REPUBLIC OF ESTONIA
SAFETY INVESTIGATION BUREAU

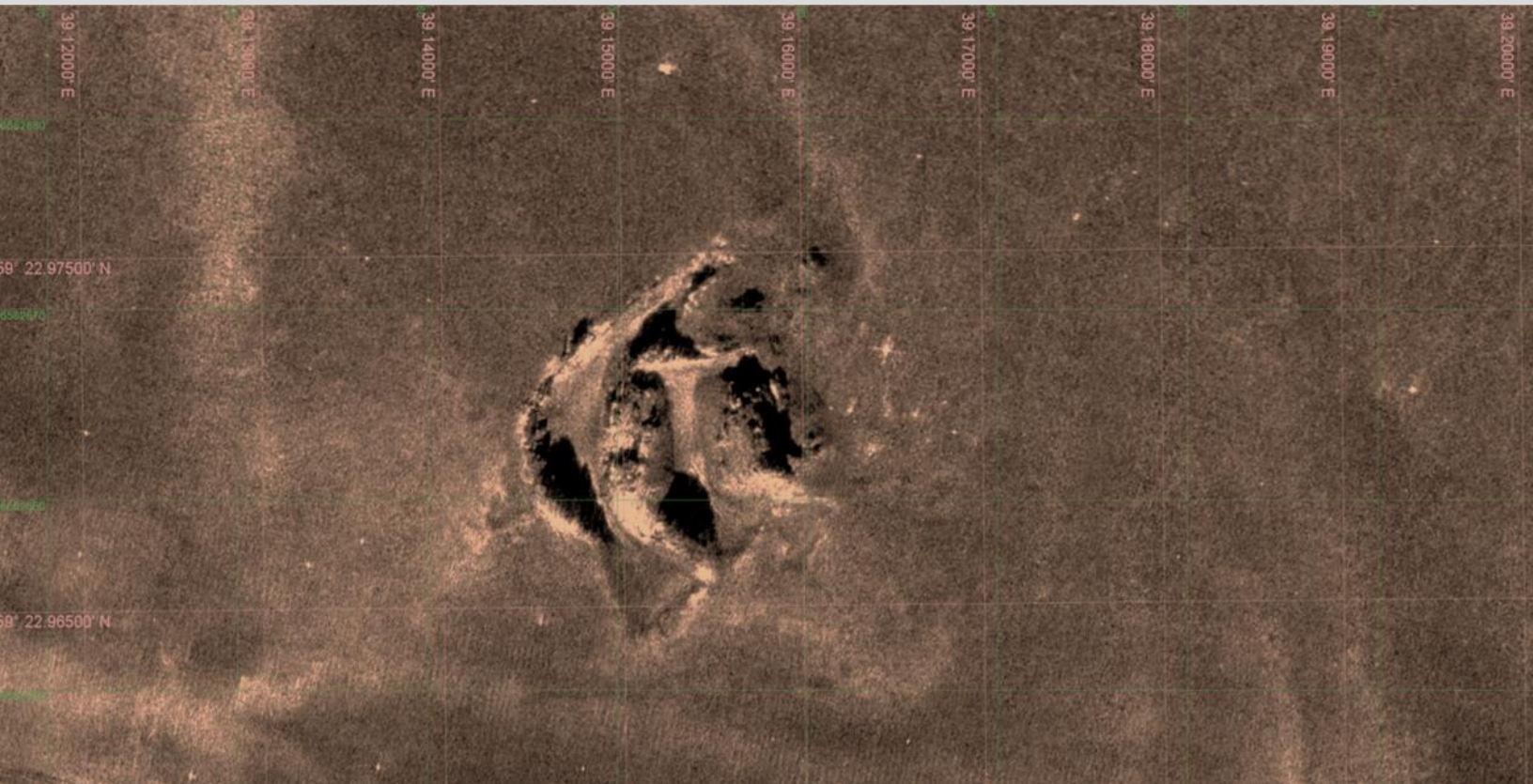
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Revision 2
2025-11-24

BOW VISOR OF MV ESTONIA

LOCATION AFTER DETACHMENT AS ILLUSTRATED IN REPORTS AND DATA

PRELIMINARY ASSESSMENT
REPORT
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Revision History

Revision	Date	Status	Description/Location of Change
Revision 0	2025-11-16	Issued for internal review	N/A
Revision 1	2025-11-19	Issued for publication	Minor formatting corrections.
Revision 2	2025-11-24	Issued for publication	Additional content added (Sec. 4.2 and 4.3). Language clarifications in Sec. 1.2 and 1.3.

Summary

During the operations to find the bow visor from MV ESTONIA, vessels from Estonia, Finland, and Sweden were involved, using different coordinate systems. The Swedish vessels used WGS84, while Finnish vessels used the Finnish National Coordinate System, KKJ. This resulted in confusion about the correctness of the visor's reported position. It has also caused suspicion about an image, seemingly showing something like a visor, resting close to the bow of MV ESTONIA. A detailed analysis of the known positions and an examination of the mentioned image, including other examples from the same time period, have been made.

Positions in the different coordinate systems have been calculated. The results show that the different positions are in practice the same. The known positions coincide with a seabed feature from where the bow visor was salvaged; this location is approximately 0.86 nm from the wreck.

The examination of extant images clearly shows that it is not a genuine sonar picture (e.g., seabed contours are seen through the hull), instead showing an intermediate phase of the sand-filling project from 1996. This is confirmed by the fact that the supposed outline of the visor changes from one intermediate survey of the sand-filling to another. Thus, the image does not show the bow visor.

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Abbreviations

Abbreviation	Definition
ADCP	Acoustic Doppler Current Profiler
CRS	Coordinate Reference System
CTD	Conductivity, Temperature, Depth
E	East
ESIB	Estonian Safety Investigation Bureau *Ohutusjuurdluse Keskus*
GRS80	Geodetic Reference System 1980
HMS	His Majesty's Ship
JAIC	Joint Accident Investigation Commission of Estonia, Finland, and Sweden
KKJ	*Kartastokoordinaattijärjestelmä* Finnish National Coordinate System
Lat	Latitude
Long	Longitude
MAS	Multi-Aperture Sonar
MV	Motor Vessel
N	North
OPV	Offshore Patrol Vessel
ROV	Remotely Operated Vehicle
RV	Research Vessel
SSS	Side Scan Sonar
WGS84	World Geodetic System 1984

1. Introduction & Scope of Work

1.1. Safety Investigation Authority

The Estonian Safety Investigation Bureau (ESIB) is a structural unit of the Ministry of Economic Affairs and Communications of the Republic of Estonia. One of the main tasks of ESIB is to conduct safety investigations of very serious marine casualties; of serious marine casualties based on the decision of a preliminary assessment, and in the case of justified interest, any marine casualties or marine incidents.

The purpose of a safety investigation is to identify the circumstances, causes and consequences of a marine casualty or marine incident, and if necessary, to provide recommendations in order to prevent such marine casualty or marine incident in the future, and to improve maritime safety, but not to blame any party or assign liability.

A safety investigation is carried out in accordance with the legislation of the Republic of Estonia, the European Union, and the International Maritime Organization, as well as relevant international agreements.

1.2. MV Estonia Accident

The ro-ro passenger ferry Estonia sank on September 28, 1994, during a voyage from Tallinn, Estonia, to Stockholm, Sweden. Of the 989 people on board, only 137 survived. The final report of the Joint Accident Investigation Commission of Estonia, Finland, and Sweden (JAIC) was published in December 1997.

On September 28, 2020, a video recording was published, showing penetrating damage on the starboard side of the hull of MV ESTONIA. Based on this new information, ESIB, along with its counterparts in Finland and Sweden, initiated on October 2, 2020 a Preliminary Assessment to find the origin of the hole and its possible impact on the sinking of MV ESTONIA.

The objective of the Preliminary Assessment is to identify the cause of penetrating deformations, to assess the validity of the conclusions presented in the final report of the JAIC and to assess whether the safety investigation of the accident should be re-opened.

1.3. Background

The visor of MV ESTONIA detached prior to the vessel's sinking. Questions have been raised about the visor's location of detachment, and whether the visor was actually closer to the vessel than has been previously described. The data acquired during the Preliminary Assessment allows assessing the visor's detachment. This document covers such facts and illustrates the known details which concern the visor's location on the seabed.

2. Visor References from the 1990s

2.1. JAIC Final Report

In the JAIC Final Report, the visor's location was mentioned twice (JAIC, 1997).

> The Commission decided at its meeting in Turku on 3–4 October that a search was to be made for the bow visor. This was done by the TURSAS, equipped with a side-scan sonar and a low-frequency echosounder. The Estonian Coast Guard vessel EVA-200, equipped with a side-scan sonar, took part in the search.
> The visor was found at 59°23,0' N 21°39,2' E about one nautical mile west of the wreck, on 18 October. That it was the visor was confirmed by ROV video-recordings.
> —JAIC, 1997, p. 119, Ch. 8.3.

It should be noted that the report makes no reference of the coordinate reference system (CRS). The same coordinates are also mentioned on p. 22, Ch. 1.

The original records from these search operations are not extant.

2.2. Visor Recovery Operation

In the logbooks of icebreaker NORDICA, the vessel which was used alongside HMS FURUSUND to recover the visor from the seabed from 16 October to 18 October 1994, the following relevant references (originally in Finnish) were made:

> **Thursday, November 17th, 1994 in the Northern Baltic**
> […]
> 0705 Furusund moved on location
> 0845 Furusund placed transponder on the bottom 20 metres in bearing 326° from the visor ([?])[1]
> 1000 Started moving towards the visor
> 1035 In position
> 1220 AutoDP Lat 59° 22.9' N, Long 021° 39.4' E, started lifting operations on the visor
> […]
> 1800 AutoDP Lat 59° 23' N, Long 021° 39.4' E
> […]
> 2300 AutoDP Lat 59° 23' N, Long 021° 39.4' E, continued lifting operations
>
> **[Friday,] November 18th, 1994 in the Northern Baltic**
> […]
> 1200 AutoDP 59° 23' N, Long 021° 39.4' E, continued lifting operations
> 1420 the visor on the hook
> 1533 the visor lifted off the bottom

[1] At the end of this line in the brackets, there is an unclear mark: 

1615 visor on the surface
— German 'Group of Experts', Enclosure 24.408.1a, Icebreaker NORDICA Logbook, 1994.

The logbooks make no mention of the CRS. But, in general terms, the coordinates from icebreaker NORDICA are relatively close coordinates with a total difference of 0.1' (arc-minute) in the north direction throughout the lifting operation. It is relevant to add that icebreaker NORDICA was operated by the Finnish Maritime Administration (*Merenkulkuhallitus* or *Sjöfartsverket*).

The recovery operation was summarized in December 1994 for the Swedish Accident Investigation Authority (*Statens Haverikommission*) in a document titled "*Ang positionen på m/s Estonias bogvisir*" ("Regarding the position of m/s Estonia's bow visor"). This document includes the following relevant references (originally in Swedish):

Coordinates from the Finnish Navy N 59°22'.97 E 021°39'.33 , ± 30 m with map datum KKJ-
[…]
At the red buoy located in the accident area, we obtained the following coordinates;
N 59°22'.95 E 021°40'.92.
—Björkander, 1994.

This document therefore clarifies the coordinate system used during the original search for the visor in October 1994 (by OPV TURSAS). The purpose of the red buoy mentioned above is unclear, but based on its probable location (defined below), it has no bearing on the question of the visor. However, as it is mentioned in the quoted document, it will also be referenced below.

2.3. "Tallinn 20.10.1994"

A document, stored at the Estonian Maritime Museum, dated 20.10.1994, reference coordinates for both the wreck and the visor as follows:

ESTONIA visor coordinates : 59 22.973 N , 21 39.223 E
ESTONIA coordinates : 59 22.926 N , 21 41.005 E
—"Tallinn 20.10.1994", Estonian Maritime Museum, MM 8414 D.

There is no coordinate information mentioned with respect to this document, however, these coordinates are very similar to the ones presented in the JAIC Final Report (ref. Sec. 2.1 for visor coordinates; the coordinates of the wreck are given in the JAIC Final Report twice, on p. 22 and 119, as "59°22,9' N 21°41,0' E").

The main difference in the coordinates is their degree of accuracy, i.e., the minutes have been rounded. With the rounding comes an inevitable loss in accuracy: using decimal minutes with one decimal, the accuracy is reduced from approximately 1.8 m to 185 m. This is illustrated in **Table 1**.

Table 1. Comparison of coordinates from the Estonian Maritime Museum archival document to the JAIC Final Report.

Description	JAIC Final Report	"Tallinn 20.10.1994"	Comment
Wreck Coordinate	59°22,9' N 21°41,0' E	59 22.926 N 21 41.005 E	N: apparently rounded E: apparently rounded
Visor Coordinate	59°23,0' N 21°39,2' E	59 22.973 N 21 39.223 E	N: apparently rounded E: apparently rounded

This means that the precision indicated by the coordinates in the archival documents, i.e., approximately 1.8 m, was reduced in the JAIC Final Report to approximately 200 m.

2.4. Other References

No other surveys in the 1990s covered the area from where the visor was recovered.

However, some charts and figures relating to 1996 sandfilling operations have been used to suggest that the visor was not actually recovered from the above-mentioned position. These images generally relate to report "ACZ-REP-DES-026-3, Detailed Report on Deformation during Sandfilling", however, similar imagery was also used in other reports. It has been said that these images represent the in-situ condition of the wreck, i.e., are from a sonar or similar measuring device.

As part of the Preliminary Assessment, some such illustrations have been georeferenced. These are shown below with specific captions; first, however, some generalizations can be made on the content of these (and similar) charts dating to the 1990s.

In general, it can be said that there was no uniform way to treat the wreck on charts or drawings during the 1990s. It is likely that draughters chose whatever method was most apposite for illustrating their report, as even reports with similar subject matters highlight the wreck differently on the seabed. The use of MV ESTONIA's schematic drawing on these images does not indicate that those parts of the vessel had been surveyed to still exist in their original shape or form.

A summary of the charts in the vicinity of the wreck of MV ESTONIA is provided as **Table 2**. These are shown below as **Figure 1** through **Figure 8**. All of these images have the same extents, so the data from one can be compared to the others by scrolling through this document.

Table 2. Summary of selected charts and figures illustrating the vicinity of the wreck of MV ESTONIA.

