



Official Rules and Mission



AUVSI & ONR's 9th Annual International Autonomous Underwater Competition

August 2 – August 6, 2006
Space and Naval Warfare Systems Center
SSC SD TRANSDEC Facility
San Diego, CA

GOAL

The goals of this competition are to advance the state-of-the-art of Autonomous Underwater Vehicles (AUVs) by challenging a new generation of engineers to perform realistic missions in the underwater environment and to foster ties between young engineers and the organizations developing AUV technologies.

SCHEDULE*:

Event		Due Date
Intent to Compete Form and Payment Due	Friday	April 28, 2006
Journal Paper and Website Due	Monday	July 17, 2006
Team Check-in Onsite	Wednesday	August 2, 2006, 2pm
Safety Inspections and In-water Practice Time	Thursday	August 3, 2006
Static Judging and In-water Practice Time	Friday	August 4, 2006
Qualifying Runs	Saturday	August 5, 2006
Qualifying Runs (a.m.) / Finals (p.m.)	Sunday	August 6, 2006
Awards Party (evening)	Sunday	August 6, 2006
Weather Day (if needed)	Monday	August 7, 2006

*subject to change

POINTS OF CONTACT:

Rules / Technical Issues:	Dr. David Novick, Sandia Nat. Lab	dknovic@sandia.gov	505-284-9360
Executive Director:	Daryl Davidson, AUVSI	Davidson@auvsi.org	703-845-9671
Logistics / Administrative:	Angela Carr, AUVSI	carr@auvsi.org	703-845-9671
Sponsorship / Media:	Gretchen Wherry, AUVSI	wherry@auvsi.org	703-845-9671

1 SCHEDULE

Teams will register on the afternoon of August 2 at the mandatory Orientation meeting. Practice will be August 3 and 4, all day. Each team will compete in a qualifying round on August 5 and/or August 6. Three to five teams will be selected to compete for the Finals round to take place on the afternoon of August 6. If weather causes a delay, the schedule will slip one day, with the finals being held on August 7. As usual, the Awards Party will take place Sunday evening, August 6.

2 MISSION & ARENA

The fundamental goal of the mission is for an AUV to demonstrate its autonomy by completing three tasks. One task is to rendezvous with a “docking station” (Station A). Another task is to have the vehicle inspect a pipeline and marking an area in the pipeline (Station B). The third task is to home in on an acoustic beacon and breach within the zone marked on the surface with floats (Station C).

2.1 Splitting the Arena

As in the past, we will operate vehicles in both halves of the arena at once. The layout in the two halves will be quite similar, as shown in Figure 4. To increase the number of teams at any given time, we will operate vehicles in both halves of the arena at once. During the practice days, both sides will be arranged in the practice configuration.

For the qualifying round, the competition side of the arena will be changed to the competition configuration, as shown in the right half of Figure 4. If our staffing permits, teams that are not making their qualifying run will be allowed to practice during the qualifying runs. Practice side pingers will be left **on** during the qualifying rounds. For the finals round, only the competition side will be in use (and, consequently only the competition side pingers will be on).

2.2 Starting Point

Each vehicle will be launched from the launch platform, whose approximate location is indicated on the arena plan.

2.3 Weight and Size Constraints

2.3.1 Vehicle

For the International AUV Competition, each entry (at launch) must fit within a six-foot long, by three-foot wide, by three-foot high “box” (1.83 m x 0.91 m x 0.91 m). Table 1 shows the bonuses and penalties associated with a vehicle’s weight in air.

Table 1. Size and weight constraints on AUVs entered into the 2004 competition		
	Bonus	Penalty
AUV Weight > 140 lbs (AUV Weight > 63.5 kg)	N/A	Disqualified!!!
140 lbs ≥ AUV Weight > 110 (63.5 kg ≥ AUV Weight > 50 kg)	N/A	Loss of 250 + 5 (lb – 110) 250 + 11(kg – 50)
110 lbs ≥ AUV Weight > 70 (50 kg ≥ AUV Weight > 32 kg)	Bonus of 2(110 – lb) 4.4(50 – kg)	N/A
AUV Weight ≤ 70 lbs (AUV Weight ≤ 32 kg)	Bonus of 80 + (70 – lb) 80 + 2.2(32 – kg)	N/A

2.3.2 Markers

A vehicle may carry up to two markers. Each marker must fit within a box 1.5" square and 6" long (3.81 x 3.81 x 15.24 cm). Each must weight no more than 1.5 lbs (0.68 kg) in air. Any marker that exceeds these limits by less than 10% will result in 500 point penalty. Any marker that exceeds these limits by more than 10% will disqualify that entry. Each marker must bear the team name or emblem. Markers will be cleared from the arena after each run. A reasonable amount of time will be spent looking for lost markers, however consider them expendable and have back ups.

