Mapping of Seafloor Debris in Intertidal Seagrass, Solent Maritime SAC

September 2024

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LIFE Recreation ReMEDIES (*LIFE18 NAT/UK/000039)*

Reducing and Mitigating Erosion and Disturbance impacts affecting the Seabed.

Citation

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Foreword

Natural England commissioned a project to identify and map the marine debris in the intertidal areas of the Solent Maritime Special Area of Conservation (SAC) as part of the LIFE Recreation ReMEDIES: ‘Reducing and Mitigation Erosion and Disturbance Impacts affecting the Seabed’ project (LIFE18NAT/UK/000039) and contributes to action C3 – Removals (seabed clean up).

Outputs of the project are a map of marine debris in the intertidal areas of the Solent Maritime SAC, with information on debris type and size, and an assessment of removability for each debris item.

Natural England commission a range of reports from external contractors to provide evidence and advice to assist us in delivering our duties. The views in this report are those of the authors and do not necessarily represent those of Natural England.

Executive summary

Background

LIFE Recreation ReMEDIES is a partnership project running from July 2019 – October 2024 and will provide the tools to deliver the conservation needed to move relevant Annex 1 habitats towards Favourable in five Special Areas of Conservation (SACs).

The Solent Maritime SAC is one of the focus areas. It is a complex site lying in one of the only major sheltered channels in Europe and has a history of high industrial and recreational activity. These have the potential to leave marine debris on the seabed, creating a hazard to marine ecology and reducing the availability of space for marine habitats and can impact seagrass beds by smothering and/or eroding it. In order to cultivate a better environment for sensitive seabed habitats, LIFE Recreation ReMEDIES aims to help towards the removal of seabed debris. The first step towards this is mapping of any marine debris within mudflats and sandflats not covered by seawater at low tide and assessing the removability of the debris items.

Method

This has been achieved through a digital walkover of the entire intertidal area of the Solent Maritime SAC using high-resolution imagery captured by APEM in Summer 2022. Objects that are not natural in colour, shape, or texture and appear to be rusted or broken were classified as abandoned seafloor debris. These were categorised, measured and had their removability assessed through a combination of their size and distance from shore. The removability was assessed on a scale from 1-11 with Grade 1 being the most accessible for removal and Grade 11 being the least. On shore validation was completed for several items to positively identify debris type classified in the digital walkover.

Finally, as the digital walkover was being completed, the frequency and area of visible anchor pressure points was also mapped and recorded.

Results

Overall, 568 debris items were identified covering a total area of 37,307.42 m^2. The most frequent category found was tyres (221), abandoned structures (112) and scrap metal (58). However, the largest area covered by debris was from abandoned structures (23,021.77 m^2), fly-tip (9,409.03 m^2) and abandoned boats (2,347.33 m^2).

The removability of debris varied greatly, with 78 objects classed as Grade 1 and 145 as Grade 11.

There was 839 anchor pressure points identified in the digital walkover and the total area impacted by these was recorded as 242,953 m^2.

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1. Introduction

Annex 1 mudflats and sandflats not covered by seawater at low tide, within the intertidal Solent Maritime Special Area of Conservation (SAC), support growth of seagrass beds. The Solent Maritime SAC (Figure 1) has historically seen significant use for industrial and recreational activity. These activities inherently facilitate abandonment of buoys and mooring structures as well as other anthropogenic waste, such as scrap metal and other commercial material. These activities and waste that may be abandoned on the seabed have the potential to create a hazard to marine ecology and reduce available space for marine habitats to flourish. These objects may also smother or erode important seabed areas which creates unfavourable growth conditions for seagrass and other sensitive designated features of the site.

Natural England commissioned APEM to identify and map potential seafloor debris in the Solent Maritime SAC (Figure 1). This work was funded as part of the LIFE Recreation ReMEDIES: 'Reducing and Mitigating Erosion and Disturbance Impacts affecting the Seabed' project (LIFE18NAT/UK/000039) and contributes to Action C3 - Removals (seabed clean up). Results of the mapping campaign will facilitate the LIFE Recreation ReMEDIES project which helps with removal of seabed debris to cultivate a better environment for sensitive seabed species and aid habitat restoration.

The specific objects of the project were to:

1. Identify and map any abandoned industrial or recreational waste material on the seafloor within mudflats and sandflats not covered by seawater at low tide of the Solent Maritime SAC.
2. Record the type of seafloor debris objects (e.g., mooring sinker, scrap metal, tyres).
3. Record the approximate size (i.e., the approximate area each item occupies on the seafloor) of seafloor debris objects.
4. Assess the accessibility of the objects based on findings.
5. Report the detailed findings of the project in a succinct and clear final report.

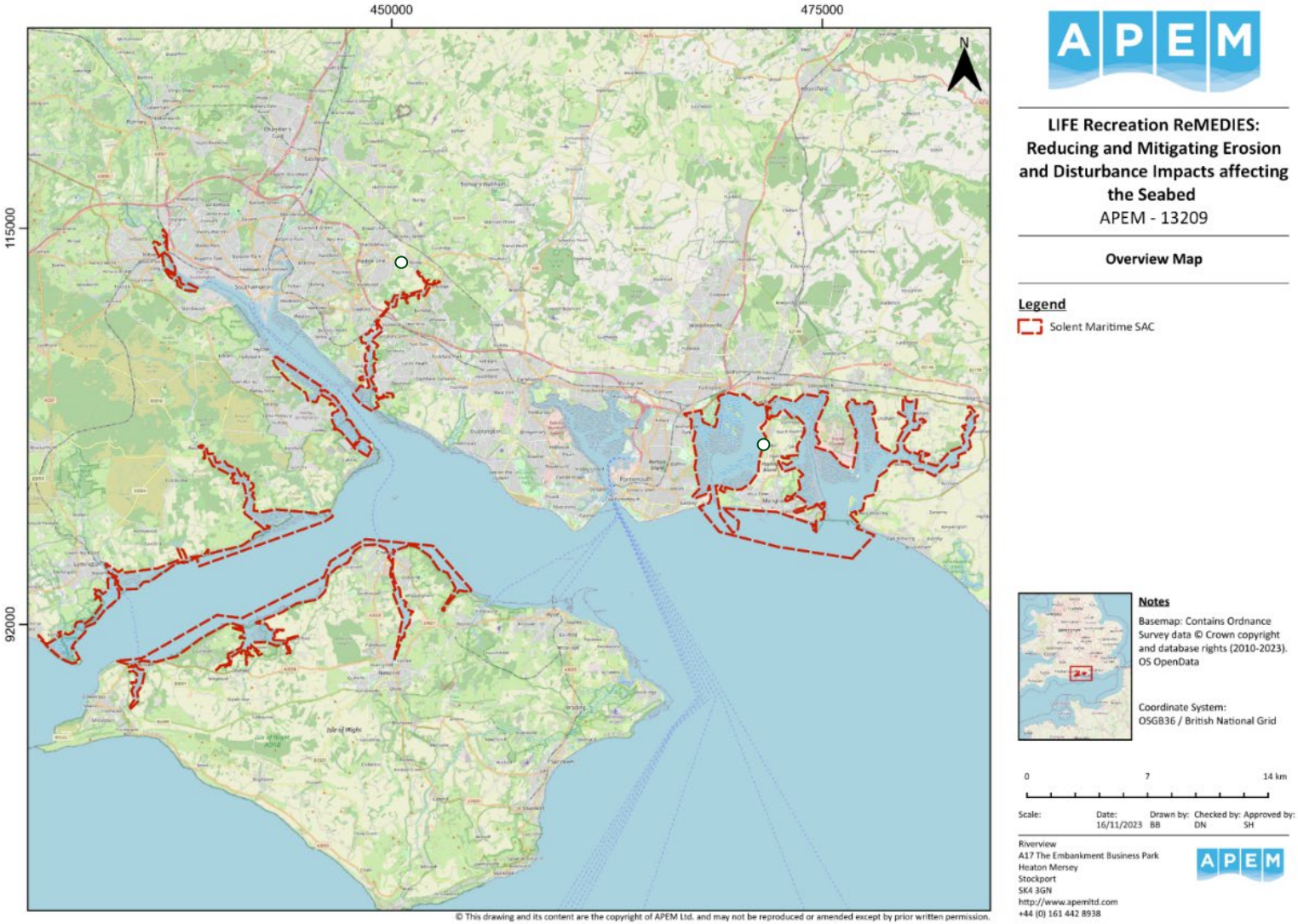

Figure 1. Overview map of study area within the Solent Maritime SAC.

