

# RANGER product demonstration prop building instructions

Regional competitions may build product demonstration props out of materials other than PVC pipe. Your regional coordinator will inform you of any changes to materials for your regional competition. NOTE: Look for a regional information document posted on your [regional website](#). This document will list any changes to the product demonstration props.

Companies should be aware that tolerances in lengths of cut pipe and length of pipe inserted into joints can change the overall dimensions of product demonstration tasks. Except where noted, companies should expect tolerances in all product demonstration props and should build their ROVs and tools accordingly. In no case should the dimensions given in this document for a product demonstration prop be used to calibrate a measuring device.

Online links and Home Depot part numbers are given for certain construction items. However, some Home Depot stores may not carry the listed items or Home Depot may not be available in your area. MATE recommends checking other local hardware stores or online sources, such as those listed below, for the required component.

<https://www.pvcfittingsonline.com/>  
<https://pvcpipesupplies.com/pvc-fittings/schedule-40-pvc-fittings/>

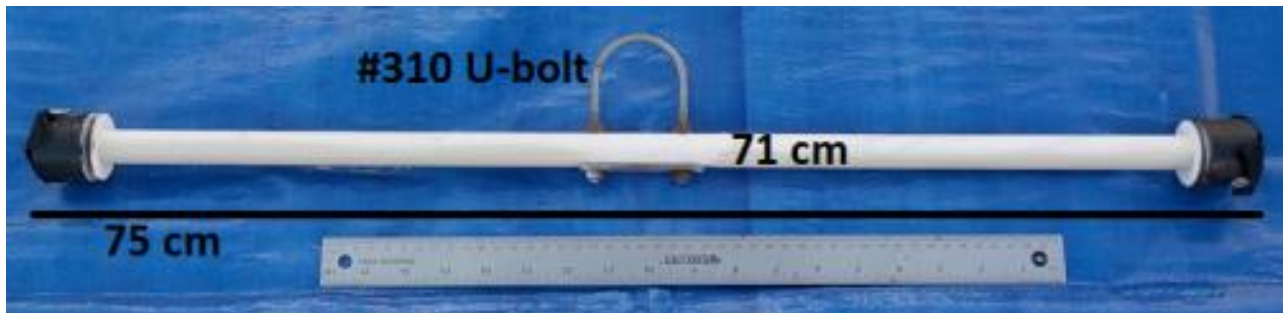
SolidWorks files will be available soon for all product demonstration props. [SolidWorks Student Edition](#) is free for MATE competitors. The [eDrawings Viewer](#) is a free download that allows the Solidworks files to be viewed dynamically.

See last page for update notes (if any).

## Task 1: Marine Renewable Energy

### The Inter-Array Power Cable

There are three sections of the inter-array power cable.



This is one section. Each section of cable is constructed from ½-inch PVC pipe with a [#310 U-bolt](#) as a grab point. Both ends of the pipe have 1-inch end cap covered with Velcro hooks. The overall length of each array cable section is 75 cm.



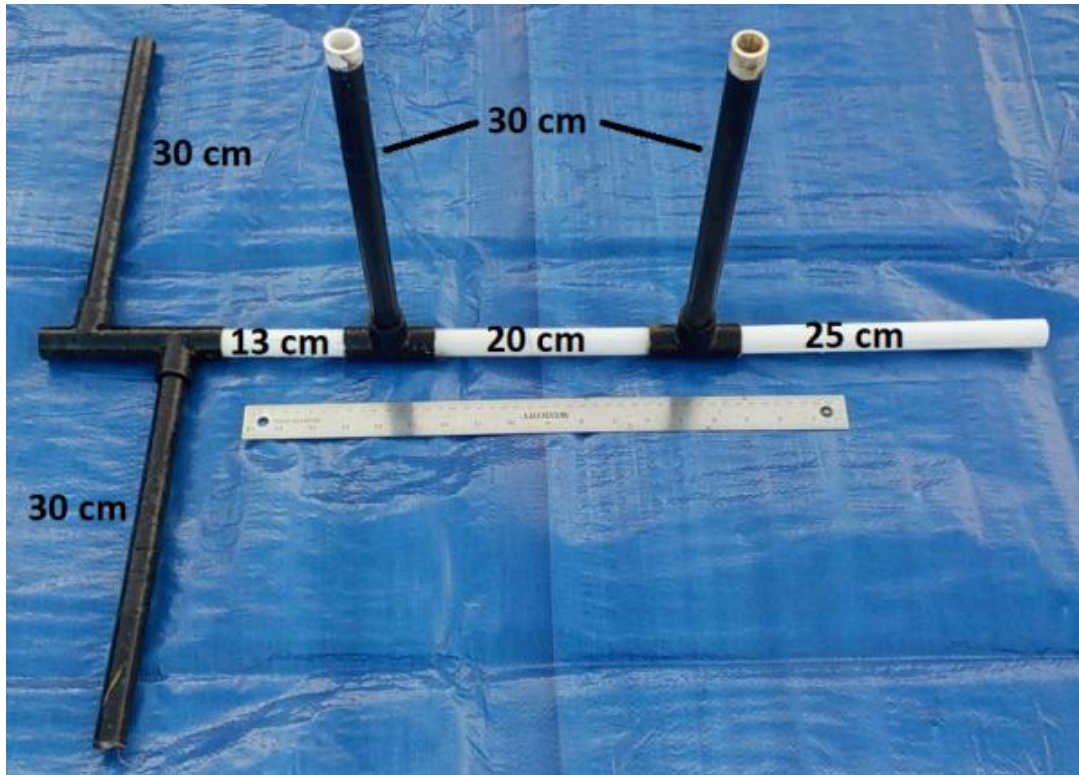
1-inch end cap covered with Velcro hooks. A 1-inch to ½-inch reducer bushing is used to connect the end cap to the ½-inch pipe. Note that screws are used to secure the Velcro to the end cap.



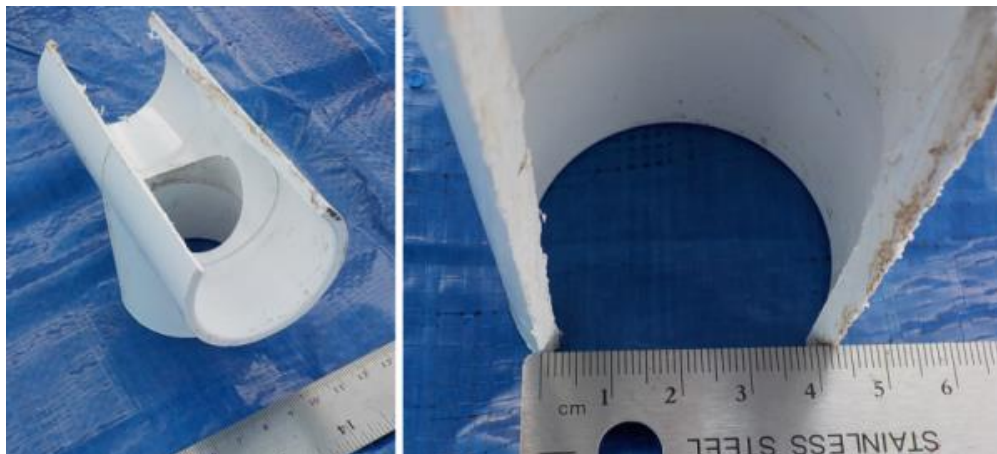
The damaged section of the inter-array cable. The damaged section is a spot of [brown](#) paint at least 1.5 cm in diameter.

### The Inter-Array Power Cable Stands

There are a total of five inter-array power cable stands.



Three of the stands hold one of the three sections of cable. The total length of the base of these stands is approximately 77 cm. When the 25 cm end of one stand is inserted into an adjacent stand, the total length of the stand will be 75.5 cm, slightly longer than the 75 cm length of the array cable. The stand does not need to be painted black.



A 1 1/2-inch tee cut to form a cradle for the inter-array cable stand.

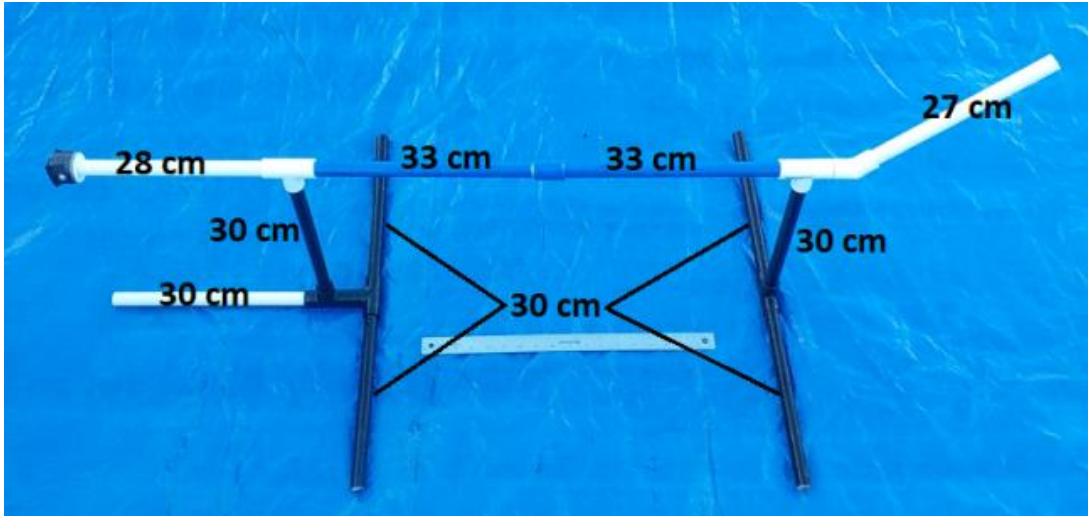


A [1 ½-inch to ½-inch reducer bushing](#) is used to connect the cradles to the stand.

