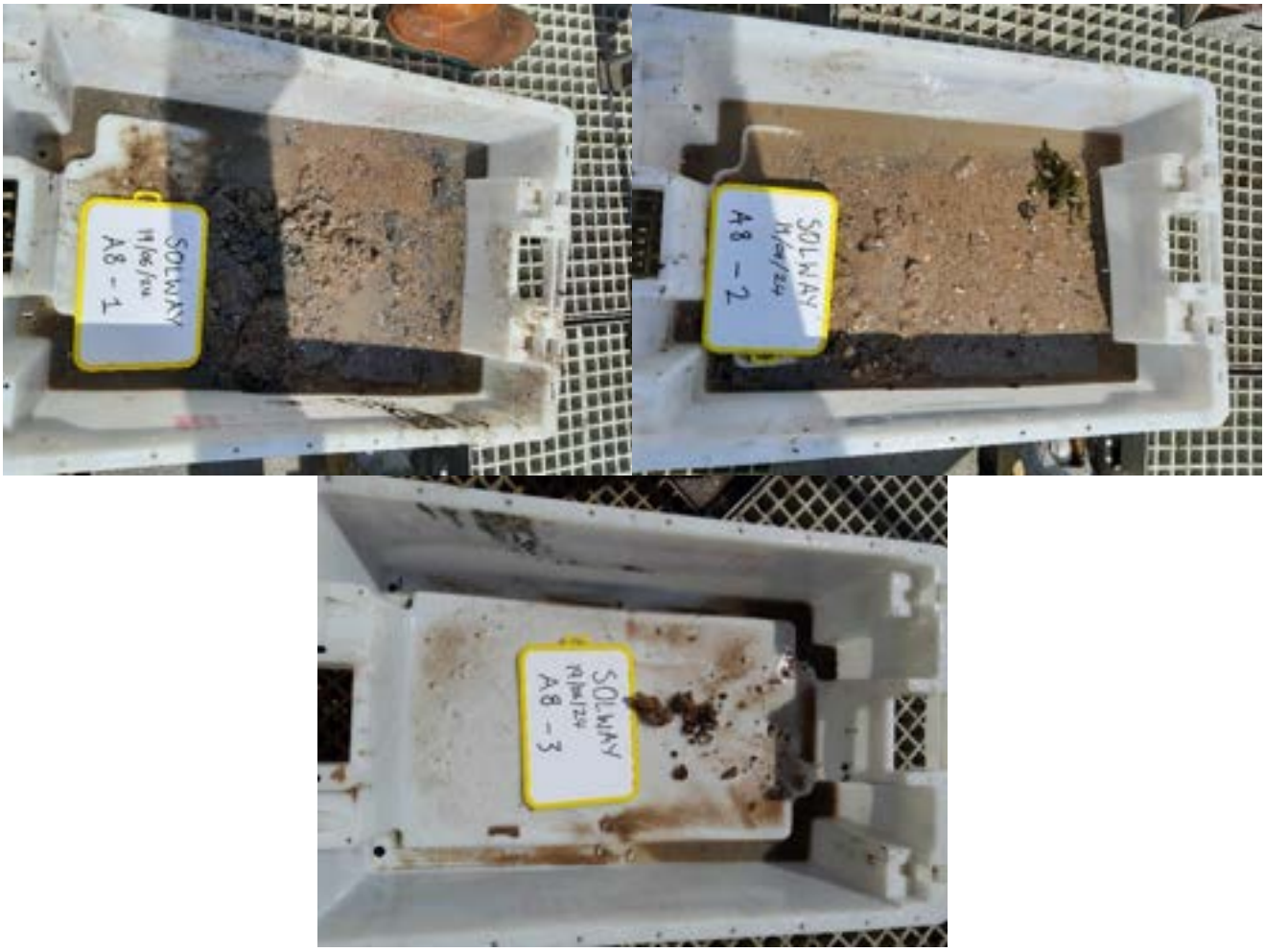

Figure 20 – Hamon Grab samples taken from A8.

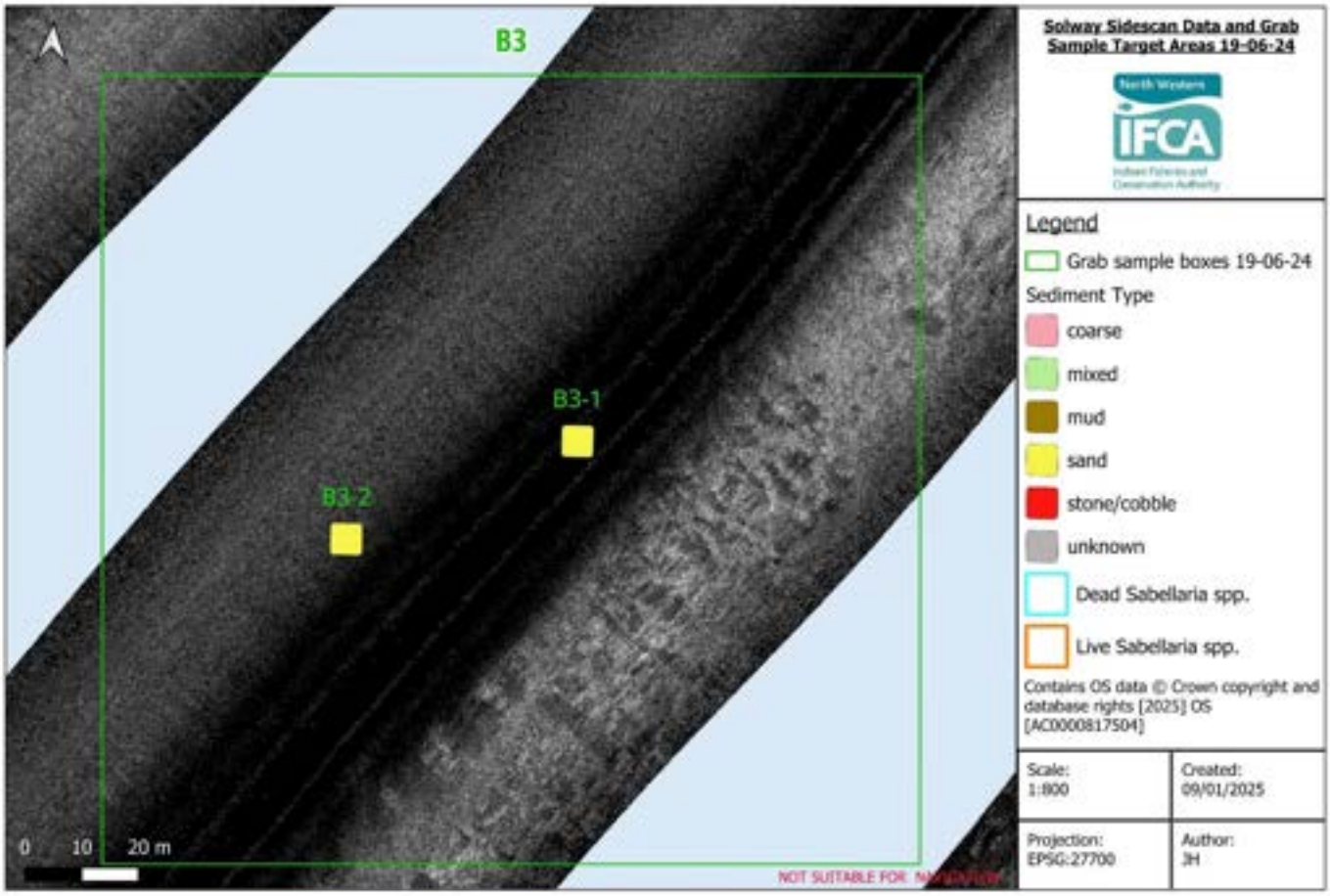

Figure 21 – Higher magnification of SSS data from target area B3 and grab sample contents for ground-truthing.

Figure 22 – Hamon Grab samples taken from B3.

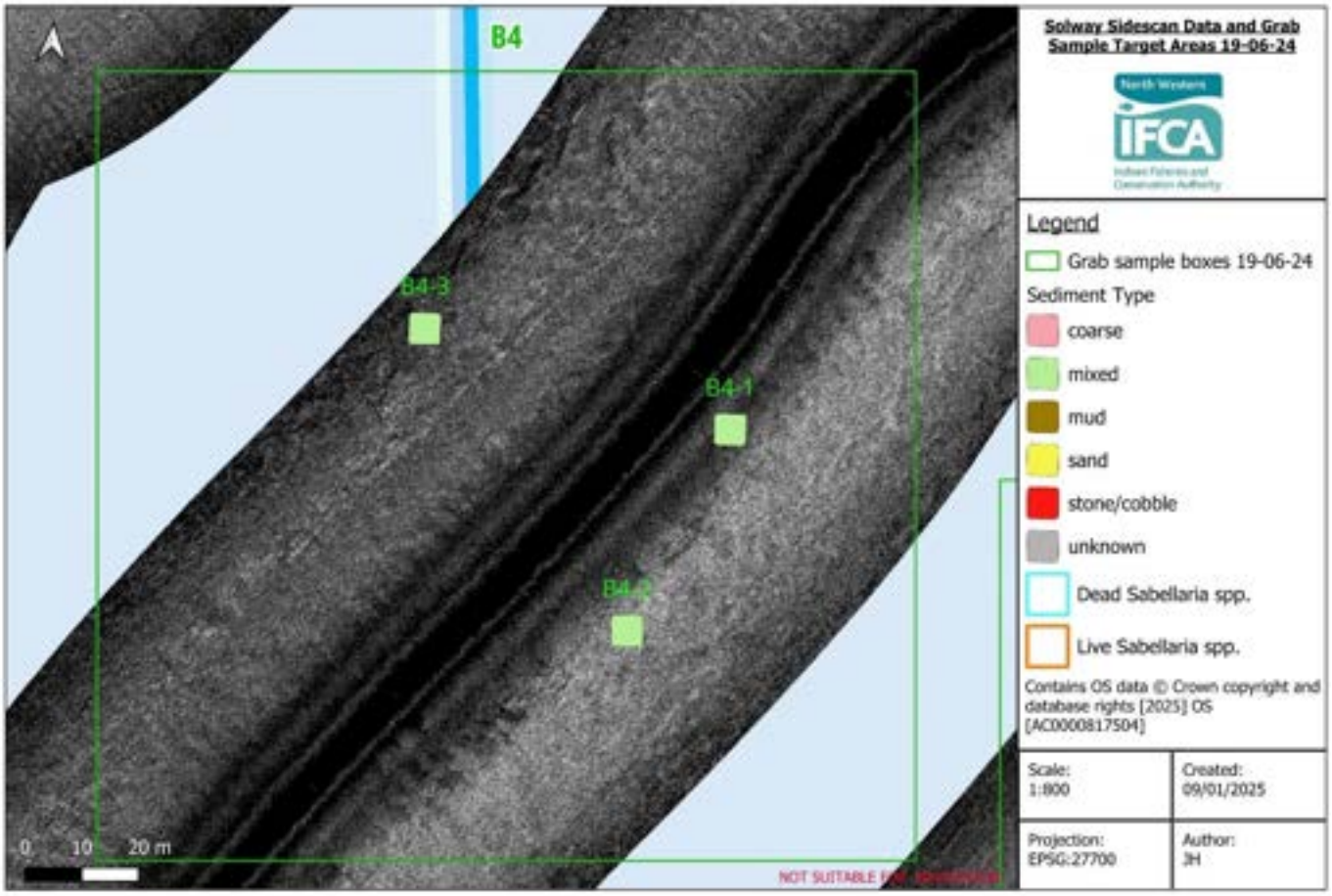

Figure 23 – Higher magnification of SSS data from target area B4 and grab sample contents for ground-truthing.

Figure 24 – Hamon Grab samples taken from B4.

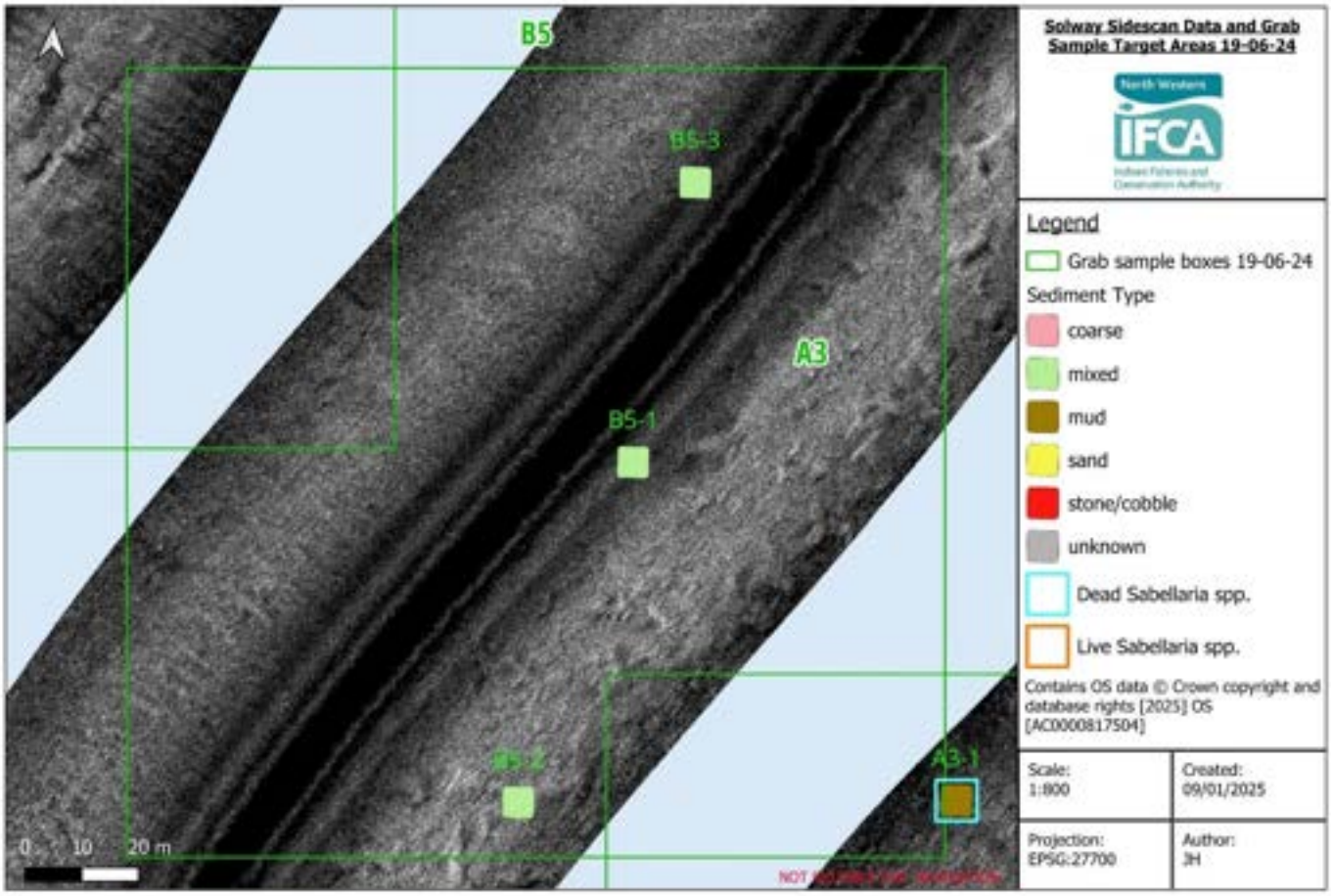

Figure 25 – Higher magnification of SSS data from target area B5 and grab sample contents for ground-truthing.