2. Method

2.1 Aerial Image Processing

APEM captured high-resolution imagery in Summer 2022 as part of the National Network of Regional Coastal Monitoring Programmes (NNRCMP). The survey required imagery to be captured at 10 cm Ground Sampling Distance (GSD). However, APEM's systems are also fitted with sideward facing (oblique) cameras with a longer focal length that facilitate capture of higher resolution imagery. From these cameras, we were able to capture imagery at 3.7 cm GSD. This imagery covers all the areas of the Solent Maritime SAC and was captured in clear conditions with a sun angle greater than 20°. The tidal state during these surveys was below mean low water springs (MLWS) and facilitated maximum potential coverage across all the mudflats and sandflats.

APEM used specialist photogrammetric software (Agisoft: Metashape v. 2.0) to create seamless orthomosaic (georeferenced) imagery for the areas of interest in the Solent Maritime SAC. These imagery data were used in further geospatial analysis.

2.2 Geospatial Analysis

2.2.1 Seafloor Debris

To effectively identify potential seafloor debris within the processed orthomosaic imagery, a detailed digital "walkover" survey was conducted using a Geographic Information System (GIS). APEM's team of trained scientists loaded all imagery into a GIS along with the survey area. A 1 km x 1 km grid was created to the extents of the survey area (Figure 2). By systematically inspecting each grid square, suspected seafloor debris was identified and tagged in the GIS. Objects that are not natural in colour, shape, or texture and appear to be rusted or broken were classified as abandoned seafloor debris. The seafloor debris type classifications used in the analysis are listed in Table 1. The habitat that each seafloor debris object occupies was derived from the Primary Habitat Inventory database from Natural England. Debris that is not within a habitat polygon, but is close to the boundary, is given a classification with an "APEM" identifier in the name.

All identified objects were captured as a vector ESRI point shapefile. For each object, the following attribute data was recorded:

- Search Grid Number.
- Seafloor Debris Type.
- File Identification Number within each Debris Type
- Approximate area (m^2) of seafloor occupied by each object.
- Distance of the object to the coastline (m).
- Accessibility of seafloor debris object.
- Main habitat that debris is within.
- Habitat code that debris is within.
- Other classification of habitat that debris is within.
- Additional habitat code that debris is within.
- Primary source of habitat classification.
- OS Easting.
- OS Northing.

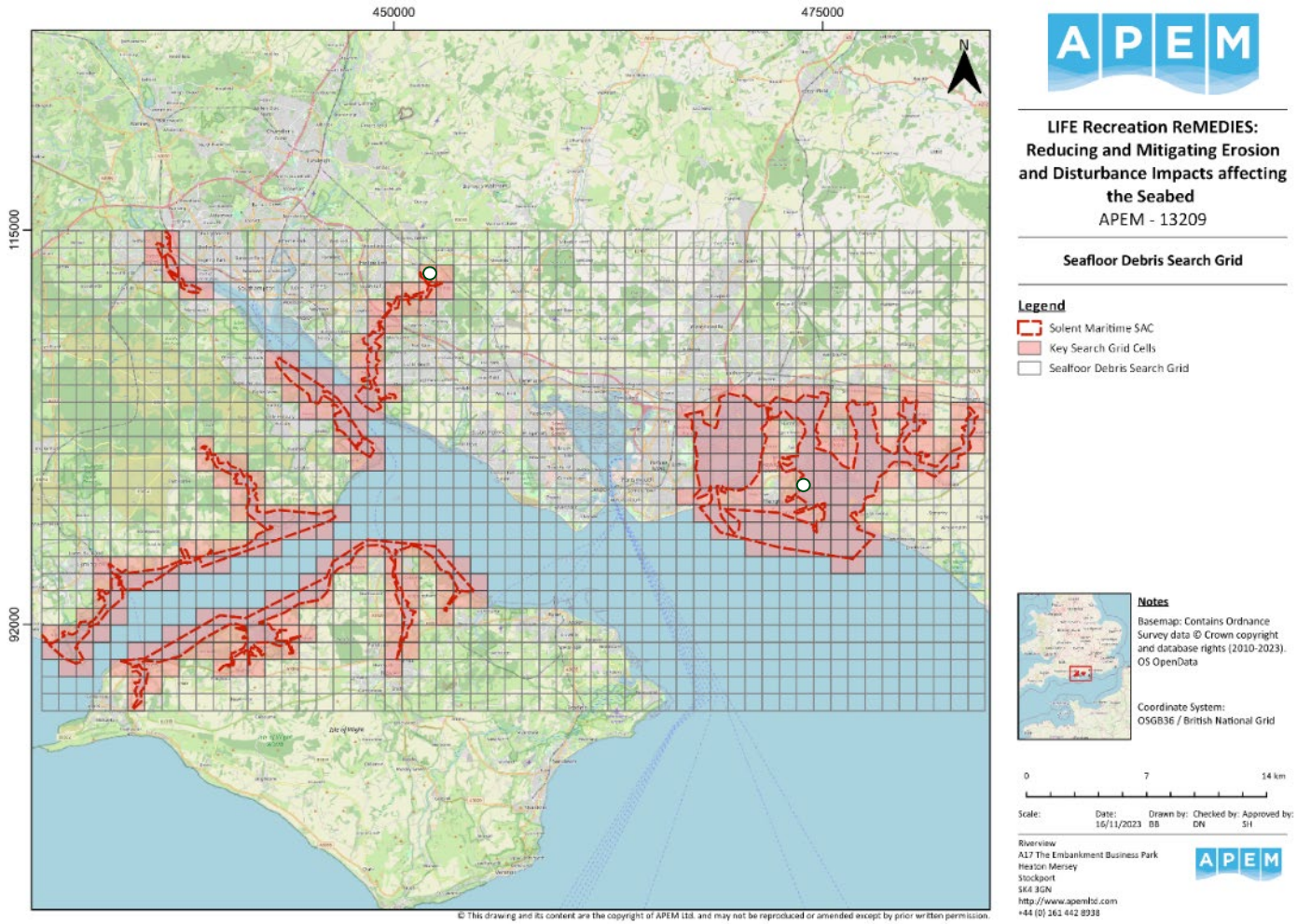

Figure 2. Search grid used for anlaysis. 1 km^2 grids were used.

Table 1. Description and definition of seafloor debris type identifed.

Seafloor Debris Type	Description and Definition
Abandoned Anchor	Anchor without actively used boats or moorings nearby
Abandoned Boat	Boat that appears disused, sunken, rusted or broken
Abandoned Structure	Structure that is disused or in disrepair (e.g., pier, support beam)
Abandoned Buoy	Mooring buoy not anchored to seafloor or boat
Cable	Cable that appears abandoned and not near moorings or structures
Fly-tip	Collection of waste that includes many waste objects
Pallet	Abandoned wooden pallet structure
Pipe	Linear objects that are white or rust coloured
Plastic Tarp	Tarp or covering on seabed that may obstruct growth
Scrap Metal	Objects that appear to be scrap metal that is rust coloured
Tyre	Abandoned tyres
Unmarked Container	Containers that are abandoned. May be circular or square/rectangle in geometry
Wheel	Circular metal objects that appear rust coloured
Wood Plank	Wooden or metal planks

2.2.2 Anchor Pressure

Points of anchor pressure on the seabed were identified from the imagery. The same 1 km x 1 km search grid to identify seafloor debris was used to identify anchor pressure points (Figure 2). All identified anchor pressure points were tagged in a GIS. The approximate area that anchors, moorings, and the associated boats occupy on the seafloor, was calculated.

Table 2. Description and definition of anchor pressure points identified.

Seabed Disturbance	Description and Definition
Anchor Pressure	Anchors, moorings, or boats that cause visible depressions and erosion of the seabed

2.2.3 Seafloor Debris Accessibility

Potential accessibility of seafloor debris objects were assessed on two key factors: 1) the distance the object is from the shoreline; 2) the area each item occupies on the seafloor. The distance of the object from the shoreline metric is weighted more

than the object size. For example, an object that occupies 0.5 m^2 on the seafloor and is 55 m from the shoreline could qualify for grades 1 to 10 based on its size. This object is therefore assigned the lowest possible grade based on the distance from the shoreline, which in this case would be grade 2. However, an object that occupies 0.5 m^2 but is 490 m from the shoreline, will receive a grade of 10, and is deemed too difficult to access. An object occupying 6.5 m^2 would receive a minimum of grade 7 based on size. If the object was 10 m from the shoreline, it would receive a grade of 7. However, if the object was 430 m from the shoreline is would receive a grade of 9. Following this method, an accessibility grade was attributed to each identified debris object (Table 3). Objects with a greater distance from the shoreline and that occupy a large area on the seafloor would require significantly more effort to access.