Publication	Date	Shown Data	Wreck Display Method	Reference
RW-NMA-EST-REP-001, Chart 10030-1187-1	11-Jul-1995	Bathymetry & geotechnical locations	Rough wreck outline with overlapping data samples.	**Figure 1**
ACZ-REP-DES-001-1, Chart ACZ-DWG-DES-200-01	26-Jan-1996	Bathymetry	No wreck outline, but continuous contours.	**Figure 2**

Publication	Date	Shown Data	Wreck Display Method	Reference
ACZ-REP-DES-003-3, Chart ACZ-DWG-DES-100-01	11-Apr-1996	Bathymetry	Partial vessel schematic with break in data.	**Figure 3**
ACZ-REP-DES-026-3, Chart ACZ-DWG-ASB-710-01	07-Nov-1996	Bathymetry	Partial vessel schematic with overlapping contours.	**Figure 4**
ACZ-REP-DES-026-3, Chart ACZ-DWG-ASB-710-09	07-Nov-1996	Bathymetry	Partial vessel schematic with overlapping contours.	**Figure 5**
ACZ-REP-DES-026-3, Chart ACZ-DWG-ASB-710-10	07-Nov-1996	Bathymetry	Partial vessel schematic with overlapping contours.	**Figure 6**
ACZ-REP-DES-026-3, Chart ACZ-DWG-ASB-710-11	07-Nov-1996	Bathymetry	Partial vessel schematic with overlapping contours.	**Figure 7**
ACZ-REP-DES-026-3, Annex 1	07-Nov-1996	Bathymetry & Seabed sample locations	Partial vessel schematic with overlapping contours.	**Figure 8**

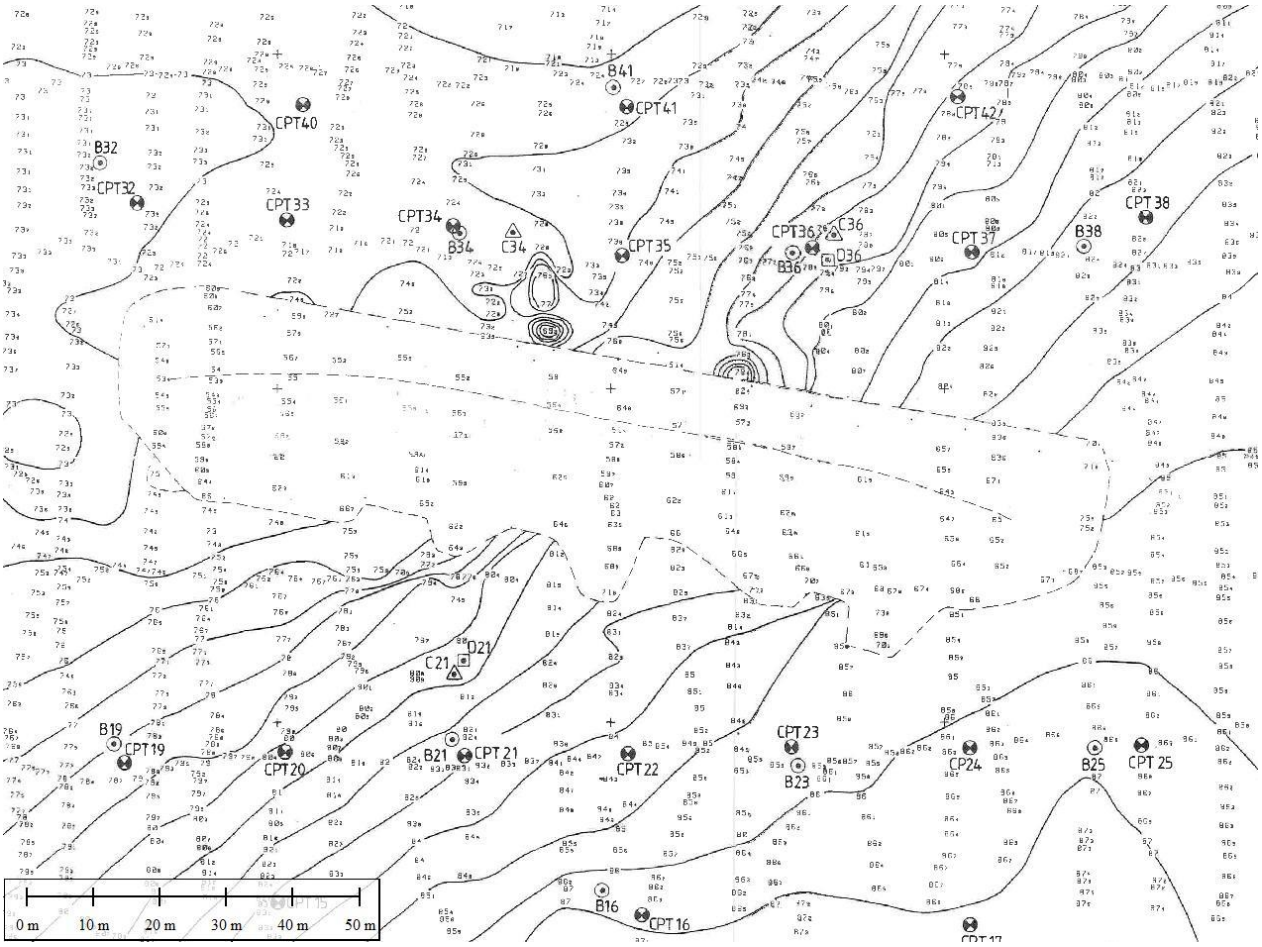


***Figure 1**. RW-NMA-EST-REP-001, Chart 10030-1187-1. Detailed Bathymetric Survey & Core Locations.*

The data for this chart was acquired in May 1995.

A rough outline of the wreck, has been drawn based on measured soundings. The outline of the wreck is blunt at the bow, to the east.

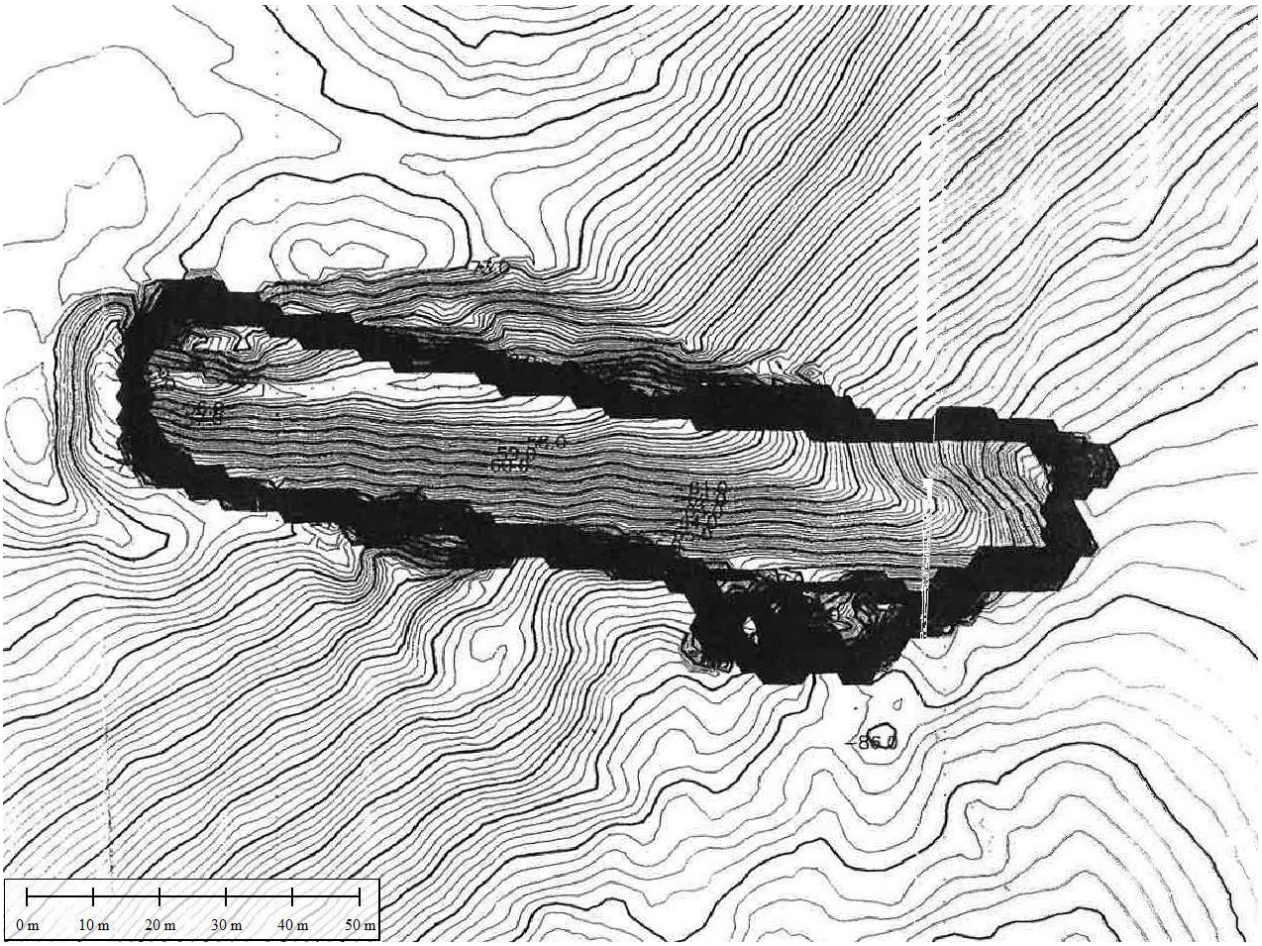


***Figure 2**. ACZ-REP-DES-001-1, Chart ACZ-DWG-DES-200-01. Complementary Investigations, Bathymetric Survey, Detailed Plan Vie, Sheet 1 of 6.*

The data for this chart was acquired from Dec 1995 to Jan 1996.

Only bathymetric contours are shown with the contours highlighting a relatively blunt bow, to the east.

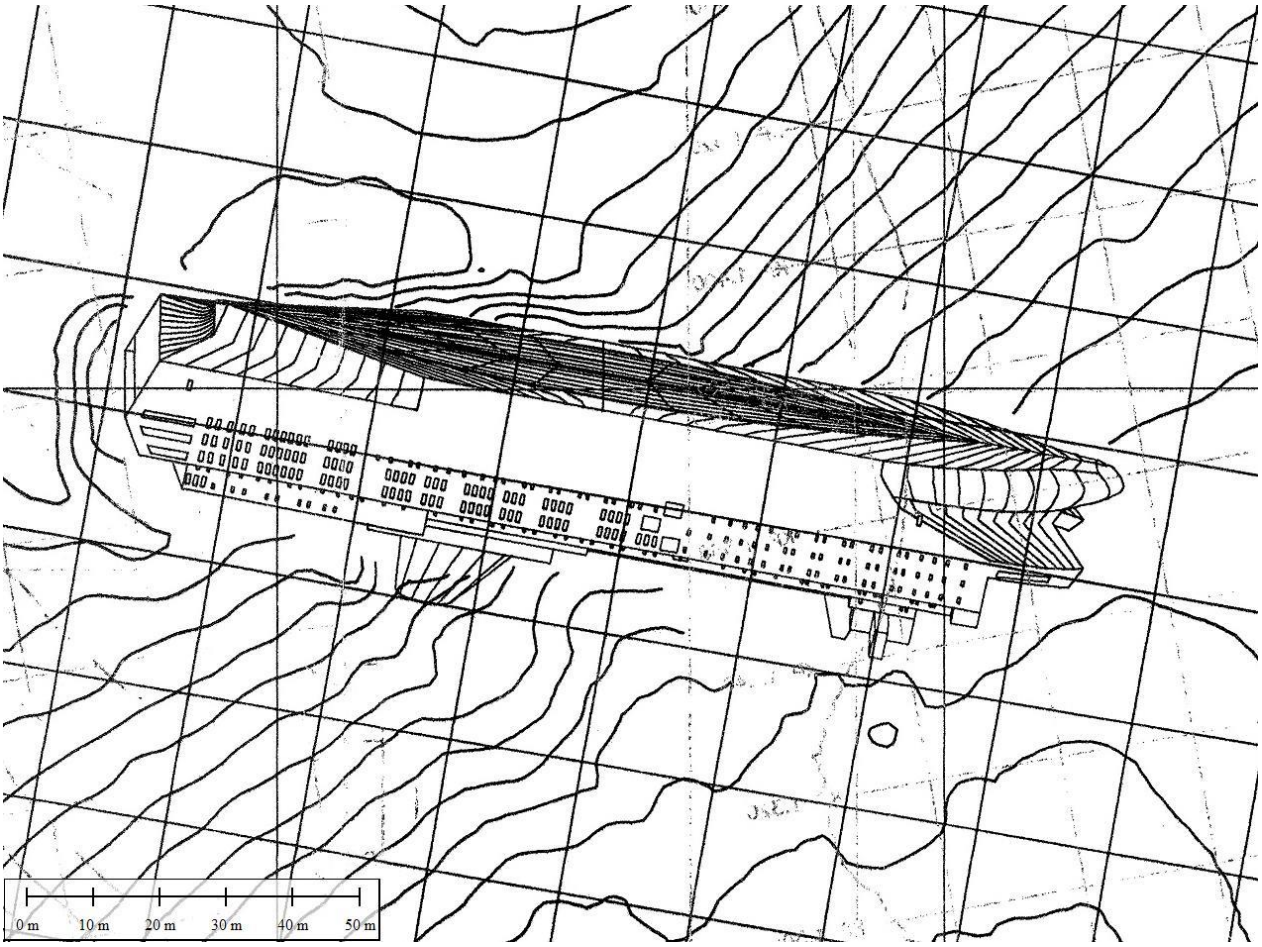


***Figure 3**. ACZ-REP-DES-003-3, Chart ACZ-DWG-DES-100-01. Design Basis, Bathymetric Survey, Grid Key Plan, Sheet 1 of 1.*

The data for this chart was acquired from Dec 1995 to Jan 1996.

Bathymetric contours are cut as they approach the vessel, with a partial schematic of the vessel placed into the resulting gap. The funnels extend into the seabed (through measured soundings) and windows are indicated as intact. This schematic does not represent the real condition of the ship, but instead works an indicative illustration of the approximate assessed bearing and heel.

The image of the vessel is not acquired by geophysical or camera equipment; it is only a simplified drawing of MV ESTONIA. Any real image, e.g., an image resulting from a side scan sonar (such as the one used on the survey vessel SUUNTA to locate the wreck on 29–30 September 1994) would show a shadow beyond the tallest feature that the equipment would have pinged from its vantage point. In this case, it would mean that either the below waterline part or the above waterline part of the vessel would not have any significant detail to illustrate it.

