Trimble.

Tech Tip Thursday

Construction Surveying ● Earthworks ● Siteworks Machine Guidance ● Roadworks ● Groundworks ● **Marine Construction** ● Connected Site ● Augmented Reality ● Office Software

Date: **19/03/2026**

Prepared by: **Daniel Fernandez - WEN Sales Engineers Manager**

Understanding marine earthmoving: Rock dumping application

The application

In marine construction, long-distance earthworks are a frequent and fundamental requirement, mirroring the logistical demands of terrestrial projects where trucks are routinely used to displace vast quantities of material. To bridge this gap in a maritime environment, the industry utilizes split hopper barges, specialized vessels designed to transport and deposit dredged material with high efficiency. Unlike standard flat-top barges, a split barge is engineered with a hull that is longitudinally divided into two separate sections connected by massive hinges. This unique configuration allows the entire vessel to mechanically split open at the bottom, utilizing powerful hydraulic cylinders to discharge its cargo directly onto the seabed. This capability ensures that material—whether intended for land reclamation, beach nourishment, or underwater foundations—can be placed with high precision, eliminating the need for external unloading equipment and significantly streamlining the construction timeline.

The challenge

Beyond the technical logistics, the core challenge lies in the inherent featureless nature of the open sea, where the absence of physical landmarks or visual references makes the sea surface a deceptive canvas for precision work. In terrestrial construction, a driver can see a stake in the ground or a boundary fence, but a barge captain must navigate a vast, shifting environment where the target site is hidden beneath meters of water. This lack of "spatial anchors" creates a constant struggle to maintain the vessel's exact station against the relentless influence of currents, wind, and swell, all of which threaten to drift the barge off-target during the critical moments of discharge. Furthermore, managing the material itself involves the difficulty of "seeing" what has been accomplished; once the hull splits and the load is released, the material disappears from view, making it an arduous task to verify the exact shape of the resulting underwater mounds or to confirm that the intended volume reached the seabed without being dispersed by sub-surface flows. This invisibility necessitates a rigorous level of oversight, as reporting the success of the operation depends on interpreting indirect data rather than simple visual confirmation.

What does Trimble offer to overcome this challenge?

To seamlessly address these operational hurdles, Trimble Marine Construction software, paired with purpose-built Trimble hardware, provides a comprehensive solution that transforms these maritime uncertainties into a controlled, high-precision process. By integrating real-time data and robust positioning capabilities, this suite of tools allows operators to overcome the lack of physical landmarks, ensuring that every load is placed with surgical accuracy. This synergy not only simplifies the complexity of underwater earthworks but also maximizes efficiency and transparency, enabling projects to meet rigorous engineering standards while significantly reducing the margin for error in the open sea.

What does the sales configuration for this solution look like?

The following table shows the right parts needed to install a TMC system on a split barge with cm accuracy. In addition, the right source of corrections must be added, being any of the Trimble offerings possible (base station, VRS or RTX), as well as 3rd party signals.

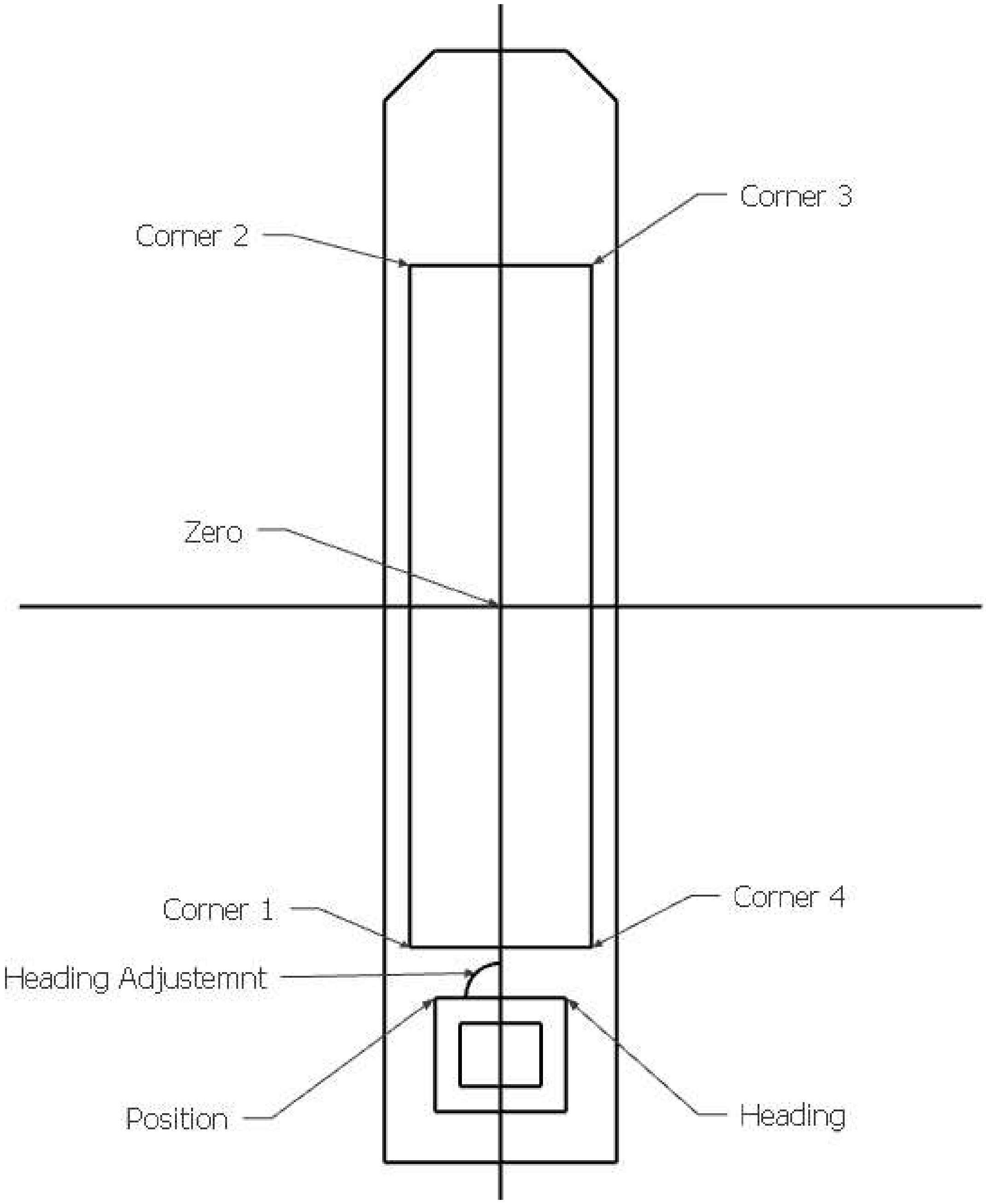
PN	Description	Qty
113300-00	Trimble Marine Construction (TMC) Software	1
TABV12-102-I7	VERSO 12 Touch Display, 4G (ROW), 11th GEN i7	1
132477-050	Cable - VERSO Power, 5M	1
132339-050	CBL,SIG,5.0M,M12,A-CODE,DOUBLE_END,MALE_TO_MALE,IP68_IP69K	1
132126-050	Cable Ethernet- 5.0m, M12A-8P(M) to M12A-8P(F)	1
110262-00-HH	Bracket - Display, Magnetic Mount	1
115108	MECH,MOUNT,4.75X4.75in,2.25in_D_SIZE_BALL,STEEL_REINFORCEMENT,VESA75/100,AL	2
115109	MECH,ARM,8.375in,DOUBLE_SOCKET,2.25in_D_SIZE_BALL,AL	1
92320-24	Kit - Rugged Power/CAN/ETH Add-on for TMC_CSD/TMC_WCN/Groundworks platform kits	1
MAR-MPS566-450	GNSS Heading Receiver - MPS566 410-470 MHz UHF Rover	1
MPS566-CFG-PR	Trimble MPS566, GPS/GLN/GAL/BDS, 3F, MSK, HDG, Precise Rover with RTK Base	1
128018-00	Kit - Mounting bracket with screws, R750, MPS566	1
GNSS-AC-INT	Kit - GNSS AC Power R750, MPS566 International	1
44830-00	Antenna - GA830, GNSS/MSS(Global)/Beacon, Marine	2
52607-HH	Accessories - POLE EXTENSION 25 CM	2
92296-15	Cable GNSS Antenna TNC to TNC LMR400-UF 15 meter	2
56510-64	Kit - External UHF Antenna 430-450MHz R750 MPS566	1