Table 3. Accessibility grade of seafloor debris.

Grade	Object Size (m^2)	Distance from shoreline (m)
1	≤ 1	≤ 50
2	≤ 2	≤ 100
3	≤ 3	≤ 150
4	≤ 4	≤ 200
5	≤ 5	≤ 250
6	≤ 6	≤ 300
7	≤ 7	≤ 350
8	≤ 8	≤ 400
9	≤ 9	≤ 450
10	≤ 10	≤ 500
11	≥ 10	≥ 500

2.3 Seafloor Debris Identification Validation

Fieldwork was carried out to validate the potential seafloor debris which had been identified and tagged in the aerial imagery. This field work focused on key areas that contained different debris types to validate the location, number, and type of seafloor debris identified. The field work also served to validate the method APEM proposed to identify potential debris and confirm its utility to map coastal areas with the high-resolution imagery APEM routinely collect.

APEM analysed all available tide and sun angle data from October 2023 to March 2024. This analysis permitted APEM's remote sensing scientists to determine the most suitable date and times to conduct the field work. The most appropriate time to conduct the ground investigations was estimated when the lowest tidal state overlapped with the brightest lighting conditions and the maximum amount of available daylight. This was estimated to be November 21, 2023 – November 23, 2023, and are the dates that the ground validation field work was conducted. Seafloor debris that was located close to the shoreline and within walking distance

from publicly accessible areas (e.g., coastal walking paths, car parks) were identified and targeted for the ground validation field work. Ground photos were taken, and approximate locations were recorded so that the objects tagged in the aerial imagery could be matched with those identified on the ground.

3. Results

3.1 Geospatial Analysis

3.1.1 Seafloor debris type

APEM's remote sensing scientists identified 568 objects that may potentially be seafloor debris. The number of identified objects, and the associated proportion in each seafloor debris type class, is listed in Table 4. Tyres are the most abundant type of seafloor debris identified in the aerial imagery with up to 39% of all objects identified on the seafloor in the Solent Maritime SAC assigned to this category. Abandoned structures are the second most abundant seafloor debris type identified (19.5%). Scrap metal is the third most abundant (10%) seafloor debris type identified. The spatial distribution of potential seafloor debris is shown in Figure 3.

Table 4. Seafloor debris type identified and area each debris object occupies.

Seafloor Debris Type	Number of Debris Type	Cumulative Area (m^2)	Proportion all Debris
Abandoned Anchor	24	96.85	4.23%
Abandoned Boat	40	2,347.33	7.04%
Abandoned Buoy	2	12.34	0.35%
Abandoned Structure	112	23,021.77	19.72%
Cable	22	1,268.80	3.87%
Fly-tip	9	9,409.03	1.58%
Pallet	2	12.47	0.35%
Pipe	20	72.69	3.52%
Plastic Tarp	1	3.96	0.18%
Scrap Metal	58	749.48	10.21%
Tyre	221	122.52	38.91%
Unmarked Container	49	123.82	8.63%
Wheel	1	0.52	0.18%
Wood Plank	7	65.83	1.23%
Grand Total	**568**	**37,307.42**	**100%**

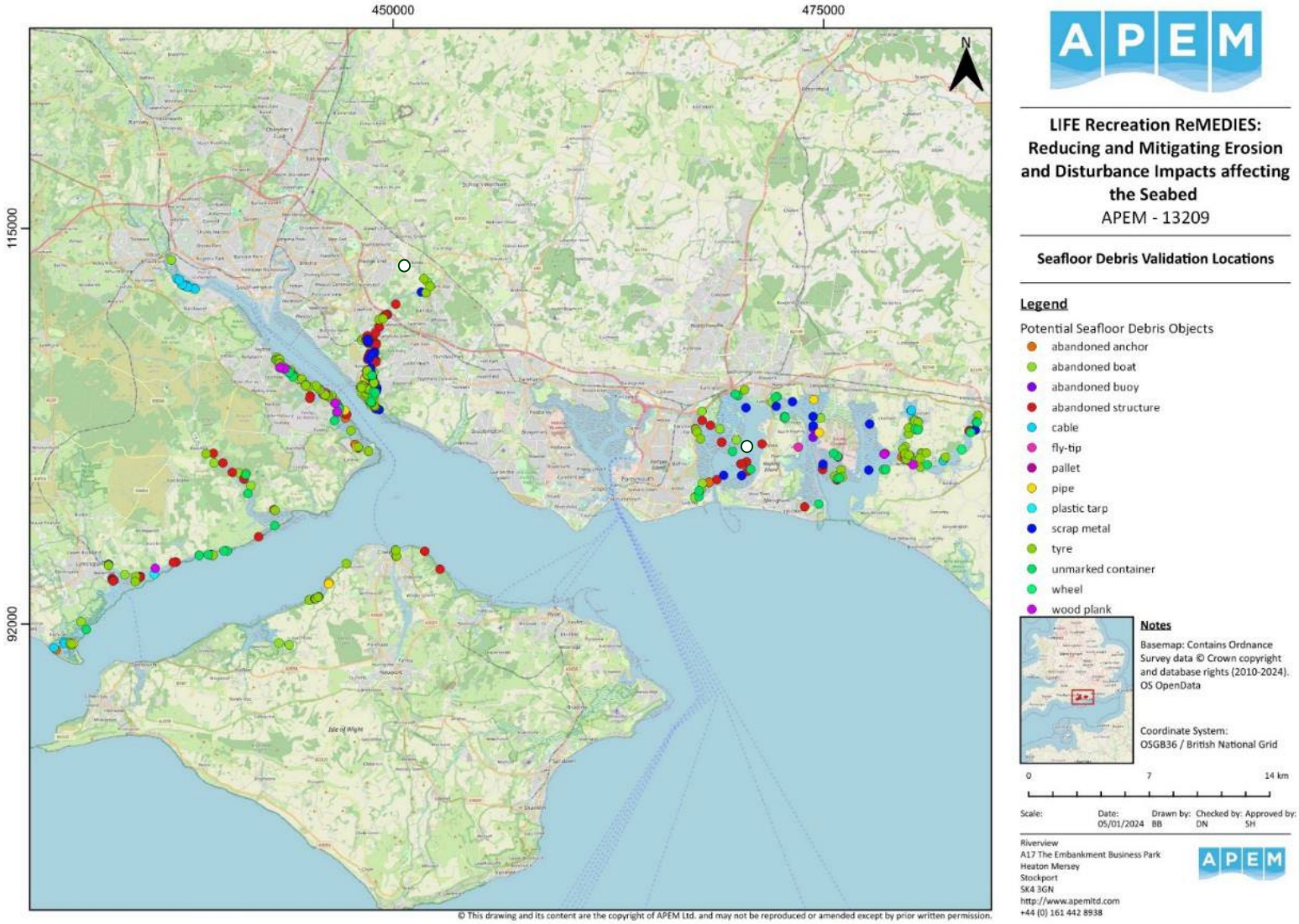

Figure 3. Distribution and type of seafloor debris identified in The Solent Maritime SAC.

The concentration of seafloor debris in the Solent Maritime SAC per square kilometre is shown in Figure 4. The greatest concentration of seafloor debris identified is in the River Hamble estuary, with up to 54 objects per km^2 identified (Figure 4).