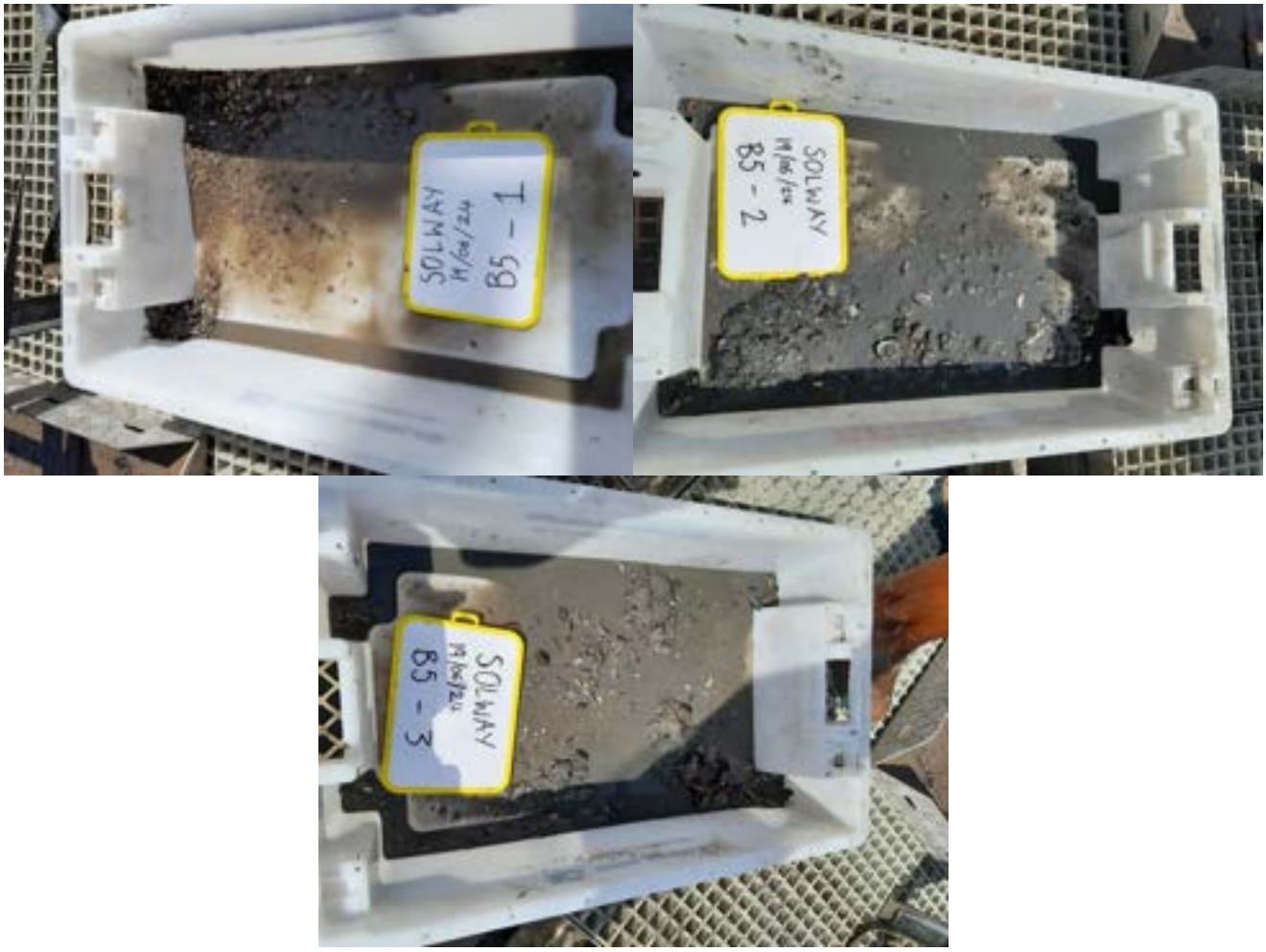

Figure 26 – Hamon Grab samples taken from B5.

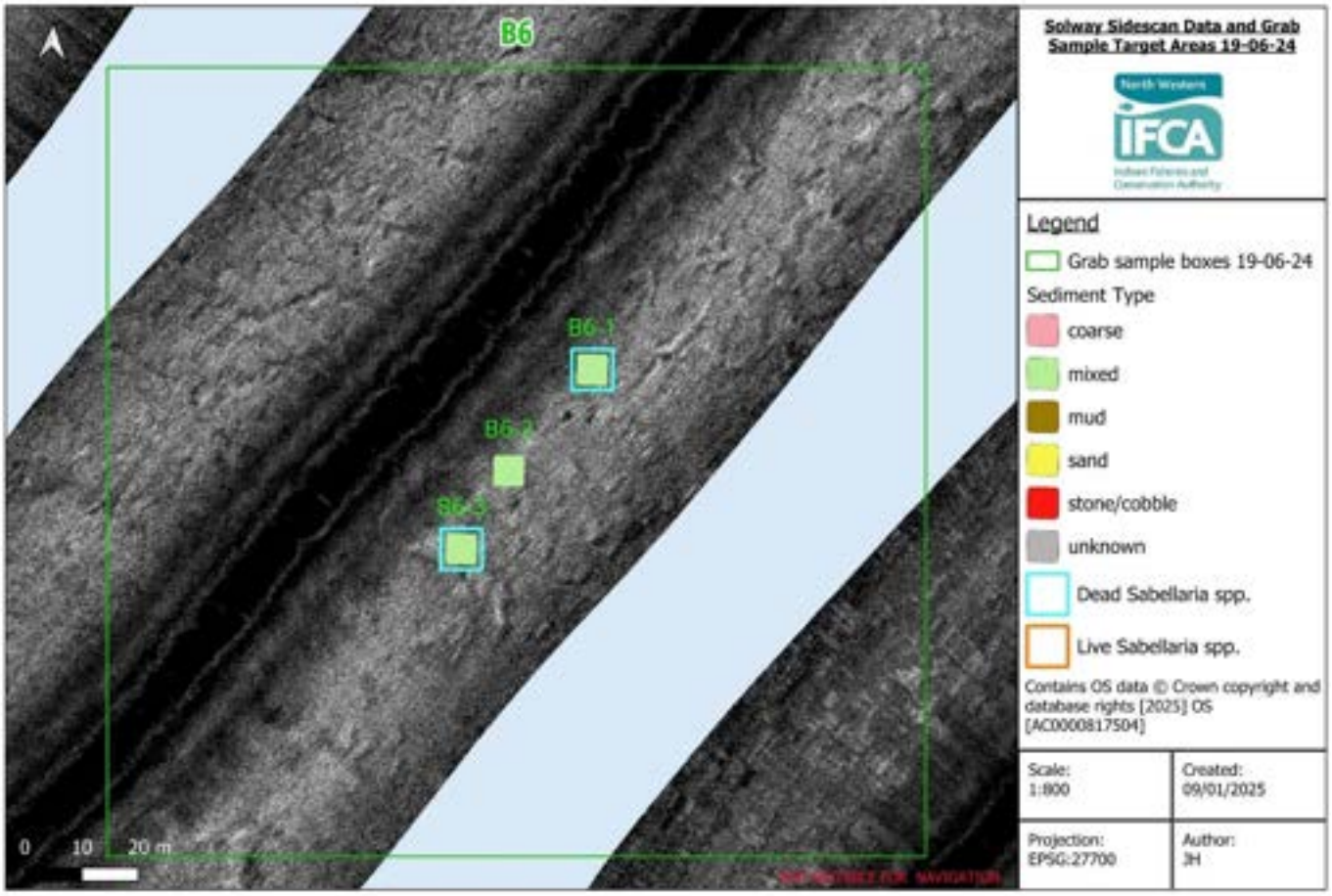

Figure 27 – Higher magnification of SSS data from target area B6 and grab sample contents for ground-truthing.

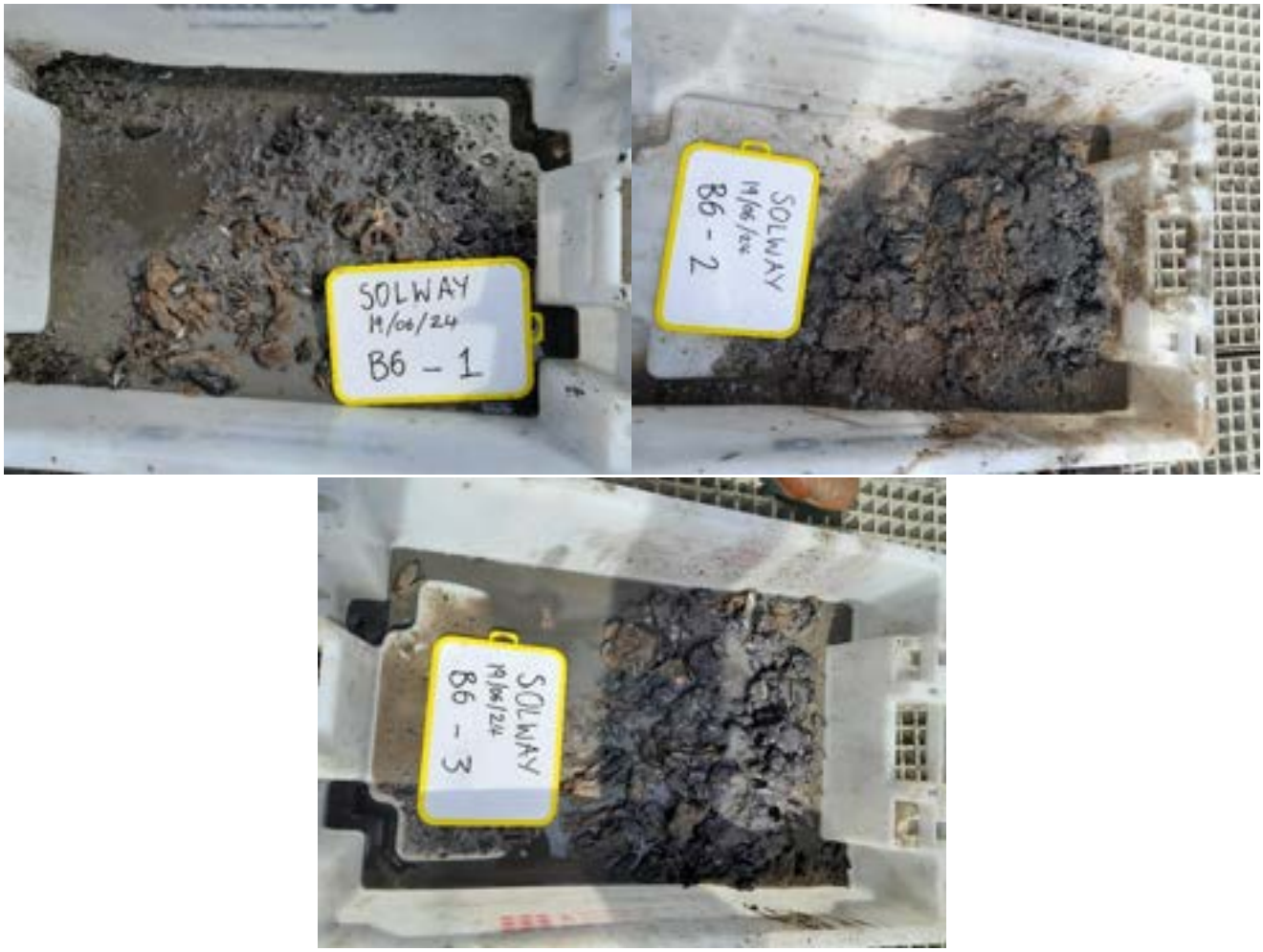

Figure 28 – Hamon Grab samples taken from B6.