The installation and measure up

The installation of this system is very simple and only requires placing the position and heading antennas at any convenient location along the barge to ensure perfect reception without any sky obstruction, creating a baseline longer than 2m to ensure the best heading accuracy. Usually, the top of the cabin is a great spot, as this allows easily connecting the antennas to their receiver, which sits in the pilot’s cabin, together with the rest of the harness and system’s screen. This is also a great spot for the radio antenna in case there is one as it is high and free of obstructions, which ensures longer reception in open seas.

The measure up of the system is also very simple although still requires the use of a total station to get the most accurate setup. The total station is always set on the deck of the same barge (and not out of the boat as very often someone on site might suggest) with the compensator disabled, to ensure that all the points measured are good on relative distances to each other (even if the hole set is fully wrong in absolute position) - same as any other machine control measure up.

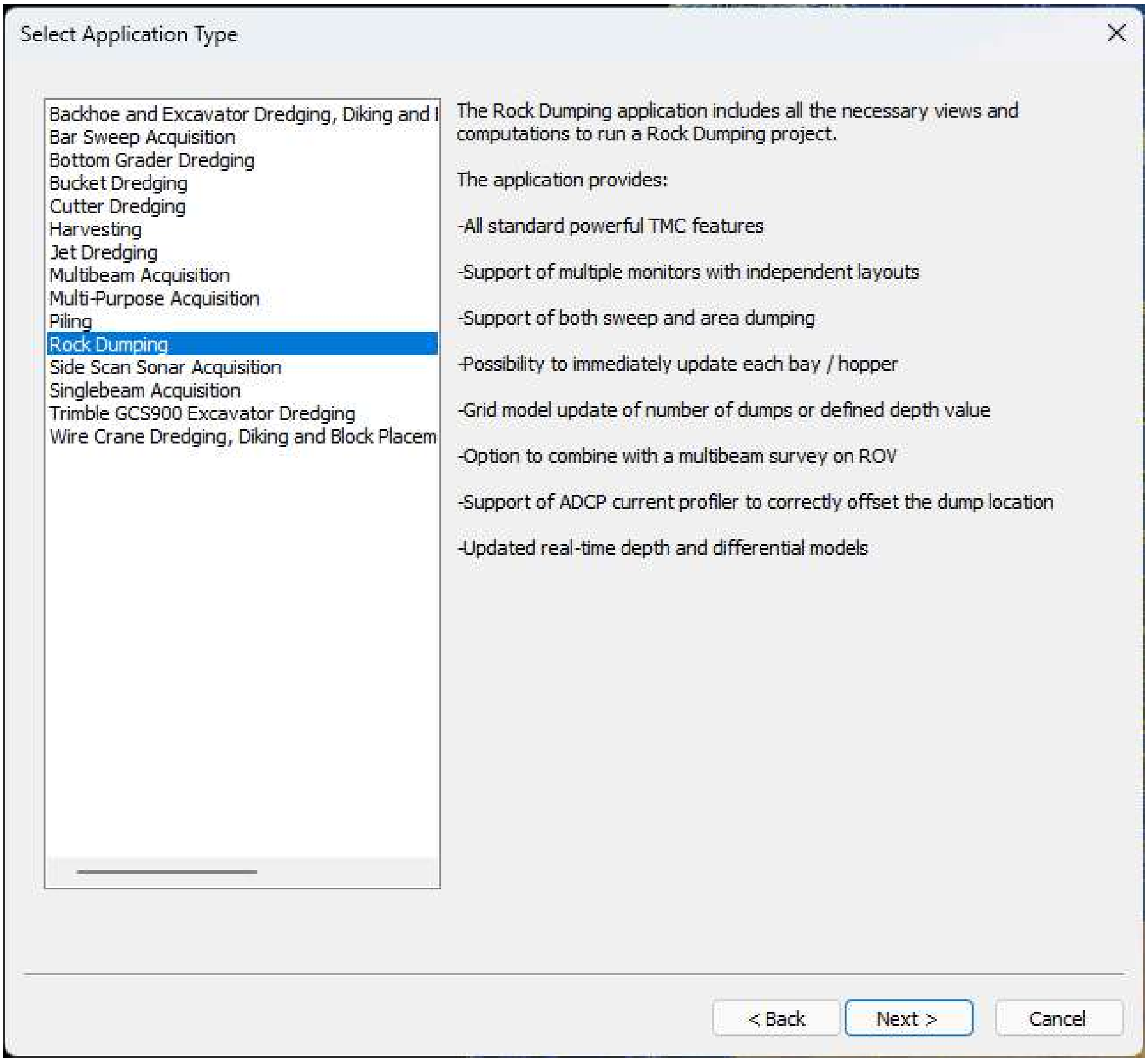
The required points to be measured is as shown on the diagram:



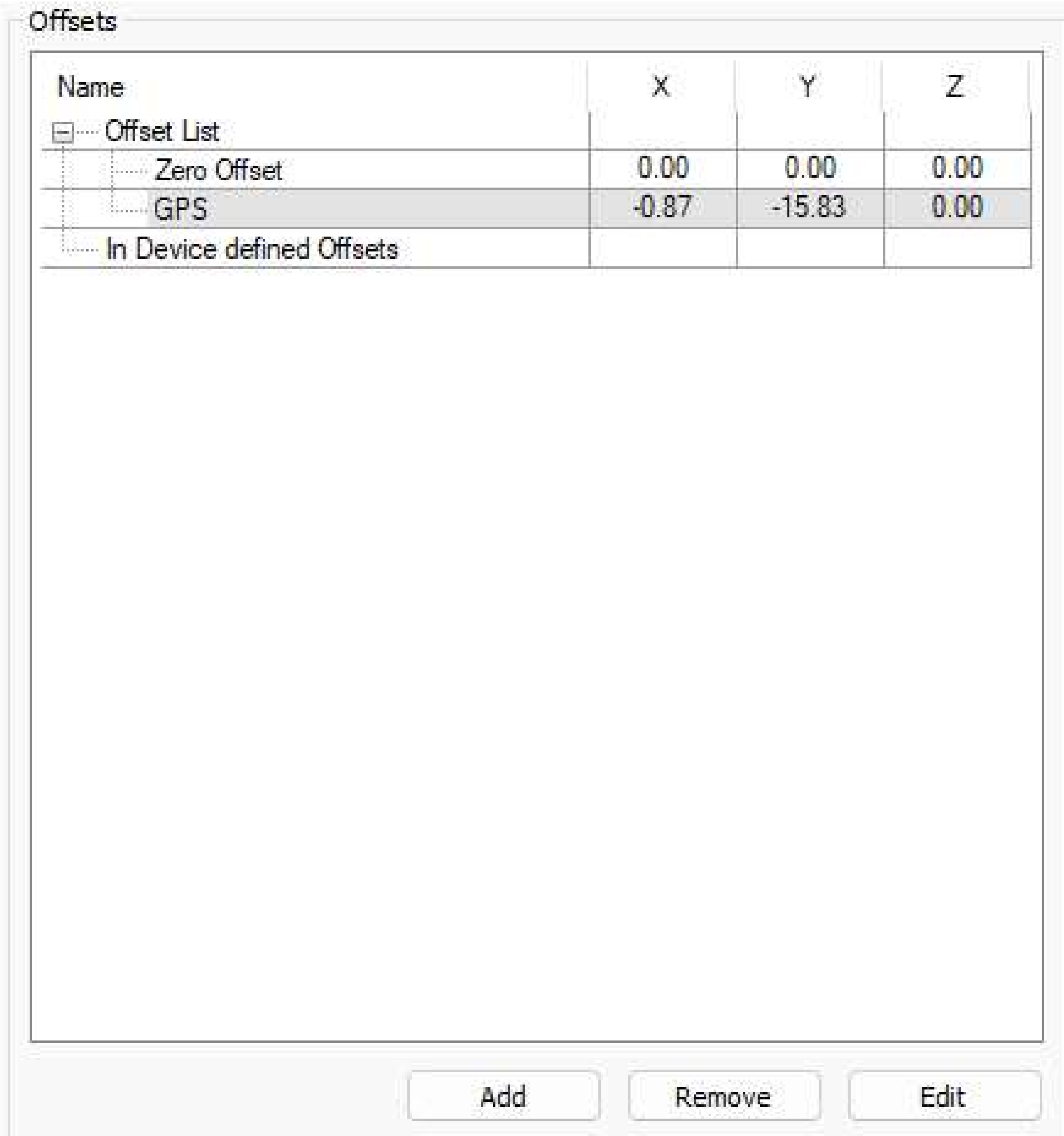
Position antenna APC allows placing the whole vessel on absolute coordinates. The heading antenna APC allows us to compare the H-Pos baseline with the pitch axis of the vessel to compute the heading adjustment. The four corners define the shape of the “hold” compartment where the material is kept during transportation. Some vessels may have more than one hold - if this is the case, their four corners must be measured too. The order of the corners does not matter. Lastly, we also measure any significant point that allows drawing an accurate shape of the vessel. For modeling, one can choose between 3D modelling on Sketchup or creating a plan, side and back views using Trimble Business Center or any other CAD tool.

How to configure TMC for this application

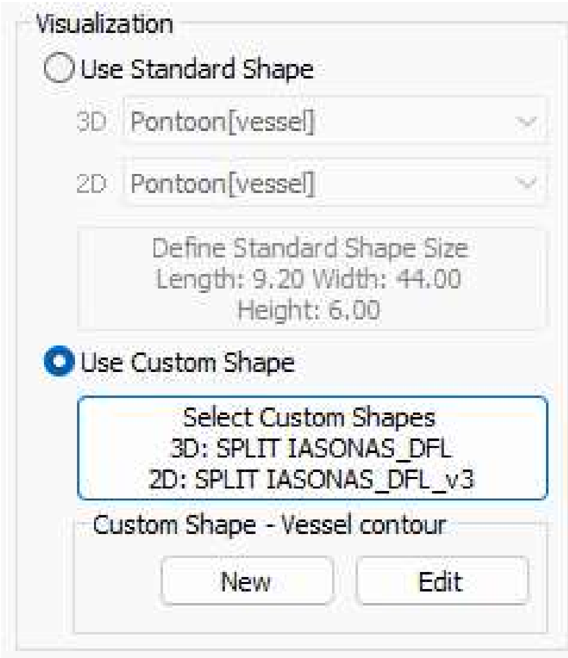
In order to complete a split barge project configuration, you must select "Rock Dumping" as the application type, which will enable the right computations needed to succeed ("Multi-Purpose Acquisition" application will also do).



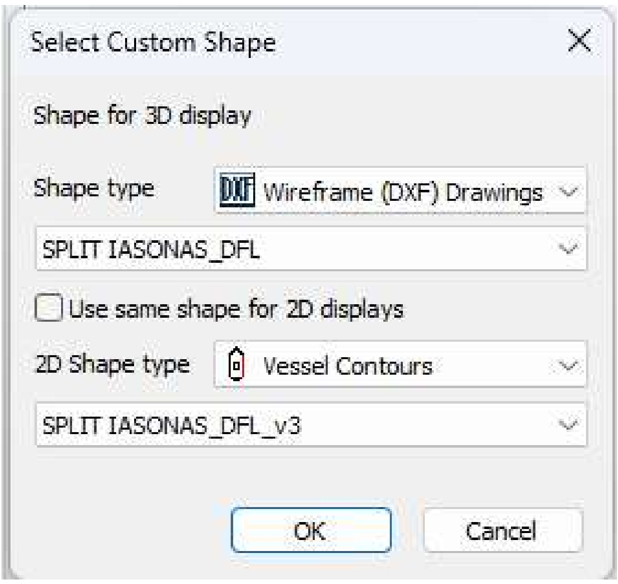
The only two offsets required are the “Position Antenna” offset, which is the distance of this related to the zero of the vessel along the pitch and roll axis (z does not matter on this application) and the “Zero” offset, always present, that can be established anywhere in the barge. In this case, the center of the hold has been established. Positives are front and right directions, while negatives are backwards and left.