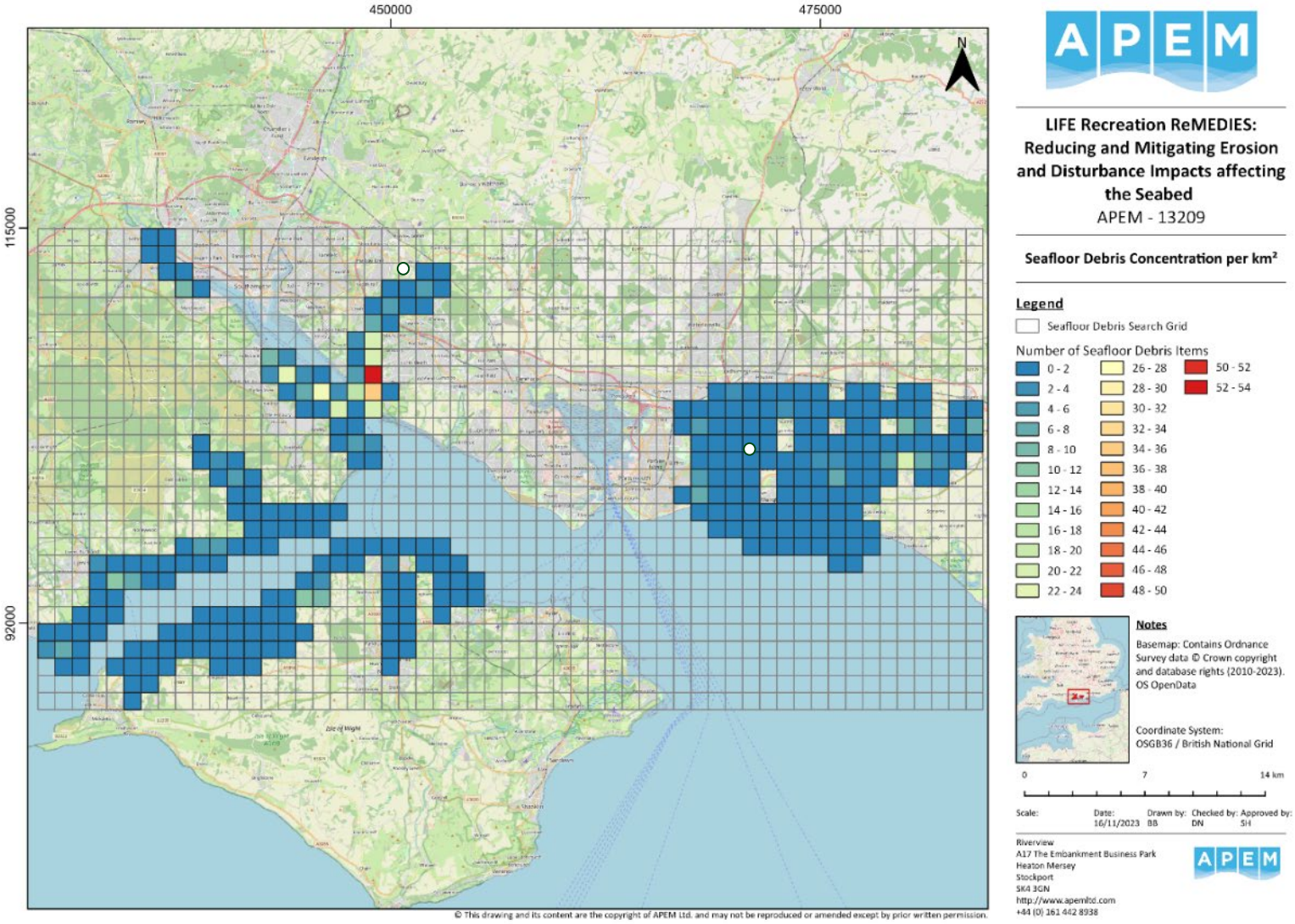

Figure 4. Concentration of seafloor debris in the 1 km² search grid.

3.2 Aerial Imagery Results

Many of the seafloor debris objects identified are only visible in high-resolution aerial imagery and not readily identifiable in satellite imagery (Figure 5). Discussed below are the results of the seafloor debris that comprise the largest proportion of all identified seafloor debris, including tyres, abandoned boats and shipwrecks, abandoned structures, scrap metal and pipes.

Figure 5. Comparison of APEM's high-resolution aerial imagery and satellite imagery. (a) APEM's 3.5cm GSD high-resolution imagery. (b) Latest imagery available from Google.

3.2.1 Tyres

Tyres make up the greatest proportion (39%) of identified seafloor debris. 221 tyres were identified from the aerial imagery. The tyres range in size, from small car tyres (Figure 6) to large tyres potentially used on large machinery (e.g., tractors, lorries etc) (Figure 7).

Figure 6. Collection of small tyres surrounding tidal creek.

Figure 7. Individual large tyre near cliff section of shoreline.

3.2.2 Abandoned boats and shipwrecks

39 abandoned boats and shipwrecks were identified in the aerial imagery. Abandoned boats comprise the 5th largest proportion of identified seafloor debris (6.9%). Identified boats range in size and degree of deterioration, from relatively recent abandonment (Figure 8) to boats where only a skeletal frame remains (Figure 9).

Figure 8. Small abandoned boat in salt marsh. The boat actively erodes seafloor as evidenced in the image.

Figure 9. Large wooden shipwreck identified and tagged on shoreline.

3.2.3 Abandoned structures

111 Abandoned structures were identified in the aerial imagery and proportionally make up the second most identified seafloor debris item (20%) (Table 4). The objects range in origin, size, and geometry (Figures 10 and 11).

Figure 10. Abandoned structure with clear crossbeam support features.

Figure 11. Abandoned structure with an unknown origin.

3.2.4 Scrap metal and pipes

Scrap metal and pipe debris make 10% and 4%, respectively, of all identified seafloor debris (Table 4). Many types of scrap metal and pipe debris objects were identified, including large diameter pipes (Figure 12), and even abandoned pontoon boat hulls (Figure 13).

Figure 12. Scrap metal pipe identified and tagged on shoreline.

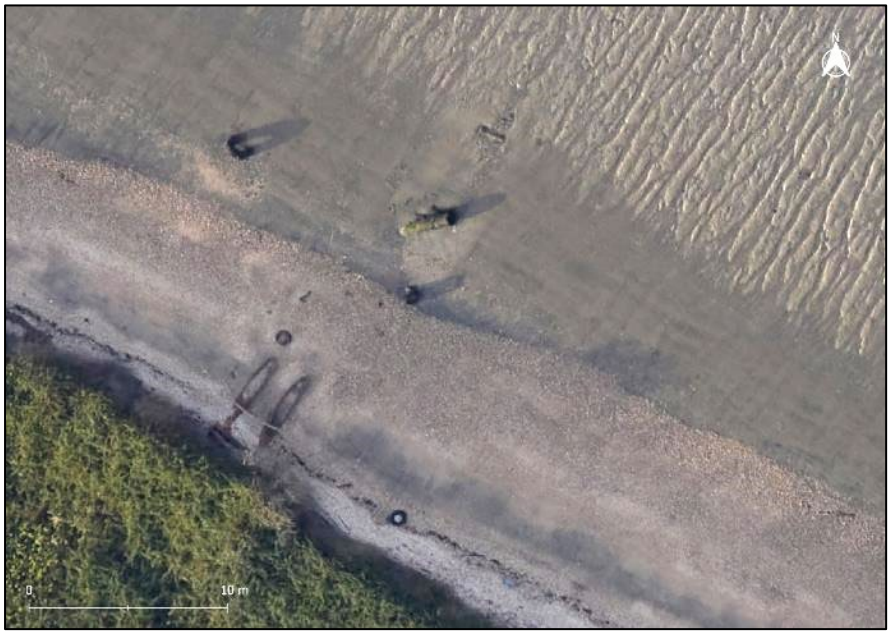

Figure 13. Scrap metal including pipe sections and what appear to be abandoned pontoon boat hulls.

3.2.5 Anchor Pressure

APEM's remote sensing scientists identified 839 pressure points in this study. An example of a section of the SAC where anchor pressure was mapped is shown in Figure 14. The total area that mooring anchors and attached boats occupy on the seafloor is measured to be up to 242,953 m^2 (0.24 km^2). The distribution of the approximate area that each identified anchor pressure point occupies on the seafloor is shown in Figure 15.

Figure 14. Example of anchor pressure locations identified in aerial imagery.

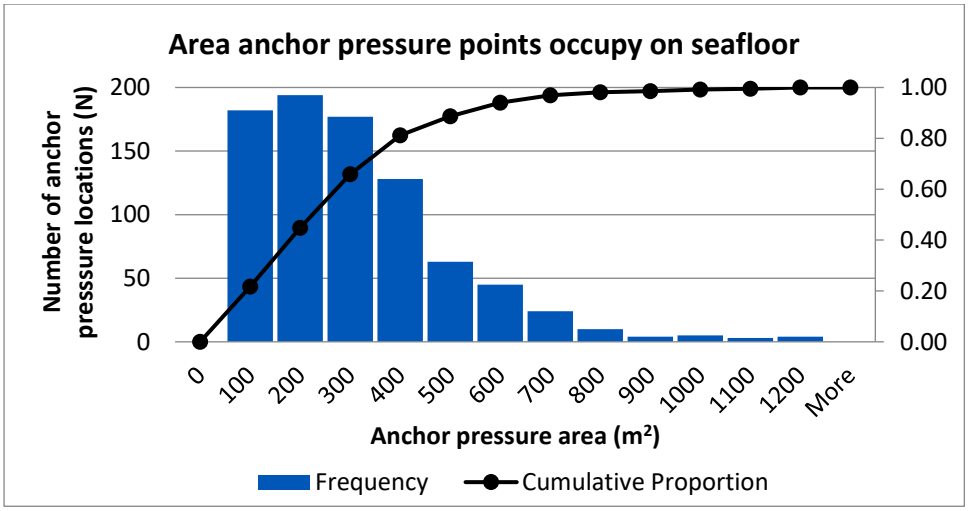

Figure 15. Distribution of anchor pressure areas that occupy the seafloor identified in the study area.