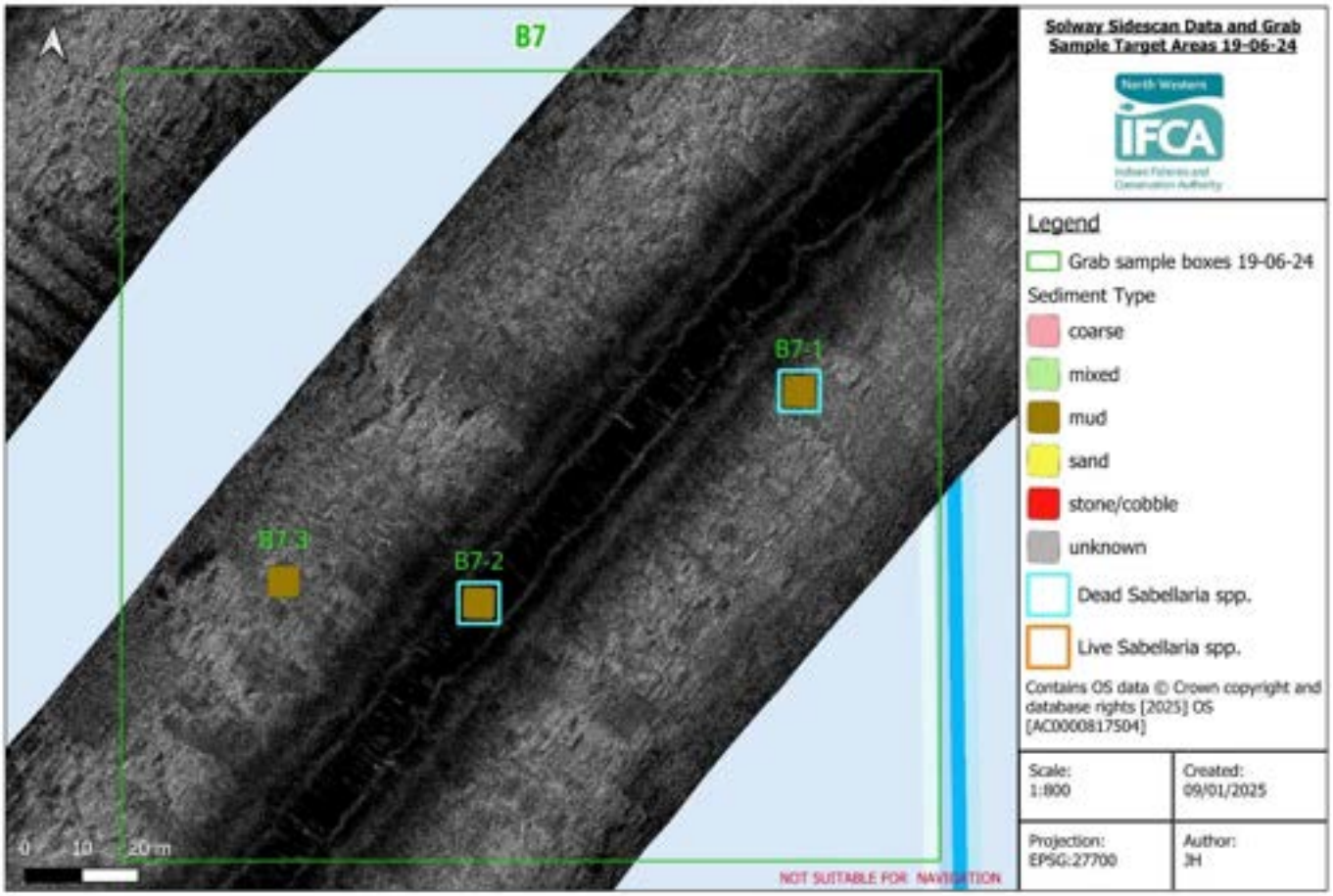

Figure 29 – Higher magnification of SSS data from target area B7 and grab sample contents for ground-truthing.

Figure 30 – Hamon Grab samples taken from B7.

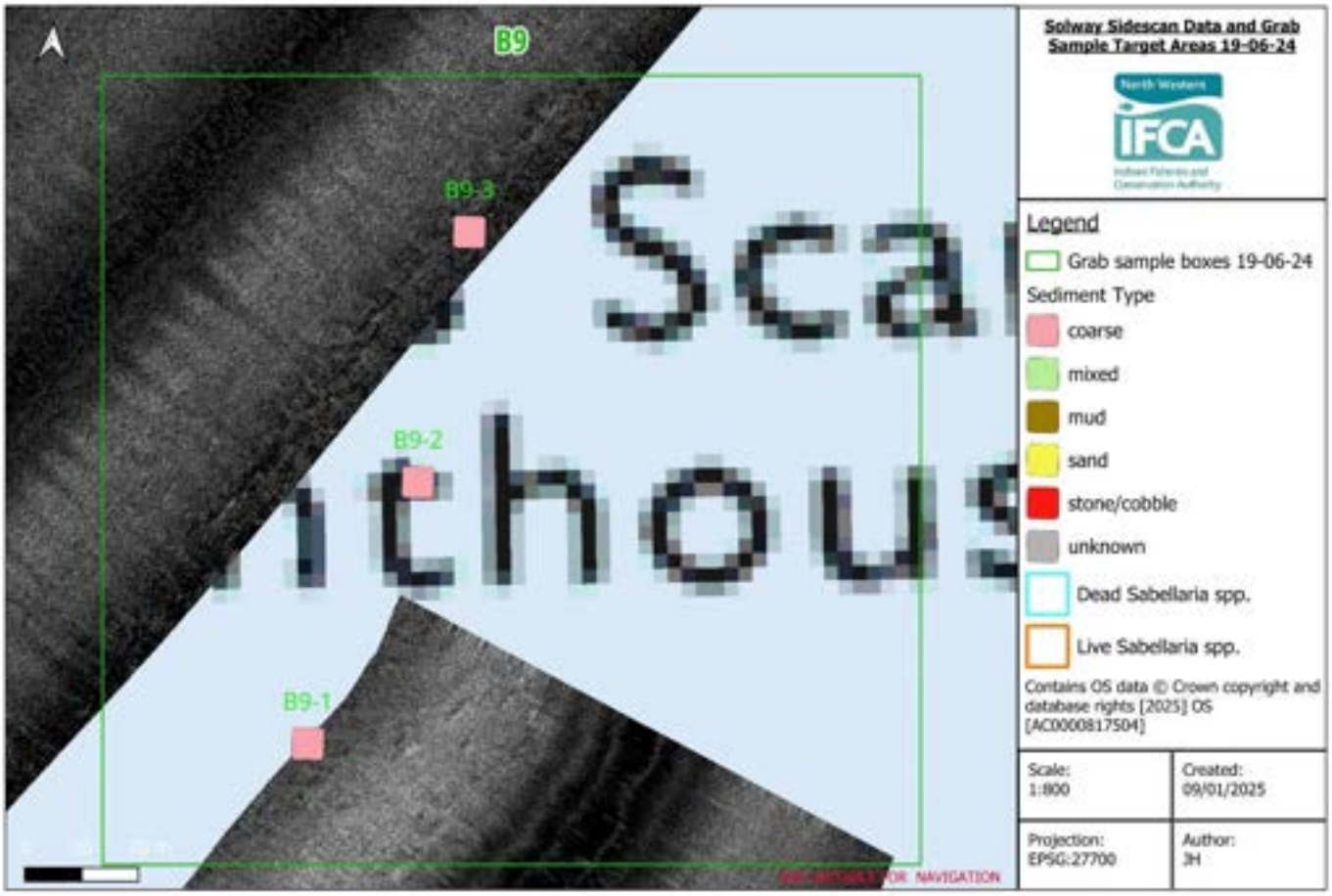

Figure 31 – Higher magnification of SSS data from target area B9 and grab sample contents for ground-truthing.

Figure 32 – Hamon Grab samples taken from B9.

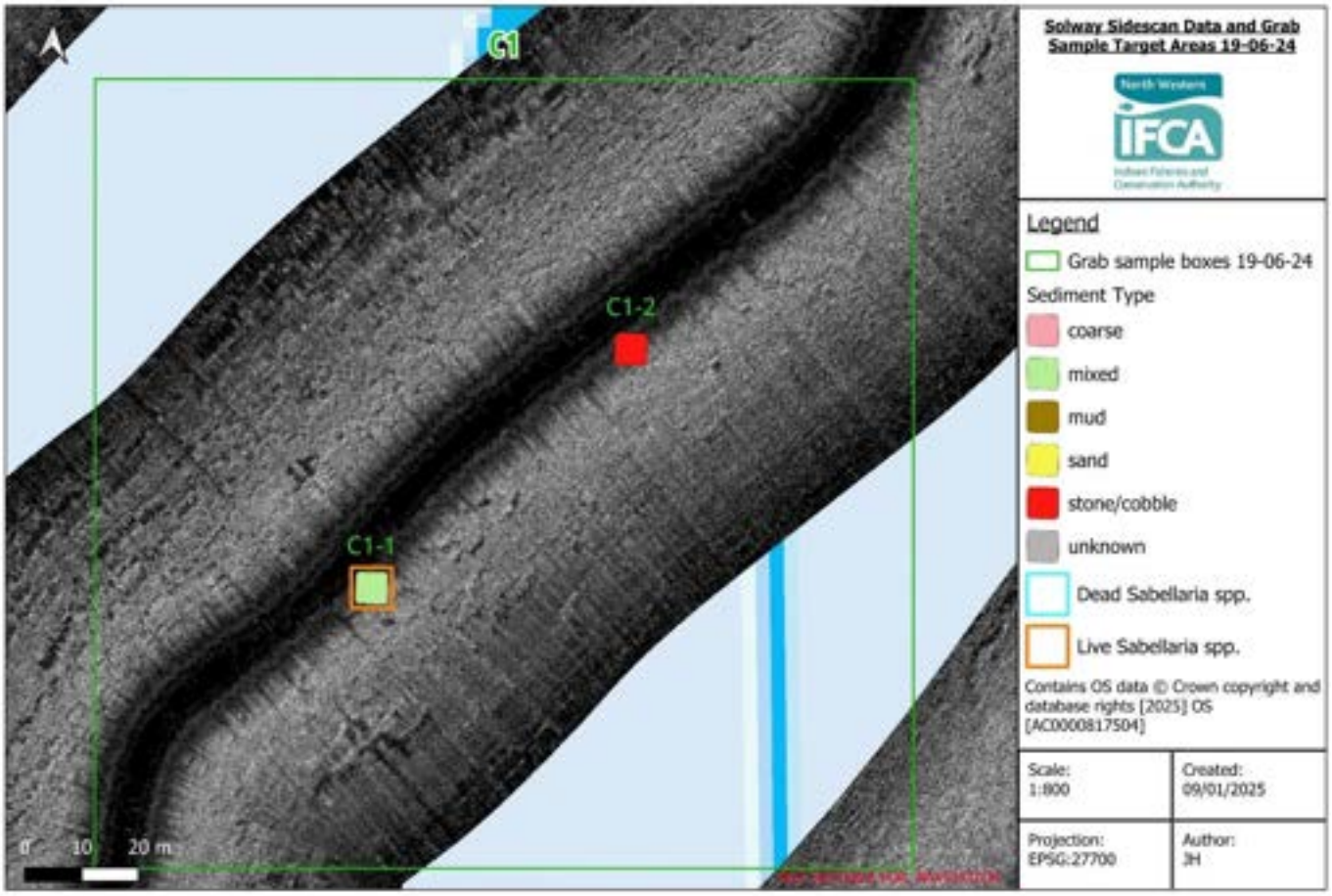

Figure 33 – Higher magnification of SSS data from target area C1 and grab sample contents for ground-truthing.

Figure 34 – Hamon Grab samples taken from C1.

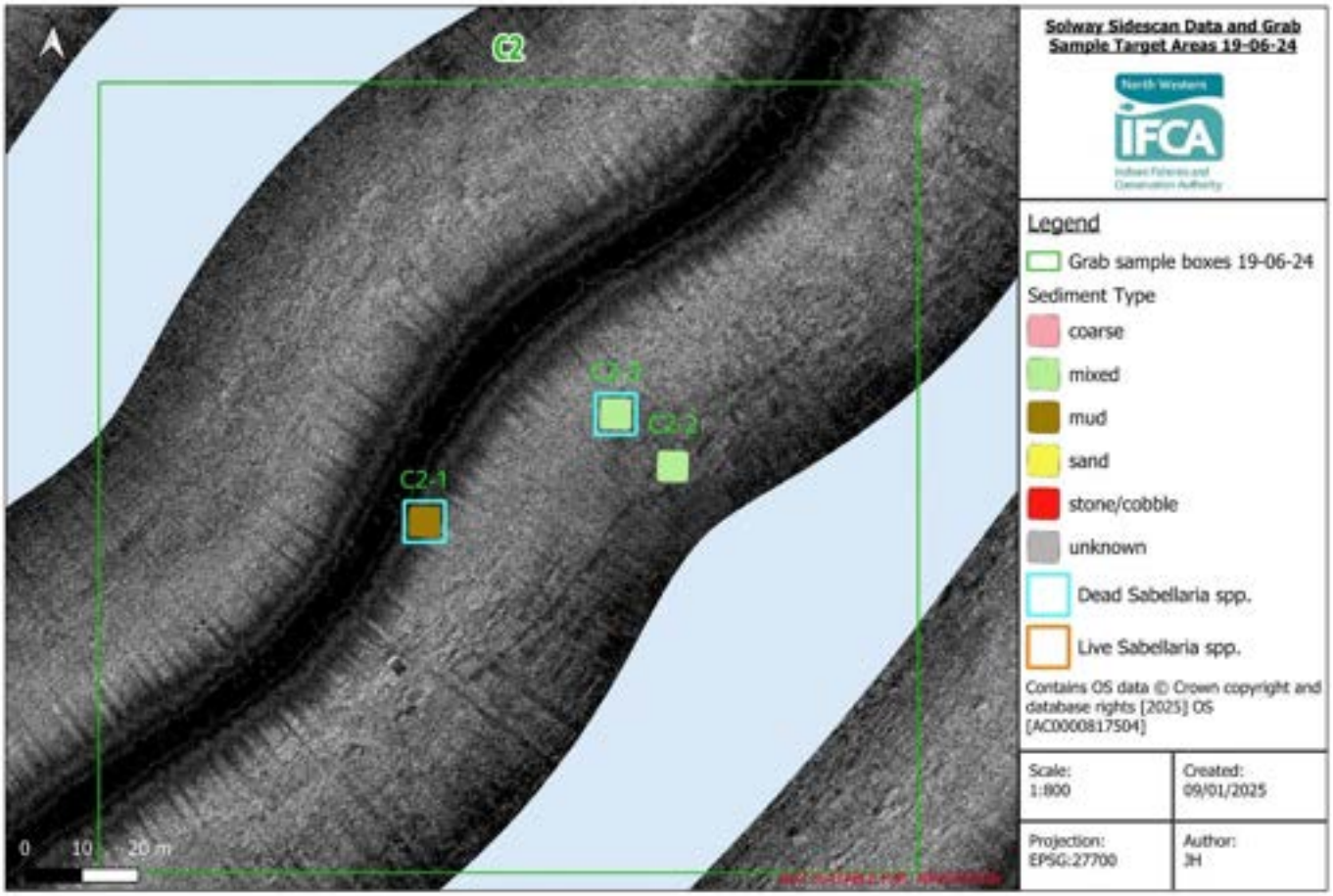

Figure 35– Higher magnification of SSS data from target area C2 and grab sample contents for ground-truthing.