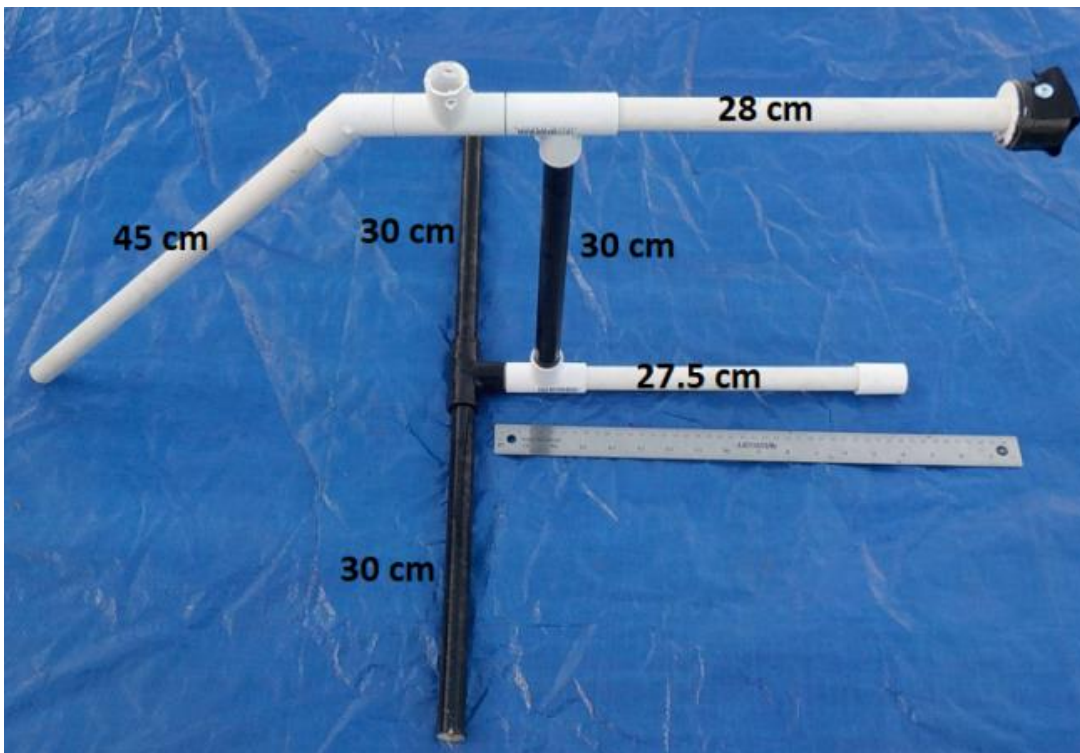


Two cradles connected to one stand.





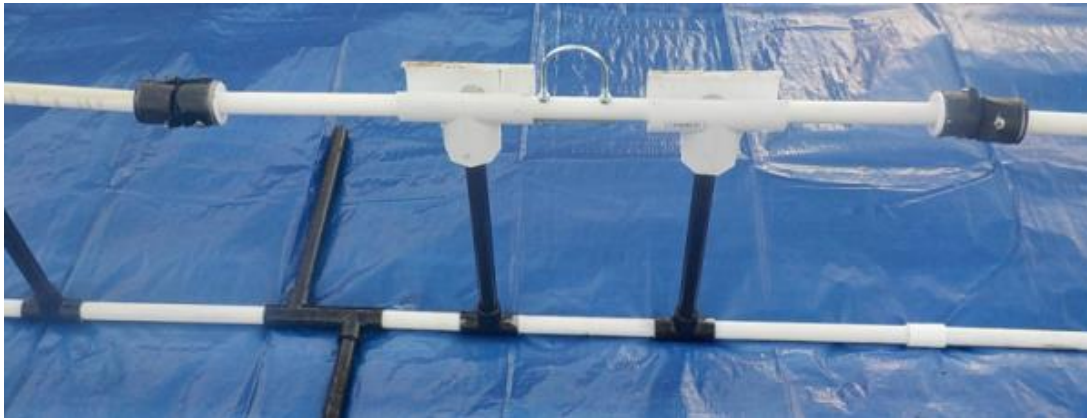
Two of the stands make up each end of the inter-array cable. One end of the inter-array cable will have the damaged buoyancy module attached. On this end the 27 cm pipe angled up represents the inter-array cable that leads to the floating offshore wind turbine.



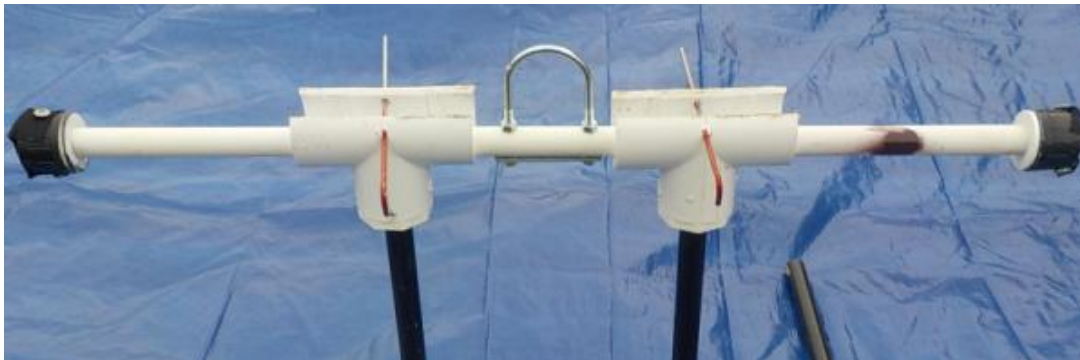
The other end of the inter-array cable will have the ghost net attached. On this end the 45 cm angled down represents the inter-array cable that leads to the offshore substation.



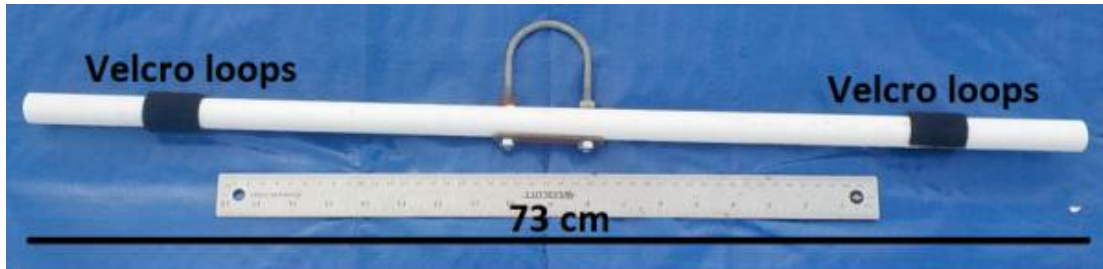
All five stands connected together. Note that 3/8-inch rebar inserted inside the central PVC pipes of the inter-array cable stands will provide weight and stability to the stands.



An inter-array section of cable in two cradles.



The array cable secured in place with [pins](#). The pins are inserted through two 1/4-inch holes drilled in the cradles. Note: The pins are positioned over the 1/2-inch pipe of the array cable; they do not pass through the pipe of the array cable.



The new section of cable.



A wet-mateable connector constructed from a [1-inch x 1-inch x 1/2-inch tee](#).



Both wet-mateable connectors on the new section of cable. Note that the Velcro loops on both the cable and connectors will provide enough friction to hold the wet-mateable connectors onto the cable during transport, but still allow ROVs to slide the connectors along the pipe.



The new inter-array cable installed into two cradles.





The wet-mateable connector secured to the end of the old array cable.

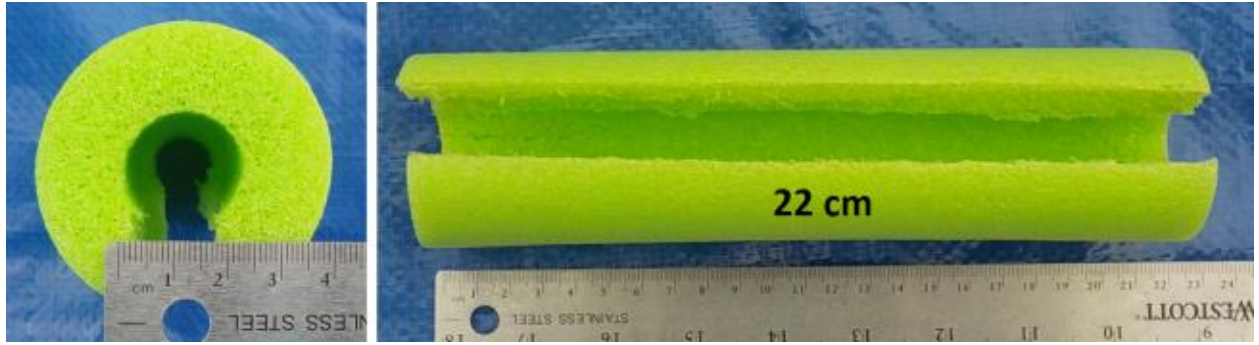
**NOTE:** The goal of the stands is to hold the three sections of the inter-array cable in a line, with the ends of each section of cable 0.5 cm from the end of the adjacent cable. Companies may need to slightly adjust the length of pipes in the stands so that all of the cables line up properly.