3.2.6 Seafloor debris size

APEM's remote sensing scientists have estimated that 47% of all identified objects occupy less than 1 m^2 of the seafloor (Figure 16). However, 23% of all objects identified occupy more than 10 m^2 of the seafloor. The approximate cumulative area that each seafloor debris type occupies on the seafloor is listed in Table 4.

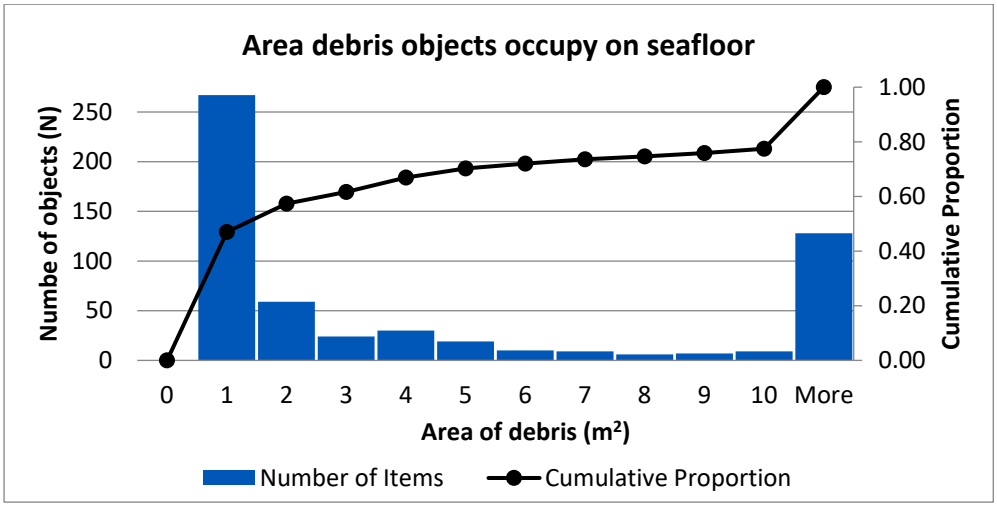

Figure 16. Distribution of seafloor debris objects and approximate area occupied on the seafloor.

3.2.7 Seafloor debris Accessibility

APEM's remote sensing scientists classified seafloor debris as "Accessible" based on the criteria described in Section 2.2.3. The distance of each seafloor debris object from the shoreline was calculated (Figure 17). This distance was compared with the approximate area that each object occupies on the seafloor. The distribution of accessibility grade is shown in Figure 18. The associated accessibility grade of all identified debris objects is shown in Table 5. APEM's scientists mapped all locations of seafloor debris and attributed the associated grade to them, as shown in Figure 19.

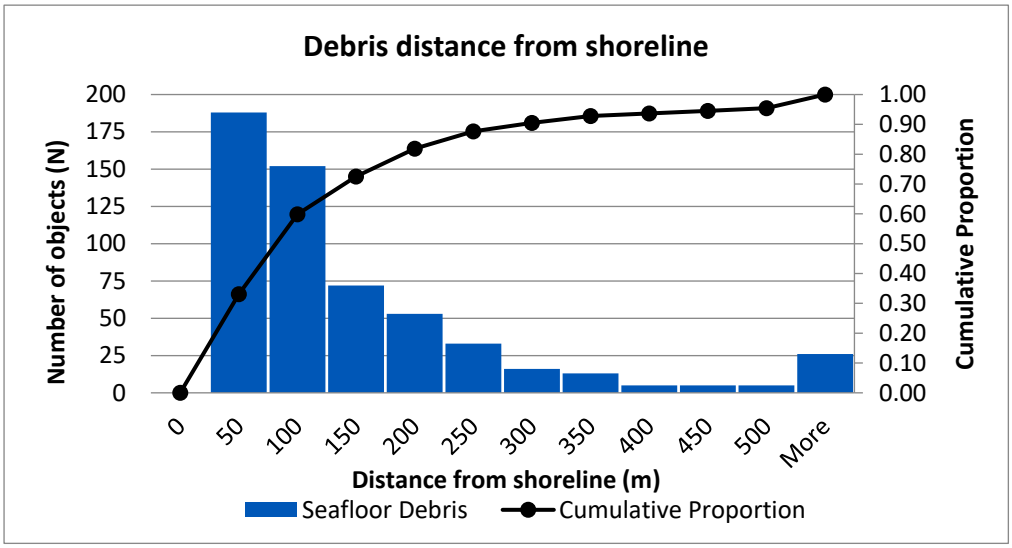

Figure 17. Potential seafloor debris item distance from shoreline.

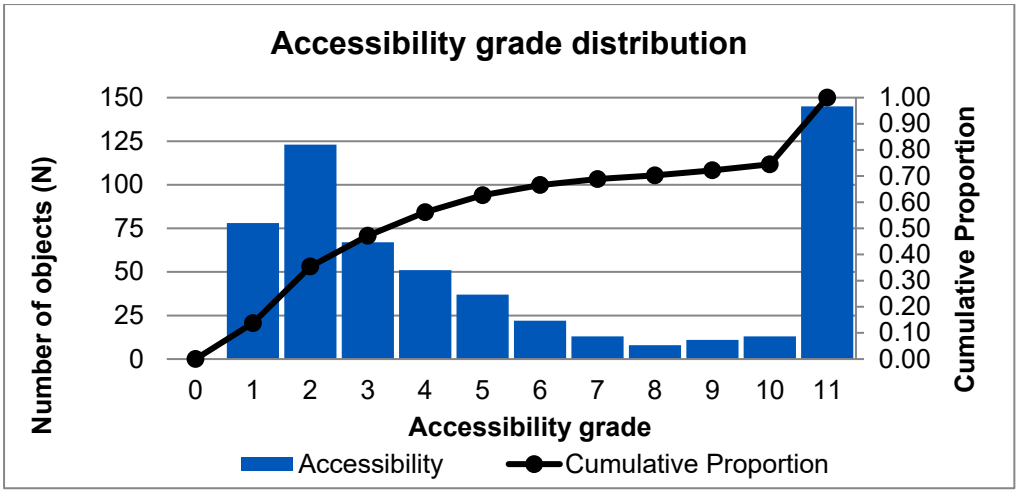

Figure 18. Potential seafloor debris accessibility grade distribution.

Table 5. Seafloor debris Accessibility.

Grade	Object Size (m^2)	Distance from shoreline (m)	Number of seafloor debris objects
1	≤ 1	≤ 50	78
2	≤ 2	≤ 100	123
3	≤ 3	≤ 150	67
4	≤ 4	≤ 200	51
5	≤ 5	≤ 250	37
6	≤ 6	≤ 300	22
7	≤ 7	≤ 350	13
8	≤ 8	≤ 400	8
9	≤ 9	≤ 450	11
10	≤ 10	≤ 500	13
11	≥ 10	≥ 500	145