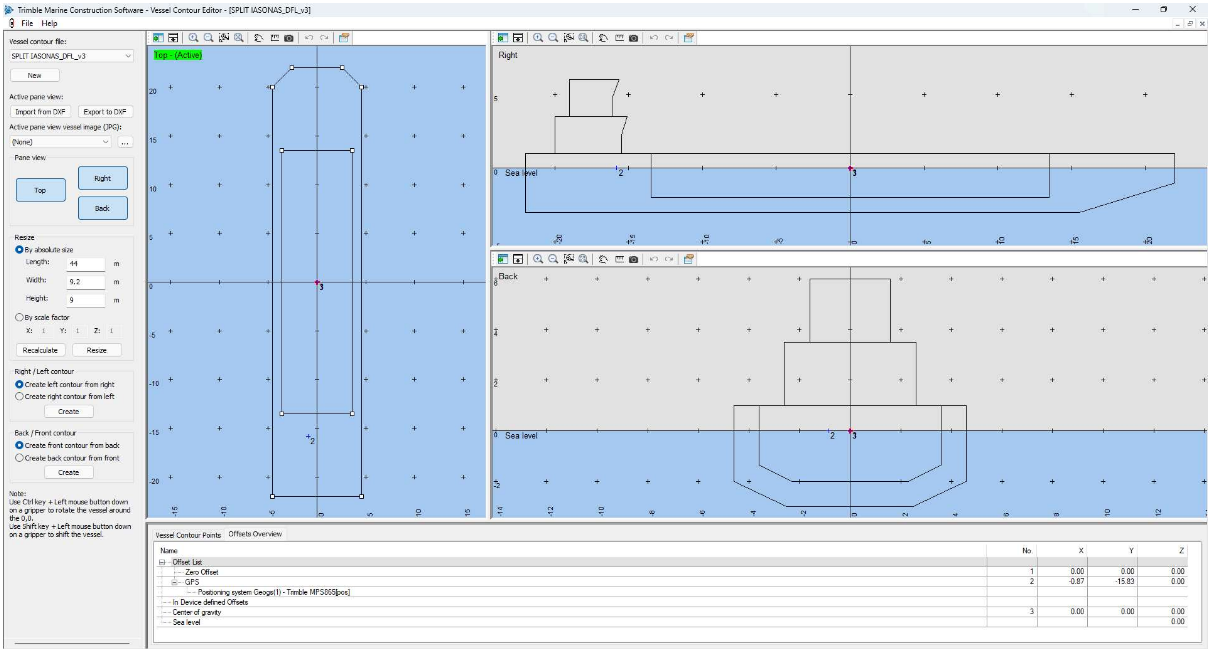
The shape of the vessel will be custom, as it has to be defined according to the measurements already taken.



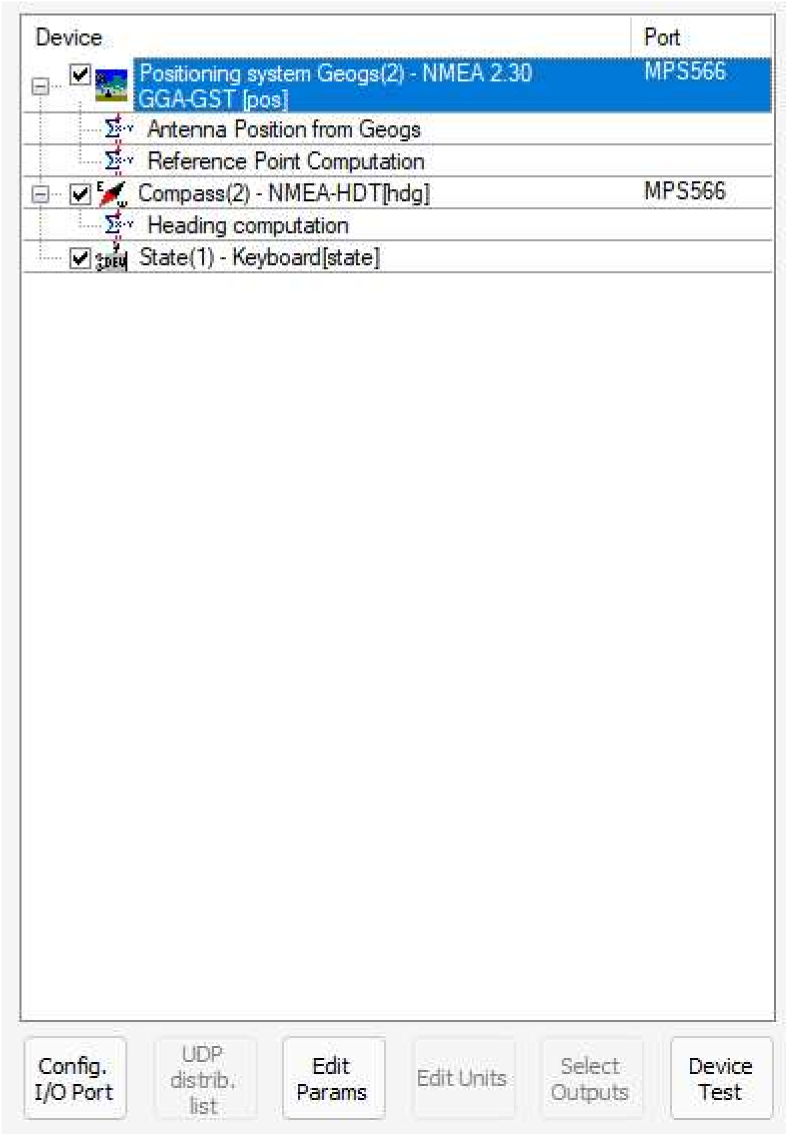
Usually, 3D Sketchup models are used to define custom shapes on 3D visualization, but in this particular example, a DXF file has been taken as shape type. This DXF file has been generated according to the measurements executed and avoids the need to know how to model on Sketchup. This DXF file must be previously placed on the "Project Common Folder" to be displayed on the list as an optional 3D display.



For the 2D views, “Vessel Contours" have been generated from plan, side and back views of the vessel, as shown on the underneath picture. They can be reviewed or edited by pressing on the “2D Overview” button, at the "Geometry page”. If a 3D Sketchup model had been used, these three views would have been taken from the model.