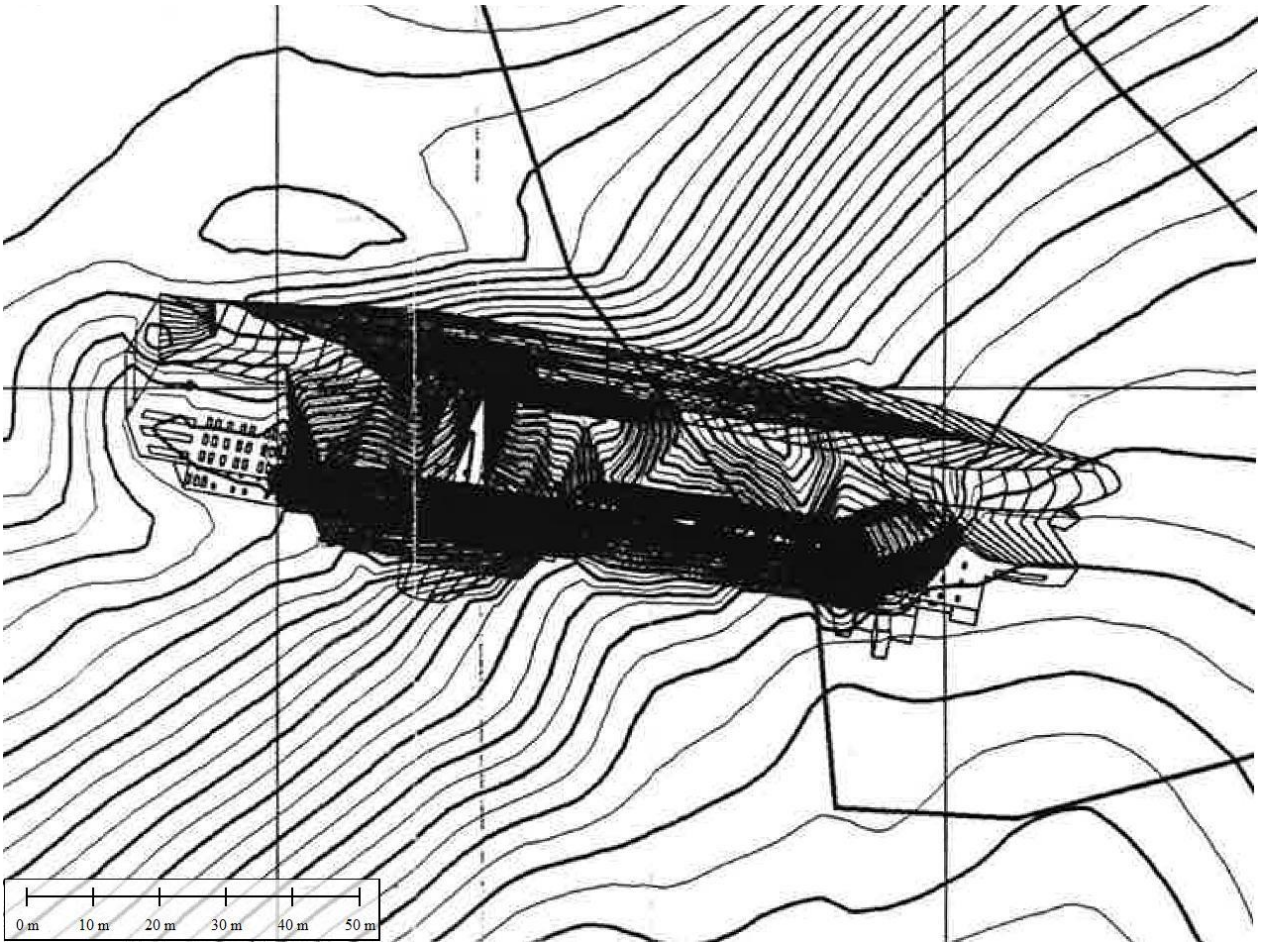


***Figure 4**. ACZ-REP-DES-026-3, Chart ACZ-DWG-ASB-710-01. As-built Drawing, Bathymetric chart int#16, Sandfilling Phase I, Sheet 1 of 11.*

The data for this chart was acquired from Jun 1996 to Jul 1996. In particular, this chart depicts the 16th intermediate bathymetric survey during the wreck covering operations.

Bathymetric contours continue through the area where the vessel lay on the seabed. The contours are not cut. In addition, a partial schematic of the vessel has been placed in its assessed location. Seabed contours continue through the bow, the stern, and the funnel, as well as through the rest of the wreck. Some of the shown information exists above the seabed (e.g., the stern) while parts are shown to rest below it (e.g., the funnel) with no apparent differentiation in the method of display. The visor is shown as one part of the schematic of the complete MV ESTONIA.

Altogether the Sandfilling Phase I drawings extend through 11 sheets, with the differences between these stemming from the state of the bathymetry being depicted as each chart depicts an intermediate bathymetry survey. Four additional, associated drawings were also included under the cover ACZ-REP-DES-026-3.

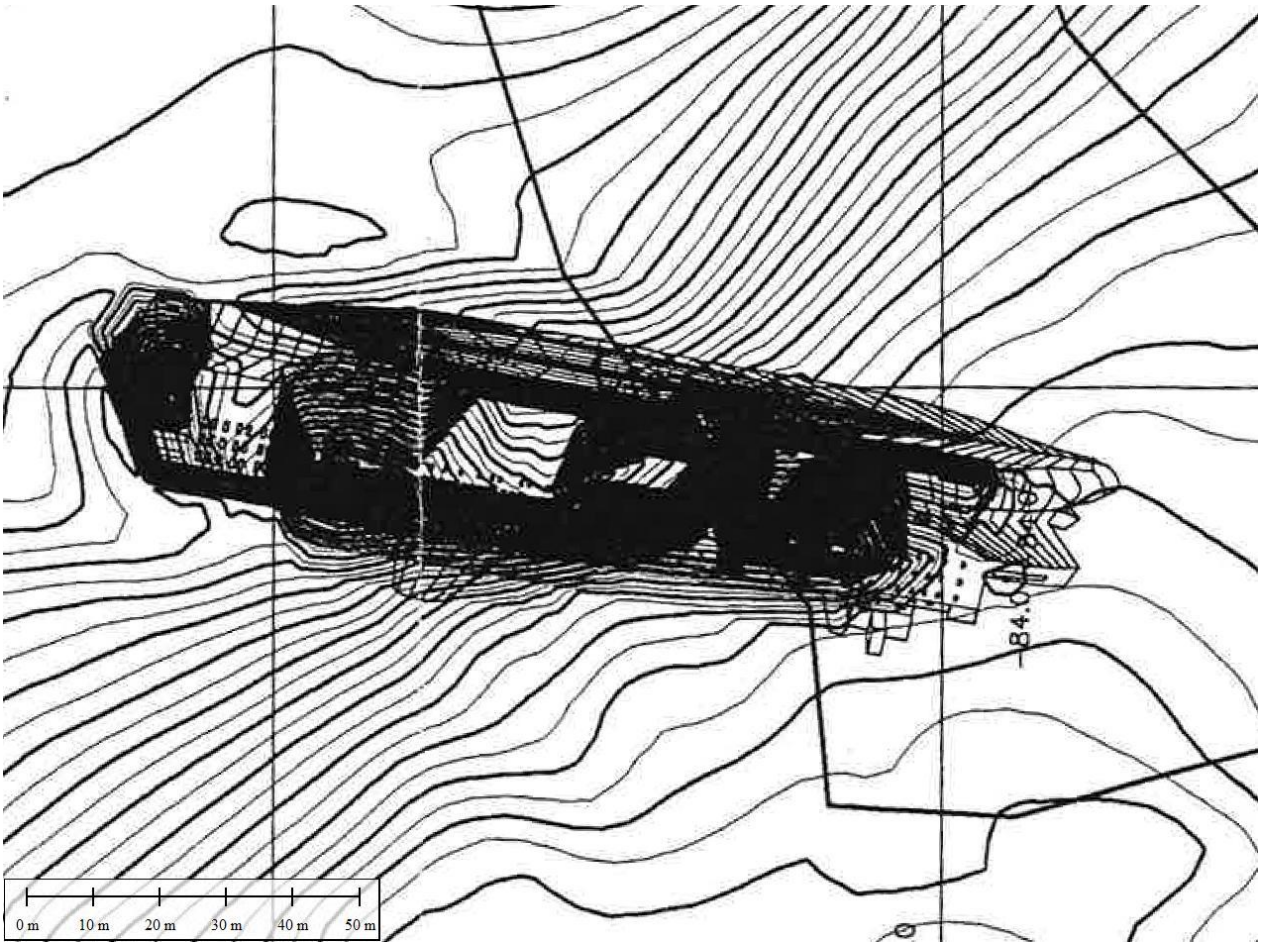


***Figure 5**. ACZ-REP-DES-026-3, Chart ACZ-DWG-ASB-710-09. As-built Drawing, Bathymetric chart int#26, Sandfilling Phase I, Sheet 9 of 11.*

The data for this chart was acquired from Jun 1996 to Jul 1996. In particular, this chart depicts the 26th intermediate bathymetric survey during the wreck covering operations.

*The substantive contents of this chart are the same as on **Figure 4**, with differences introduced due to variations in bathymetry from one intermediate survey to another.*

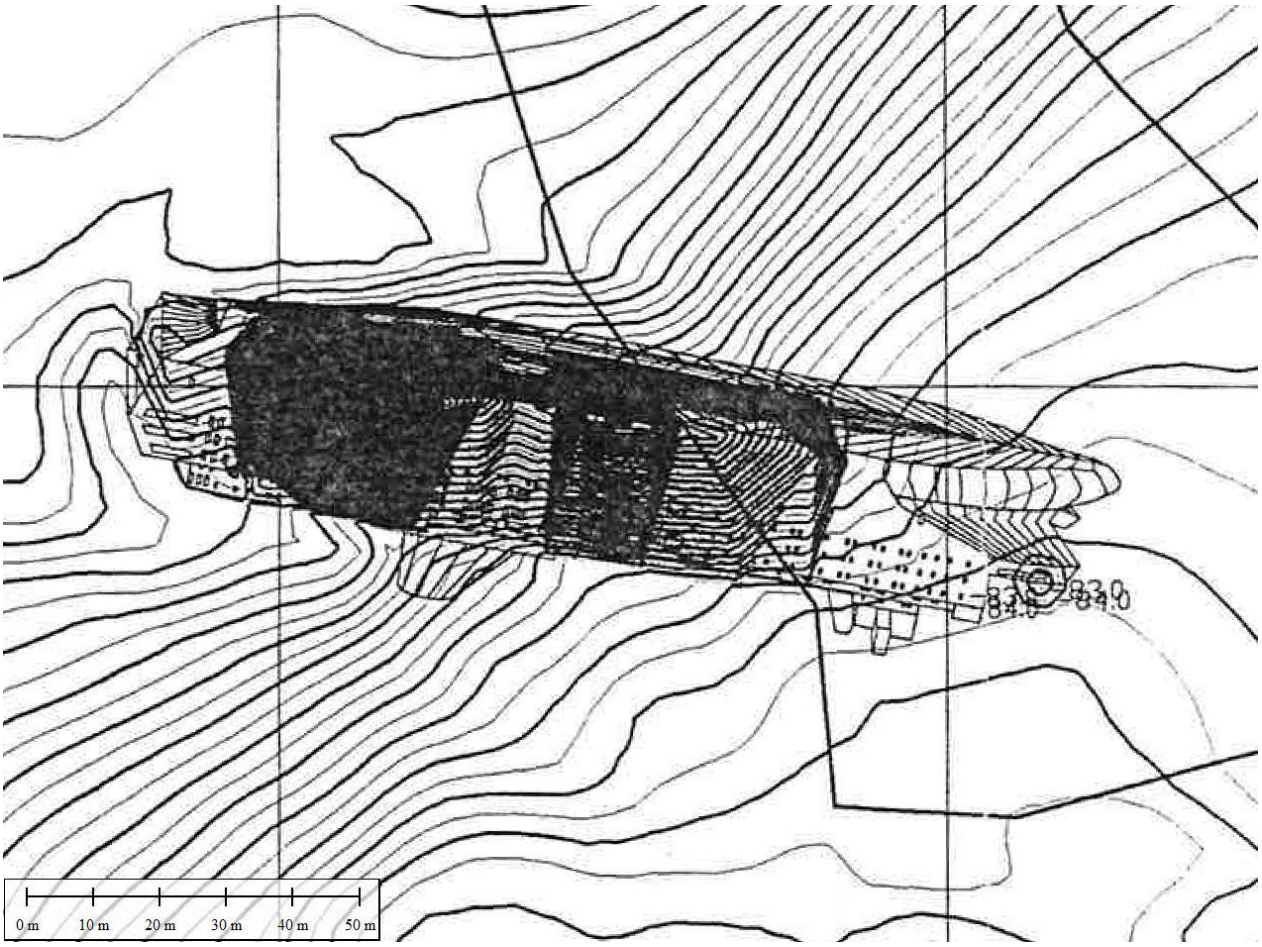


***Figure 6**. ACZ-REP-DES-026-3, Chart ACZ-DWG-ASB-710-10. As-built Drawing, Bathymetric chart int#28, Sandfilling Phase I, Sheet 10 of 11.*

The data for this chart was acquired from Jun 1996 to Jul 1996. In particular, this chart depicts the 28th intermediate bathymetric survey during the wreck covering operations.

*The substantive contents of this chart are the same as on **Figure 4**, with differences introduced due to variations in bathymetry from one intermediate survey to another.*

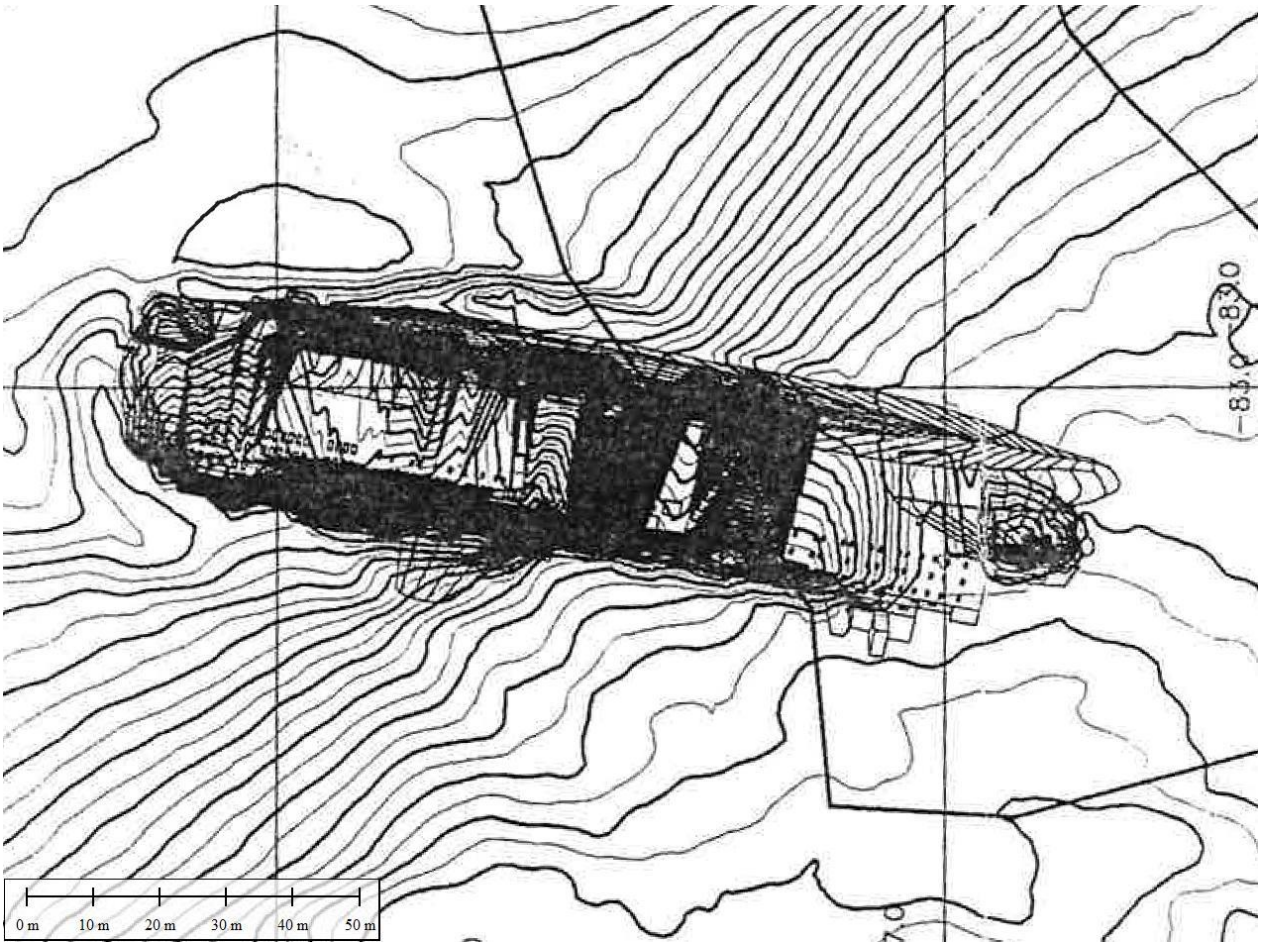


***Figure 7**. ACZ-REP-DES-026-3, Chart ACZ-DWG-ASB-710-11. As-built Drawing, Bathymetric chart int#29, Sandfilling Phase I, Sheet 11 of 11.*

The data for this chart was acquired from Jun 1996 to Jul 1996. In particular, this chart depicts the 29th intermediate bathymetric survey during the wreck covering operations.