3 Description of Tasks

The Launch point, Gate (shown in Figure 5), Docking Station, Pipe Inspection, and Surface Zone will be placed in such a way as to not have any three elements along a single line.

3.1 Docking Station (Station A)

This task consists of a docking station with an omnidirectional **RED** light located 4-6 feet (1.2-1.8 m) off the floor of the pool (see Figure 6). The light will be modulated at two different rates. A 3 kHz flash rate (square-wave, 50% duty cycle) will be gated on and off at 3 Hz. The goal is to "dock" with the light, which means you have to push the light away with your vehicle as you pass by (nose the light over). Touching the light will constitute tipping it over. The station will be slightly positively buoyant, so that it won't be set off by an incidental bump, or water current, but it also won't require a large amount of force to trigger it. If a dock is successful, the light frequency of the docking station will change to a 7 kHz flash rate gated on and off at 7 Hz for 10 seconds.

The light itself will be **RED** Luxeon III Side Emitting Star LEDs contained within a waterproof clear PVC tube. A longer flooded tube will be used to extend the docking station light to the desired height. Both tubes will be 1 to 4 inches in diameter (2.5 – 10.1 cm). These tubes will contain the wires to minimize any chances of the sub becoming entangled on the docking station. We will have the ability to adjust the intensity of the LEDs, with the intention of having the light sufficiently dim that it cannot be acquired directly by a vehicle at either of the other stations.

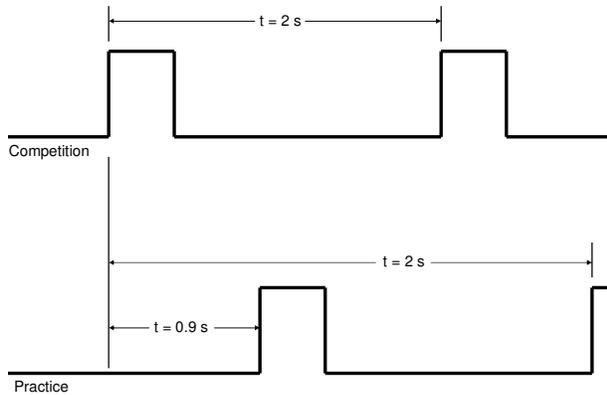
3.2 Pipeline Inspection (Station B)

This task consists of a "pipeline" constructed of three - 4 foot (1.2 m) sections of flat PVC sheet snaking their way to four 24" x 12" x 6" (0.6 x 0.3 x 0.15 m) target bins (black in color) (see Figure 7). The pipeline will be constructed of 6 inch (0.15 m) wide by 4 foot (1.2 m) long sections of flat PVC sheet. It will be painted **ORANGE**. The "pipeline" and bin are raised off the floor of the pool 1-2 feet (0.3-0.6 m) and the "pipeline" will not have a relative angle between two pieces of more than 45°. Since the pipeline will be constructed from flat sheet, there will be slight gaps between each segment (both triangular from the relative angle, and spacing gaps caused by the two ends not touching [but they will be close]).

The two "lines" of the pipeline will, in general, point to the Docking station and the Surface zone. The bin will be surrounded by a rectangular shape with a 6" (0.15 m) border (white in color with green hatching). The hatching will consist of **GREEN** 1" (2.54 cm) lines with a 2" (5.08 cm) spacing (see Figure 8). Up to two markers can be dropped into the target bin. Each marker in the bin will score points.

3.3 Surface Zone (Station C)

This task consists of an acoustic pinger located 4 feet (1.2 m) off the floor of the pool. Floating above the pinger on the surface will be two concentric octagons representing the surface zone (see Figure 9). The octagons will be constructed from ½" PVC pipe. The inner octagon will have a "diameter" of 9 feet (2.74 m) while the outer octagon will have a "diameter" of 15 feet (4.6 m). In order to obtain full points for this zone, your vehicle must surface fully inside the octagon (no portion of the sub touching the structure). The inner octagon is worth more points than the outer.