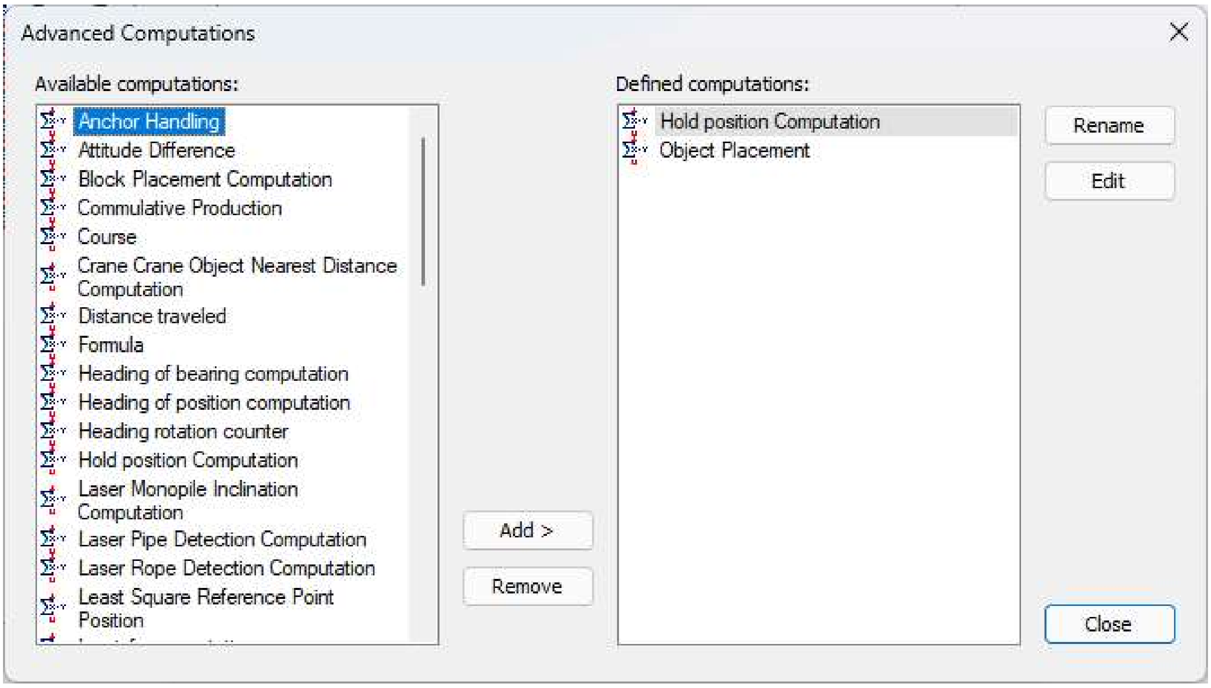


In terms of equipment, this application requires three different types of drivers: “position and compass”, which comes from the same device, the receiver, and “state”, that could come from a remote joystick, but in this case the keyboard will function as a switch.

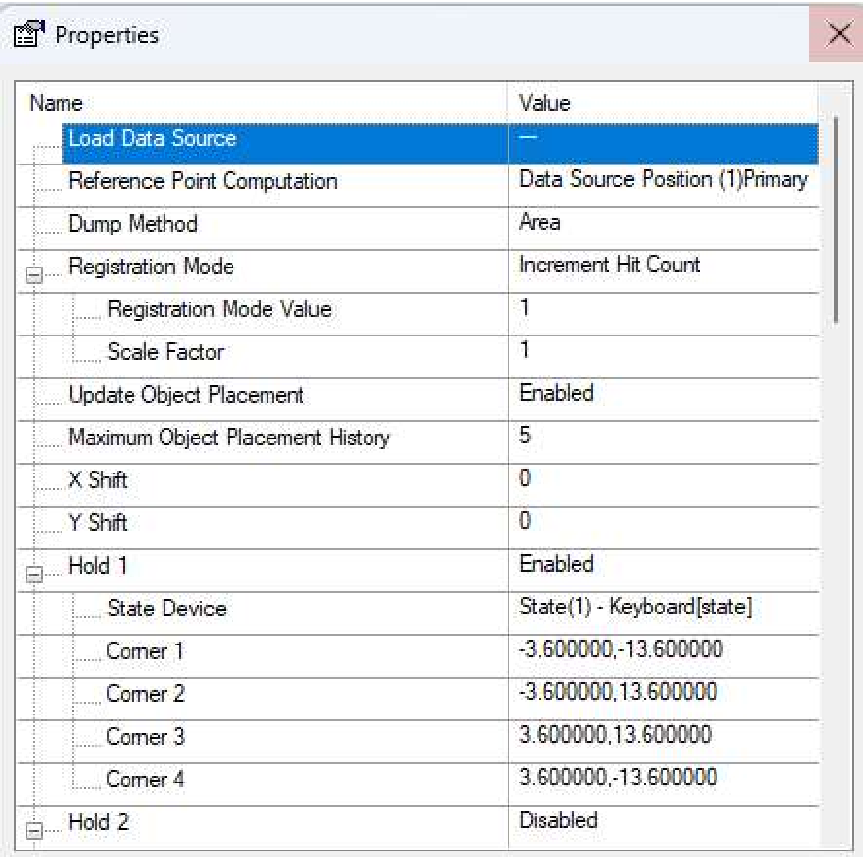


These drivers are commonly used on TMC, therefore the article won’t go too deep on how to set the equipment, the ports required or how to test connectivity. Just to remind that the “position driver” is required to be assigned to the position antenna offset (AKA GPS), so the system knows where in the barge the global coordinates are taken from. Also, it’s important to ensure that the “Time Stamp Mode” is set to “Compute Clock”, as in any other TMC application and on the “heading driver” properties, we can adjust the heading correction computed at the measure up.

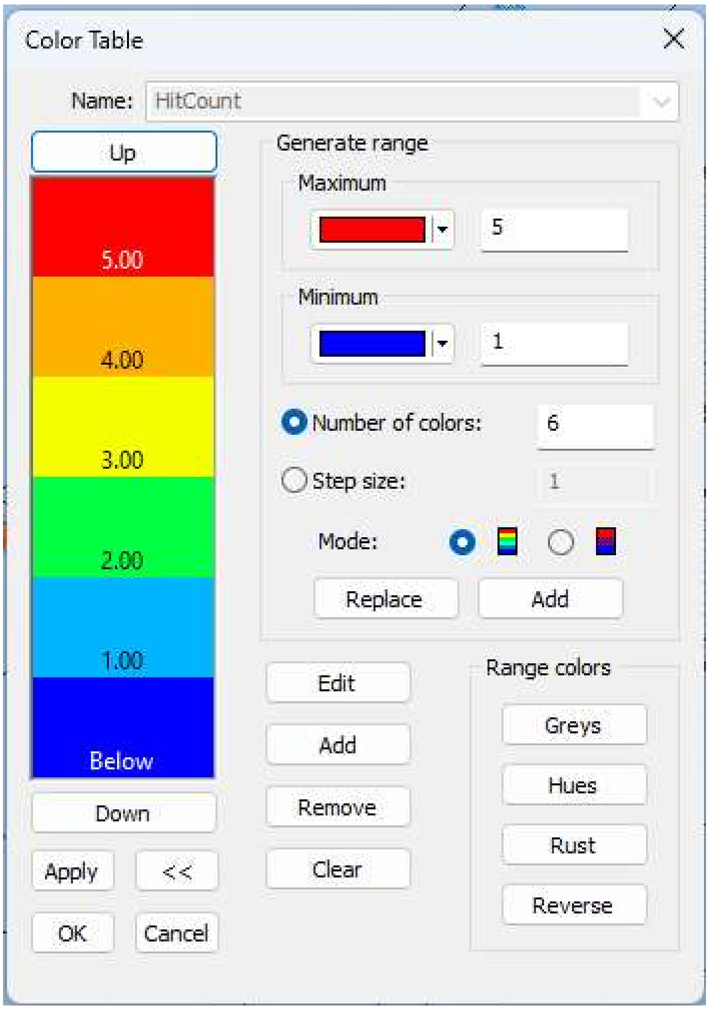
At the computations tab, one advanced computation must be added: "Hold Position Computation". A second advanced computation called "Object Placement" may also be added in case of requiring precise numeric guidance navigation to the dumping site, although this feature will be described in a separate article, as most of the cases does not require its use.