*The substantive contents of this chart are the same as on **Figure 4**, with differences introduced due to variations in bathymetry from one intermediate survey to another.*

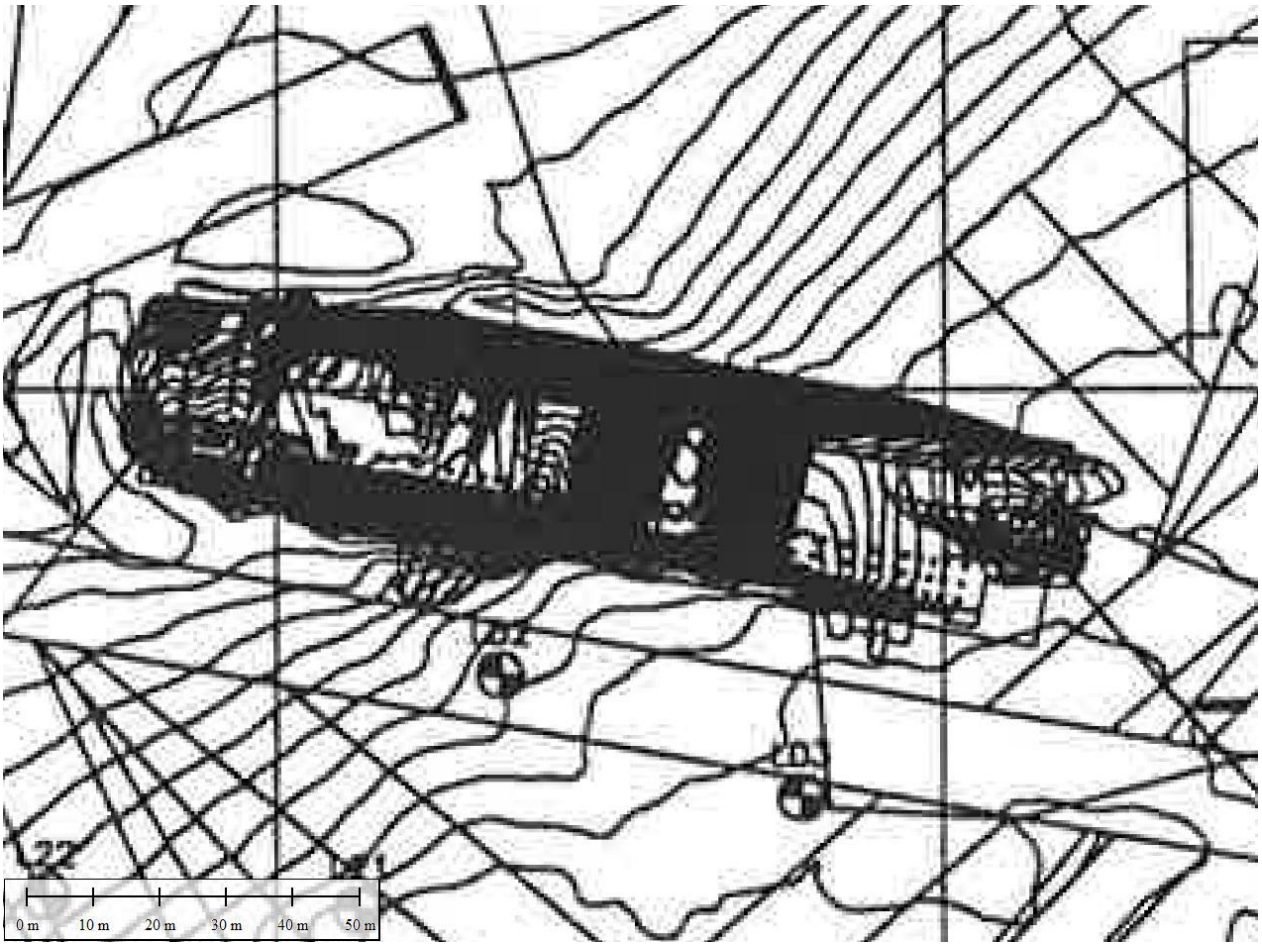


***Figure 8**. ACZ-REP-DES-026-3, Annex 1. Protection of M/S Estonia, Seabed soil samples, Locations.*

The data for this figure was acquired from Jun 1996 to Jul 1996.

*The figure shows the schematic of the vessel with overlapping contours. This image is essentially a low-resolution version of the chart shown as **Figure 7**.*

3. Visor References from the Preliminary Assessment

3.1. Geophysical Reconnaissance Report

The report published by Stockholm University (Jakobsson et al., 2021) covering the July 2021 geophysical, geotechnical, and environmental surveys at the wreck site of MV ESTONIA briefly mentions the assumed location of the visor based on the coordinates provided by JAIC and the Finnish Navy alongside a quick mention of the uncertainty of the provided coordinates. In addition, Jakobsson et al. (2021) included a figure ("Figure SS5") showing a seabed feature which was interpreted as the mark left by the visor when it fell on the seabed; an enhanced version of the image was provided in Appendix 4 as "Larger version of Figure SS5". This is reproduced below as **Figure 9**.

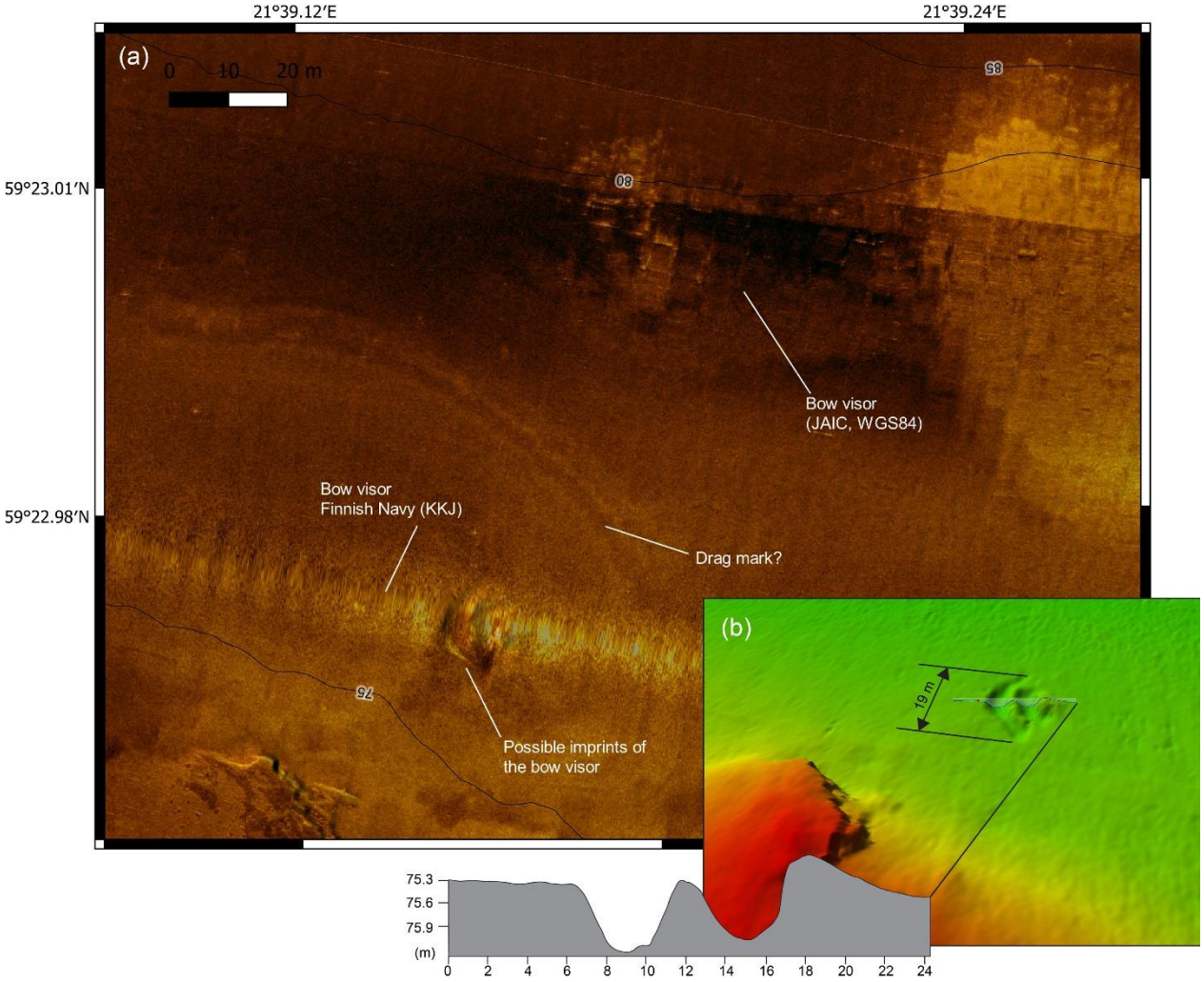


***Figure 9**. Image of the interpreted location where the visor lay on the seabed. Jakobsson et al. (2021), Appendix 4, "Larger version of Figure SS5." This is the first known publication of the interpreted seabed imprint left by the visor.*

*For clarity, the "Drag mark?" highlighted on the figure is a typical natural seabed feature for this area and there is no reason to associate it with the visor. Similar marks occur in numerous places throughout the extant datasets. Such examples are highlighted on **Figure 10**.*

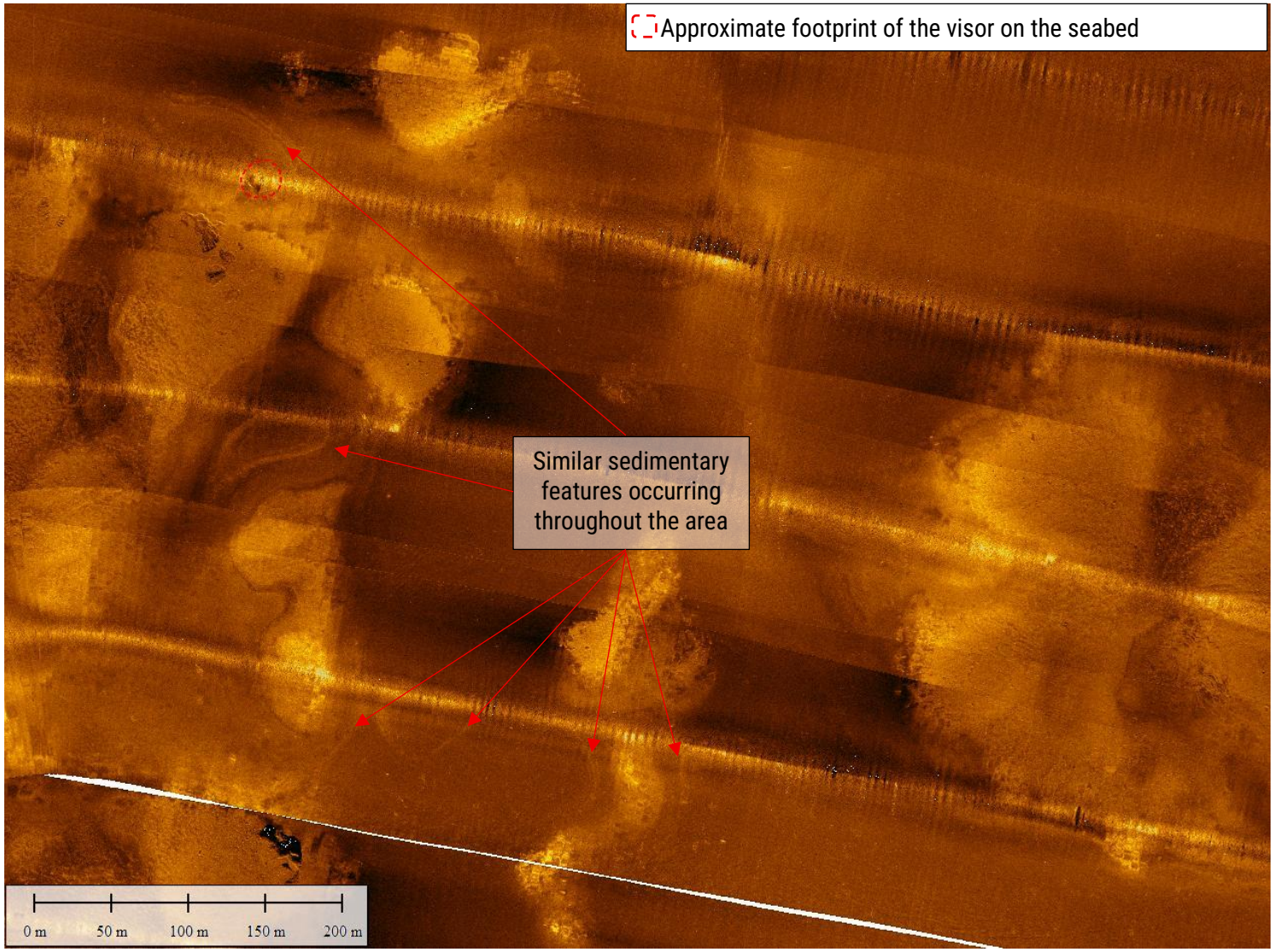


***Figure 10**. Illustrating seabed features similar to ones shown on Figure SS5 of Jakobsson et al., 2021.*

4. Visor Seabed Location in Extant Data

4.1. Coordinates

Several datasets have been acquired during the Preliminary Assessment which cover the vicinity of the coordinates as denoted in the JAIC Final Report (Section 2.1) and the visor recovery operation summary (Section 2.2). However, to describe these more fully, it is necessary to first discuss the mentioned coordinates.

As the original information in both cases—the finding of the visor and the recovery of the visor—was provided by Finnish institutions, it is first relevant to note that the most likely CRS for these was *Kartastokoordinaattijärjestelmä* (KKJ, the Finnish National Coordinate System), the default geodetic datum and coordinate system for Finland from 1970 to 2003/2005. Difference between World Geodetic System 1984 (WGS84) and KKJ coordinates varies from location to location, but in the Central Baltic Sea is sufficient to introduce a shift. This would mean that someone who was treating the provided KKJ coordinates as WGS84 coordinates would be looking in the wrong place.