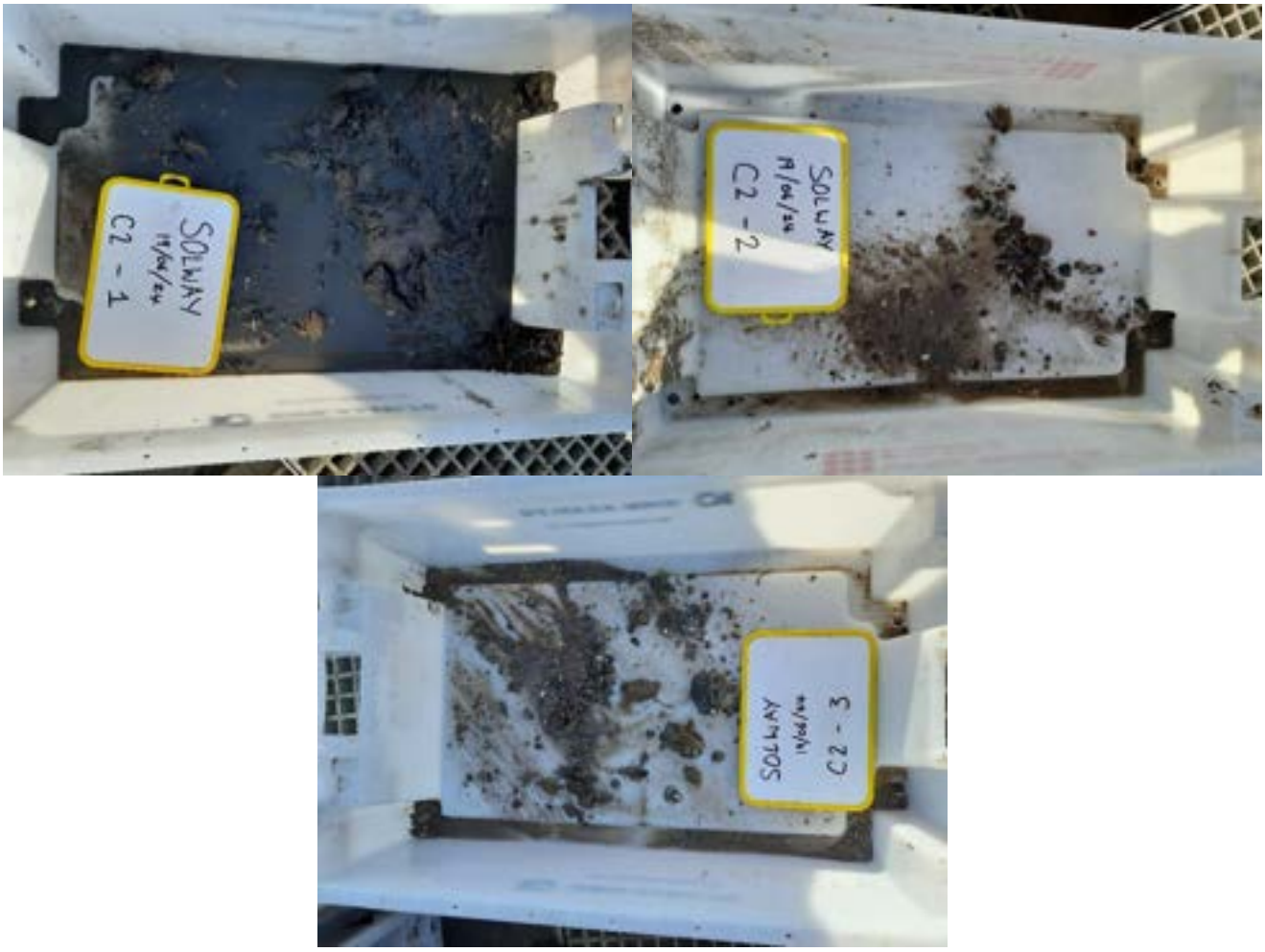

Figure 36 – Hamon Grab samples taken from C2.

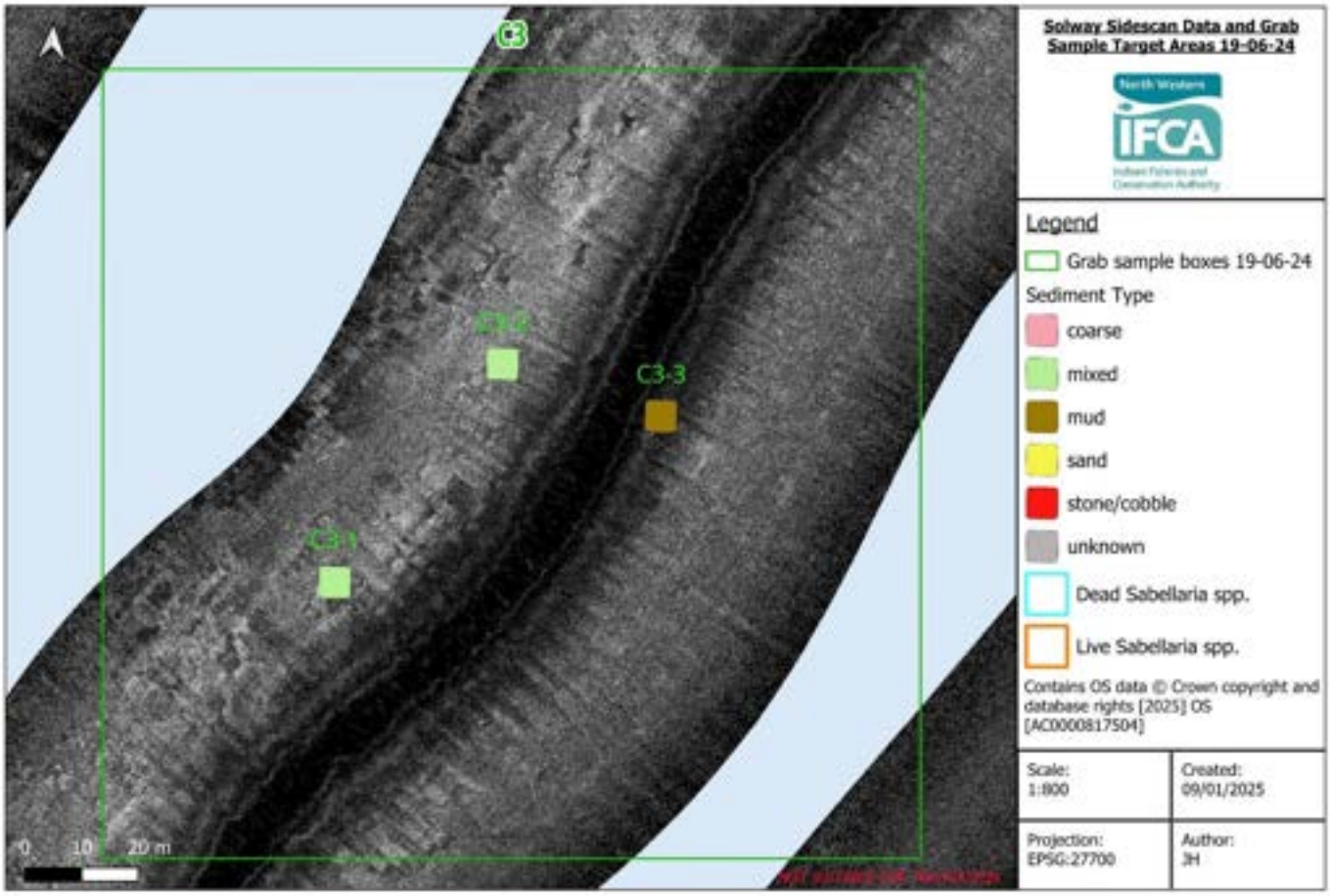

Figure 37 – Higher magnification of SSS data from target area C3 and grab sample contents for ground-truthing.

Figure 38 – Hamon Grab samples taken from C3.

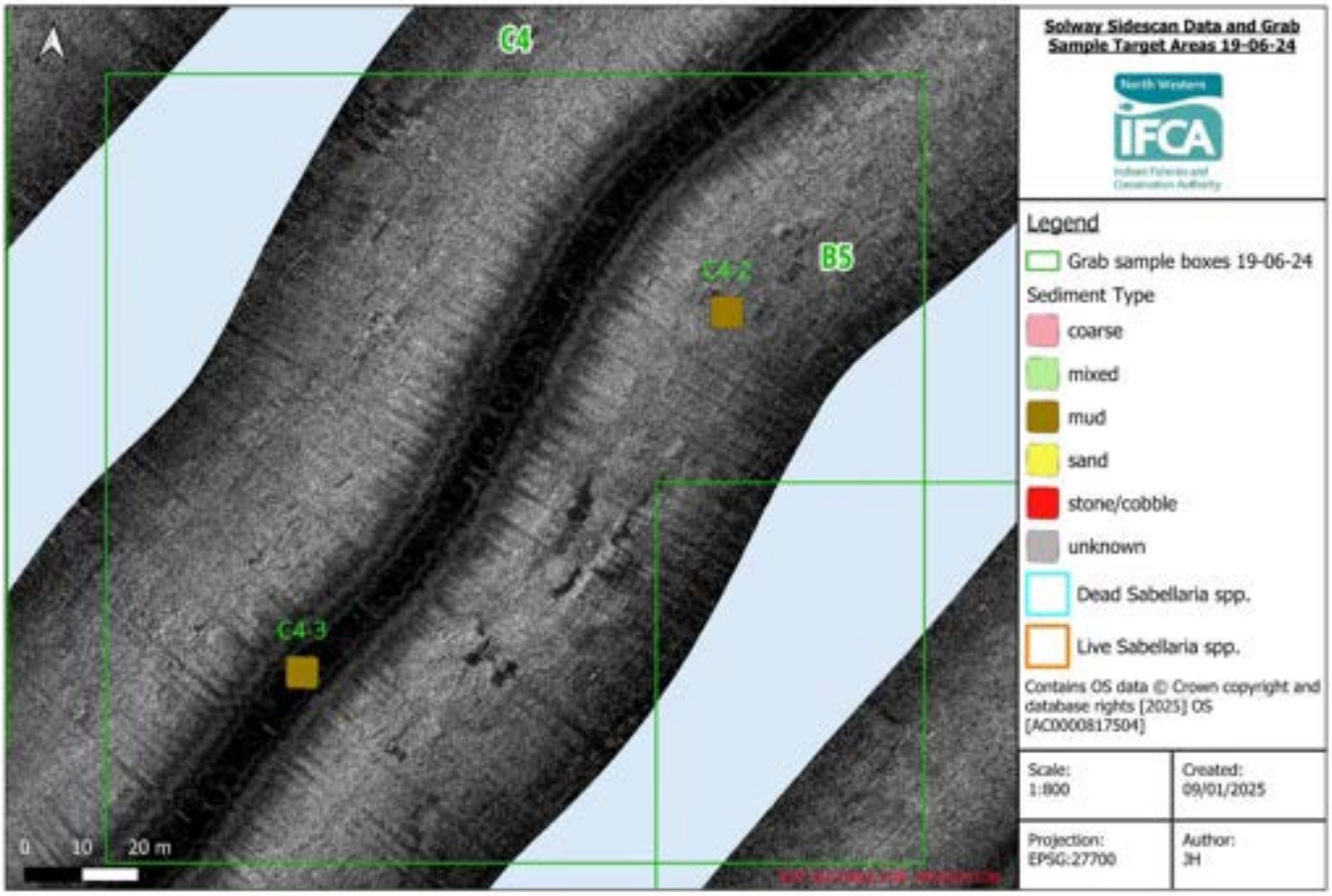

Figure 39 – Higher magnification of SSS data from target area C4 and grab sample contents for ground-truthing.

Figure 40 – Hamon Grab samples taken from C4.

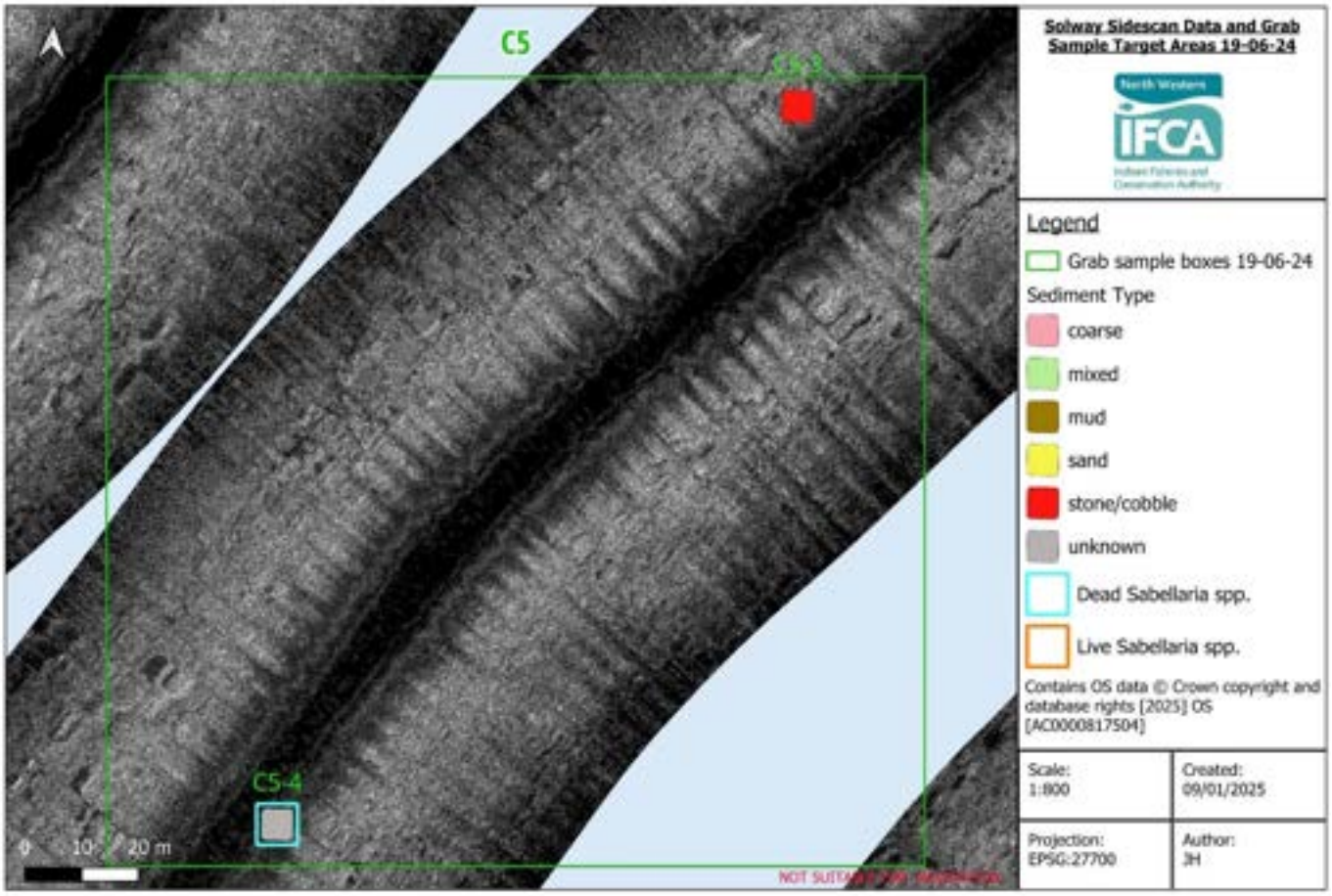

Figure 41 – Higher magnification of SSS data from target area C5 and grab sample contents for ground-truthing.