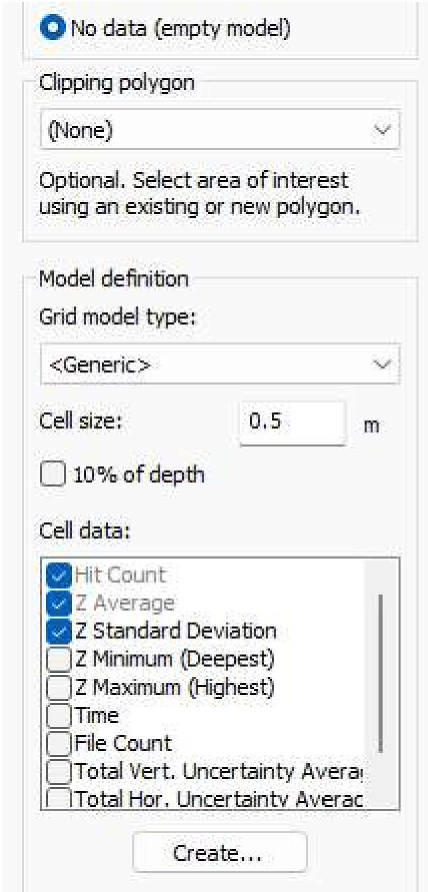
“Hold Position Computation” allows to define the vessel coordinates of the four corners of the hold, as well as which device will be updating it (keyboard state in this case). Also, the “registration mode” can be defined as “Increment hit count”, so every time the barge does an unload on the same spot the grid model will change its colour according to the colour table later defined. It’s also possible to change this behaviour and add an increment on height per pulse or set the elevation to a specific Z at the pulse. “Area Dump Method” is intended for stationary dumps, while “Sweep Dump Method” will record the material for as long as the switch remains pressed, painting the whole area travelled by the hold. It’s important to ensure that the hold is enabled and defined or otherwise the grid model won’t update. Some vessels have several independent compartments - up to eight can be defined.



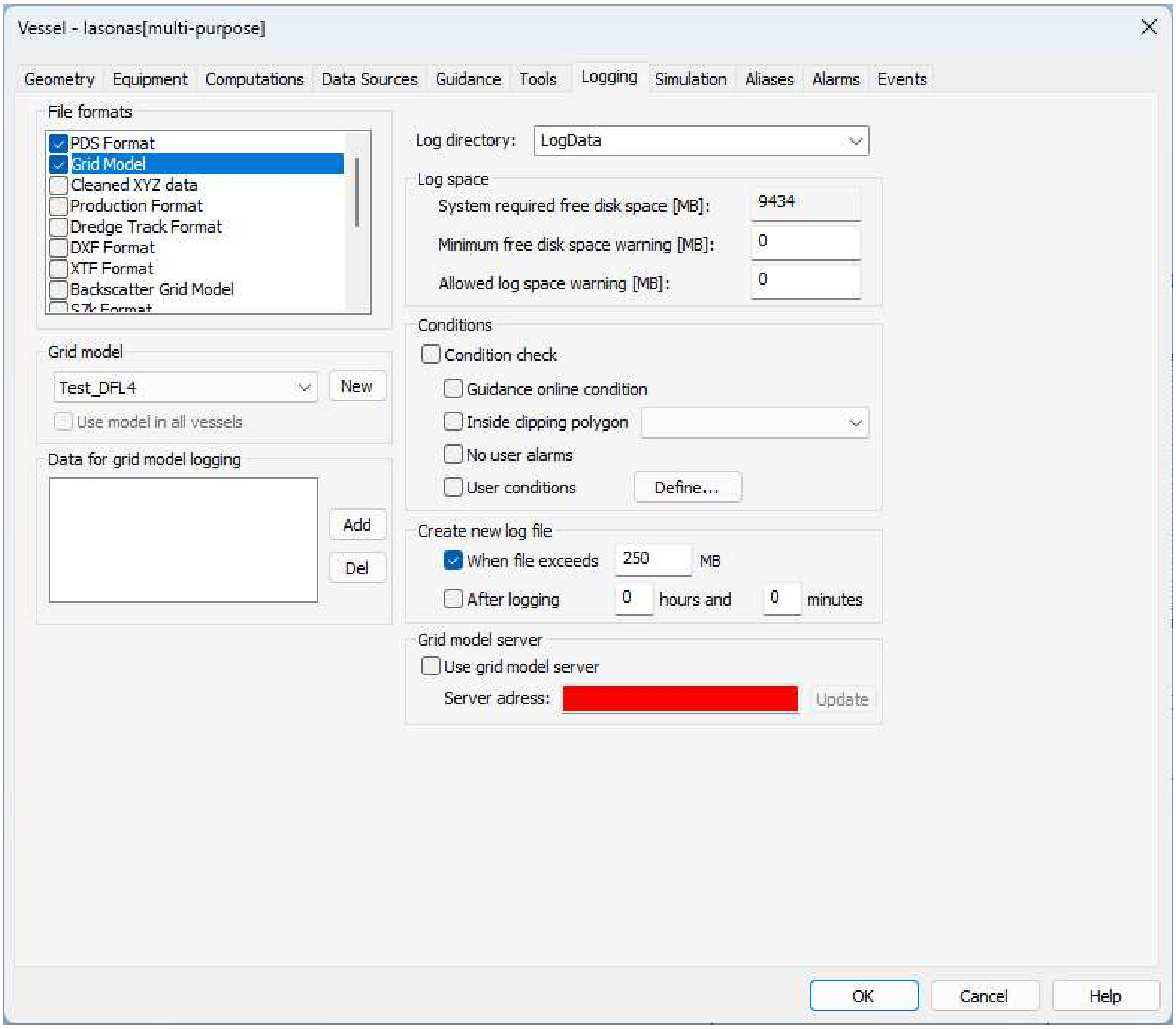
A "Hit Count" colour table must be created to log the hits. This must be created as a "Generic Colour Table" and then, specify the amount of colours or hits to be done per spot. This project has been set with six hits, meaning that a barge location will be considered finished when the barge unloads six times on it. Every number of unloading will have a colour assigned.



At the next step, an "empty grid model" has to be created following the common ways to create them. No data is needed.



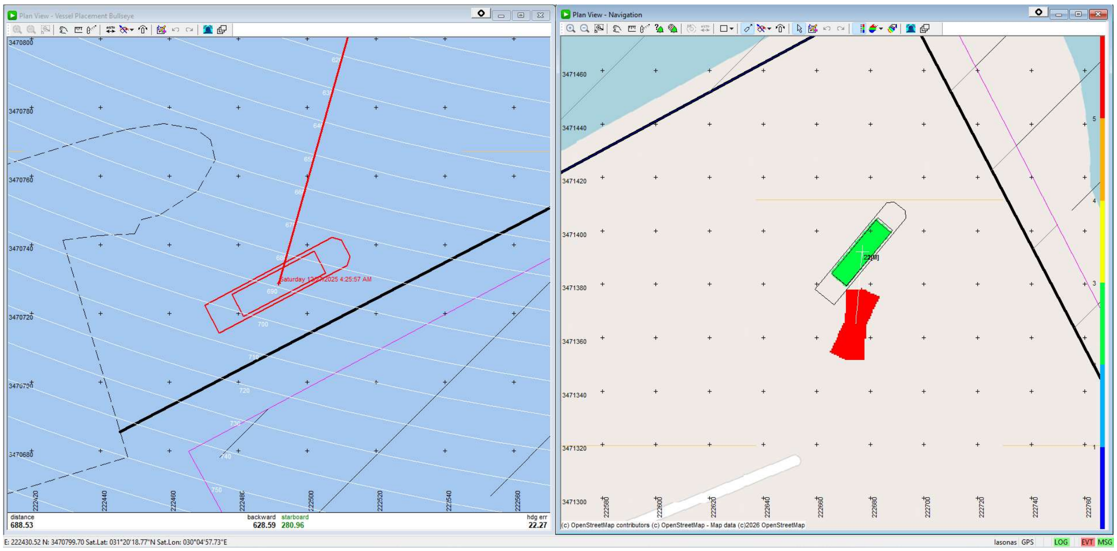
On the "Logging Settings" page, the created grid model must be selected and the "Grid Model File Format" must be enabled.