We will place an acoustic pinger on a pole at the center of each surface zone. The competition and practice side will ping at a rate of 0.5 Hz (2 seconds), and separated by 0.9 seconds. The pingers will be synchronized. The schedule will be:

Unit 1 (Competition)	pings $t=0 \text{ s}$
Unit 2 (Practice)	pings $t=0.9 \text{ s}$
Unit 1 (Competition)	pings $t=2 \text{ s}$
Unit 2 (Practice)	pings $t=2.9 \text{ s}$
Etc.	

This gives the reverbs from each pinger (near) maximal time to die out. Note that for the final runs, only the competition side will be pinging, and will therefore have a 2 s delay to further reduce any reverberations in the pool. The ping duration is 1.3 ms with a sound level of 187 dB.

3.4 Interference

Vehicles that interfere with competition elements may be disqualified at the judges' discretion. "Interference" does not include cases where, in the opinion of the judges, a vehicle is attempting to complete one of the three tasks (e.g., brushing against the gate; nosing aside the docking station; brushing against the floating rings of the recovery zone). If a vehicle becomes entangled on the gate, docking station, or recovery zone floats, the run will be declared completed. Teams may keep the points earned on that run, or may have the AUV returned to the launching platform and start another new run. If a new run is begun, all points from the previous run are lost. See Section 5 Official Rules, Submissions and Fees for more information on interference.

3.5 Acoustics

We are leasing ORE model 4330B transponder/responder units (<http://www.ore.com>). They will be operated in responder mode, and each unit will be preset to one of the following frequencies: 22, 23, 24, 25, 26, 27, 28, 29, or 30 kHz. Since we cannot specify the frequency settings of the units we will receive, we will not be able to report them to the teams until the start of the practice runs.

3.6 Random Order Light Display

The Random Order Light Display will be placed just beyond the gate, and off to the right (near the right side when facing the gate from the Launch Platform), angled slightly toward the center of the gate). The light will be positioned to project a horizontal display 10-12 feet (3.05-3.55 m) off the floor of the pool. The tops and sides will be shielded in the attempt to reduce the effects of sun and surface reflections.

The Information for the random bin is shown in a light box and is encoded in color of the light and its dual-modulation flash rate, similar to the Docking Station.

Red light with flash rates of	5 kHz flashed on/off @ 5 Hz = 45° hatching
Red light with flash rates of	2 kHz flashed on/off @ 2 Hz = Non-hatched
Green light with flash rates of	5 kHz flashed on/off @ 5 Hz = Short sided hatching
Green light with flash rates of	2 kHz flashed on/off @ 2 Hz = Long sided hatching

The indicator lamps will be arrays of Lumileds Superflux™ LEDs (<http://www.lumileds.com/>) mounted inside of an Otter Box (<http://www.otterbox.com/>) with a clear lid (special order item). The otter box will be positioned such that the longest axis is horizontal. The **Red** and **Green** LEDs will be arranged column-wise from this orientation and will contain 6 interlaced columns of red and green LEDs of 10 LEDs each (see Figure 5).

4 OFFICIAL RULES, SUBMISSIONS AND FEES

1. The official source for all information concerning rules, interpretations, and information updates for the International Autonomous Underwater Vehicle Competition is the World Wide Web home page at: <http://www.auvsi.org/competitions/water.cfm>
2. An *Intent to Compete* form, available on the website, and the entry fee must be completed. The submission must be in English and is not considered official until the entry fee of five hundred U.S. dollars (\$500) has been received by AUVSI. As the competition format cannot handle an unlimited number of entries, the organizers reserve the right to limit the total number of entries that are allowed to compete by declaring the competition closed to new entries before the due date above. As with all official information, this announcement (should it be necessary) will appear on the official website.
3. During the competition, the vehicle must operate autonomously, with no control, guidance, or communication from a person or any off-board computer (including the GPS constellation). The vehicle and any parts connected to the vehicle must submerge and remain submerged. No item may break the surface or be left floating while the vehicle is underway.
4. Teams must submit a journal paper and a website for evaluation by the judges.
5. There will be a preliminary round that all teams will compete in. After the preliminary round, the judges will convene and tally their scores. The judges have the discretion to select the number of teams entering the finals as they deem appropriate. Teams will be accepted into the finals round in rank order from the preliminary round. We anticipate that three to five teams will be accepted into the finals.
6. After the competition, the judges will issue overall standings. Any team that is accepted in the finals round will be ranked ahead of all teams that are not accepted into the finals round.
7. Each team will have 20 minutes on the dock. The first 5 minutes constitute the preparation period. During this time, the vehicle may not be deployed in the water. The 15-minute-long performance period immediately follows.