Therefore, it is important to at least consider the possibility that both the coordinates in the JAIC Final Report as well as in the logbooks of icebreaker NORDICA were recorded in KKJ.

The Preliminary Assessment has transformed the assumed KKJ coordinates into WGS84, using the National Land Survey of Finland online calculator (accessed 19 October 2025).[2] The results are listed below in **Table 3**. These coordinates were all assigned an ID so as to easier distinguish them on maps. The IDs are listed for easy reference in **Table 4**.

***Table 3**. KKJ coordinate transformations into WGS84.*

Original Coordinates	Report Section	Original Coordinates (Decimal)	Transformed WGS84 Coordinates	ID
59° 23.0’ N 021° 39.2’ E	Sec. 2.1	59.383333 N 021.653333 E	59.383387 N 021.650109 E	#1
59° 22.9’ N 021° 39.4’ E	Sec. 2.2	59.381667 N 021.656667 E	59.381721 N 021.653443 E	#2
59° 23.0’ N 021° 39.4’ E	Sec. 2.2	59.383333 N 021.656667 E	59.383388 N 021.653443 E	#3
59° 22.97’ N 021° 39.33’ E	Sec. 2.2	59.382833 N 021.655500 E	59.382887 N 021.652276 E	#4
59° 22.95’ N 021° 40.92’ E	Sec. 2.2	59.382500 N 021.682000 E	59.382555 N 021.678777 E	#5

[2] A geodetically important distinction is that actually the National Land Survey of Finland calculator only provides the option to transform KKJ coordinates to the EUREF-FIN-GRS80 coordinate system. However, as per Uikkanen (2024), “The difference between GRS80 and WGS84 ellipsoids is so small, that it can be ignored in most applications”.

Original Coordinates	Report Section	Original Coordinates (Decimal)	Transformed WGS84 Coordinates	ID
59° 22.973’ N 21° 39.223’ E	Sec. 2.3	59.382100 N 021.683417 E	59.382151 N 021.680172 E	#6
59° 22.926’ N 21° 41.005’ E	Sec. 2.3	59.382883 N 021.653717 E	59.382933 N 021.650471 E	#7

***Table 4**. Coordinate references and source descriptions.*

ID	Report Section	Description (Source & Commentary)
#1	Sec. 2.1	JAIC Final Report, p. 119, Ch. 8.3. [Also on p. 22, Ch. 1.]
#2	Sec. 2.2	NORDICA logbook, 17-Nov-1994. Start of lifting operations at 12:20.
#3	Sec. 2.2	NORDICA logbook, 17-Nov-1994. First recorded automatic positioning fix at 18:00.
#4	Sec. 2.2	*Ang positionen på m/s Estonias bogvisir.* Coordinates from the Finnish Navy. [Only coordinates specifically noted to be in KKJ.]
#5	Sec. 2.2	*Ang positionen på m/s Estonias bogvisir.* Red buoy coordinates in the accident area.
#6	Sec. 2.3	”Tallinn 20.10.1994”. Visor coordinate.
#7	Sec. 2.3	”Tallinn 20.10.1994”. Wreck coordinate.

When loading these coordinates into a GIS software (Global Mapper Pro v26.2), it becomes clear that Location #5, the red buoy, is unrelated to the visor. This is shown as **Figure 11** with a related commentary. In short, these coordinates were most likely provided natively in WGS84, which makes sense as its source, HMS FURUSUND, was a Swedish naval vessel.

The sources for all other coordinates were Finnish vessels, operated either by the Navy or other governmental institutions, however, as only Location #4 was explicitly stated to have been recorded in KKJ, only this was loaded twice (original KKJ and transformed) into the same software as mentioned above. The other locations (Location #1 through Location #3) were loaded three times. The results, along with the approximate footprint of the visor on the seabed, are shown as **Figure 12**.

In short, especially for Location #1, it is impossible to say definitively whether the JAIC Final Report uses coordinates that were natively recorded in KKJ or which had already been transformed into WGS84. In both cases, the coordinates refer to a position within 70–155 m of the actual visor location. However, the

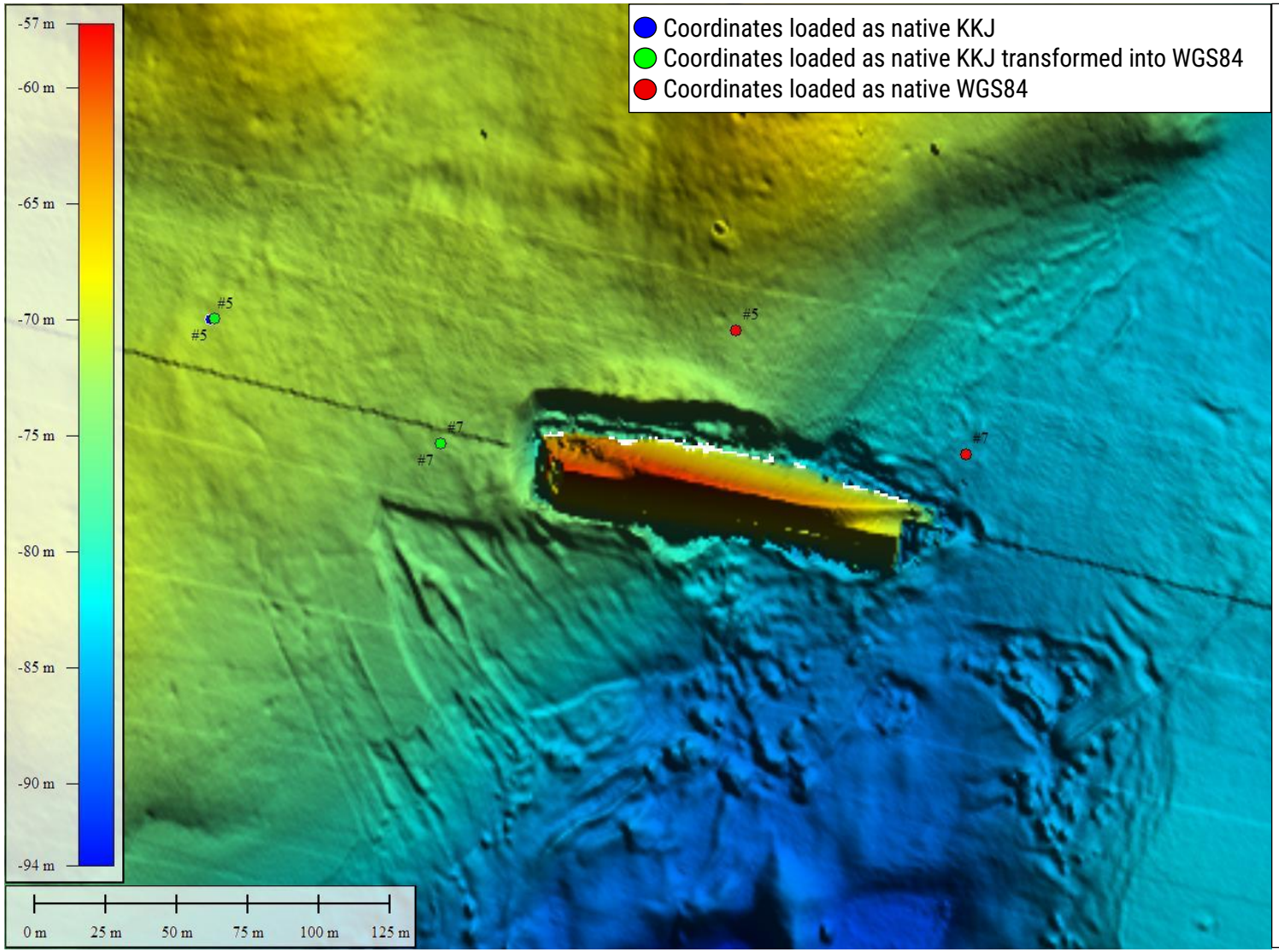
coordinates for Location #1, when transformed into WGS84, align closely (<10m difference) with the KKJ positions from the logbooks of NORDICA, so it is possible that this transformation was carried out for the recording of locations in the JAIC Final Report.

Location #4 (known to have been recorded in KKJ) is located immediately to WNW of the visor imprint; the ±30 m remark in *Ang positionen på m/s Estonias bogvisir* was sufficient to include essentially all of the still-extant seabed imprint from this visor in 2023.

The most likely explanation for Locations #2 and #3 is that these were recorded in KKJ. This aligns relatively well with the lifting procedure, with the icebreaker being positioned to SE originally during the lifting operation, and later to the NE. The distance from the centre of the seabed imprint to Location #2 is approximately 130 m, while the distance to Location #3 is approximately 80 m.

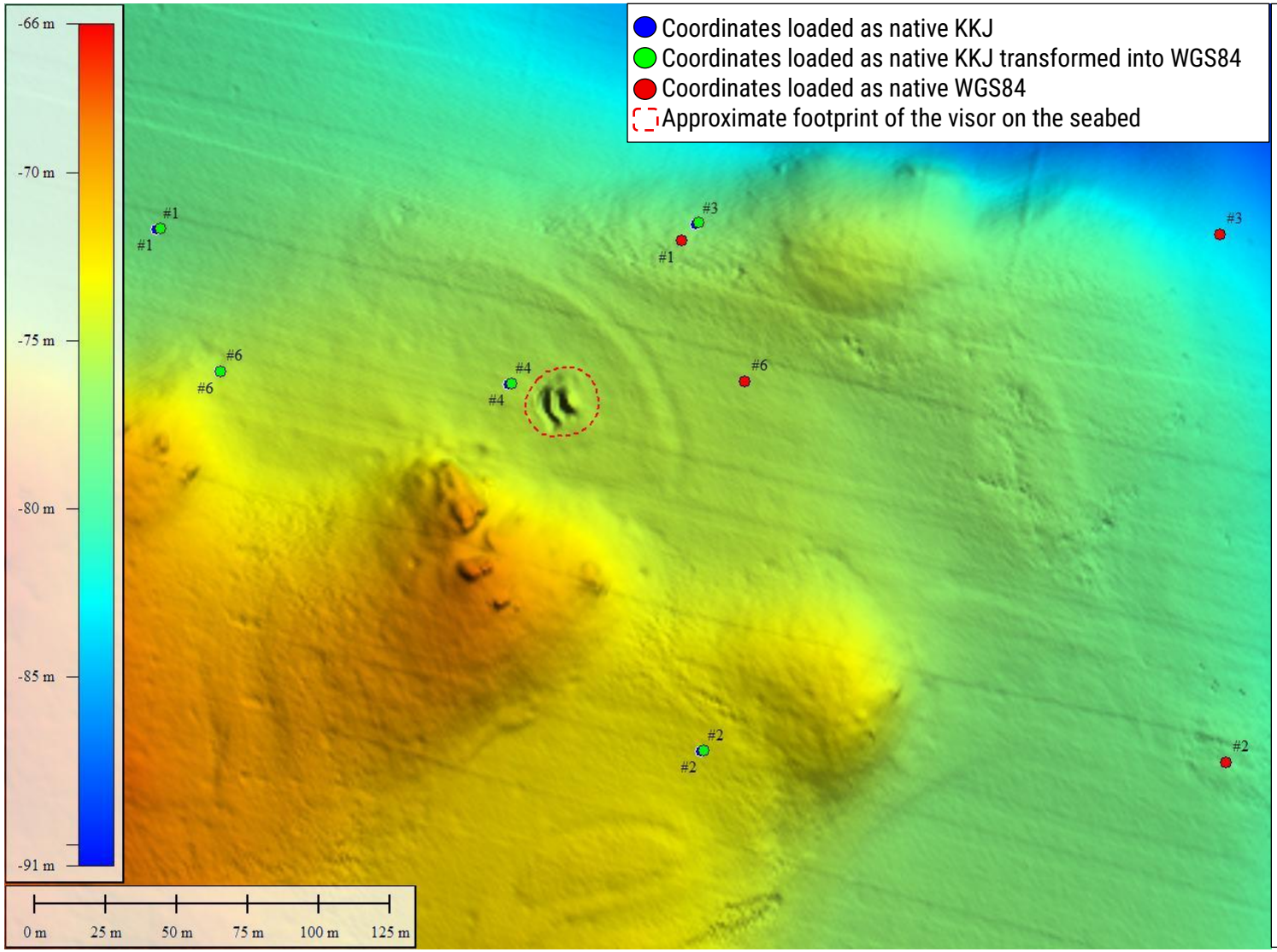
Location #7, the location of the wreck, looks offset from the modern wreck position, however, presuming that it was recorded in WGS84, it occurs within 7 m of the wreck bow position as reported by Rockwater A/S after their 1994 survey (occurring 26 November through 8 December).

Figure 13 illustrates our interpretation of the most likely position each coordinate was supposed to represent with respect to the visor recovery. Taking into account the precision at which these coordinates were recorded (up to approx. 185 m), the size of the vessels in question, and the uncertainty at which position was being recorded (e.g., whether icebreaker NORDICA had a separate positioning beacon for the visor recovery crane or whether the coordinates represent the ship's antenna), all locations can be said to refer to the same approximate area.