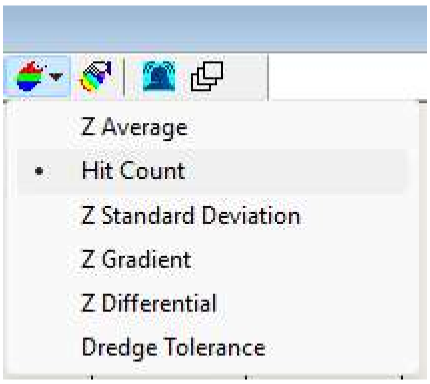
From here, any other valuable project object information can be loaded, such as WMS backgrounds, DXF charts, Ortophotos, etc.

Also, any other guidance object such as waypoints, work areas, runlines, routes or vessel positions can be loaded to guide the pilot to the load and unload areas.

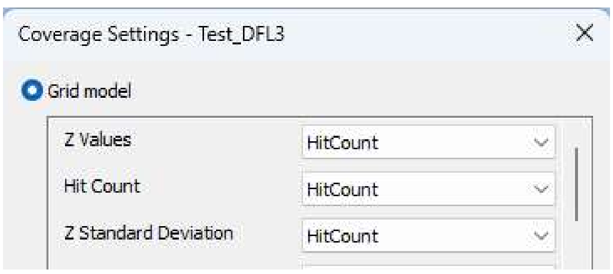
Once the project and its information is set, on the "Acquisition/Online" mode, as many views as needed can be created, although usually, we will need at least two, one for navigating to a loading/unloading place and one for the hit count map, in order to understand how many times the barge has been dumped on the same area.



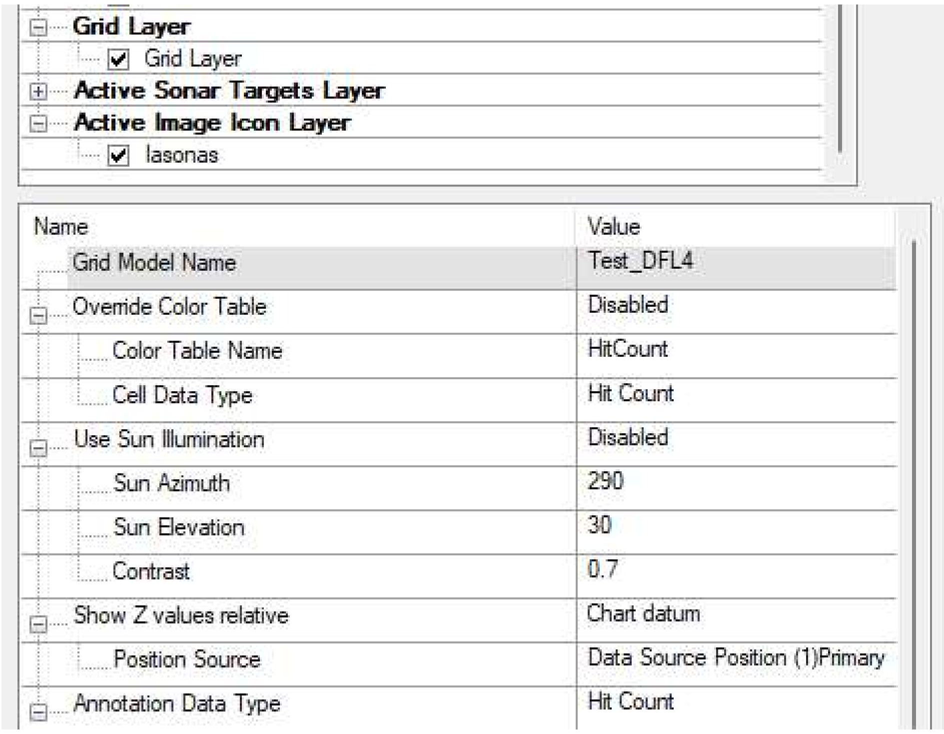
Focusing on the material dumping control, the "Hit Count" grid model color mode must be selected.



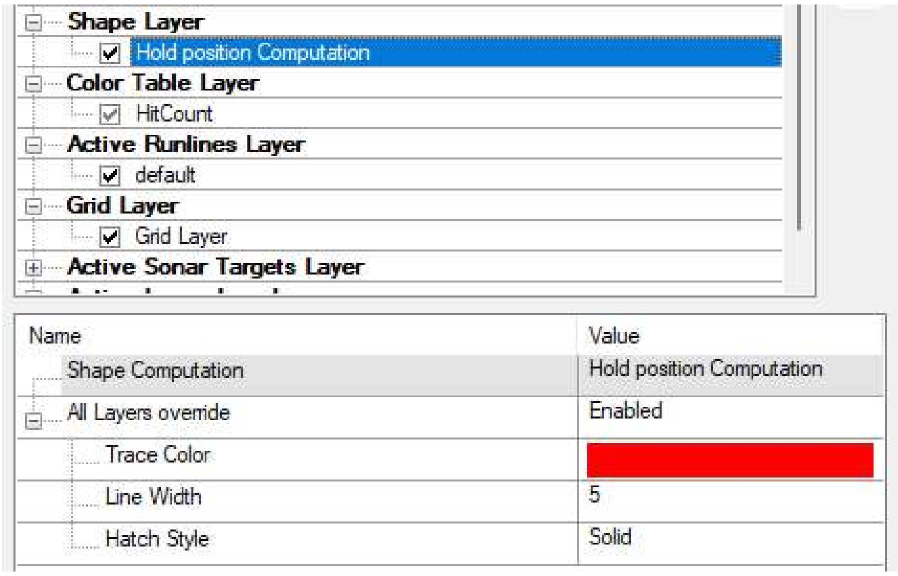
On the "Coverage Settings", the Z values and "Hit Counts" of the grid model must be set to read at the colour table previously created.