Preparation period: The vehicle may remain on the crane, or be placed on the dock. A team may waive any portion of the 5-minute-long preparation period and start the 15-minute-long performance period. Once the performance period starts, the team loses any unused time in the preparation period.

Performance period: When the officials signal the start of the performance period, the team may ask to have the vehicle deployed into the water and released to perform the mission. Only tournament officials may deploy and recover the vehicle. The time required to deploy and/or recover does not count against the 15-minute limit. This is to prevent unsafe actions in an attempt to speed the deployment and recovery processes.

8. Multiple runs: A team may attempt multiple runs during the performance period. Once a team has the officials redeploy their vehicle, all points earned in previous runs are lost.
9. Ending a run and retrieving a vehicle: At any time while a vehicle is running, the team captain can signal the end of the run and request the retrieval of the vehicle. Only officials may retrieve a vehicle and return it to the dock. The countdown clock for the performance period stops when the official touches the vehicle to recover it. The clock continues it's countdown once the team establishes communication with the vehicle, or the vehicle is safely back at the dock, whichever is first (i.e. if a team has wireless communication with the sub, the countdown clock continues while the diver is returning the sub to the start).

10. **NEW!** A team may use any of their 15-minute-long performance period time to survey the arena. The survey, however, must be completed autonomously. Unlike performing a competition run, the clock will continue to run while retrieving a vehicle.
11. If a vehicle experiences a significant interference from a piece of equipment, line, cable, or diver deployed in support of the competition, the team captain may ask, at that time, to have the clock stopped, the vehicle returned to the dock, and for the judges to add back to the clock their best estimate of the time used in that run up to the point of interference. If the team captain does not make this request in a timely manner (as determined by the technical director or his designee) then the option is lost. Interference with a gate, light, or target object does not qualify for this option, and a vehicle interfering with those items may be disqualified at the judges' discretion.
12. The mission ends when any of the following occur:
 - The 15-minute performance period ends.
 - The judges order the end of the mission.
 - The team captain requests the end of the mission.
 - The vehicle breaches the surface (as determined by the judges, see Section 10.6 for more detail).

5 VEHICLES

1. Each team may enter only one vehicle into the competition. Each vehicle will be physically inspected by the competition judges. The judges may disqualify any vehicle that they deem to pose an unreasonable safety hazard.

The judges will confer with representatives of the host facility, and any vehicles that, in the opinions of the judges or the representatives of the host facility, pose an unreasonable risk to the integrity of the host facility will be disqualified. The AUVSI and the host organization, their employees and agents, as well as the organizing committee, are in no way liable for any injury or damage caused by any vehicle, nor for any damage or injury caused directly or indirectly by the disqualification of a vehicle.

Each vehicle must operate autonomously during its dive. While carrying out the mission, no communication is permitted between the vehicle and any person or off-board computer. Vehicles must operate solely on their ability to sense and maneuver in the arena using on-board resources.

2. The weight of each vehicle must be less than 140 lbs (63.5 kg). Note that bonus points are awarded to vehicles that are below 110 lbs (50 kg), and penalties assessed for those that exceed it (Table 1). The entire vehicle must fit within a box that is 6 feet long, 3 feet wide, and 3 feet deep (1.83 m x 0.91 m x 0.91 m).
3. All vehicles must be battery powered. All batteries must be sealed to reduce the hazard from acidic or caustic electrolytes. Batteries may not be charged inside of sealed vessels at any time while on the site of the competition and/or while engaged in the competition. The open circuit voltage of any battery in a vehicle may not exceed 60 VDC. If a team has any questions or concerns, they are encouraged to contact the organizing committee.
4. No materials (except for the markers and compressed air used to blow ballast) may be released by the vehicle into the waters of the arena.
5. For the safety of your vehicle, we require it to be slung on a harness or sling of some type. Even if the vehicle is light enough to hand carry, we wouldn't want anyone to slip and destroy a piece of equipment. Also, we need to weigh the vehicle, and require that the vehicle be slung somehow for the measurement. Please see the document *Harnessing the Submarine* (available on the official website) for hints and ideas on how to accomplish this.
6. **NEWish!** All vehicles must bear a clearly marked kill switch that a diver can readily activate. This switch must disconnect the batteries from all propulsion components and devices in the AUV. All