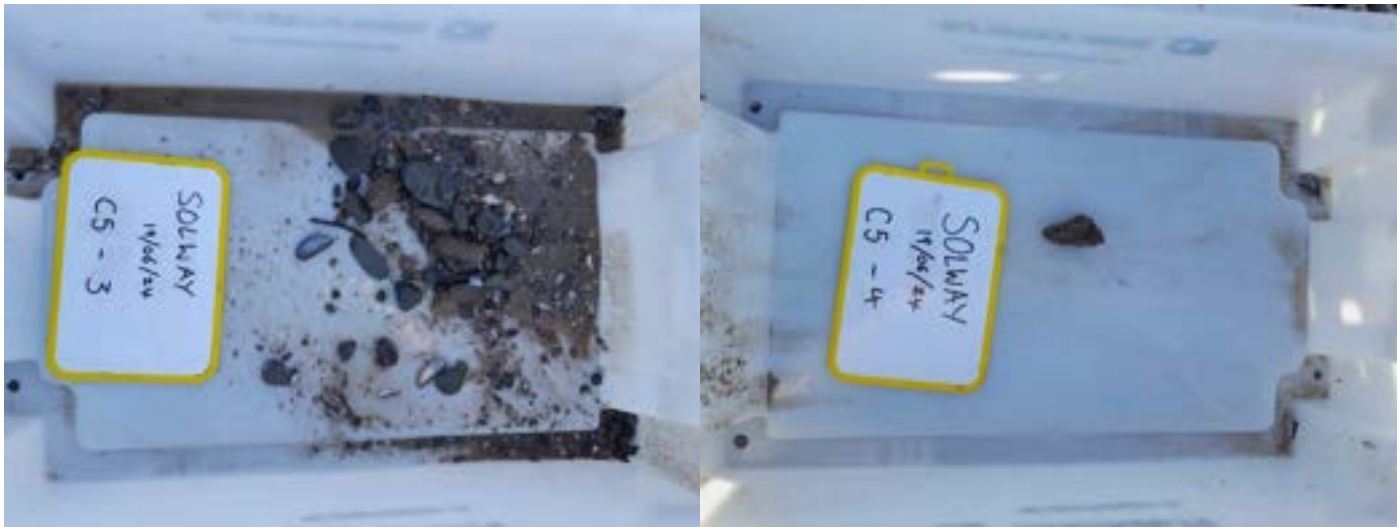

Figure 42 – Hamon Grab samples taken from C5.

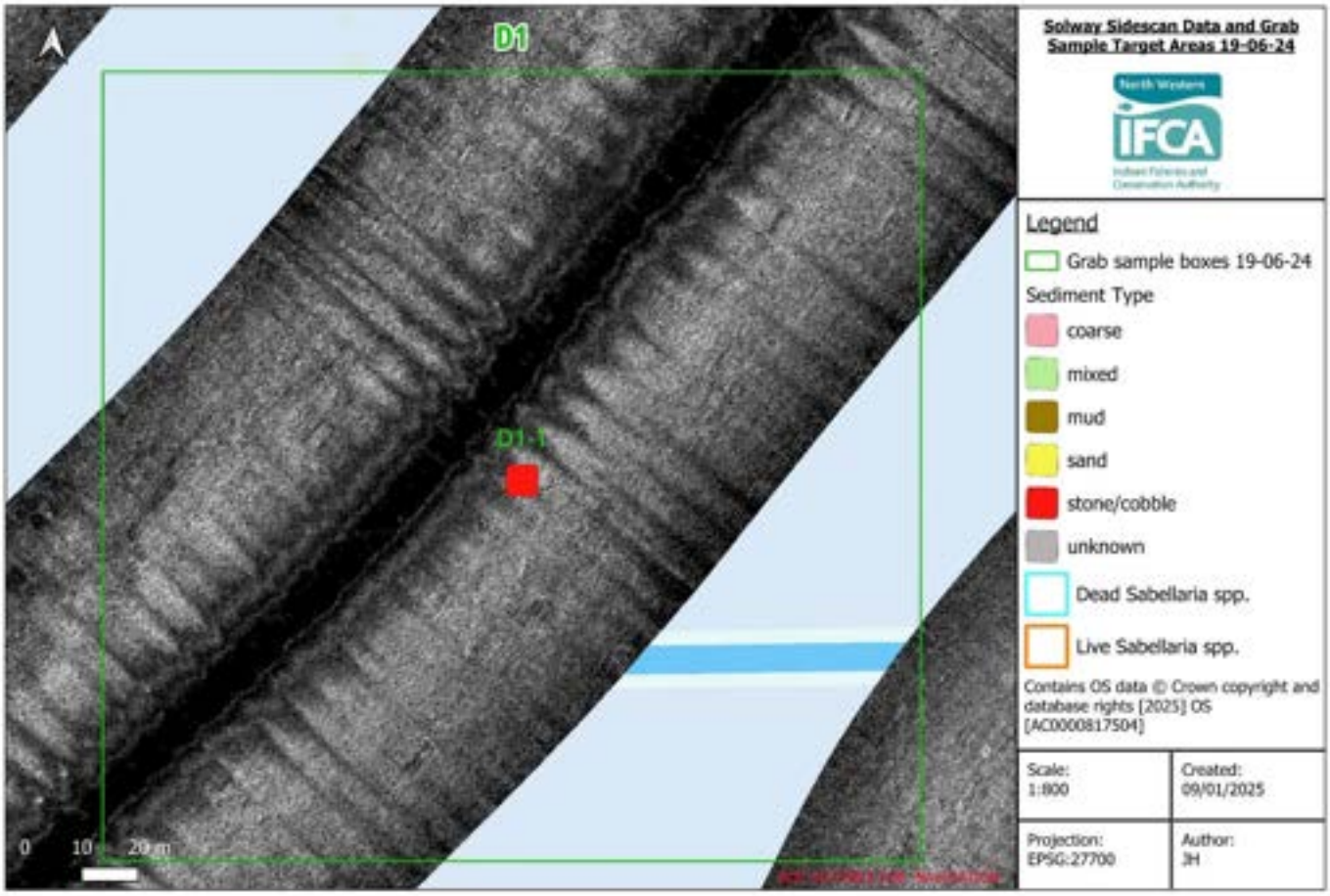

Figure 43 – Higher magnification of SSS data from target area D1 and grab sample contents for ground-truthing.

Figure 44 – Hamon Grab samples taken from D1.

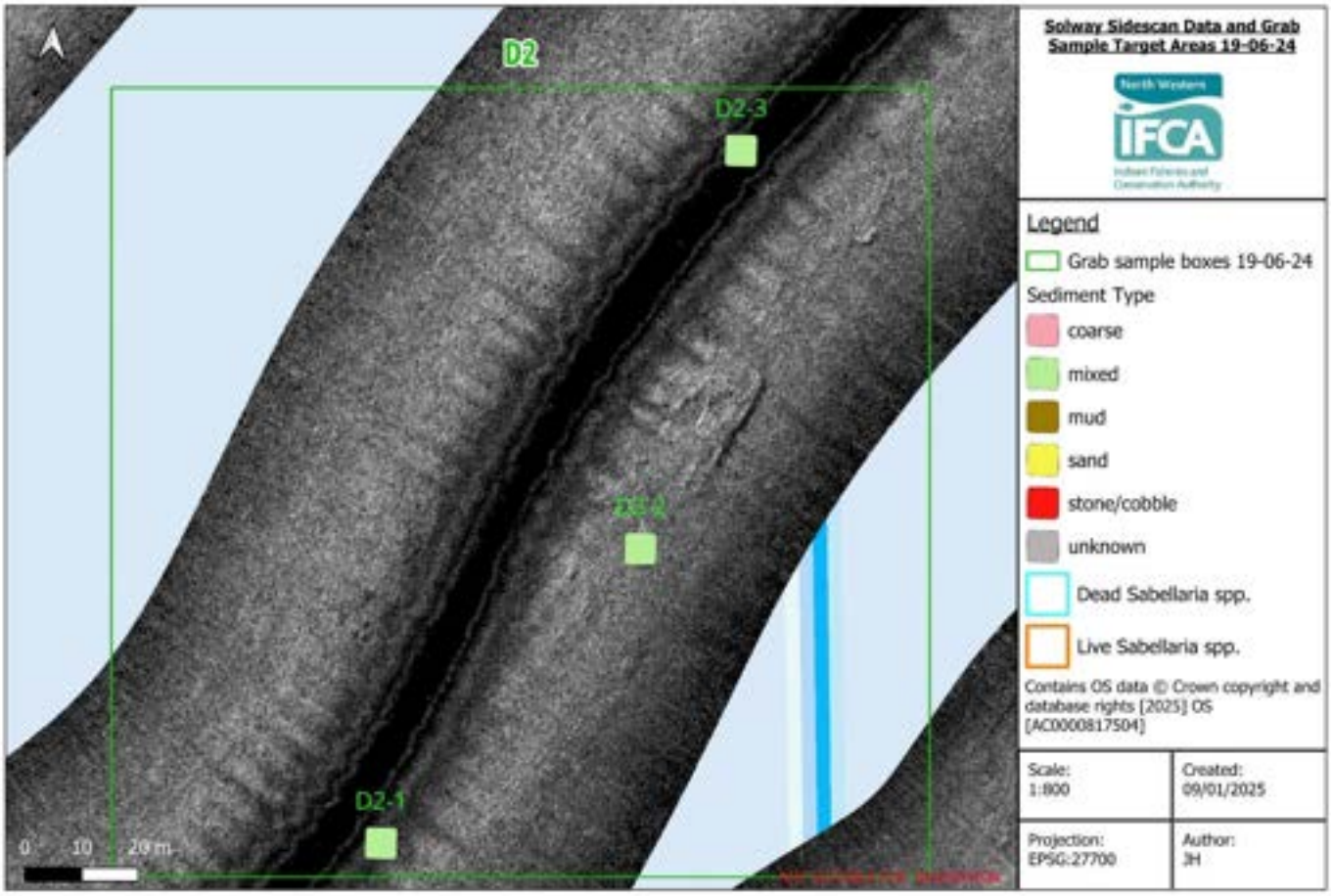

Figure 45 – Higher magnification of SSS data from target area D2 and grab sample contents for ground-truthing.

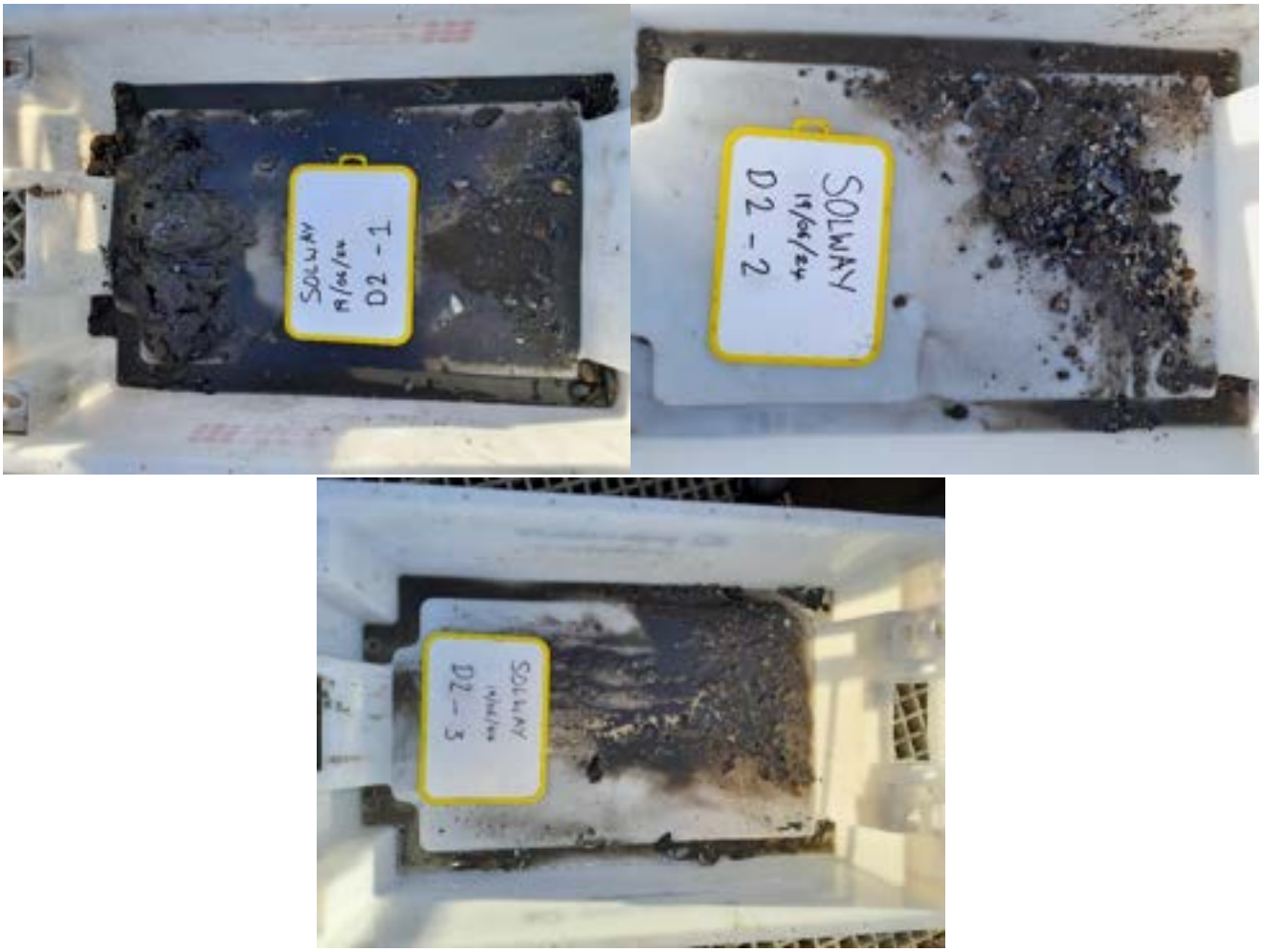

Figure 46 – Hamon Grab samples taken from D2.