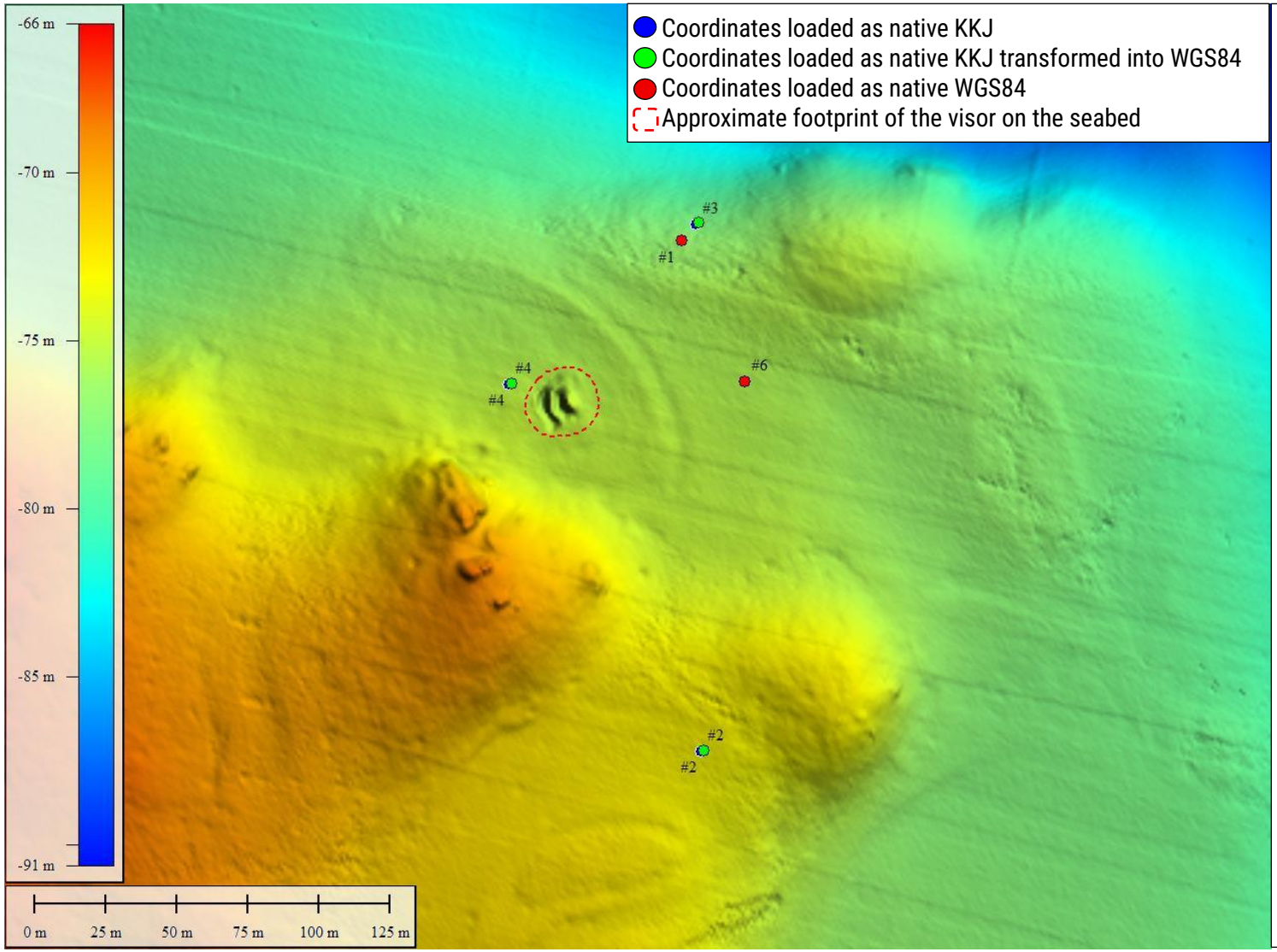
The red Location #5 here represents the most likely location of the mentioned red buoy. This location makes sense intuitively if this buoy was placed to mark the location of the wreck as it was located approx. 25 m to the north of the midships. Also, as the source for these coordinates was HMS FURUSUND, a Swedish ship, it is highly unlikely that they would have been using a Finnish coordinate system to record positions.
The native KKJ and transformed KKJ to WGS84 coordinates mostly overlap, as expected.

***Figure 11**. 2023 Bathymetry with Location #5 and #7 loaded thrice.*



With the most likely scenario that previous coordinates were converted into WGS84 for inclusion in the JAIC Final Report, Locations #1 and #6 match well with Location #3 and #4, both of which were probably originally recorded in KKJ.

***Figure 12**. 2023 Bathymetry with Locations #1–#4 and #6 loaded several times. Location #4, known to be in KKJ, was only loaded twice (original and transformed).*



The most likely interpretation of the coordinates:
Location #1 was provided in the JAIC Final Report as WGS84; with the coordinate values rounded from the more precise Location #6 information (also in WGS84).
Meanwhile, the coordinates as recorded on icebreaker NORDICA (Locations #2 and #3) were in KKJ.

***Figure 13**. 2023 Bathymetry with Locations #1–#4 and #6 loaded with their most likely original CRS only.*

4.2. Distance to the Wreck

The estimate in the JAIC final report that the visor was located “about one nautical mile west of the wreck” (ref. Sec. 2.1) can be re-evaluated taking into account the assessed information about coordinates. This can also be compared against modern data.

For reference, the positions of the wreck and visor’s seabed imprint were determined as shown in **Table 5** during the Preliminary Assessment.

Table 5. Geographic Coordinates for the Wreck and Visor Seabed Imprint from the Preliminary Assessment.

Description	Latitude (WGS84)	Longitude (WGS84)
Wreck*	59.382087° N ≈ 59° 22' 55.5120" N	021.680752° E ≈ 021° 40' 50.7060" E
Visor Seabed Imprint	59.382827° N ≈ 59° 22' 58.1768" N	021.652618° E ≈ 021° 39' 09.4257" E
* The wreck’s location was determined from the 2021 bathymetry, representing the shallowest measured depth (-58.5m). In comparison to the prior locations for the wreck, this is by the stern.		

Comparison of the distances is provided as **Table 6**.

Table 6. Distances between the Wreck and the Visor Seabed Location.

Source	Report Section	Wreck Coordinates (WGS84)	Visor Coordinates (WGS84)	Distance
JAIC Final Report	Sec. 2.1	59.38167° N 021.68333° E	59.38333° N 021.65333° E	1715 m ≈ 0.93 nm
„Tallinn 20.10.1994“	Sec. 2.2	59.382100° N 021.683417° E	59.382883° N 021.653717° E	1690 m ≈ 0.91 nm
Preliminary Assessment	N/A	59.382087° N 021.680752° E	59.382827° N 021.652618° E	1601 m ≈ 0.86 nm

In general, it can be said that the definition of exact locations or distances was not a priority for JAIC, who were principally interested in the handling of the accident investigation.

4.3. Imprint

The imprint left by the visor on the seabed has been covered several times using modern hydrographic, geophysical, or other survey methods. The following section describes these datasets, along with illustrative images. The datasets are summarized in **Table 7**.

***Table 7**. Datasets at the visor location.*

Acquisition Dates	Acquisition Vessel	Survey Methods Used	Methods Characterizing Visor Location
05-Oct-1994 to 18-Oct-1994	OPV TURSAS	Echo sounder, SSS, & ROV	SSS
18-Aug-2006 to 22-Aug-2006	RV MERIDIAN	MBES	MBES (bathymetry)
08-Jul-2021 to 15-Jul-2021	RV ELECTRA AF ASKÖ	MBES, sub-bottom profiler, mid-water sonar, SSS, sound velocity profiler, CTD, ADCP, camera, grab sampler, & piston corer	MBES* (bathymetry) & SSS
23-Nov-2023 to 29-Nov-2023	RV SKAGERAK	MBES, MAS, & CTD	MBES* (bathymetry) & MAS
01-Jul-2024 to 04-Jul-2024	Icebreaker EVA-316	Camera	Camera

* For the surveys carried out during the Preliminary Assessment, backscatter was also acquired during the MBES survey. Multi-beam backscatter characterizes the acoustic intensity of seabed sediments, i.e., is similar in principle to a side scan sonar (SSS) or multi-aperture sonar (MAS), only much lower frequency (less resolute).

In archival material, images relating to the visor on the seabed in the 1990s have been preserved. The actual paper rolls from OPV TURSAS may be extant, but have not been located. However, a public bulletin from 19 October 1994[3] included the image of the visor on p. 5. This is reproduced here as **Figure 14**. No information about the visor's location, orientation, or other properties can be made based on this.

The first extant dataset from which the Preliminary Assessment has digital data for dates to 2006, when a Finnish hydrographic survey covered this area (shown as **Figure 15**). Next, the Preliminary Assessment set out by organizing a geophysical reconnaissance in 2021 which covered a larger area, including the previous location of the visor on the seabed (shown as **Figure 16**). In addition, the 2023 high-resolution seabed survey covered the same area (shown as **Figure 17**). Of these, the high-resolution survey also included the most resolute MBES data; the definition of the visor imprint is best in the 2023 data.

Backscatter from 2021 and 2023 are shown as **Figure 18** and **Figure 19**, respectively. In general, the resolution of the backscatter is lower and there is not much detail to be seen in these datasets for this location.

SSS from 2021 is shown as **Figure 20**. MAS from 2023 is shown as **Figure 21**. The MAS image is the most

[3] *"M/S Estonian kansainvälinen tutkintakomissio, Tiedote 19.10.1994, Julkinen 19.10.1994 klo 18.00"*.

detailed geophysical image acquired to date, showing several long marks in the seabed along with a very well defined shape.

In addition, a dive (Dive 7) was carried out at the location of the visor sediment depression during the ROV video survey in 2024. Images from this were published in 2024, but are republished here as **Figure 22** and **Figure 23**. Altogether, one thin elongated object was observed during this dive.

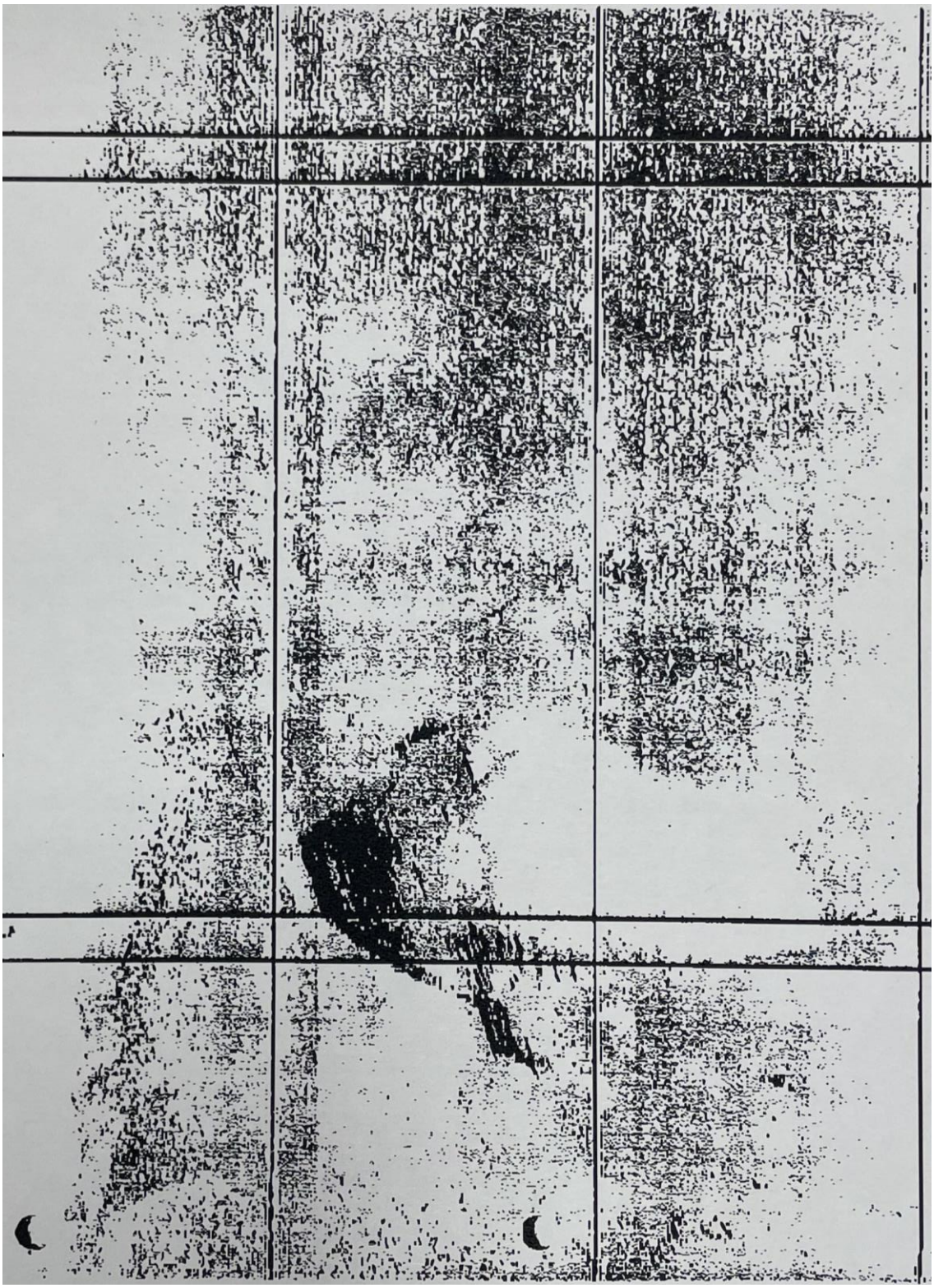


***Figure 14**. 1994 side scan sonar, waterfall view, visor on seabed. Source: "*M/S Estonian kansainvälinen tutkintakomissio, Tiedote 19.10.1994, Julkinen 19.10.1994 klo 18.00*", p. 5.*