props must have shrouds. The shrouds must surround the prop and have at least a 2" (5.08 cm) distance between the spinning disk of the prop and the edges of the shroud (front and back). If you have a guard across the opening, this distance can be minimal. A vehicle will not be allowed in the water without a properly working kill switch and prop shrouds.

7. All vehicles must be buoyant by at least one half of one percent (0.5%) of their mass when they have been shut off through the kill switch.
8. Teams may comprise a combination of students, faculty, industrial partners, or government partners. Students may be high school, undergraduate and/or graduate students. Interdisciplinary teams are encouraged. Members from industry, government agencies, or universities (in the case of faculty) may participate; however, full-time students must compose at least 75 percent of each team. Participants must be enrolled at their schools for at least 12 credit hours or more per quarter/semester during winter and spring to be considered "students." The student members of a joint team must make significant contributions to the development of their vehicle. One student member of the team must be designated as the "team captain." The team captain, and only the team captain, will speak for the team during the competition run. Only the student component of each team is eligible for the cash awards.
9. No team member is allowed to enter the arena at any time (this includes wading, swimming, and diving as well as floats, boats, etc.). Competition officials will be responsible for recovering lost vehicles. Officials will make all reasonable efforts to recover a lost vehicle but cannot guarantee that they will be able to do so. All teams recognize that by entering the competition, they risk damage to or the loss of their vehicle. The judges, officials, hosts, and sponsors can take no responsibility for such damage or loss.
10. The officials will suspend the operation of a vehicle at any time they deem that it is required by safety or security considerations. Teams may be required to submit technical descriptions of their vehicles to the officials in advance of the competition, with the goal of identifying potential safety concerns well in advance. When requested, such technical information submitted to the judges will be held in confidence until the end of the competition.
11. The officials will suspend the competition at any time they deem that it is required by safety or security considerations.

6 JOURNAL PAPER

Each team is required to submit a journal paper that describes the design of their vehicle and the rationale behind their design choices. This paper may be no more than 10 pages long (including all figures, references, and appendices). Additionally, each journal paper must include an abstract of no more than 250 words. The journal paper and abstract must be printed on standard 8.5 × 11-inch paper, with margins of at least 1 inch on all sides, and all text must be in 12-point or larger font. Each page must bear a footer with the page number and the team name. The journal paper will be evaluated as described below in the section on scoring.

The journal paper must be received in electronic format (pdf is preferred) via email. Teams that do not meet the deadline may be disqualified from the competition.

7 STATIC JUDGING

Each vehicle will be subject to static judging before being allowed to compete. During the static display time, each team will be visited by the judges, and by the public, the press, and representatives of other organizations. The judges will evaluate each vehicle for technical merit, safety, and craftsmanship as described below in the section on scoring. Each team is required to have at least one member attending their vehicle throughout the static display period (not just during the judges' scheduled visit). Teams are also strongly encouraged to make a poster describing the vehicle. The posters can be set up next to the

vehicle during the static display period. Representatives of the press and of other organizations will be encouraged to visit each team during this period.

8 ONSITE EXPECTATIONS

The organizers have made every attempt to provide the competitors with maximum resources at the Competition site, including electrical power, test pools, Internet access, and practice time in the main pool. This event is not only opened to the public, but there is a very high possibility that a potential future employer may also be observing the event.

It is expected that **ALL** teams will be present during **ALL** days of the competition. If your team does not make it into the finals, it is expected that your team will display your vehicle and be present in the team tent during this time.

9 RESUMES

One goal of the competition is to foster links between young engineers and the companies, universities, and government agencies involved in AUV development. To advance that goal, we request that each team provide resumes of each team member, along with class year and expected graduation date. These resumes (when submitted) will be circulated to our sponsors and employers who will be considering opportunities for full-time employment, internships and co-op programs. Your participation in this new program is strongly encouraged. Electronic versions of team member resumes should be emailed to AUVSI in advance of the event.