Figure 47 – Higher magnification of SSS data from target area D3 and grab sample contents for ground-truthing.

Figure 48 – Hamon Grab samples taken from D3.

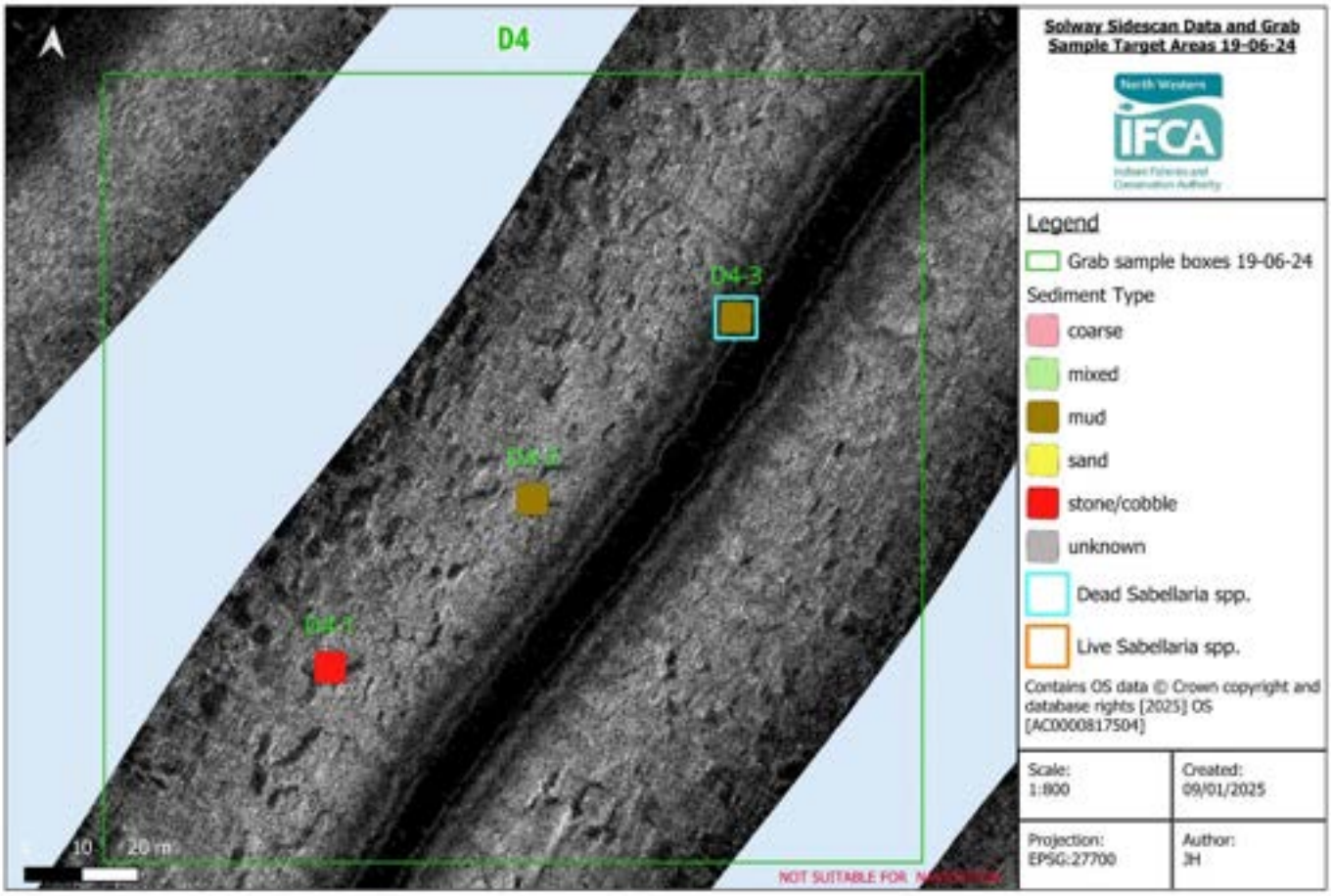

Figure 49 – Higher magnification of SSS data from target area D4 and grab sample contents for ground-truthing.

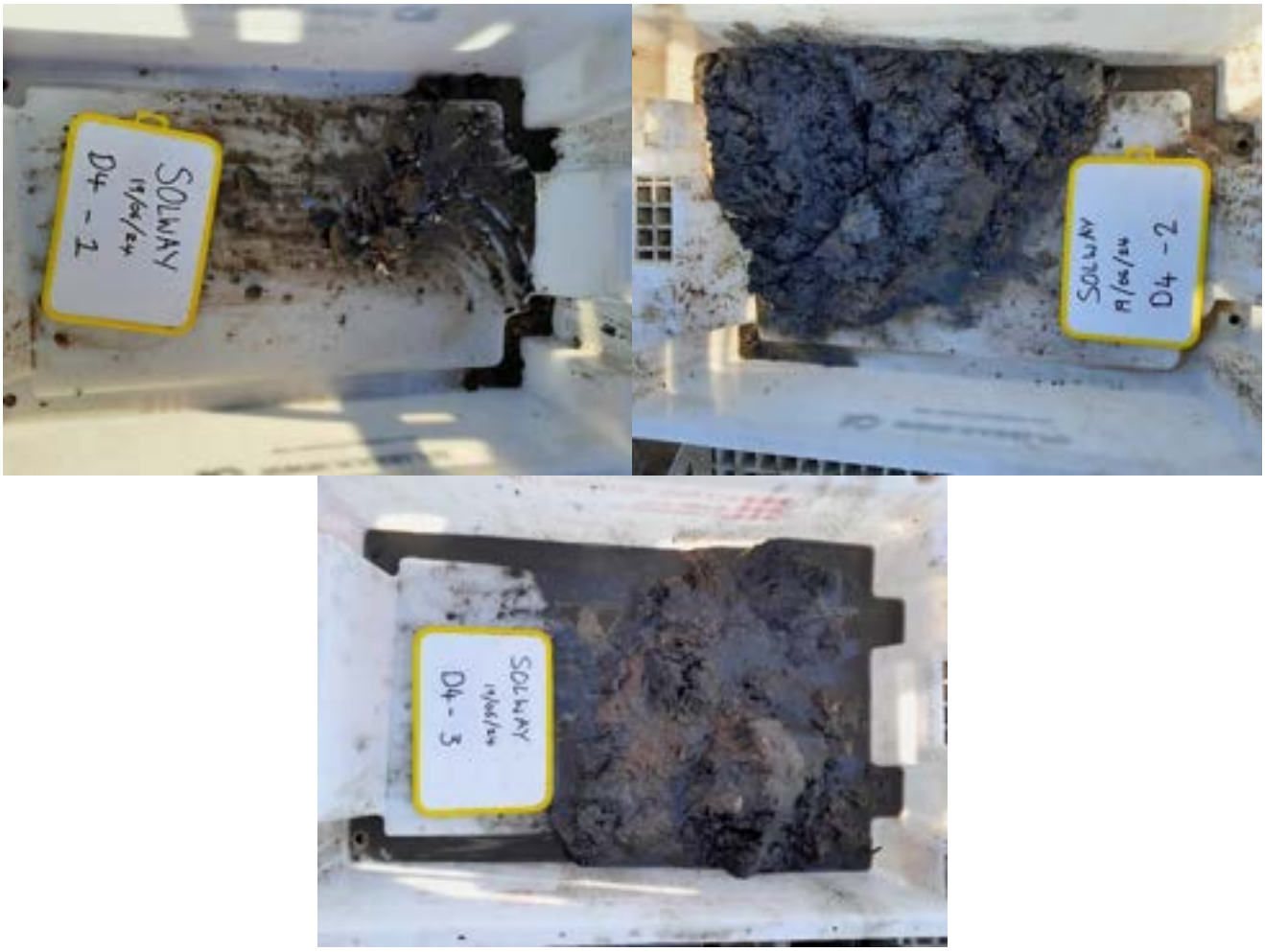

Figure 50 – Hamon Grab samples taken from D4.

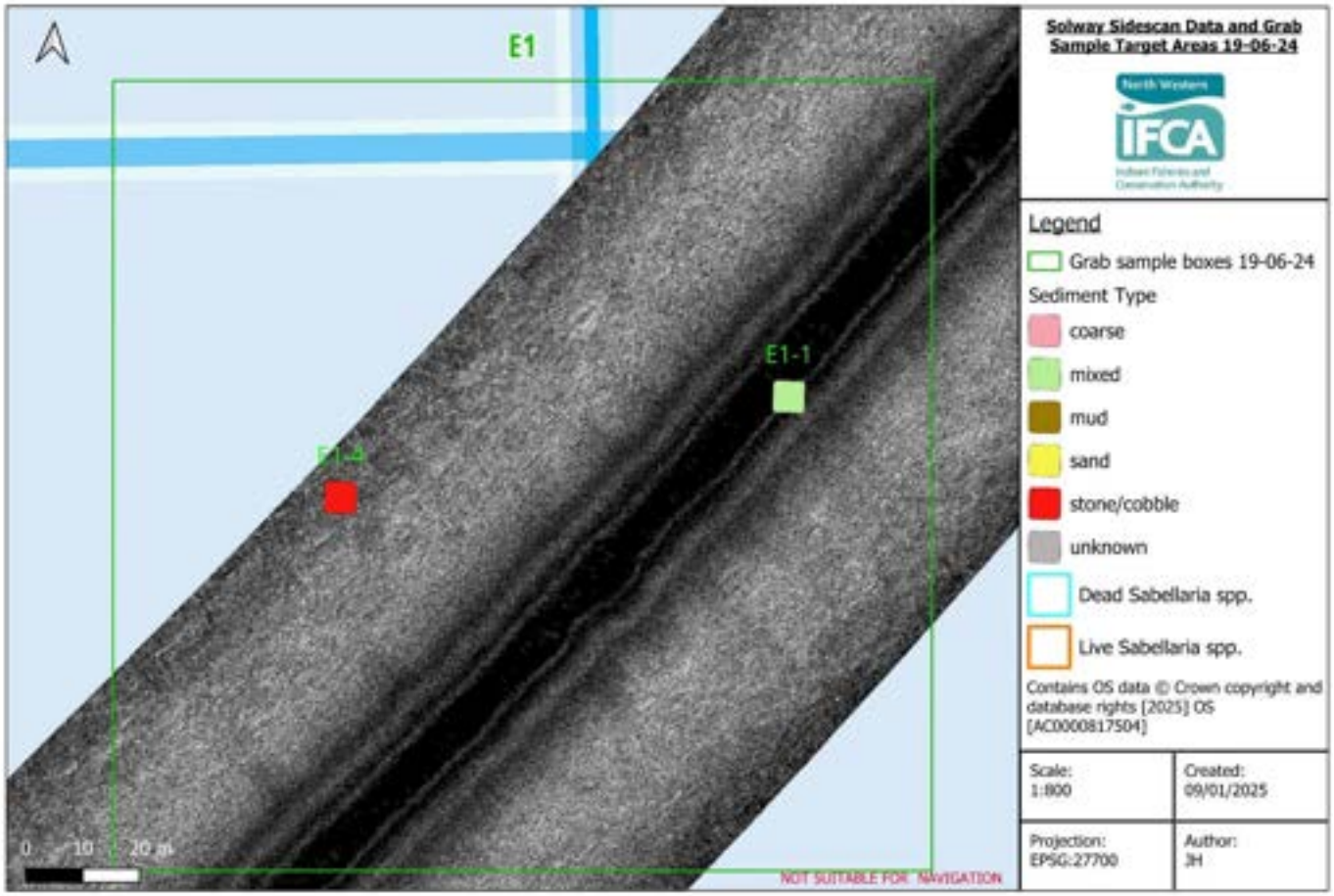

Figure 51 – Higher magnification of SSS data from target area E1 and grab sample contents for ground-truthing.

Figure 52 – Hamon Grab samples taken from E1.

4. Discussion

Use of SSS data and grab samples in the survey area enabled imagery to be produced showing an array of different habitat types in this area of the Solway. This is the first time the survey has be completed since 2021 meaning there is a significant gap in the data, but it was evident from the SSS data that the area did not appear to contain the same SSS signature where mussel was found in the 2020 and 2021 surveys, which is reflected in no mussel being found in any of the grab samples. Typically, the report would focus on the presence of mussels, the underlying habitat and the species present but due to lack of mussels being present the report will focus on the habitat information collected and further considerations to future surveys.

It should be noted that the lack of mussel in this survey and the information collected in the previous surveys (loose mussel with no byssal threads) is that although the mussel may persist for more than a year, the mussel bed may not be a permanent feature in this location, which may assist in the future of a subtidal mussel fishery.

Habitat

In target areas A5 and B3 (figures 13 and 21) all the grab samples contained sand (figures 14 and 22) and the SSS data was similar for the location of the grab samples, giving a dark image with very few strong returns. This is similar to previous surveys, giving confidence to be able to assign sand to similar SSS such as in the area to the North area of the transects.

Grabs containing mixed, coarse, stone/cobble sediment all gave a lighter imagery with varying degrees of texture and a strong return. These types are in most of the target areas, A1, A3, A8, B4 to B6, C1 to C3, C5, D1 to D3, and E1 (figures 5, 9, 20, 23, 25, 27, 33, 35, 37, 41, 43, 47, and 51).