### The Buoyancy Module

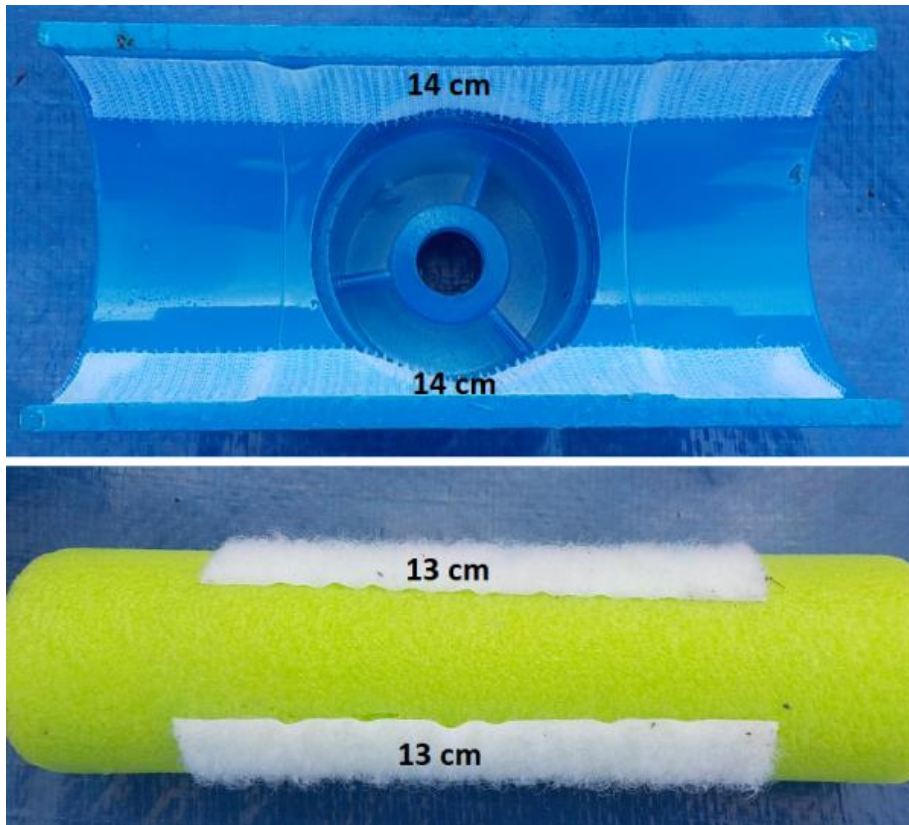


The body of the buoyancy module constructed from a 2-inch tee cut lengthwise, a [2-inch to ½-inch reducer bushing](#) and ½-inch PVC pipe.





Foam flotation with a 2 cm slot cut out lengthwise.



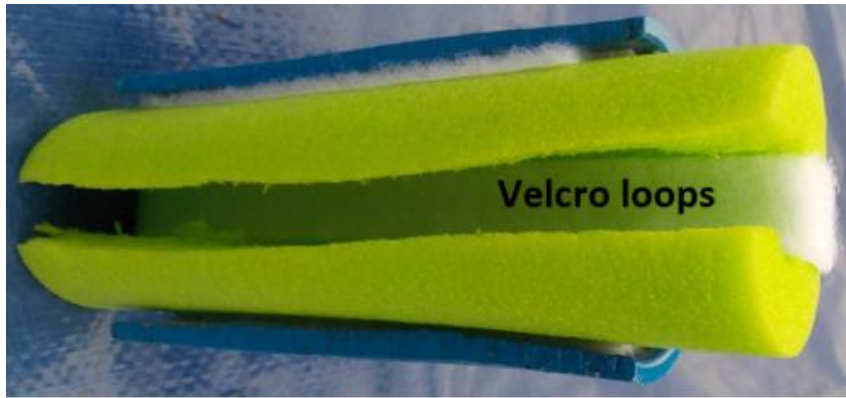
Velcro hooks on the inside of the 2-inch tee attach to Velcro loops on the foam flotation.



The complete buoyancy module.



The failed buoyancy module attached to the array cable. Note that the buoyancy module is positively buoyant in water and will stay positioned on the underside of the array cable.



The new buoyancy module with Velcro loops on the inside of the flotation. Note that the Velcro does not stick well to the foam, so the Velcro loops can be wrapped around to the outside of the new buoyancy module and secured to the PVC tee with screws.



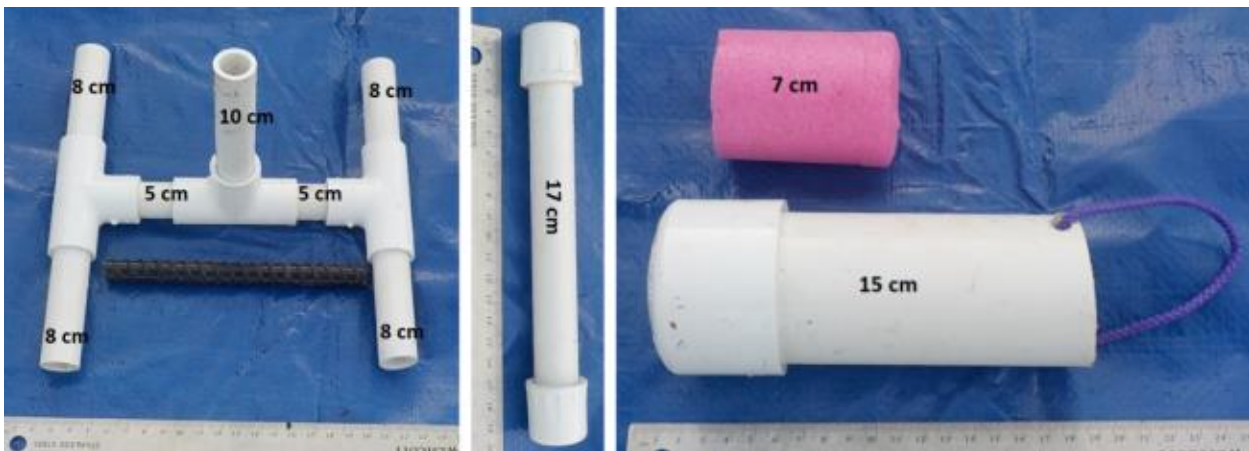
Velcro hooks on the underside of the blue section of the cable.



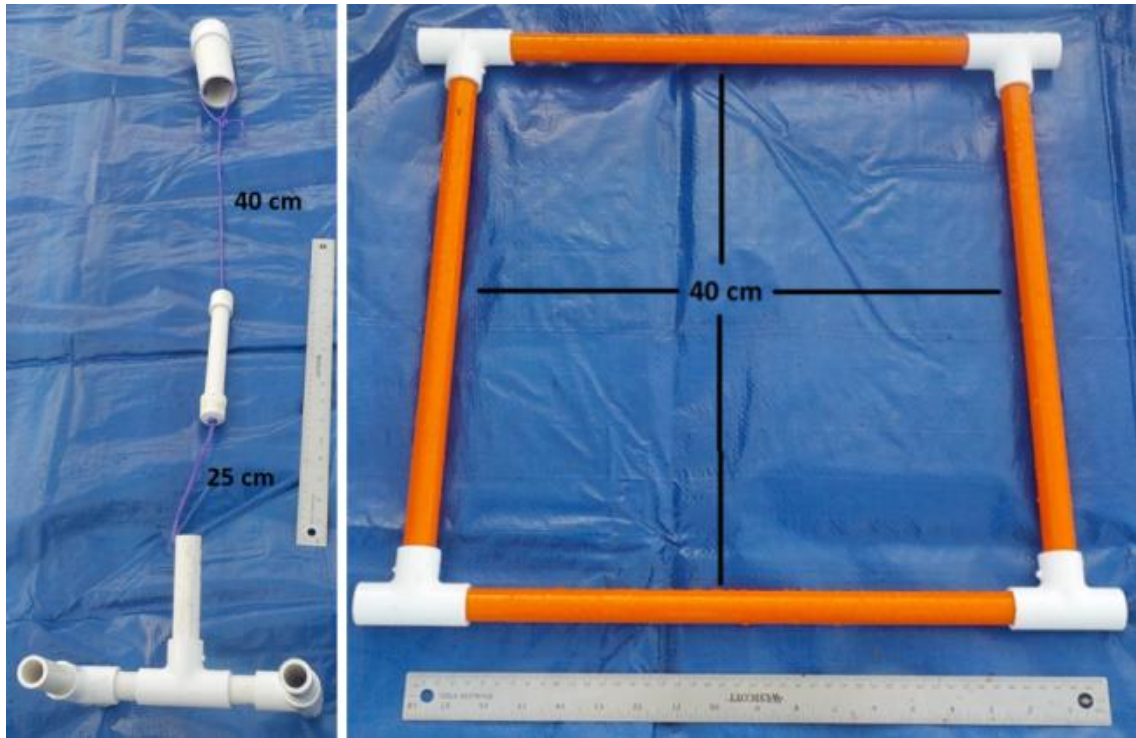


The new buoyancy module secured to the inter-array power cable. The Velcro loops inside the foam flotation are attached to the Velcro hooks on the bottom of the cable.

### The Hydrophone



Left: The hydrophone stand constructed from ½-inch PVC pipe. A length of painted rebar inserted into the pipe will act as ballast. Center: The hydrophone. Right: The float of the hydrophone constructed from 2-inch PVC pipe. Overall, the hydrophone is negatively buoyant, but foam flotation inside the pipe will provide buoyancy so that it is lifted off the bottom of the pool.



Left: The hydrophone components. Right: The designated area for the hydrophone.