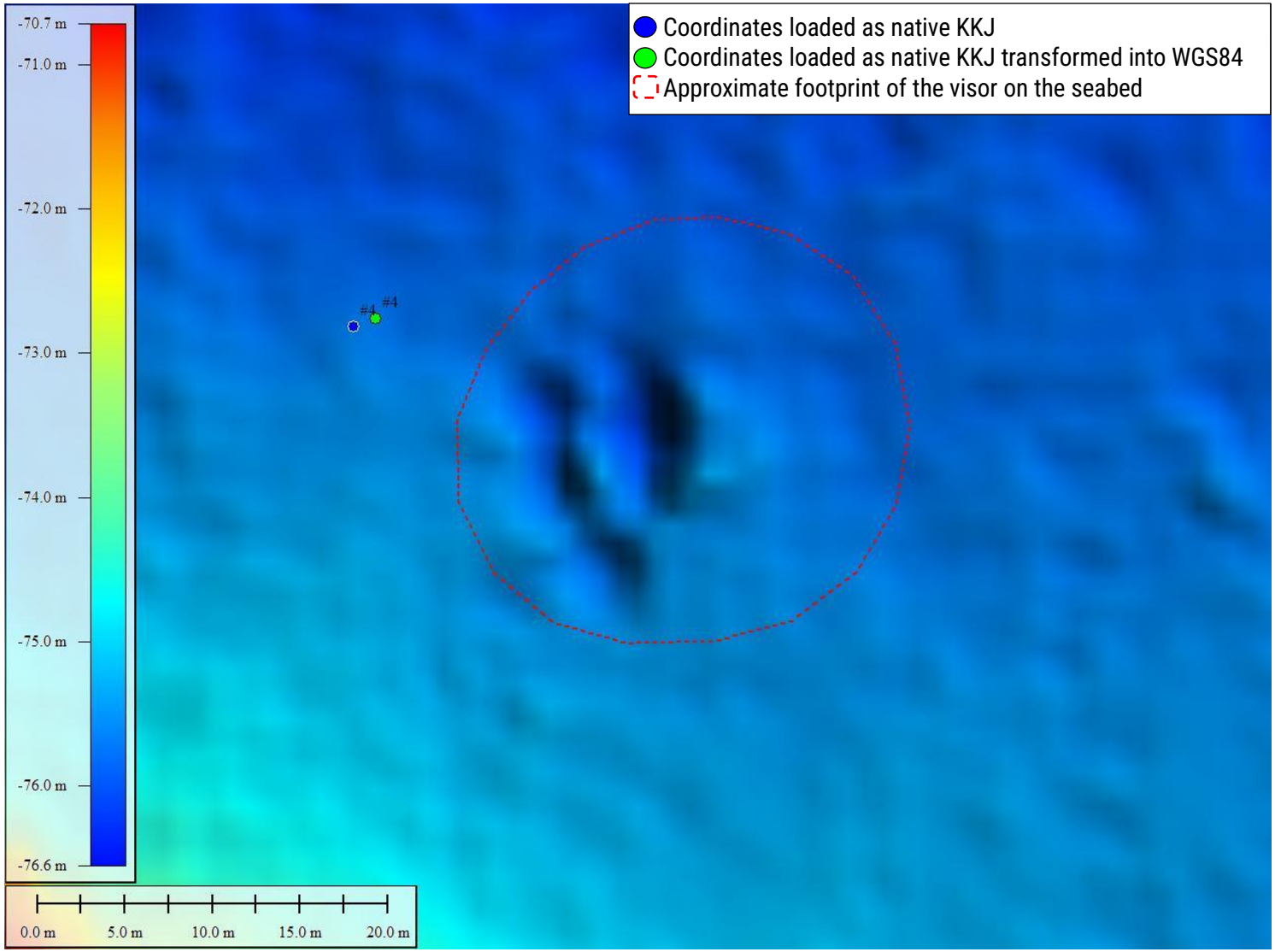


***Figure 15**. 2006 bathymetry.*

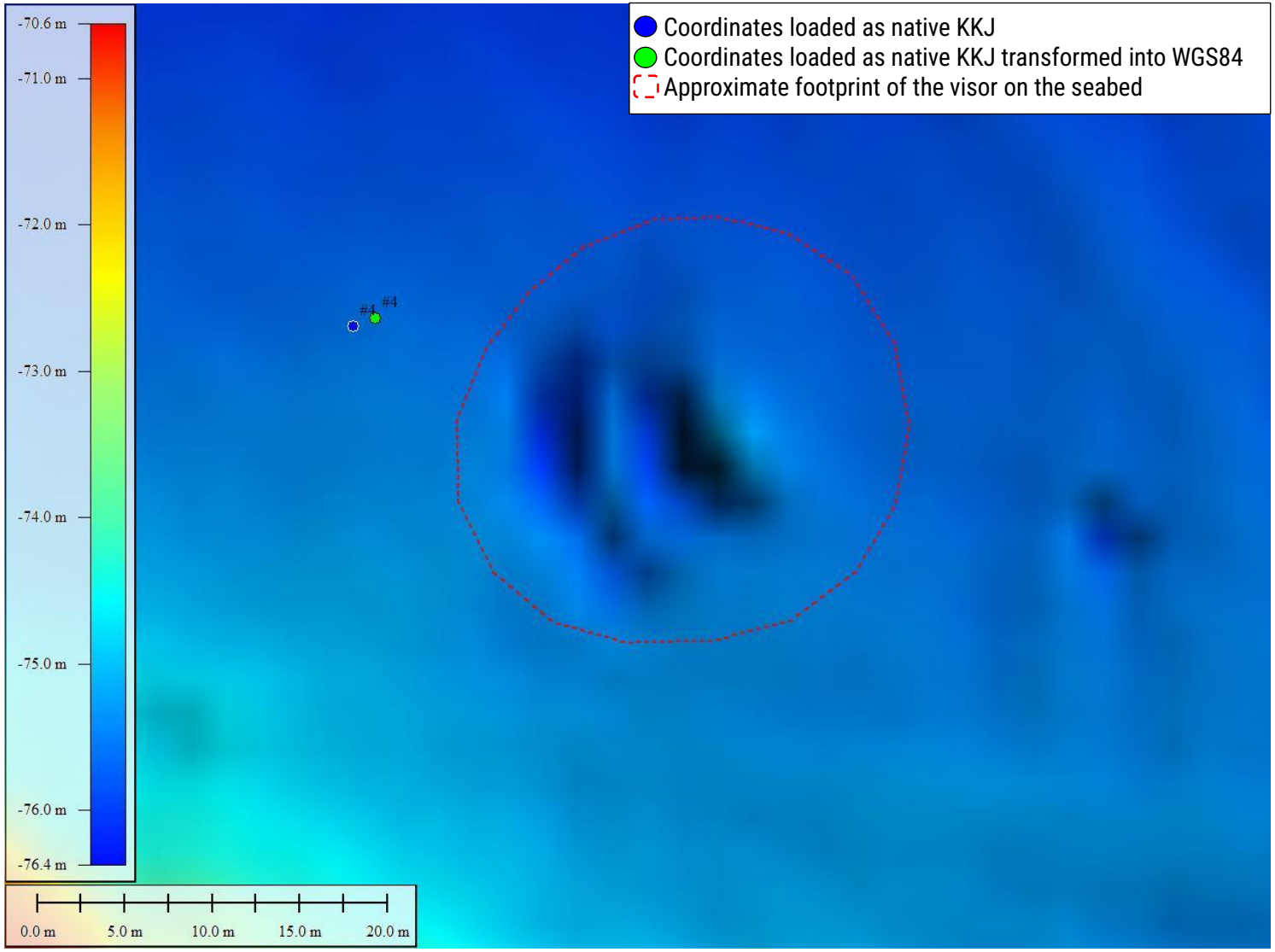


***Figure 16**. 2021 bathymetry.*

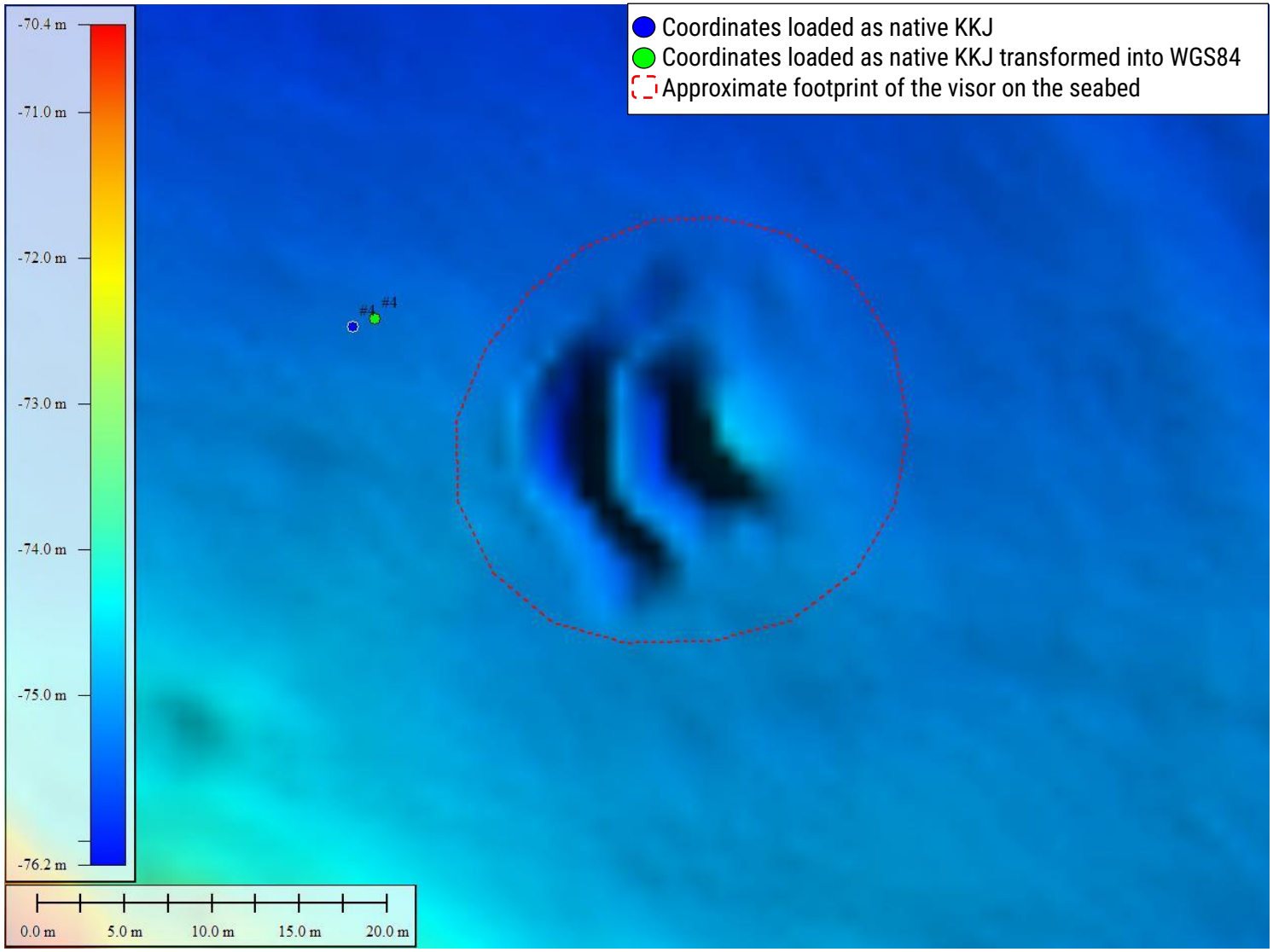


***Figure 17**. 2023 bathymetry.*

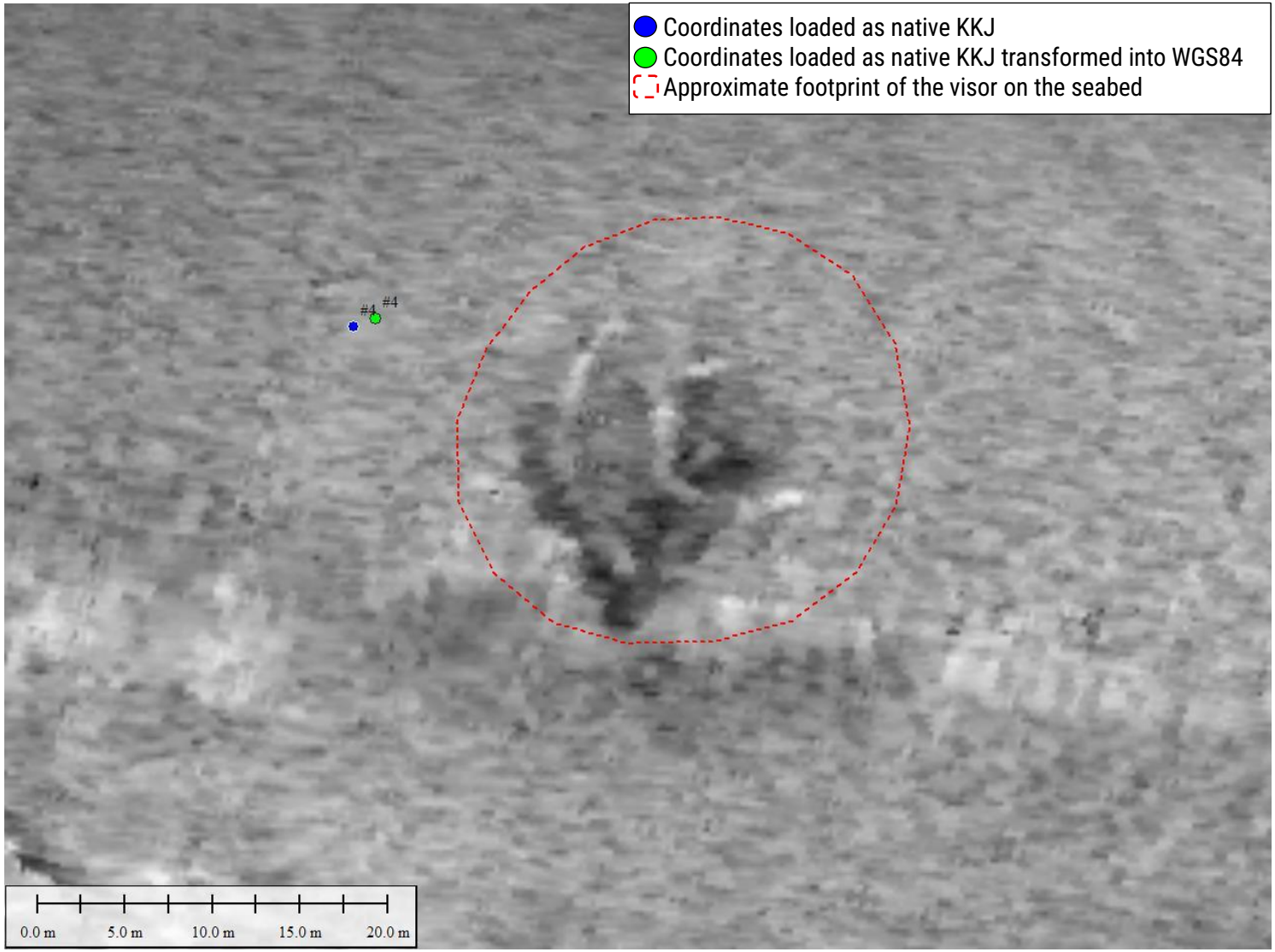


***Figure 18**. 2021 backscatter.*

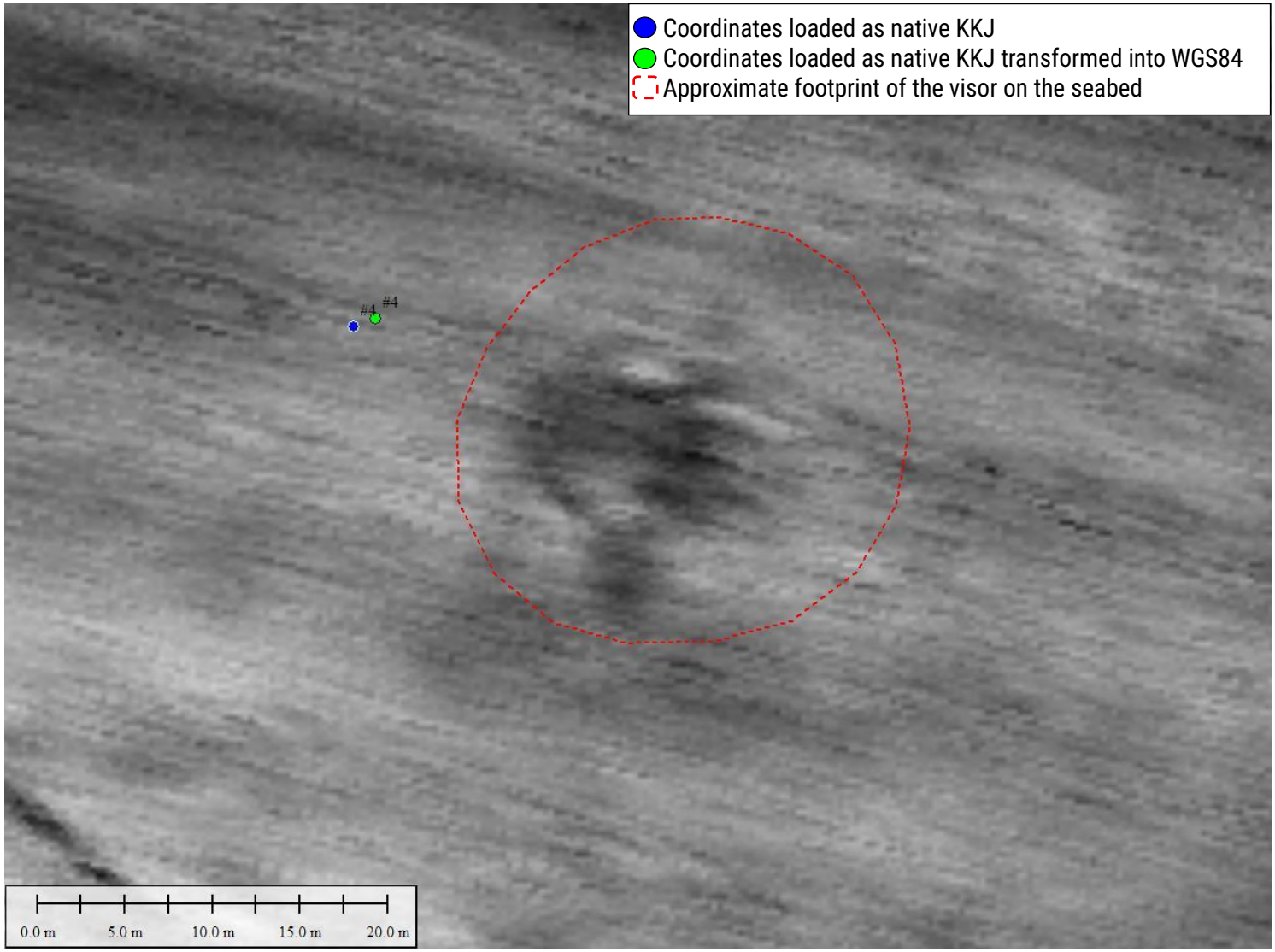


***Figure 19**. 2023 backscatter.*

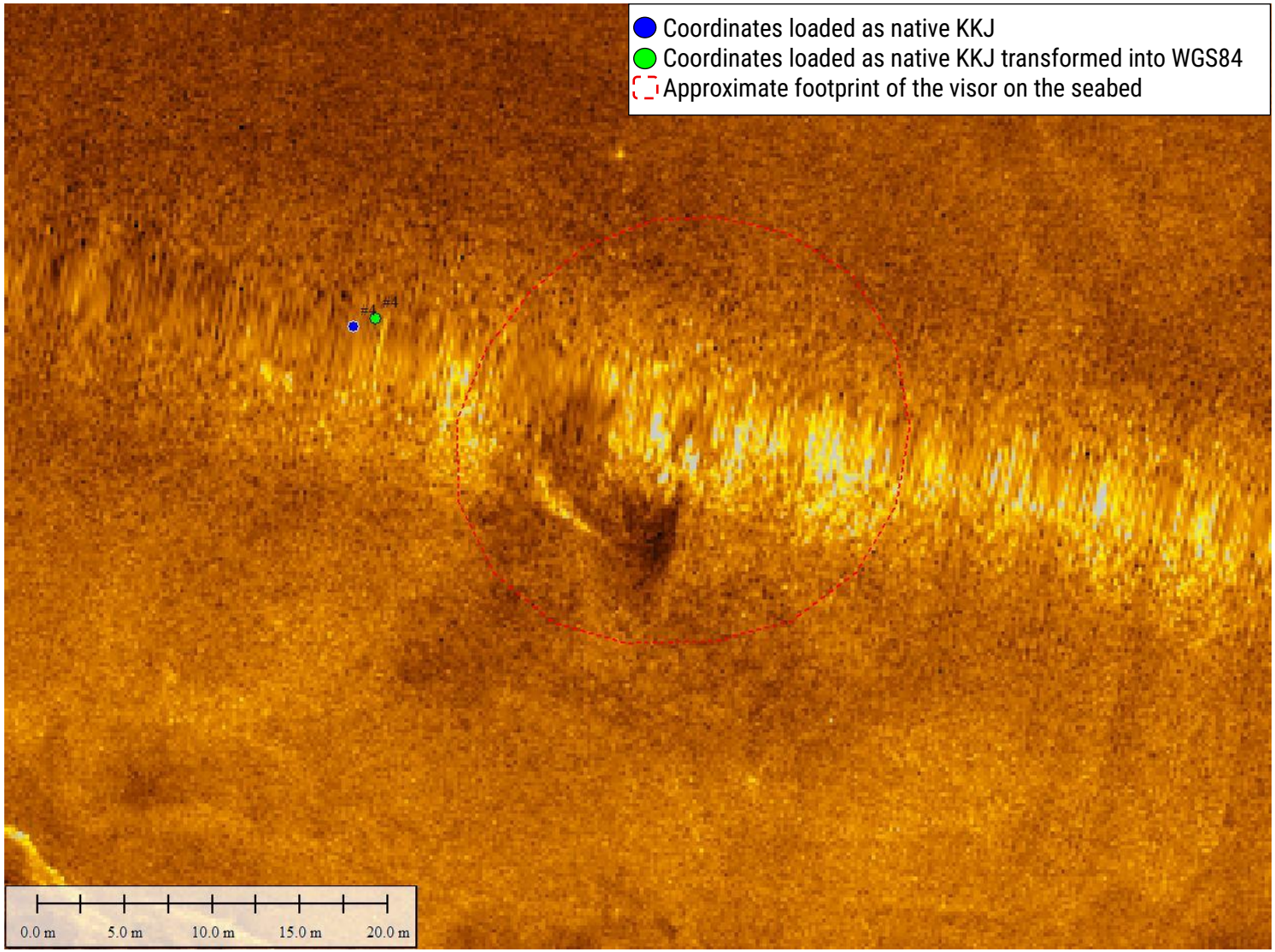


***Figure 20**. 2021 side scan sonar.*

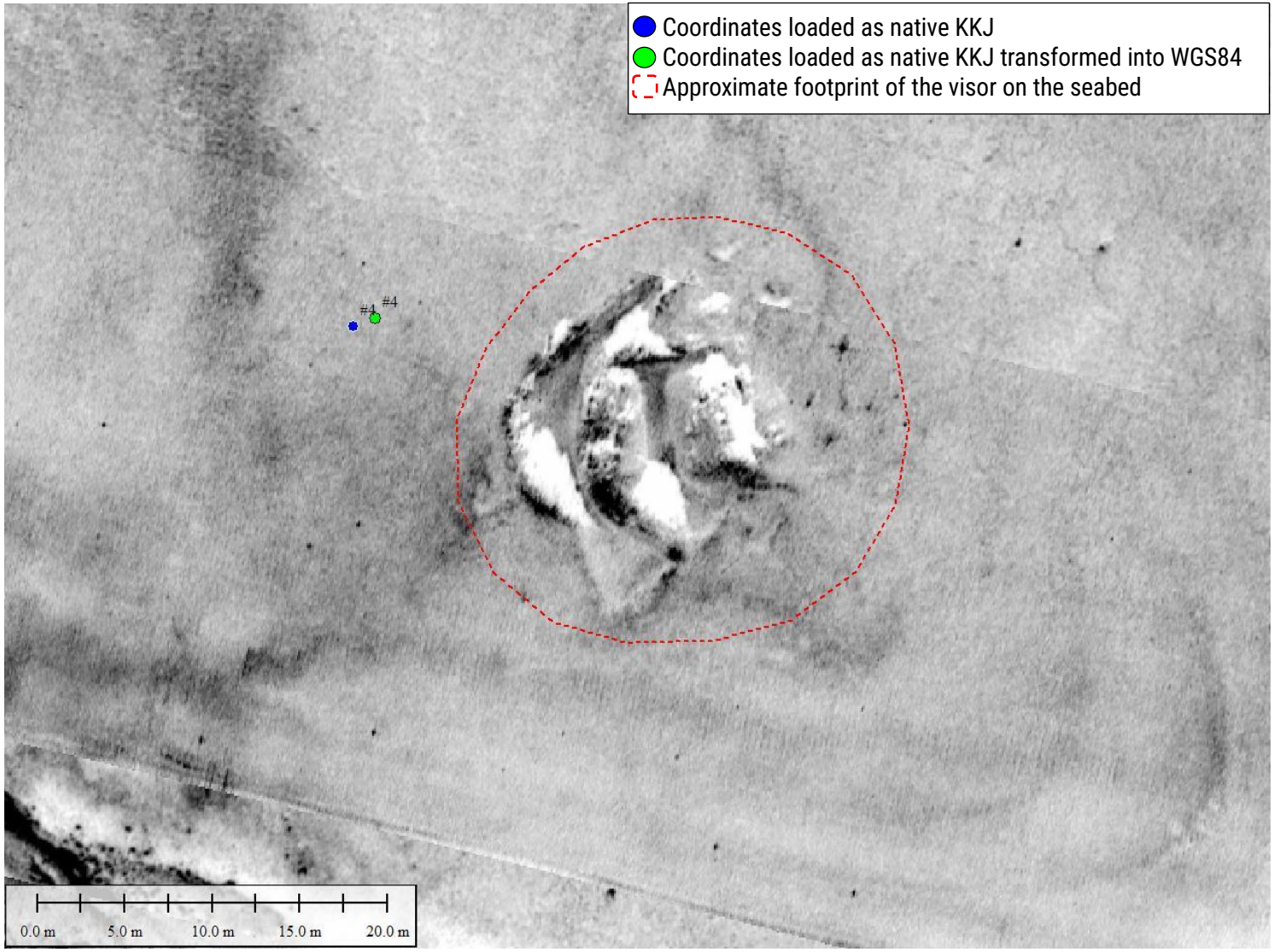


***Figure 21**. 2023 multi-aperture sonar.*



***Figure 22**. 2024 ROV Dive 7, Camera Capture #1. Image from OJK (2024).*

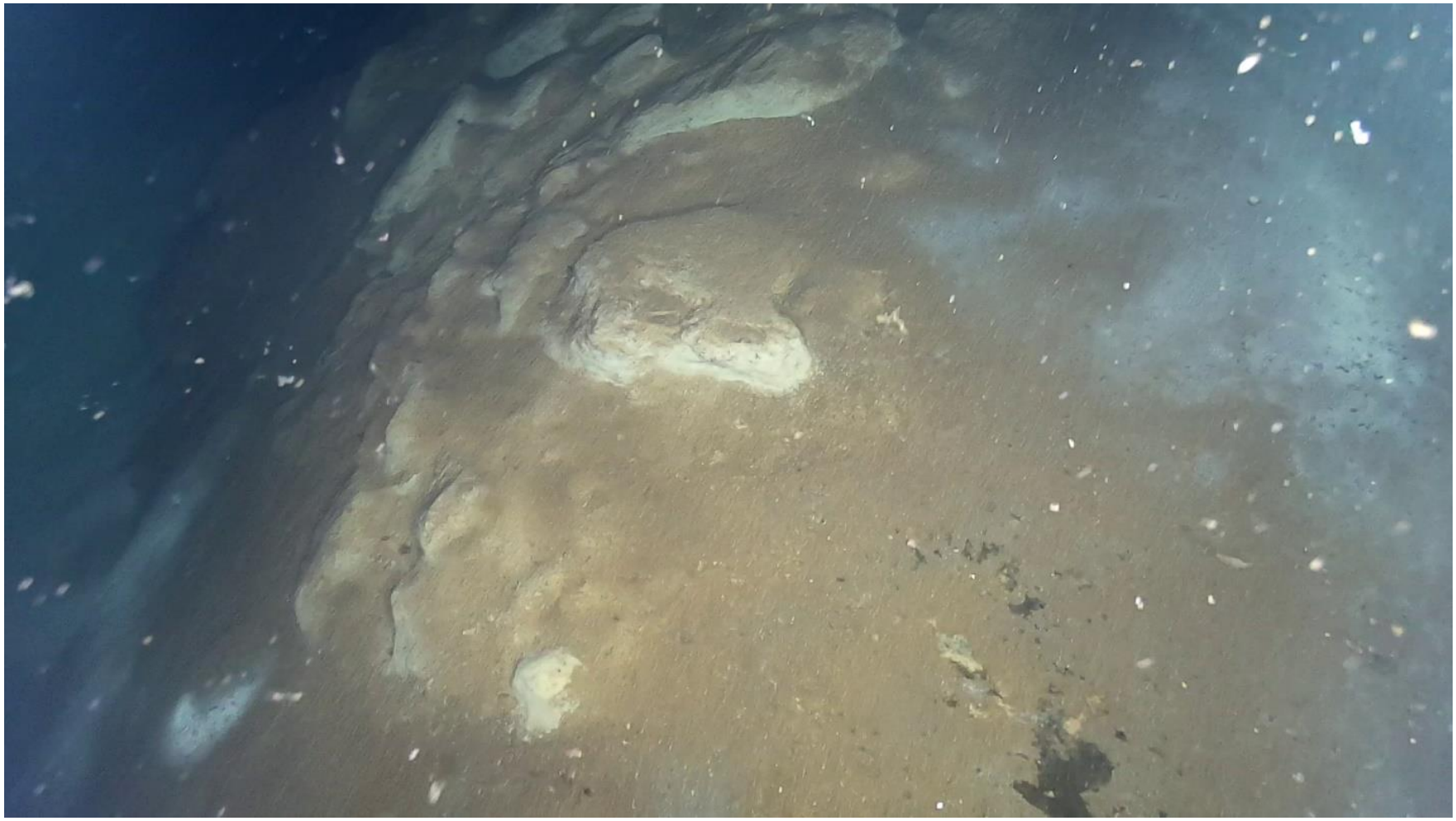


***Figure 23**. 2024 ROV Dive 7, Camera Capture #2. Image from OJK (2024).*

5. Analysis

The operation to search and recover the visor from MV ESTONIA was an international operation, involving Estonian, Finnish, and Swedish authorities. During 1994, Finland primarily used a different coordinate system. The visor's location is not thoroughly considered in data from 1990s. The wreck is depicted on charts that date to the 1990s in various ways, with no general commonalities. The manner in which the wreck was depicted was probably left to the individual draughter. This could cause confusion, and result in the impression that there were doubts about the exact position of the visor. However, on no known chart is the visor indicated to have lain by the bow of the vessel.

It is not possible to state exactly which coordinate systems were used in the JAIC Final Report and in published documents. In the case there has been any doubt of what coordinate system have been used, assumptions have been made. These involve that Swedish vessels would have been using the coordinate system used in Sweden (WGS84) and that Finnish vessels would have been using the coordinate system used in Finland at the time (KKJ). These assumptions were checked by loading in all various coordinates from the 1990s in every coordinate system, and the coordinates then reduced to their most likely intended position. This process resulted in an estimation that while the Finnish ships used KKJ for their positioning, all coordinates were converted into WGS84 for the JAIC Final Report.