Considerations for Future Surveys

All SSS surveys in the Solway have balanced SSS coverage with quality of data and the time taken to complete the survey in an area which is significantly restricted by limited tides and weather conditions. This survey was further limited by current speed compared to previous surveys, giving less time to complete the SSS tracks and having more failed grab samples. Looking at all of the data combined, the highest quality data is collected at 100m swathe width and would be the best way forward. It is not possible to achieve 100% coverage at this resolution in one day, to achieve this the survey area would need to be reduced and or the time allocated to the survey increased.

It is NWIFCA’s intention to conduct these surveys on a quarterly basis when time and resources permits. It is possible that even though mussel is not currently present in this location, its historical occurrence means it may recolonise at a later date and so, as with other survey locations, it is important we continue to monitor the beds.

Annex A – Solway SSS Line and Transect Plan

Annex B - NWIFCA Sidescan Sonar Survey Transects Log Sheet June 2024

Tow Name	Date	Tow Start Time (UTC)	Start Co-ordinate (dec.degrees)		Tow End Time (UTC)	End Co-ordinates (dec.degrees)		Direction of Tow (degrees)	Speed of Current (knots)	Speed over Ground (knots)	Length of Cable in Water (m)	Depth of Water (m)	Altitude of Towfish (m)
			Lat	Long		Lat	Long						
1A-3A	16/06/24	09:58	54º51.399N	003º25.265W	11:01	54º50.167N	003º27.062W	225º	3	1-2	2	10	8
1B-4B	16/06/24	11:04	54º50.253N	003º27.090W	12:12	54º51.738N	003º24.932W	45º	0	2.3	2	10	8
1C-4C	16/06/24	15:35	54º50.336N	003º27.127W	16:55	54º51.893N	003º24.861W	45º	3	0.8	2	8	6
1D-4D	16/06/24	17:09	54º50.362N	003º27.292W	17:55	54º51.900N	003º24.991W	45º	1	2.5	2	8	6
1E-4E	16/06/24	18:23	54º50.472N	003º27.227W	18:56	54º50.599N	003º26.893W	45º	1	2.2	2	8	6

Heysham Flat Mussel Inspection 14-11-24

Officers present: GG, RL, WH, LM

Tides: LW 16.10 1.6m (Liverpool tides)

Officers inspected the mussel on Heysham Flat to assess if mussel was present and if seed mussel had grown on. The perimeter of the mussel bed is tracked on Figure 1.

Size of mussel on the bed varied over the entire skear (Figure 2). There were patches of size mussel mixed in with a variety of smaller sizes, most around 15-35mm (Figure 3). Most of the live mussel was also mixed in with dead shell. No small mussel seed was found. Mussel coverage across the bed was highly variable. There were dense patches (~80%) interspersed with areas of very low coverage (~10%) (Figure 4). Areas of bare cobble were also found (Figure 5). There appeared to be mussel on the outer skears, but the water depth at Dallam Dyke made this area inaccessible, and officers were unable to assess whether the mussel was dead or alive.

There was significant historic *Sabellaria alveolata* across the bed, mostly dead but some live areas were visible (Figure 6). Mussel covered all substrates including dead shell, cobble, dead and live *Sabellaria alveolata*. Numerous bird species were present feeding in the Heysham Flat area, including oyster catchers, egrets, and herring gulls.

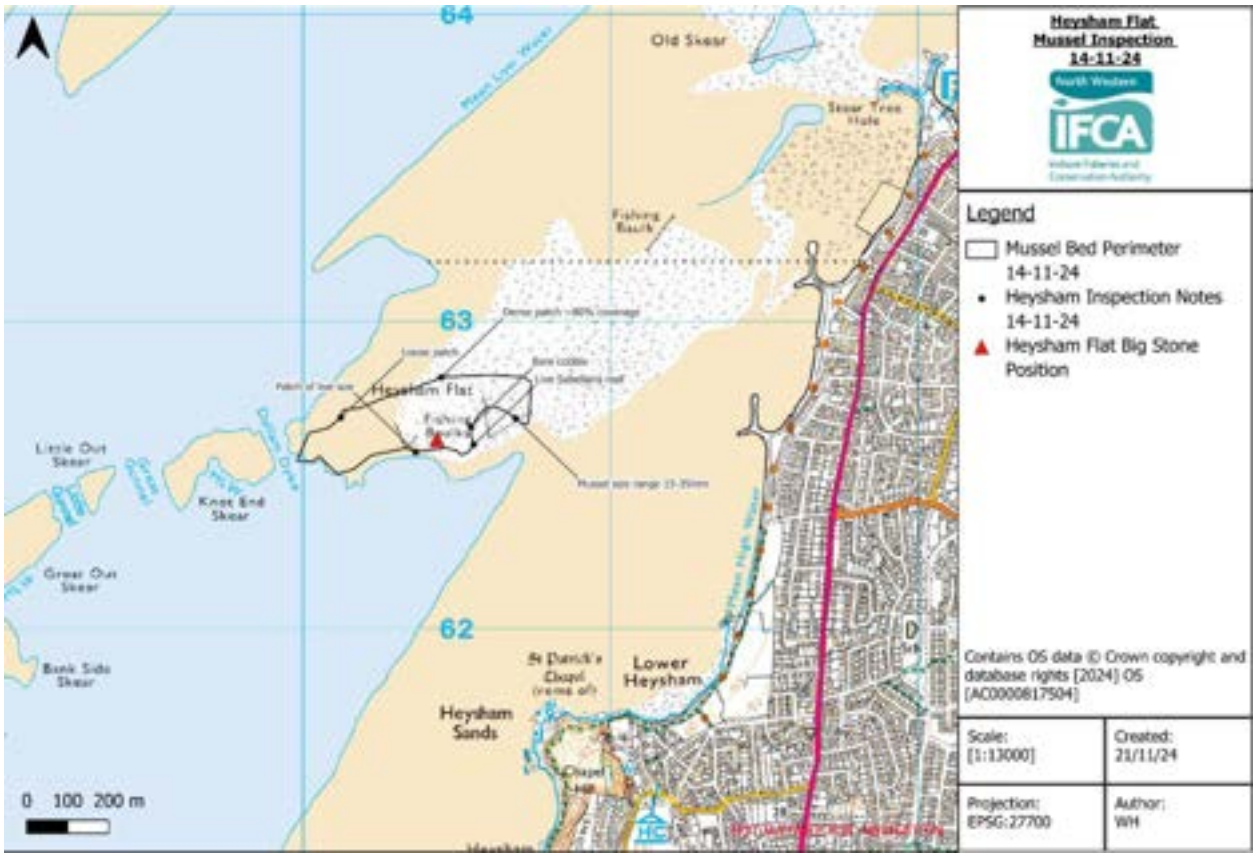

Figure 1. Map showing the mussel bed perimeter at Heysham Flat 14-11-24.

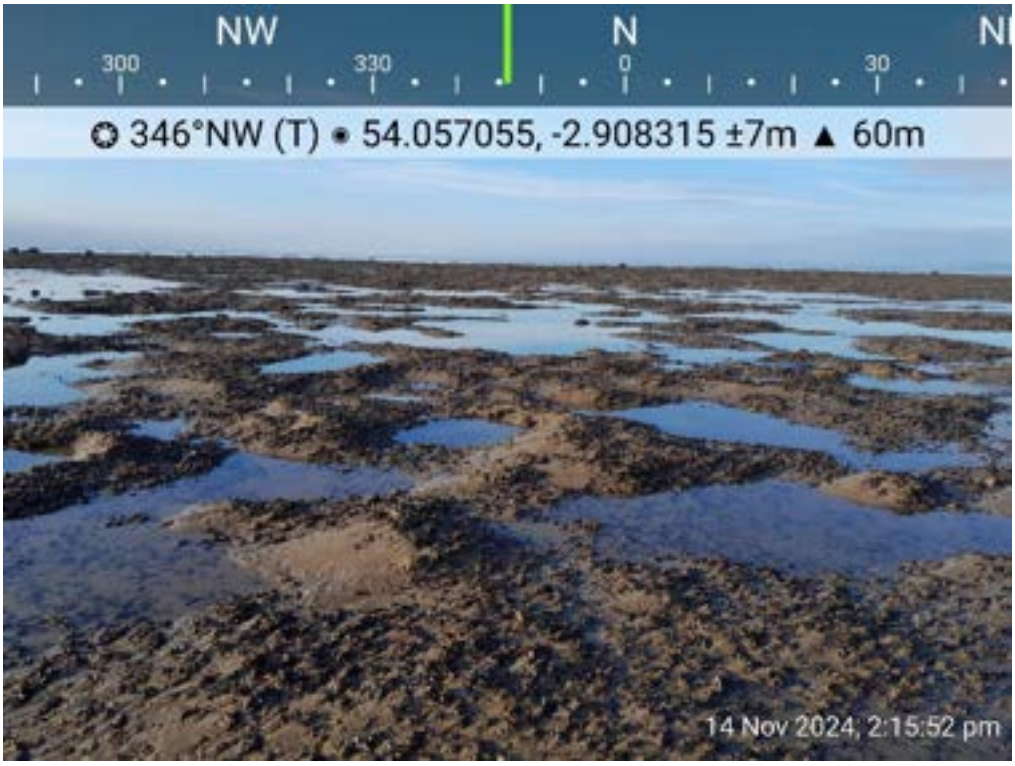

Figure 2. Heysham Flat Bed overview 14-11-24.

Figure 3. Size mussel mixed with smaller and dead shell 14-11-24.

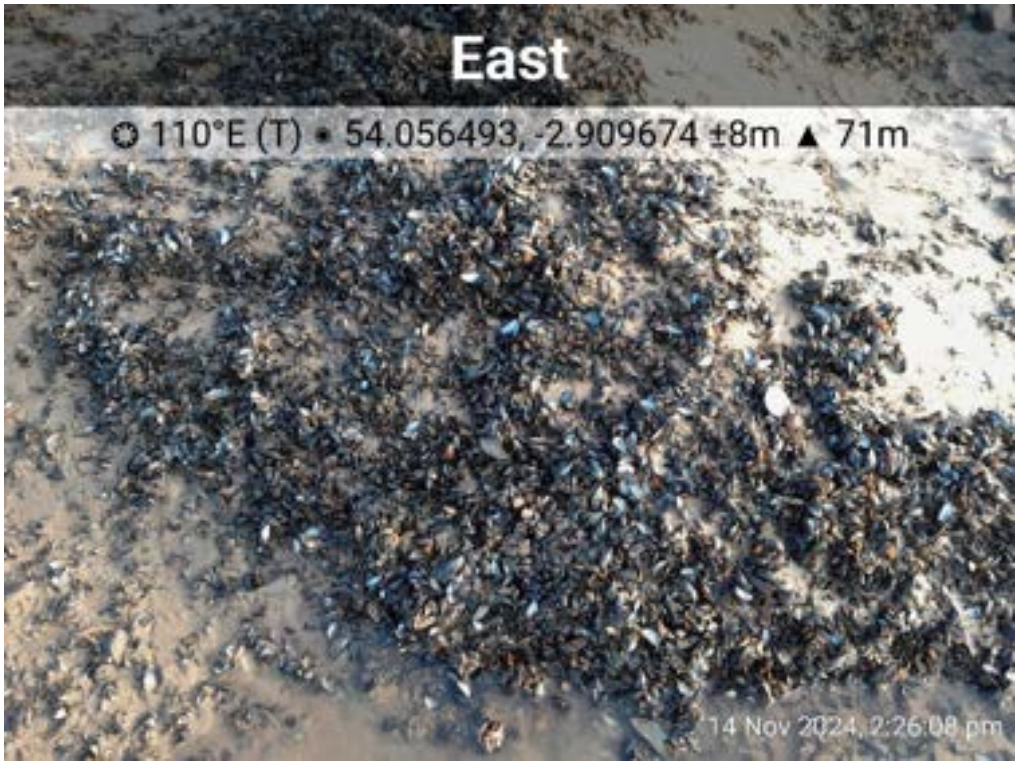

Figure 4. Mussel patch of mixed size and dead shell, mostly undersize 14-11-24.

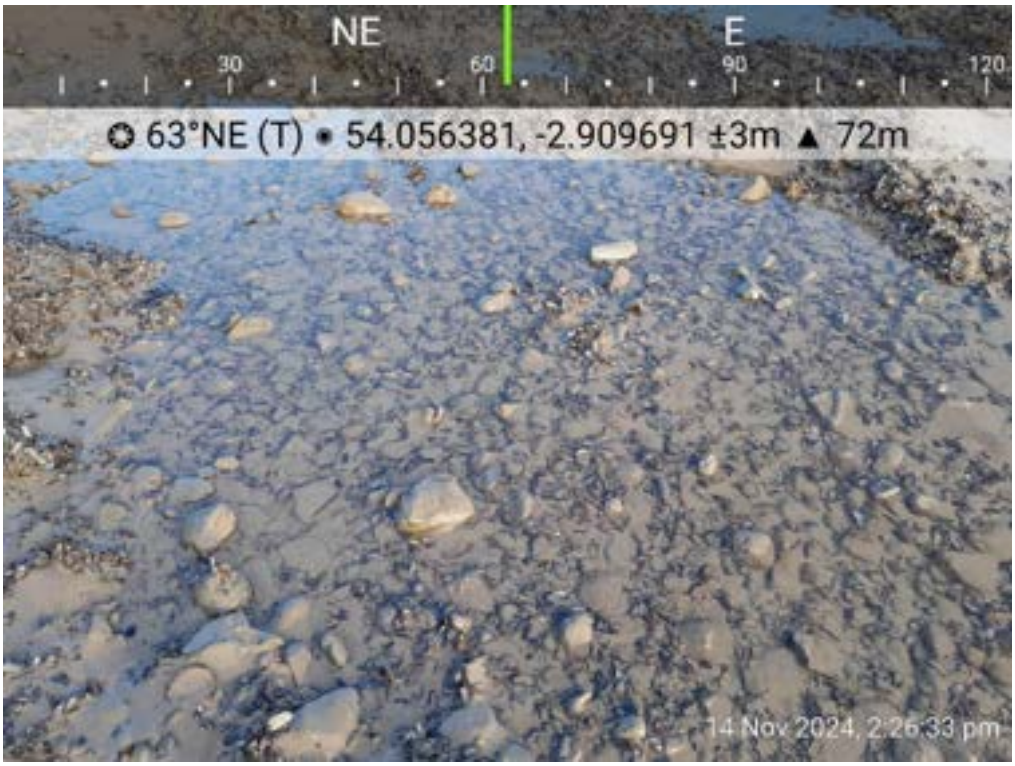

Figure 5. Bare cobble 14-11-24.