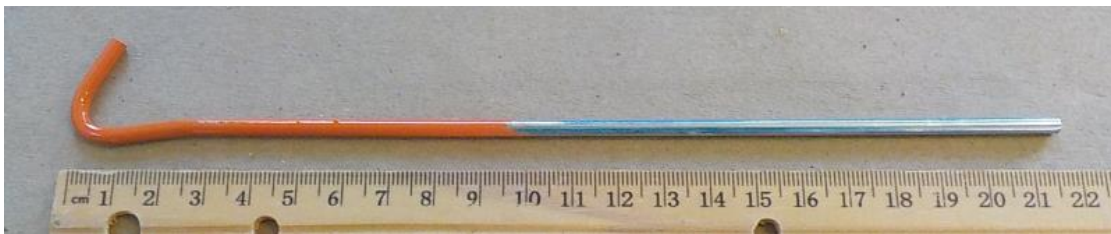
### The Ghost Net



The ghost net ½-inch PVC framework.



Left: The [decorative cloth netting](#) of the ghost net. Right: The decorative cloth netting is attached to the framework. Flotation is added to the top, and an 18 cm length of PVC is added to the bottom of the net for weight.



The ghost net [pin](#).



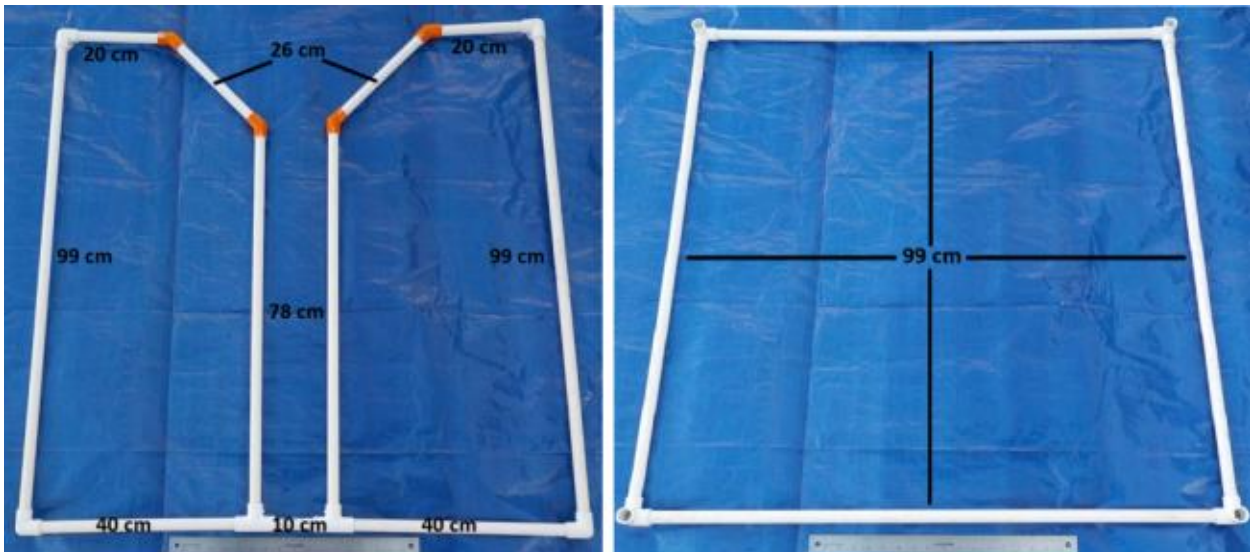
Left: The ghost net is attached to the rope. Right: The pin runs through the  $\frac{1}{4}$ " holes in the PVC tee and through loop in the rope. The other end of the rope attaches to the inter-array cable.



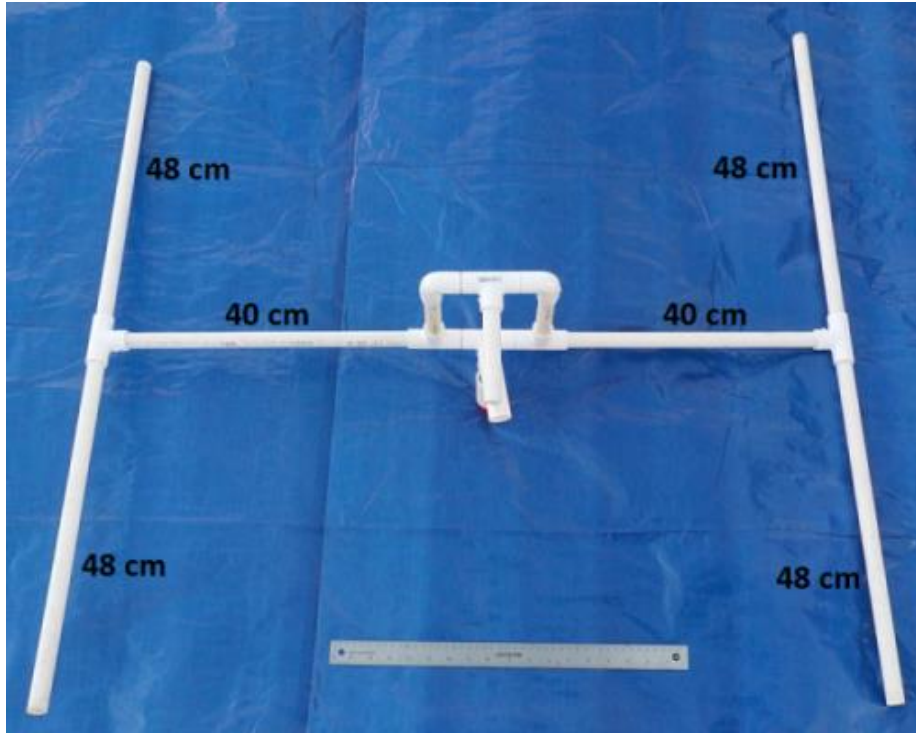


The ghost net secured to the inter-array cable

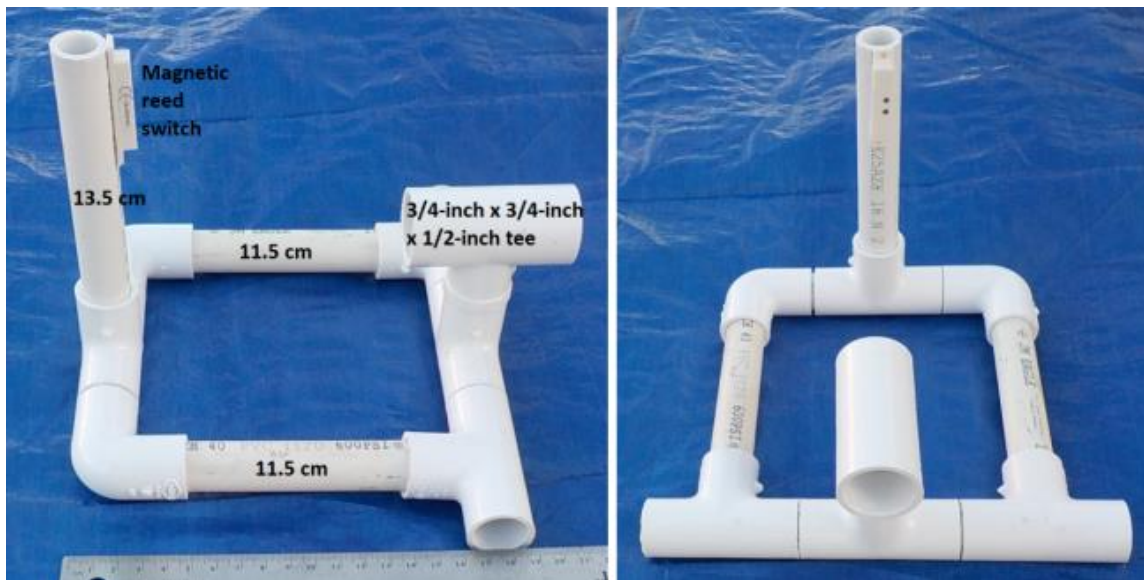
**The Resident ROV Docking Station**



Left: The top of the docking bay constructed from ½-inch PVC pipe. Right: The base of the docking bay constructed from ½-inch PVC pipe.

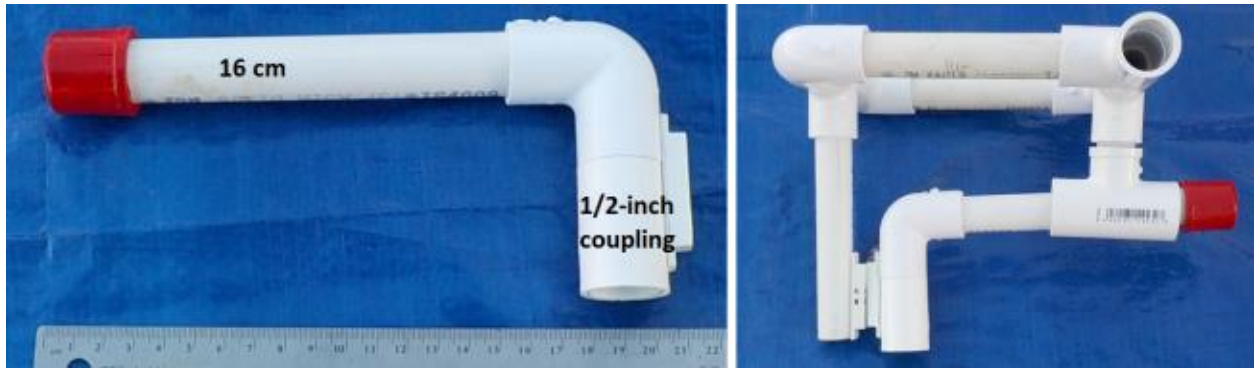


The back side of the docking bay constructed out of  $\frac{1}{2}$ -inch PVC pipe. Note: If not building the push button to illuminate the LED on the surface, use four 99 cm lengths of  $\frac{1}{2}$ -inch pipe as the four vertical stanchions.



Side view and front view of the framework for the push button at the back of the docking bay constructed from  $\frac{1}{2}$ -inch PVC and a  $\frac{3}{4}$ -inch x  $\frac{3}{4}$ -inch x  $\frac{1}{2}$ -inch tee.