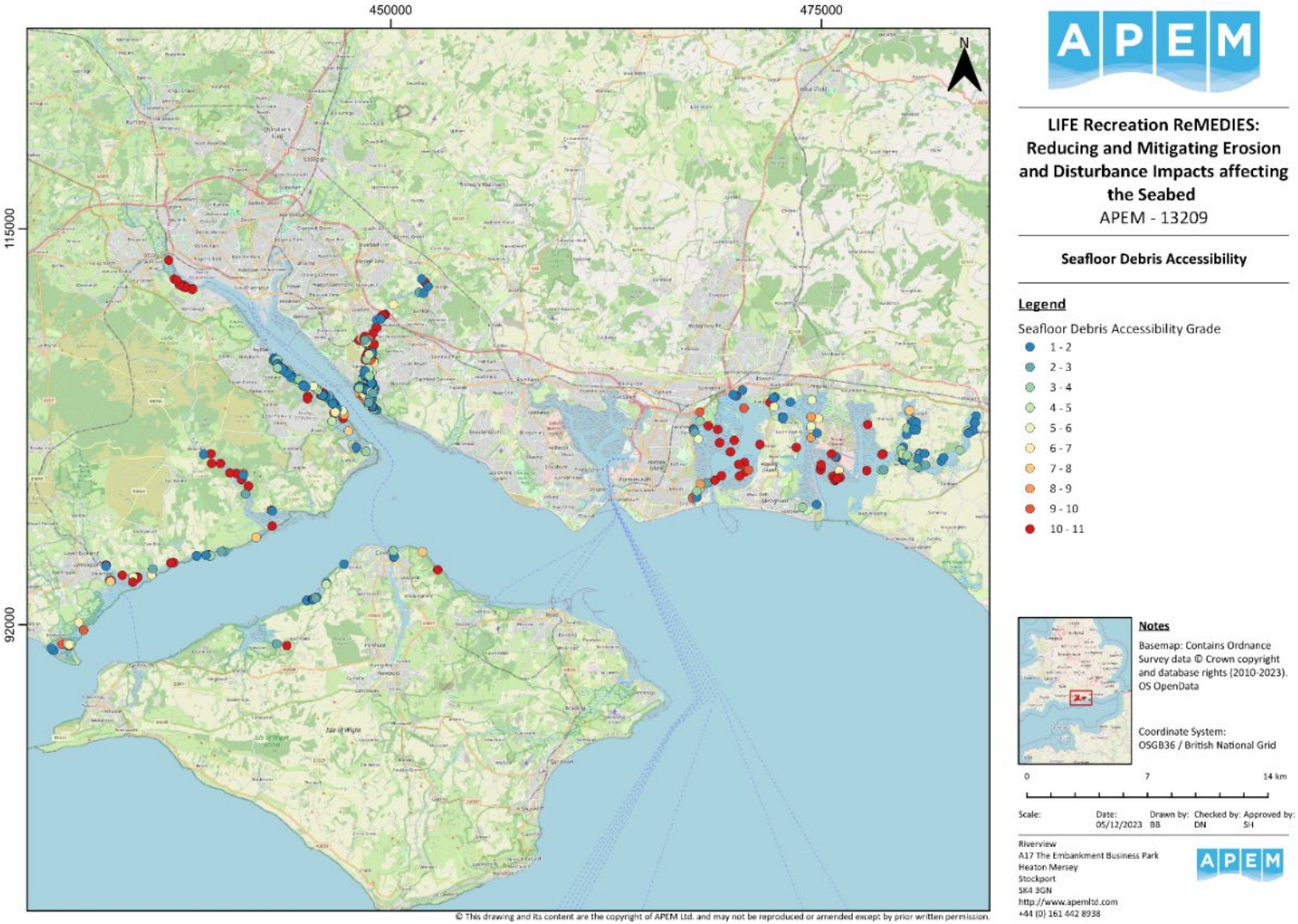

Figure 19. Map of seafloor debris and associated accessibility grade.

3.3 Field Work Validation

Field work was conducted to validate potential seafloor debris identified in the high-resolution aerial imagery. Four key areas were selected as the focus of the field work. The image analysis process found that each of the sites shown in Figure 20 contained a range of seafloor debris types such as tyres, abandoned boats and structures, and scrap metal.

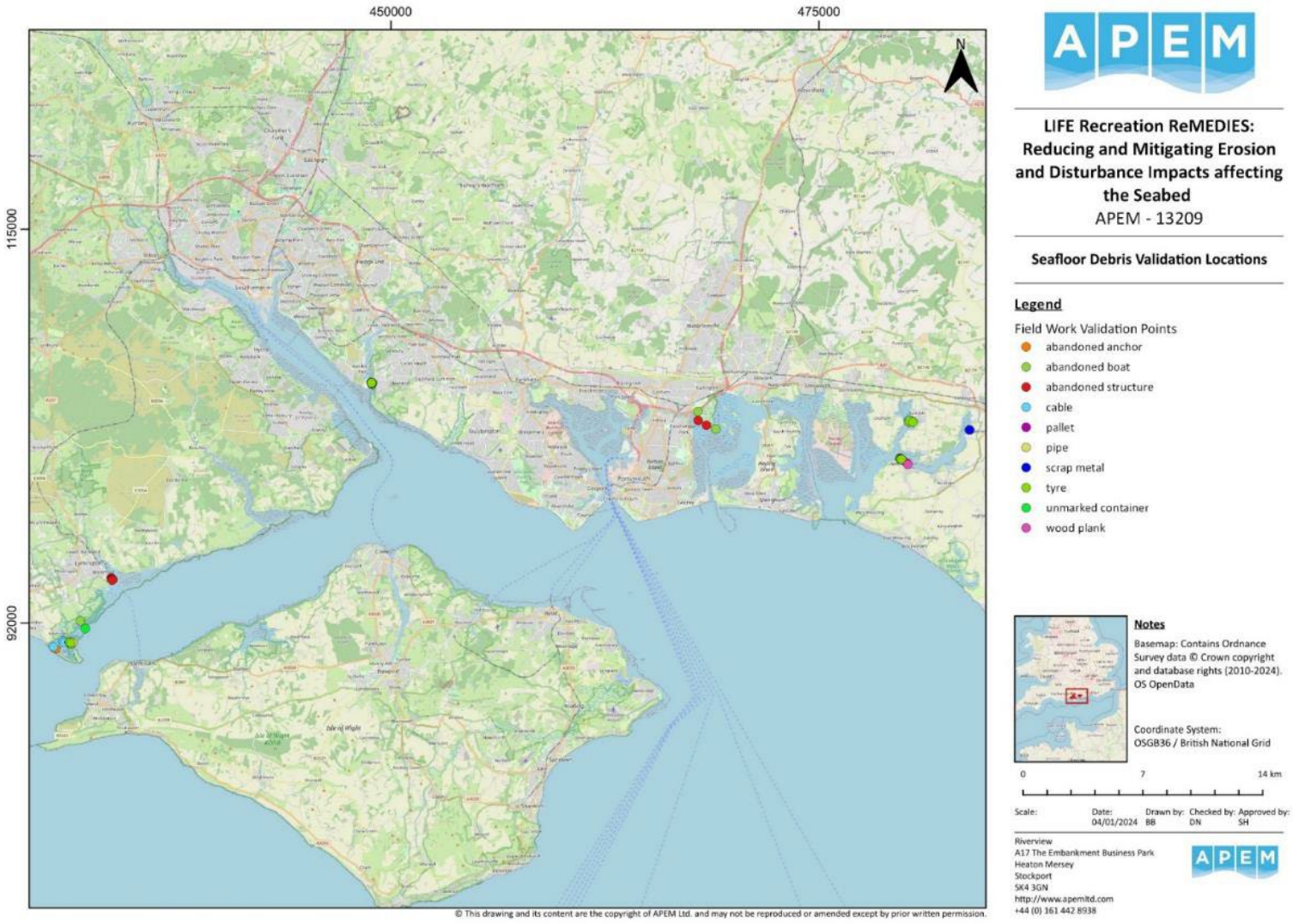

Figure 20. Field work validation localities.

3.3.1 Tyres

The field surveys found that tyres were the most identified seafloor debris objects which aligned with the results of the aerial imagery analysis. Many of the tyres identified during field work were not immediately visible from the shoreline (Figure 21). However, APEM's field scientists were only able to positively identify tyres from a close proximity. Seaweed appeared to cover more than 50% of most of the tyres identified in the field. This coverage made positive identification from the shoreline difficult. However, because tyres are circular in shape (Figure 22c) and the vegetation that grows on the tyres retain the circular shape (Figure 22d), they remain identifiable from vertical aerial imagery, as shown in Figure 23.