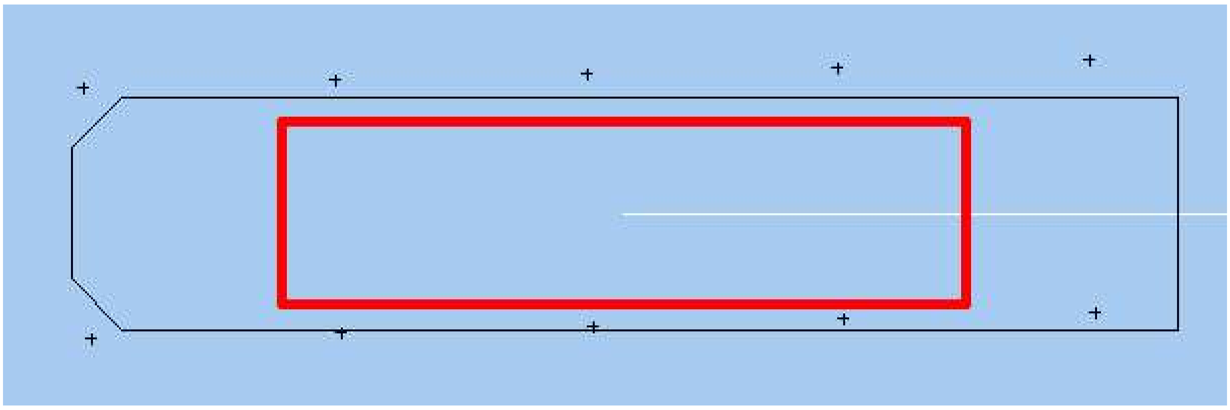


Then, on the "View Properties" of the plan view, the created grid model must be selected as reference grid model for the view, ensuring that the cell data type is set as "hit count" and the right hit count colour table is selected. Optionally, an annotation layer can be added, which will overlay a text with the amounts of dumping made per place.

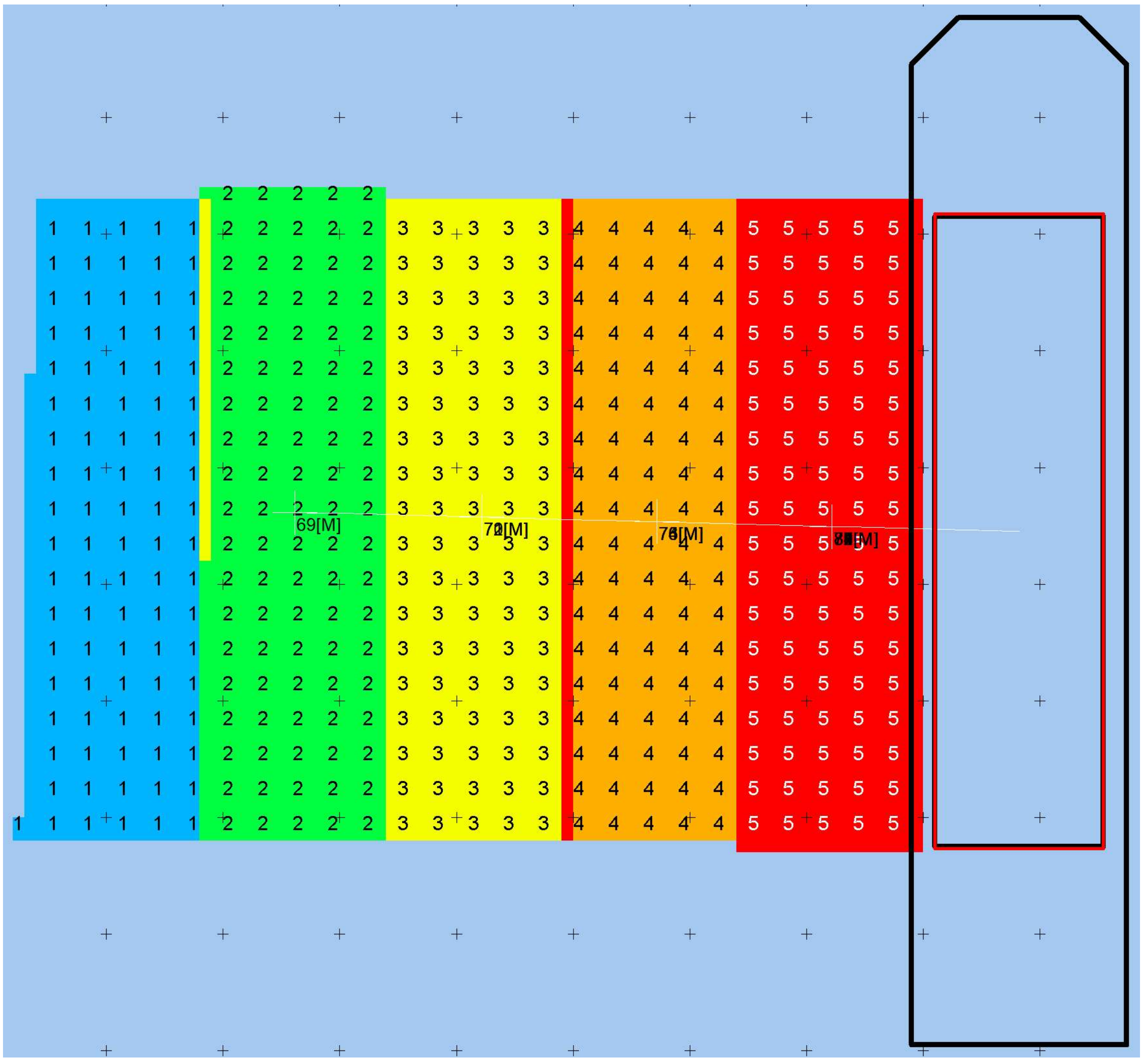


If the hold position wants to be visualized, at the same "View Properties", a new "Shape Layer" must be added with the hold position computation as data source. It's painted in red to improve its visualization.





The following screen shows the operator's navigation plan view with five strips where successive incremental dumps have been done.



This allows the operator to bulk as much material as needed on the precise area to backfill, ensuring that the exact amount finishes on the desired place. This is particularly useful on backfilling projects such as reclamation jobs, scour protection around offshore wind turbine foundations, pipeline and cable padding, underwater trench infilling, and the construction of artificial reefs or breakwater cores.

The following table shows the importance of the precision on the different examples listed:

Application	Why Precision is Critical
Scour Protection	Ensuring an even layer of rock around a monopile to prevent seabed erosion from currents.
Pipeline/Cable Padding	Placing specific material "lifts" over sensitive infrastructure without damaging it.
Trench Infilling	Guaranteeing the trench is fully capped to the design grade after a pipe has been laid.
Breakwater Cores	Building the internal "skeleton" of a harbor wall to exact GPS coordinates before placing armor stone.
Environmental Capping	Placing a clean layer of sand/silt over contaminated sediments without disturbing the layer underneath.

Conclusion

The integration of Trimble Marine Construction (TMC) software and hardware effectively strips away the "blind" nature of underwater earthworks. By transforming a standard split hopper barge into a high-precision positioning instrument, operators move away from guesswork and toward data-driven execution.

Through the use of dual-antenna GNSS heading, custom 3D vessel modeling, and sophisticated "Hit Count" grid mapping, the system provides a digital eyes-on-the-seabed. It solves the primary maritime challenges of drift, lack of landmarks, and material invisibility, ensuring that rock dumping is not just a matter of disposal, but a feat of sub-surface engineering.