Left: The push button with a magnet installed. Right: The button pushed in and the magnet adjacent to the [magnetic reed switch](#).



The docking bay framework.





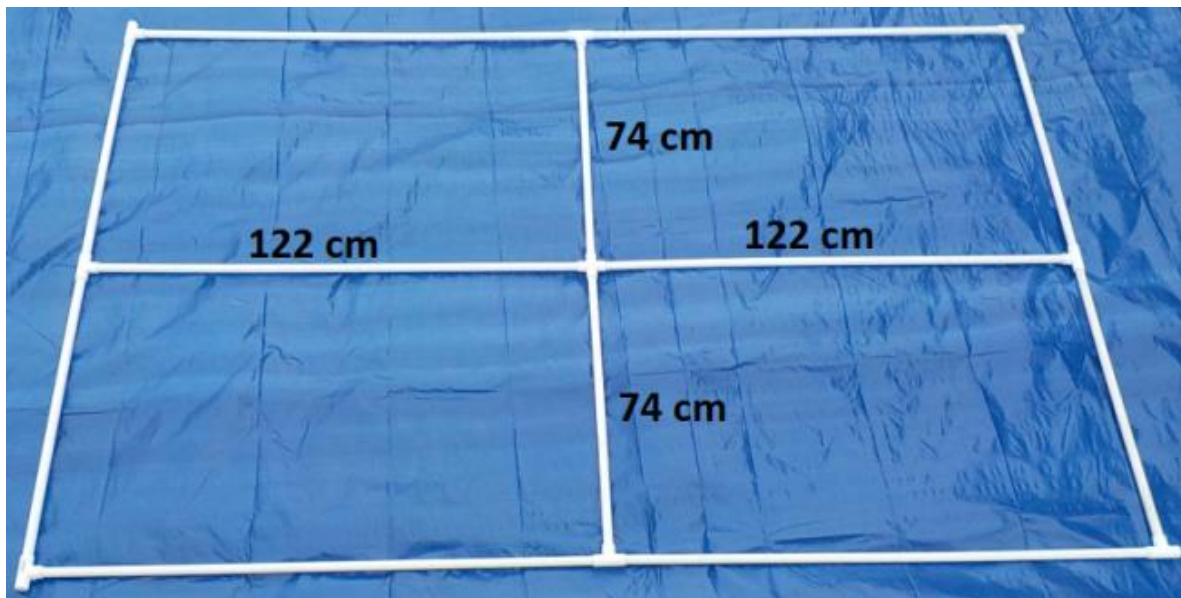
Left: [Corrugated plastic sheeting](#) on top of the docking bay. Right: Corrugated plastic sheeting on the sides of the docking bay.



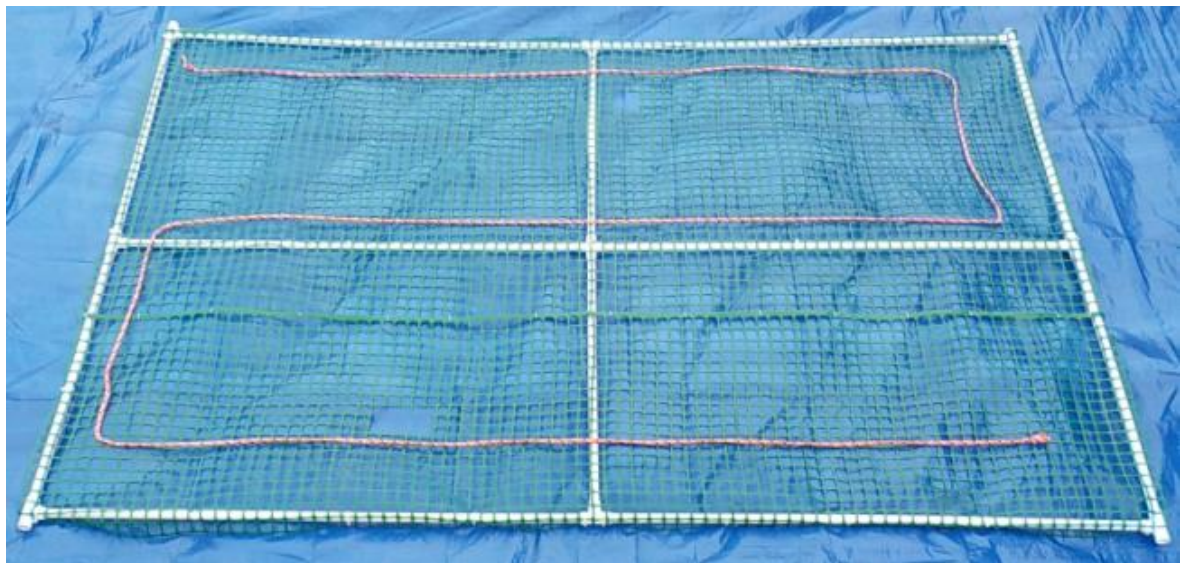
The docking bay with corrugated plastic sheeting attached.

## Task 2: Offshore Aquaculture and Blue Carbon

### The Offshore Aquaculture Fish Pen



The ½-inch PVC framework for the fish pen.



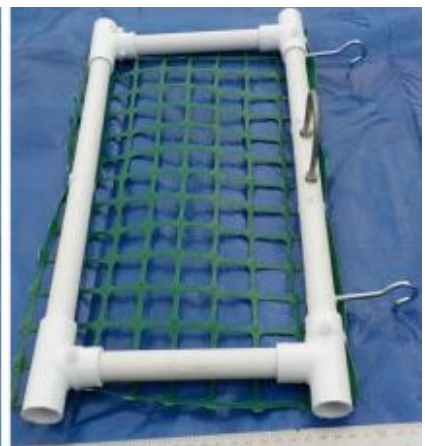
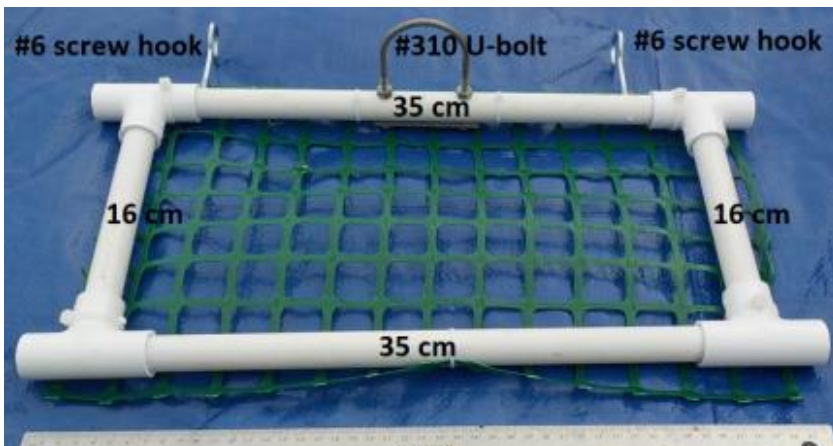
The fish net pen with [1-inch mesh netting](#) with [red rope](#) attached.





A damaged area of the fish net pen.

### Patch for Repairing the Pen



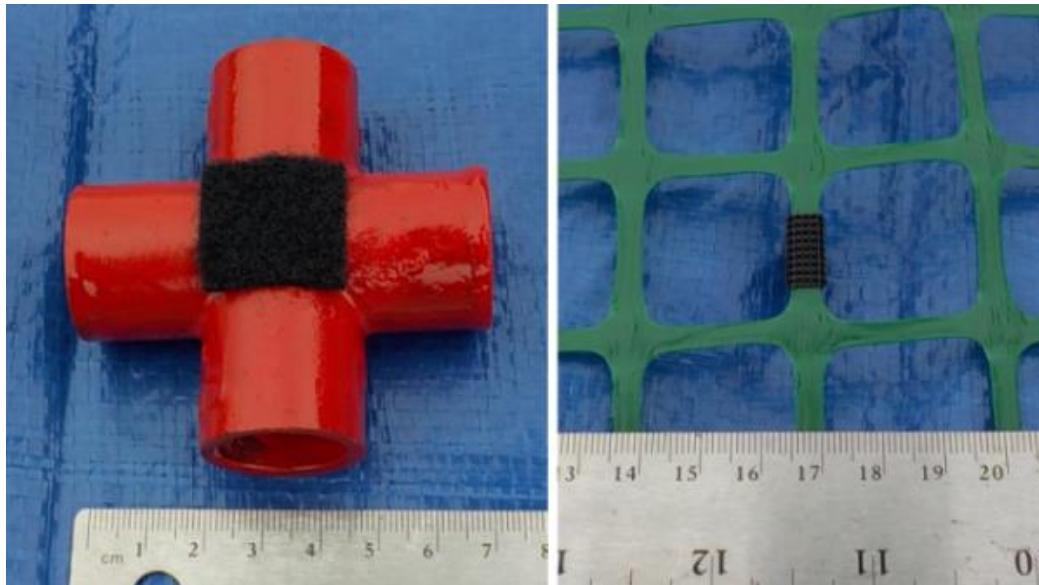
Left: The fish net pen repair patch front view with dimensions. Two [#6 Screw hooks](#) act as attachment points to the mesh netting of the fish pen. Right: A side view of the fish net pen repair patch.



The repair patch installed successfully over a hole in the net.