Figure 6. Patch of live *Sabellaria alveolata* 14-11-24.

Walney Channel Mussel Inspection 12-11-24

Officers present: ID, JH, LL, LM, WH

Tides: LW 14:20

Walney Channel was inspected by officers to establish the extent, condition and size class of the mussel present. Both the primary mussel patch as well as a secondary patch were inspected. Officer notes have been mapped in Figure 1.

Mussel condition varied across the patches at Walney Channel. There are substantial areas of black size mussel (Figure 2), particularly in the more northernly patch, however, there are also large areas of dead shell, blue mussel and heavily barnacled mussel (Figures 3 and 4).

The mussel size was consistent across patches. Across the more southernly patch whilst lower condition the mussel was all of size (between 45-60mm), and likely all from one year class (Figure 5 and 6). The more northernly patch contained some undersized mussel (between 40-50mm) however this mussel was less barnacled and consistently black. There were some areas of scour (Figure 7). Several sea birds were also seen feeding around the mussel bed including oystercatchers.

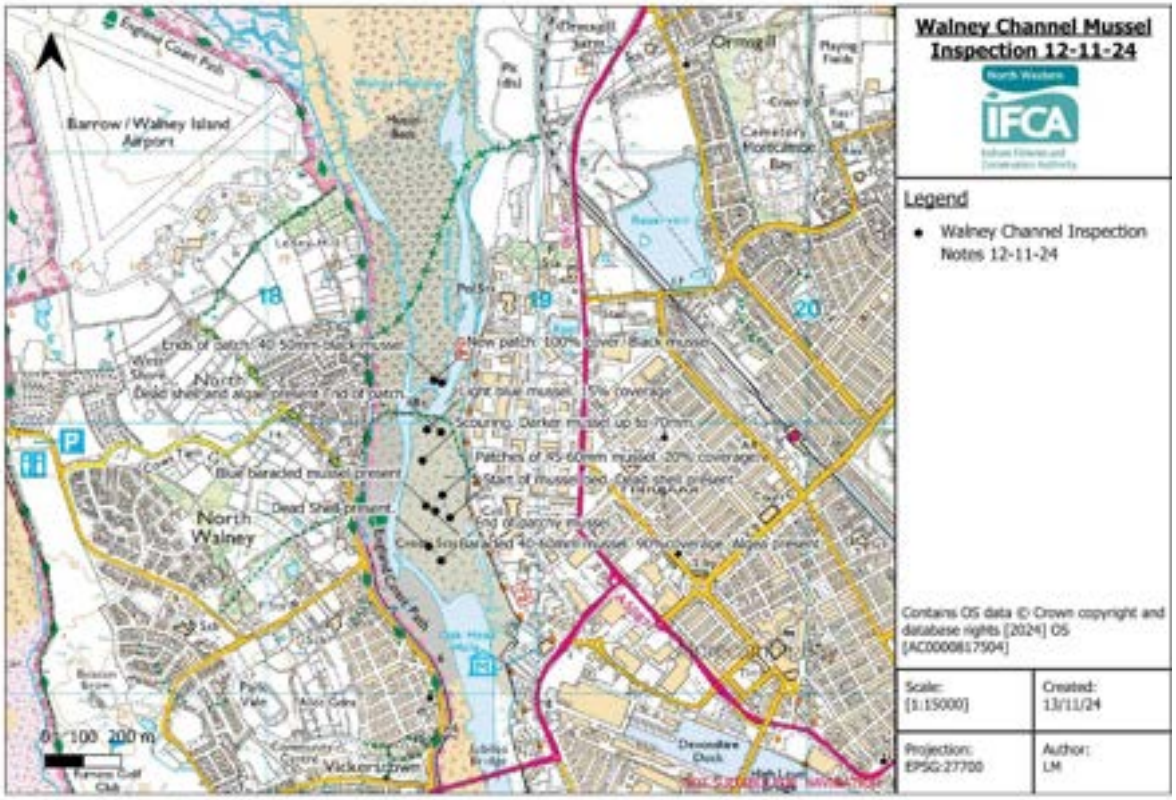

Figure 1. Map of officer inspection notes at Walney Channel 12-11-24

Figure 2. Black Mussel at Walney Channel 12-11-24

Figure 3. Blue and barnacled mussel 12-11-24

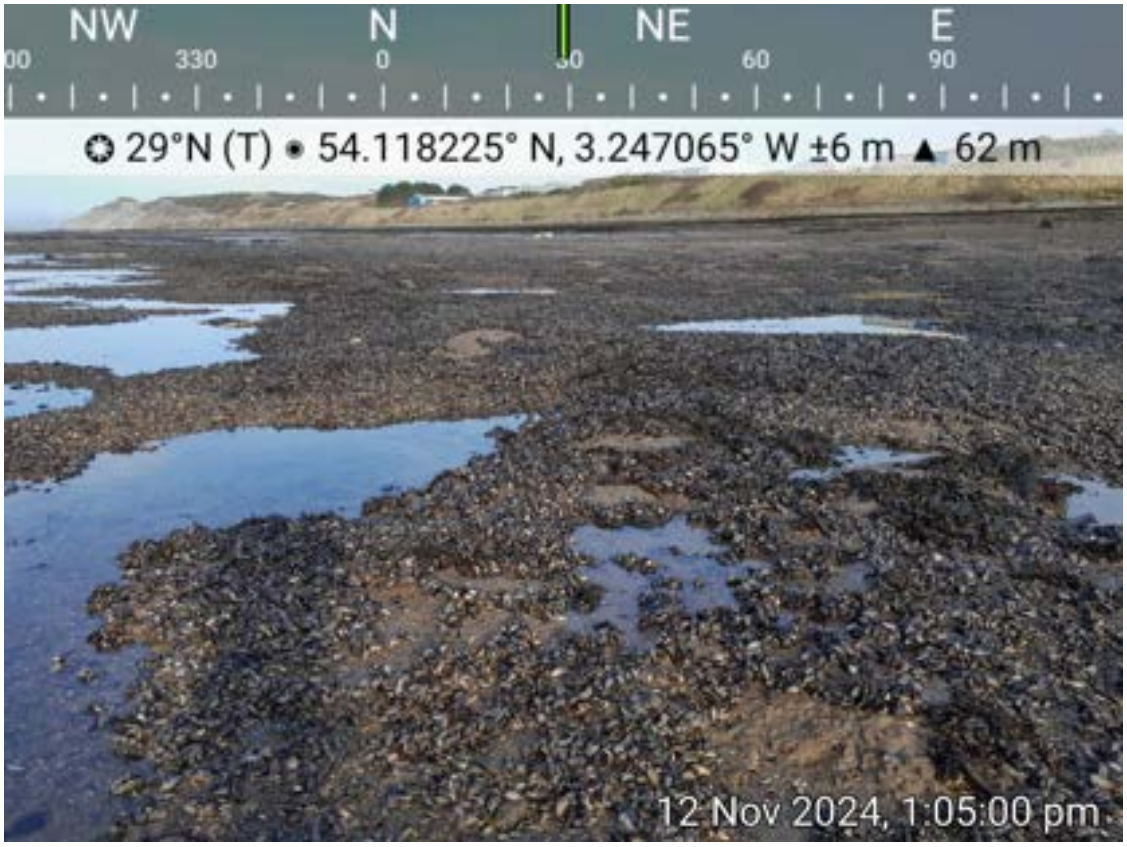

Figure 4. A mixture of dead shell and blue mussel 12-11-24

Figure 5. 45-60mm mussel 12-11-24

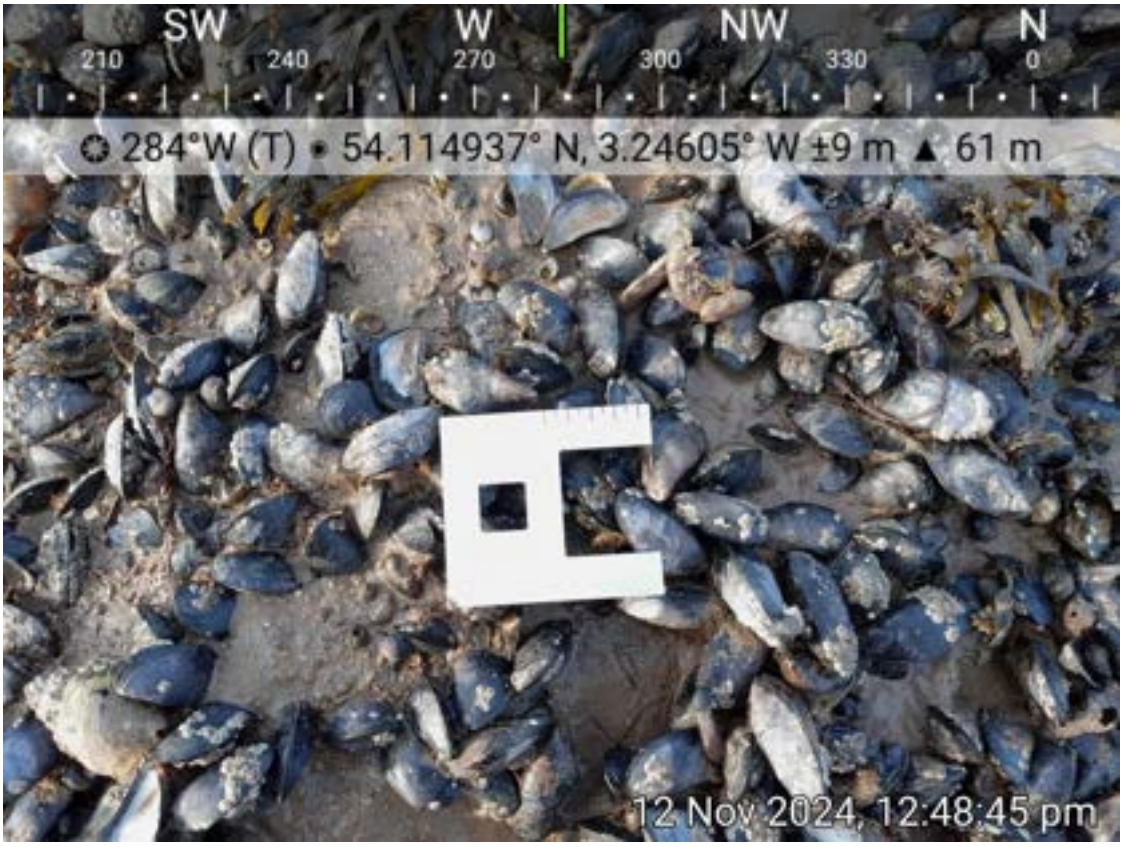

Figure 6. size mussel 45-60mm 12-11-24

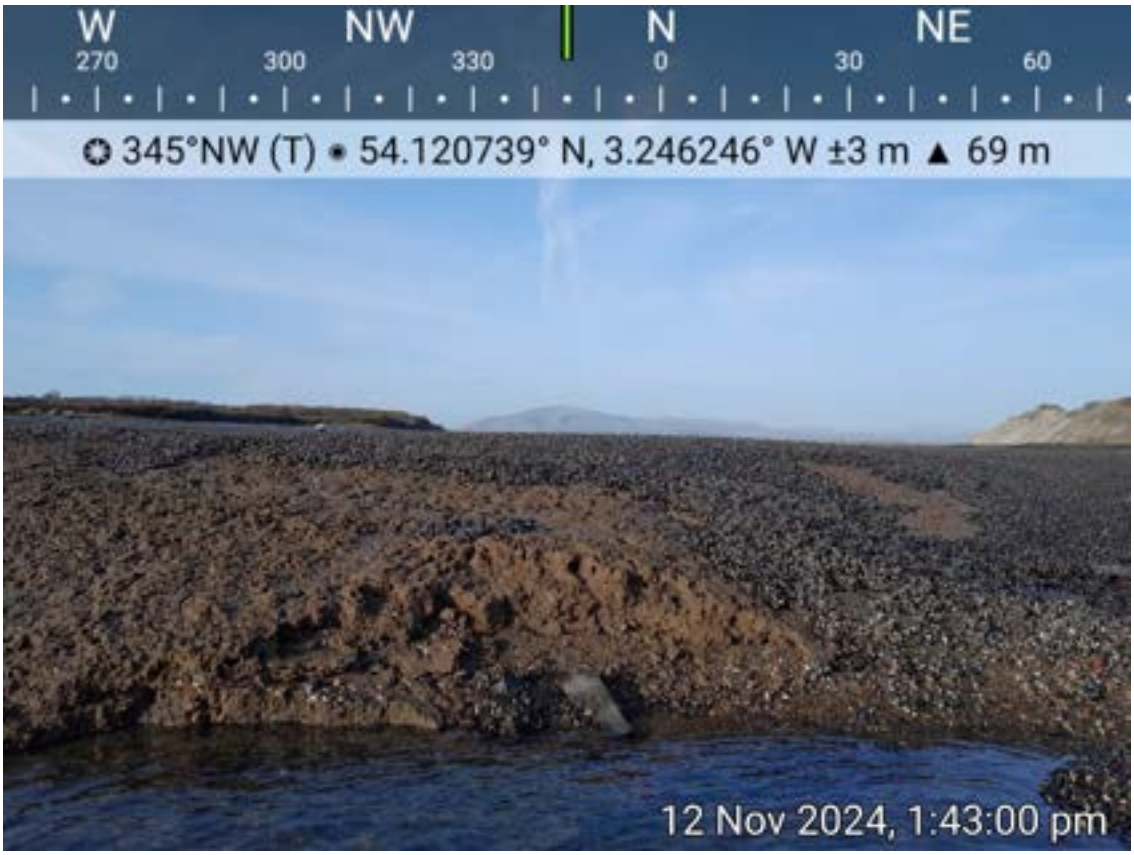

Figure 7. areas of scour 12-11-24