If the different positions, based on the relevant CRS, are transformed to the other CRS, it shows that all provided coordinates highlight the area in the vicinity of the seabed imprint, as first published and described after geophysical surveys in 2021. Hence, the result shows that the position is in practice the same, especially considering the inaccuracies associated with some of the coordinates from the 1990s. This position coincides with the seabed imprint, i.e., the location where the visor rested before it was brought to the surface.

There is another feature on the seabed, close to this position. This mark has been interpreted as a possible drag mark, but it is a typical natural seabed feature, the likes of which occur throughout the area surveyed during the Preliminary Assessment. Thus, it has nothing to do with the bow visor or its salvaging.

In discussions following the foundering of MV ESTONIA, an image, supposedly based on a sonar picture, has been used to argue that the bow visor in fact lay in the very near vicinity of the bow of the vessel. The analysis shows that those charts only represented the in-situ results of the sand-filling project then ongoing in 1996. The image is not a sonar picture, and it does not show the bow visor.

6. Conclusions

The question of the visor's location when found on the seabed was investigated. It is not possible to state exactly which coordinate systems were used in the JAIC Final Report and in published documents, but all provided coordinates highlight the area in the vicinity of the seabed imprint, as imaged in data from 2006 to 2024.

The visor's location is not thoroughly considered in data from 1990s. The wreck is depicted on charts that date to the 1990s in various ways, with no general commonalities.

The imprint of the visor was illustrated using various datasets.

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