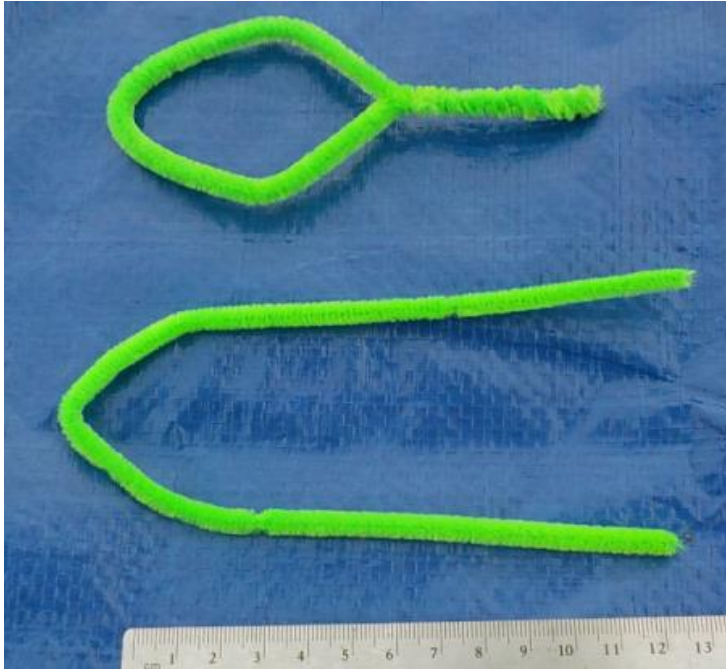
## Marine Growth



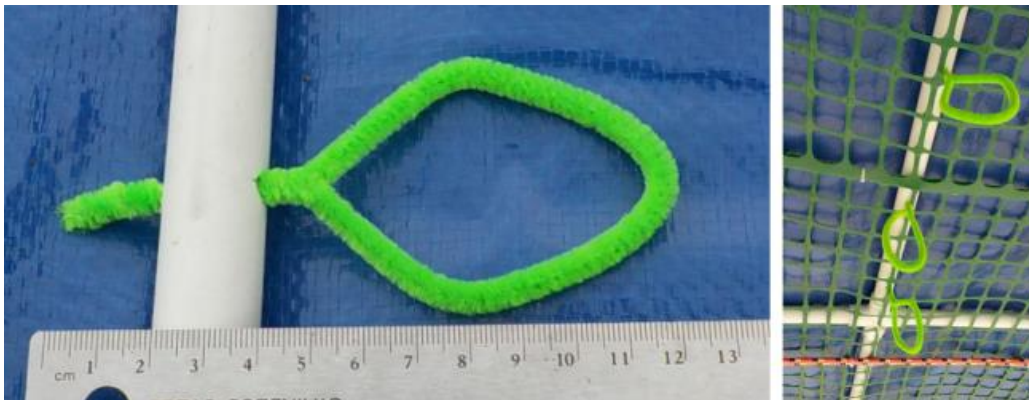
Left: ½-inch cross of the encrusting marine growth with a 2 cm x 2 cm square of Velcro loops. Right: Velcro hooks on the mesh net pen. A 2.5 cm x 1 cm rectangle of Velcro hooks around the mesh will create a 1 cm x 0.8 cm area of Velcro to secure the encrusting marine growth.



The encrusting marine growth attached to the fish pen netting.



An algal marine growth. Four cm of the two ends of the [chenille strip \(pipe cleaner\)](#) are twisted together to create the algal marine growth.



Left: The algal marine growth inserted into a 3/16-inch hole in the PVC pipe. Right: Three algal marine growths on the fish net pen.

## “Mort”



A [plastic fish](#) “mort”. A 30 cm rope acts as a grab loop. Weights (painted rebar) inserted into the mort will achieve negative buoyancy.

## Collection tube



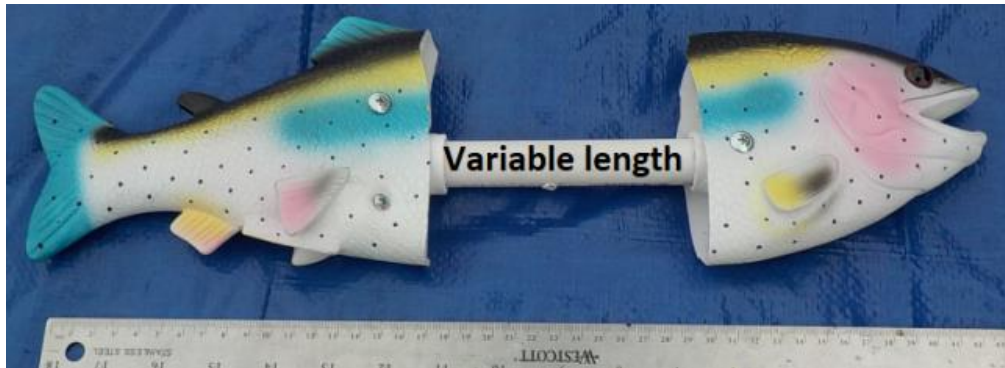
5-gallon bucket is the collection tube for the mort.



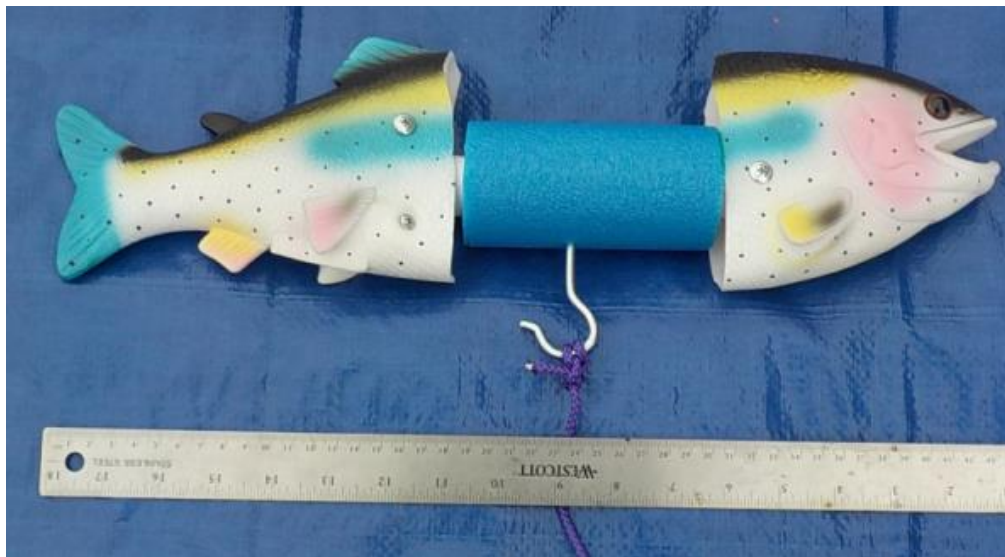
## Fish



The variable length of ½-inch PVC pipe for the fish.



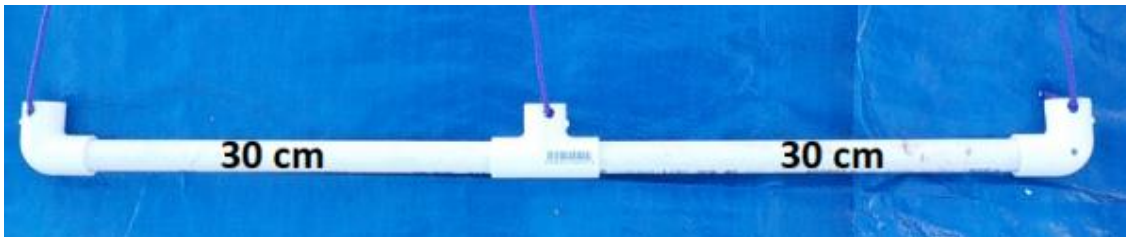
The rubber fish is cut just in front of the dorsal fin and each end of the fish is attached to a tee on each end of a variable length of PVC pipe. Note that 3 screws are used to attach each side to the tee; two on one side of the fish, one on the other side of the fish.



Foam flotation is added to the ½-inch PVC pipe. A #6 screw hook passes through the foam flotation and is attached to the variable length of PVC pipe. A rope is attached to the screw hook. The other end of the rope is attached to a weight.



Three fish of various lengths above the ½-inch PVC pipe base.

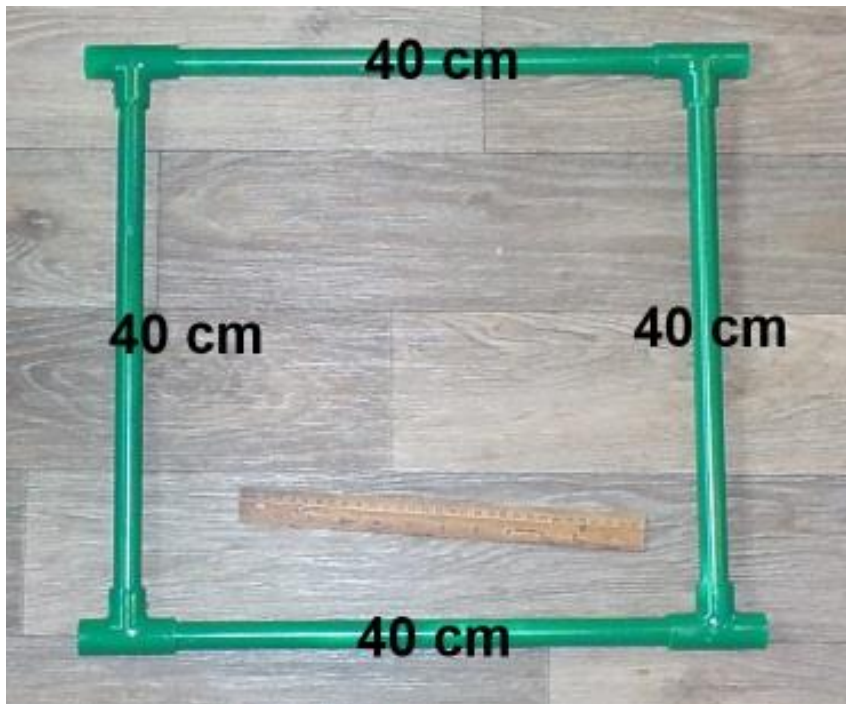


The base of the three fish. Note: Add weight on top of the base to secure it to the bottom of the pool.