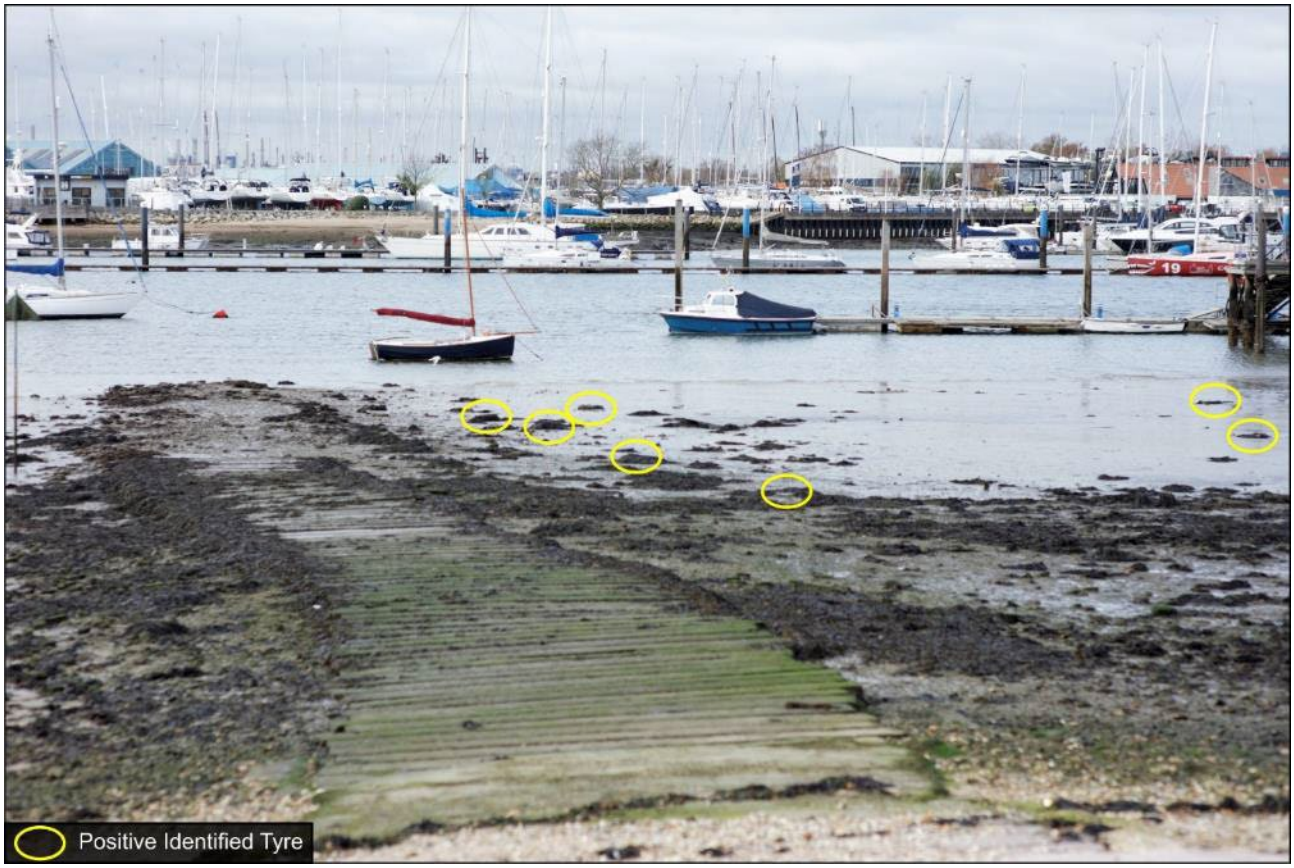

Figure 21. Overview of tyres identified from a photograph captured during the ground survey.

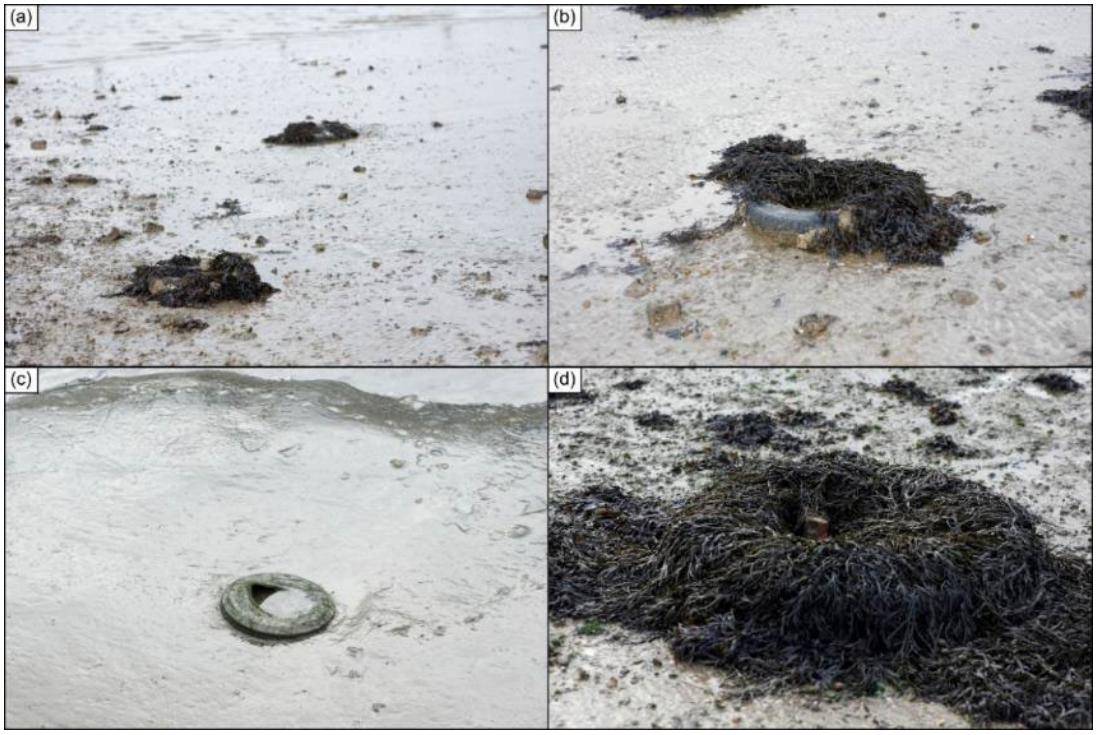

Figure 22. A sample of tyres captured in imagery captured during the ground surveys.

Figure 23. An aerial image documenting multiple tyres near shoreline, as seen in Figure 22.

3.3.2 Abandoned boats and shipwrecks

Sites of abandoned boats identified in aerial imagery were targeted for the fieldwork to validate their location. All targeted abandoned boats were positively identified in their mapped position (Figure 24 and 26). A boat which appeared to be abandoned was also identified from the field work that was not present at the time of the aerial imagery capture (Figure 25). Based on the timing of the photography, this suggests that the boat was abandoned after June 2022.

Figure 24. Abandoned boats of different vintages identified from aerial imagery and validated from the fieldwork. (a) Small abandoned boat. (b) Wooden remnants of what appear to be an abandoned boat. (c) Relatively older abandoned boat frame. (d) Recently abandoned boat.