## Seagrass



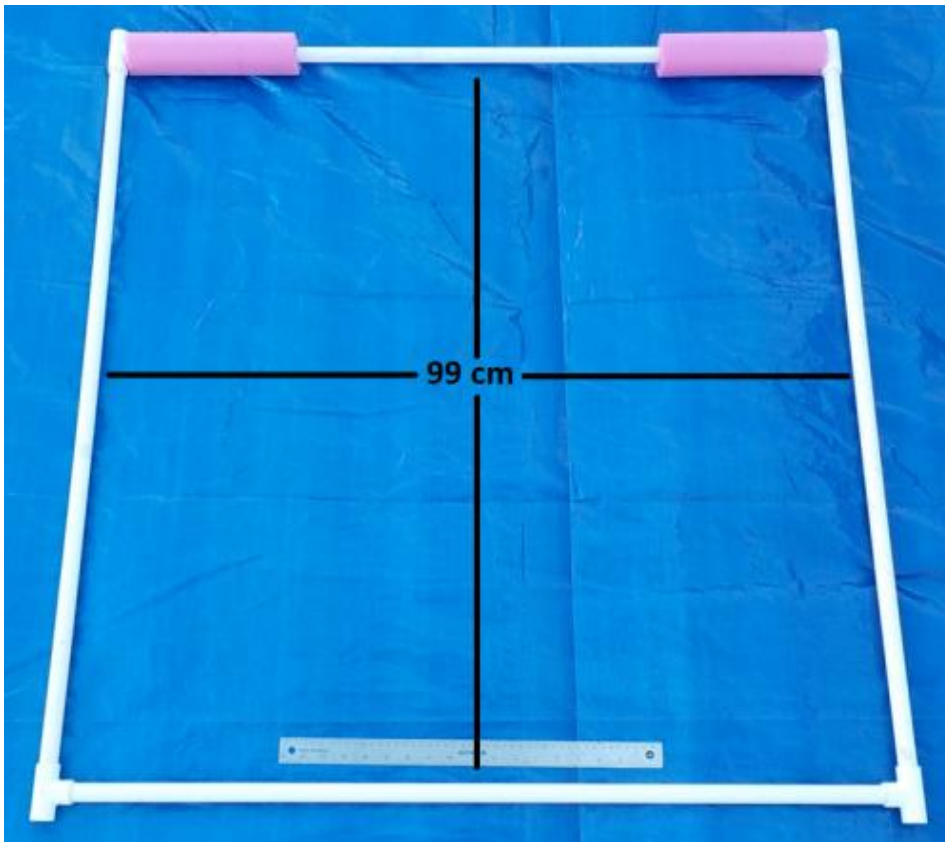
Left: The seagrass bed for planting is constructed of 1/2-inch PVC pipe, green [foam sheeting](#) and plastic mesh. Right: The seagrass bed to prune does not have the plastic mesh attached.



The designated area for planting seagrass.

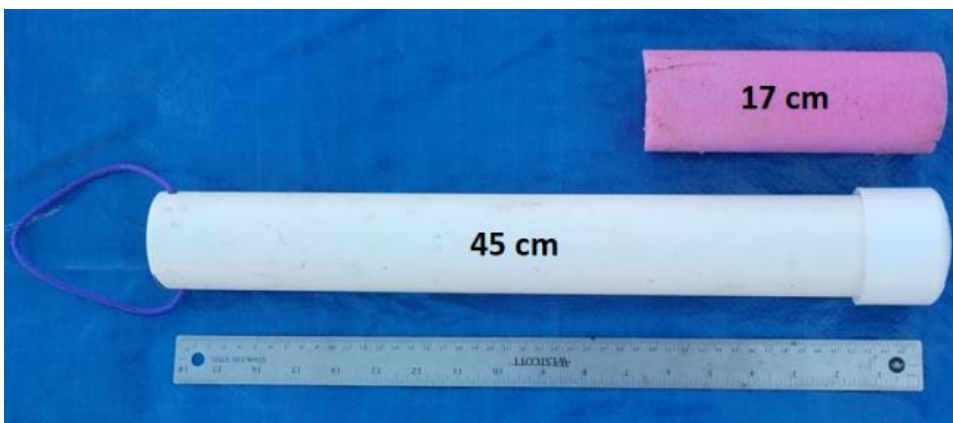


### Task 3: Antarctica Then and Now – Endurance22 and MATE Floats! The Hole in the Ice

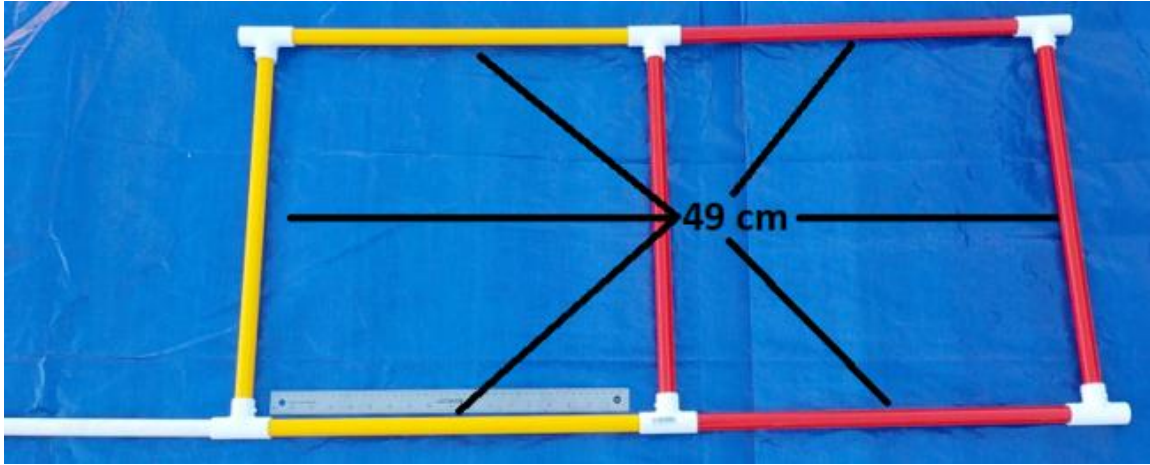


The hole in the ice.

#### The GO-BGC Float

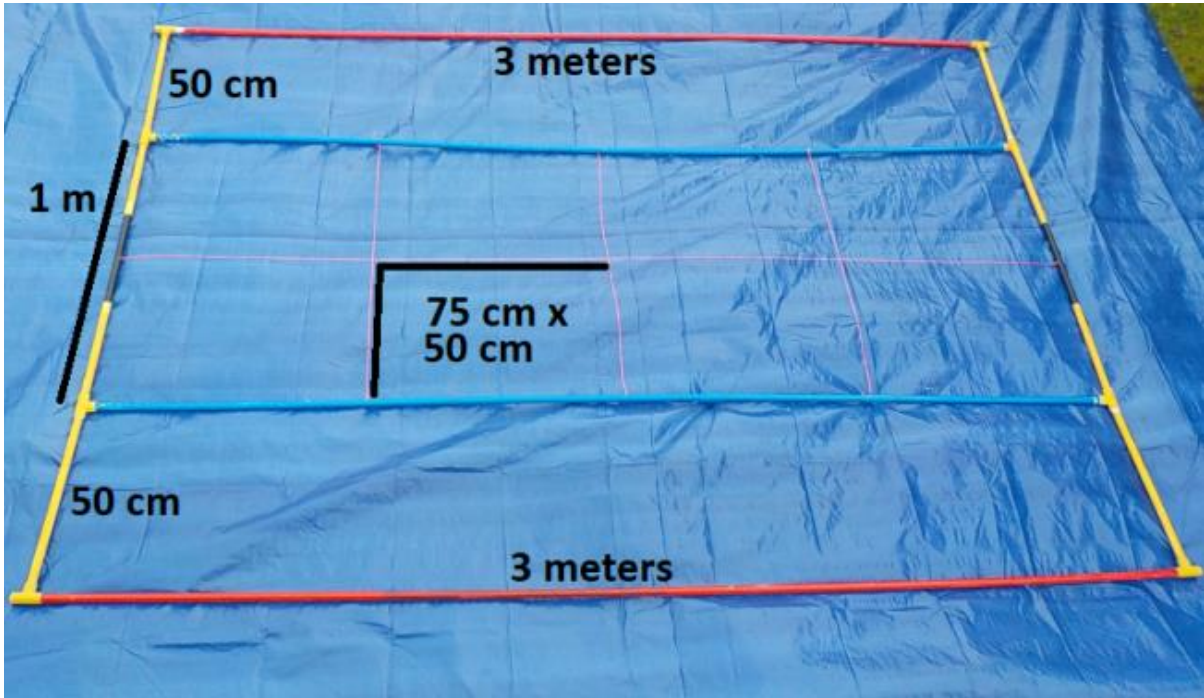


The GO-BGC float is constructed from 2-inch PVC pipe. Foam flotation at the top of the pipe will provide buoyancy. The GO-BGC float rises approximately 5 cm above the surface of the water.



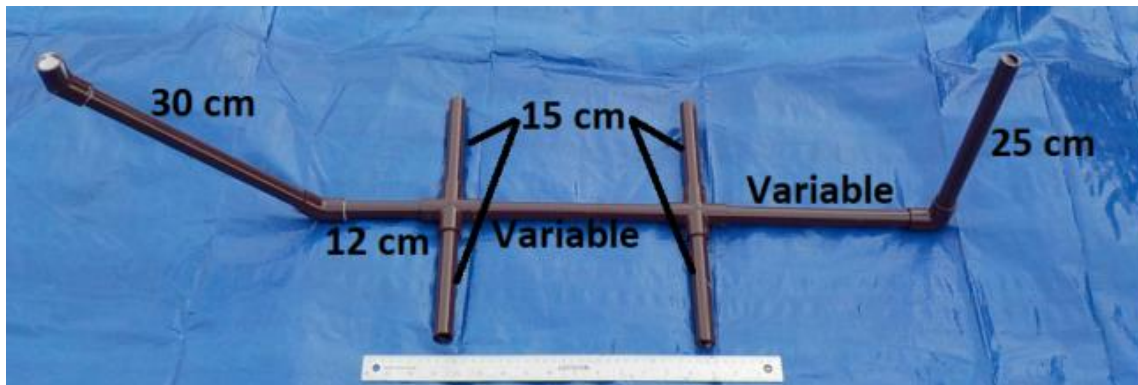
The adjacent designated areas for the GO-BGC float (red) and for deployment of the company created profiling float (yellow).

**The Wreck Site / Benthic Area**



The search area constructed from 1/2-inch PVC pipe. Pink Mason's line creates eight 75 cm x 50 cm rectangles.

## The Wreck of the Endurance



The shipwreck of the *Endurance* is constructed of ½-inch PVC pipe painted brown. Two variable lengths of pipe allow for a random overall length.



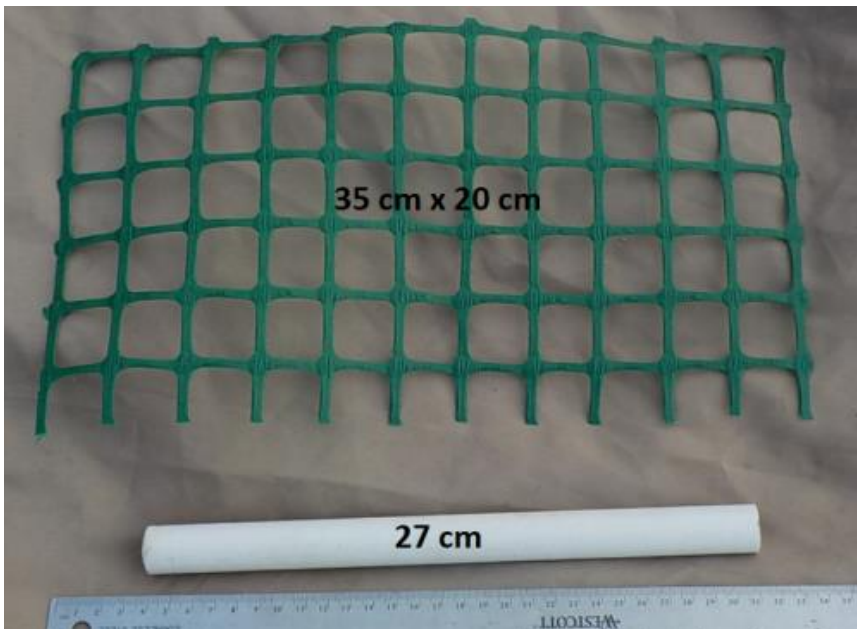
The shipwreck of the *Endurance* located in the search area.





Benthic species will be located in the search area along with the shipwreck of the *Endurance*.

### The Benthic Species



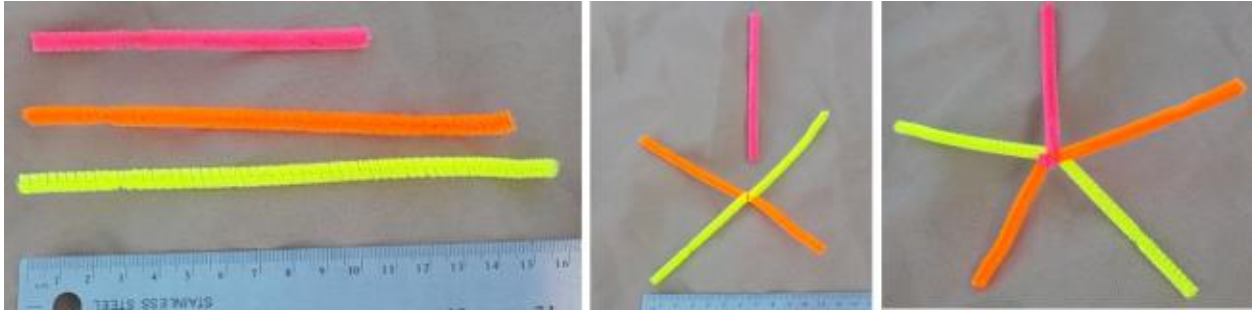
The glass sponge is constructed from 1-inch plastic mesh.



The glass sponge is painted berry pink.



The sea star is constructed from ½-inch PVC pipe and painted grape purple.



Twist the two 15 cm lengths of chenille strips (pipe cleaners together) at their centers. Twist the 10 cm length of chenille to the center of the two 15 cm lengths to create the brittle star. Note that colors may vary.

Numerous links have been provided for product demonstration props purchased from Amazon.com. You are welcomed to find other sources, but please consider using [Amazon smile](https://smile.amazon.com/): <https://smile.amazon.com/> and choosing MATE Inspiration for Innovation as your support organization. Every time you purchase an item, for the competition or otherwise, Amazon Smile will donate 1% of the purchase price to MATE Inspiration for Innovation / the MATE ROV Competition. This adds up!

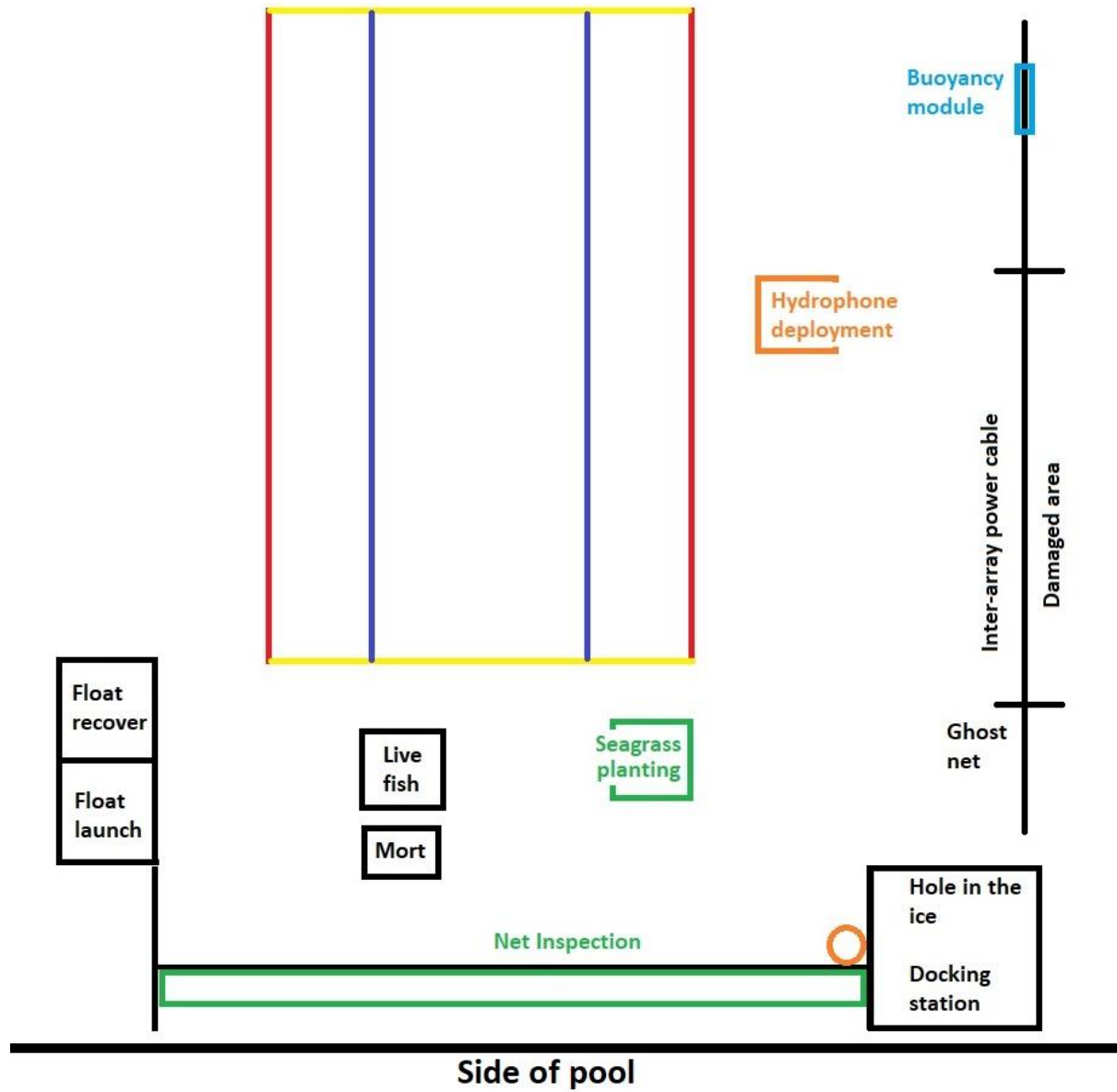
Thank you for your consideration and support!  
The MATE ROV Competition





**RANGER class product demonstration set up:**

The following is a possible underwater set up for the RANGER class product demonstration. The set up at regional events and/or the World Championship may vary.



Update Notes:

Updates are highlighted in yellow.

RANGER prop building instructions.

None