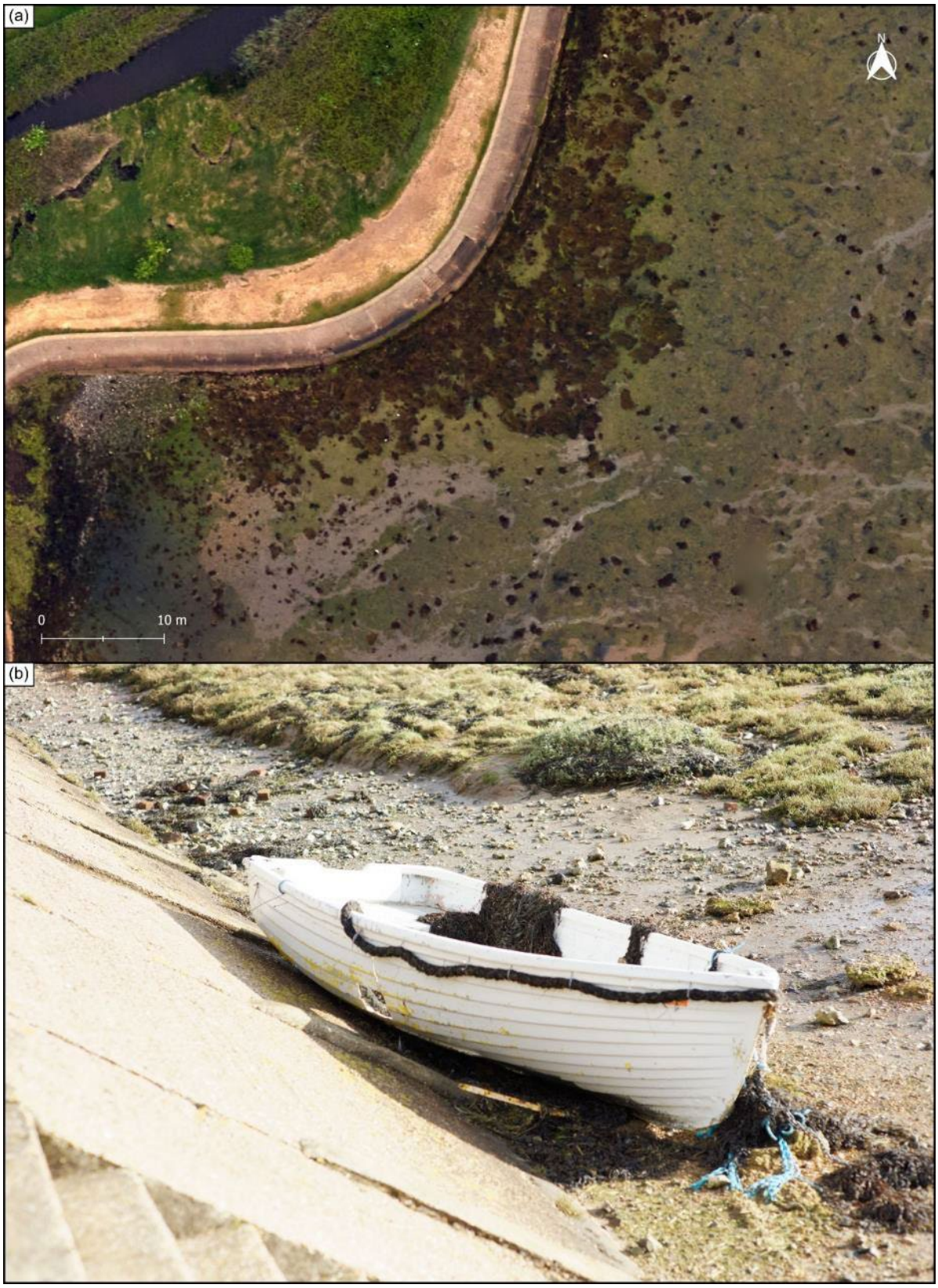

Figure 25. Recently abandoned boat identified during field work and associated orthomosaic. (a) Orthomosaic of location where recently abandoned boat was identified. (b) Recently abandoned boat.

Figure 26. Abandoned boat identified in high-resolution aerial imagery and validated from fieldwork. (a) Aerial image of identified and tagged abandoned boat. (b) Image of abandoned boat from shoreline to validate and positive identification.

3.3.3 Scrap metal

58 seafloor debris objects classified as scrap metal were identified in the aerial imagery (Table 4). Many of the objects were large and abandoned containers, metal sheeting, and even abandoned engine blocks (Figure 27). Some objects' classification, however, were only confirmed in the field (Figure 28).

Figure 27. Scrap metal engine identified in high-resolution aerial imagery and validated from fieldwork. (a) Aerial image of identified and tagged scrap metal. (b) Image of scrap metal engine from field work to validate and positive identification.

Figure 28. Scrap metal pole identified in high-resolution aerial imagery and validated from fieldwork. (a) Aerial image of identified and tagged scrap metal. (b) Image of scrap metal pole from field work to validate and positive identification.

3.3.4 Unmarked container

49 seafloor debris objects classified as unmarked containers were identified in the aerial imagery (Table 4). Many of the objects were small plastic or metal containers, like those shown in Figure 29.

Figure 29. Unmarked containers. (a) Aerial image of identified and tagged unmarked container. (b) Image of a similar type of abandoned conatiner in (a).

4. Data Outputs

All identified objects were captured as a vector ESRI point shapefile. For each item identified, the shapefile contains the following information:

- Search Grid Number.
- Seafloor Debris Type.
- File Identification Number within each Debris Type
- Approximate area (m^2) of seafloor occupied by each object.
- Distance of the object to the coastline (m).
- Accessibility of seafloor debris object.
- Main habitat that debris is within.
- Habitat code that debris is within.
- Other classification of habitat that debris is within.
- Additional habitat code that debris is within.
- Primary source of habitat classification.
- OS Easting.
- OS Northing.

5. Discussion

Interrogation of high-resolution aerial imagery that APEM collected for The Solent Maritime SAC facilitated detailed spatial mapping and analysis of potential seafloor debris. APEM's remote sensing scientists identified 568 potential seafloor debris objects. From this process, a robust dataset was created that can be used to effectively highlight areas for future investigation, removal, and mitigation work within the studied area.

Of the objects identified, tyres are the most abundant debris type identified (221; 39%), with abandoned structures comprising the second most abundant debris type (111; 20%). However, tyres occupy a significantly smaller area (122 m^2) of the seafloor than abandoned structures (23,020 m^2). Abandoned boats and shipwrecks account for nearly 7% of all debris identified, however, they occupy a significant area (2,347 m^2) of the seafloor and are 3rd amongst all seafloor debris analysed in this study. All identified seafloor debris occupy 0.0002% of the saltmarsh Annex 1 habitat, 0.0007% of the mudflat Annex 1 habitat, and 0.001% of the seagrass Annex 1 habitat in the Solent Maritime SAC study area.

The "accessibility" of each item was estimated based on the size of the object and the approximate distance each object is from the shoreline (Table 5). All seafloor debris was graded based on these metrics. From this estimation, 14% of the objects are within 50 m of the shoreline and occupy up to 1 m^2 of the seafloor. 22% of the identified seafloor debris are within 100 m of the shoreline and occupy up to 2 m^2 of the seafloor.

APEM's scientists also identified seafloor pressure locations within the study area that are caused by anchors and boats attached to them. 839 pressure locations were identified in

this study. The cumulative area of anchor pressure locations is up to 242,953 m^2 (0.24 km^2). All anchor pressure points occupy 0.12% of the saltmarsh Annex 1 habitat and 0.42% of the mudflat Annex 1 habitat. Many of the identified anchor pressure locations appear to visibly erode the seabed and may prevent seagrass and other vegetation from growing on the seafloor (Figure 14).

APEM's scientists conducted field-level studies to validate the spatial mapping and analysis method. It was found that not all objects identified in aerial imagery could be validated from the shoreline. This may be for many reasons, including varying tide level and the size of the debris. APEM captured the aerial imagery below mean low tide, such that debris may be above sea level and more visible at the time of data capture. The combination of tidal and lighting levels during autumn 2023 meant that this could not be fully replaced for the field work. Even though the tide was low enough to observe objects that were tagged for field validation, many of the small seafloor debris objects (e.g., tyres) identified from the aerial imagery are not visible from the shoreline (Figure 21). From our analysis, the number of small debris that were identified from the aerial imagery would be difficult to accurately map through ground-based survey methods. Many of the seafloor debris objects may be covered by seaweed that obstructs definition of their geometry, thereby prohibiting accurate identification (Figure 22). Given other survey platforms, such as hovercraft, it may be possible to obtain better viewing angles of each item. However, this was beyond the scope of this study as the high-resolution aerial imagery provided a view that facilitated accurate identification. Because the imagery was also georeferenced, an accurate measurement of each item was also efficiently taken.

6. Conclusion

APEM analysed high resolution aerial imagery data and identified over 500 potential seafloor debris objects in the Solent Maritime SAC. The debris range in type and size, from tyres to abandoned boat and structures. The accessibility of the debris was calculated based on the size and distance of the objects from the shoreline. This analysis suggests that objects which are further from the shoreline may be more difficult to access, and thereby, more difficult to remove. These metrics must be considered when assessing future action plans to mitigate the habitat damage seafloor debris may cause.

This study demonstrates that high-resolution aerial imagery may be used to positively identify debris on the seafloor and other coastal areas. Remote sensing analytical techniques provide rapid, safe, and cost-effective method for identifying debris and other objects that may be on the seafloor and coastal areas (e.g., estuaries, lagoons, harbours). The data presented in this report illustrates the efficacy of using high-resolution aerial imagery to positively identify objects on the seafloor and other coastal areas that may be classified as debris.

7. Future work

The positive seafloor debris identified from the high-resolution aerial imagery that APEM has and continues to collect for significant areas of the UK coastline permits the type of analysis demonstrated during this study. Further detailed mapping from high-resolution imagery along with “digital walkover” surveys could offer a potential means of investigation to identify a range of objects in other areas around UK coastline and waterways. The type of analysis conducted, and data presented in this report may be useful for further projects, stakeholder and public engagement opportunities that may aid seafloor debris removal efforts. These efforts ultimately remove pressures and improve the condition of Annex 1 habitats in the SAC.

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