10 SCORING

Each of the three tasks has a point value associated with it. A team may decide to complete an individual task, two or all three in any order. In the case of Pipeline inspection (Station B) there are two ways to score points, drop a marker in any of the four boxes (any bin) or drop a marker in the correct randomly selected bin (random bin). For any of these scoring methods, you must first pass through the validation gate.

10.1 Individual Station

You may elect to attempt to complete any one of the three stations. If the vehicle succeeds, your team will obtain the points associated with that station.

10.2 Any bin

You may choose to complete the pipeline inspection by dropping a marker (or two!) in any bin.

10.3 Random bin

For this method, the correct bin (out of the four) will be randomly chosen at the start of an autonomous run. If you drop the marker (or two!) in the correct bin you will receive major points. If you drop a marker (or two!) in an incorrect bin, you will receive points, but at lower point values than if you chose to do the "any bin" method.

10.4 Determining the bin

If you are going to attempt a marker drop in a random bin, you must state so before your run starts, otherwise the run will be considered an "any bin" run.

10.5 Breaching

When completing the sequence of tasks, a team may choose to complete the Surface Zone (Station C) first or second. In these cases (and only these cases) a vehicle may breach the surface (hopefully within the octagon) and then submerge again to complete the remaining tasks without risking disqualification.

10.6 Final Round

After the qualifying round, the Judges will rank-order the teams based on their scores from the qualifying round, and select the top 2-5 teams to compete in the final round. The point totals and rankings for the teams not selected are then frozen. For the final round, all point totals are set to zero. The final standing of teams selected for the finals will be determined by the points their vehicles score in the final round based on the Performance Measures alone. Any team which is selected to be in the finals will finish ahead of the remaining teams which were not selected.

10.7 Point Breakdown

Subjective Measures	Max. Points
Utility of team website	50
Technical merit (from journal paper)	50
Written style (from journal paper)	50
Technical accomplishment (from static judging)	75
Craftsmanship (from static judging)	75
Team uniform (from static judging)	10
Discretionary static points (awarded after static judging)	40
Total	350
Performance Measures	Max. Points
Weight	See Table 1
Each marker exceeding a weight or dimensional specification by no more than 10%	-500 per specification exceeded per marker
Pass through the validation gate	100
Maintain a fixed heading through gate	150
Dock with Docking Station (Station A)	500
Dropped marker in pipeline inspection bin (Station B)	50,100,125,500, or 2000 per marker
Surface within Surface Zone (Station C)	1500, 2000
Finish with mission with T minutes (whole + fractional)	T x 100

10.7.1 “Subjective Measures” description

Technical accomplishment and Craftsmanship: These considerations will exclude any components of the design that are or could be (in the opinion of the judges) commercially available or do not include a significant contribution by team members. In other words, if you use a well-built, well-designed, off-the-shelf computer, your team does not get points for the computer’s good technical design. You will get points for selecting a computer that is, in the opinion of the judges, well suited to the engineering needs of the vehicle.

10.7.2 “Performance Measures” description

Passing through the validation gate: The judges will use their discretion in making their determination on the vehicle passing through the gate.

Maintain a fixed heading through the gate: Did the sub travel in a straight line through the validation gate.

Dock with Docking Station: Maximum points (500) are obtained by tipping the docking station over. Partial points may be awarded with judges’ discretion.

Dropped marker in pipeline inspection bin: Maximum points are obtained by dropping a marker with the black bin. If a marker lands on the white pad surrounding the bin, 100 points are awarded. Finally, if a marker rolls off, or lands very close the pipeline inspection bin, 50 points are awarded

Surface within the surface zone: The sub must fully surface within the octagon to obtain full point value, the inner octagon worth more (2000) than the outer octagon (1500). Partial points may be awarded with judges' discretion.

Time bonus: At a minimum, a sub must tip over the docking station, drop at least one marker on the lip of the pipeline inspection bin and fully surface within one of the octagons to obtain the time bonus. These can be completed in any order.

The time bonus is a calculation of whole minutes remaining plus fractional seconds. For example, with a remaining time of 7:13, a team will receive $(7+13/60)*100 = 721.667$ points

11 SEQUENCE OF EVENTS DURING THE COMPETITION

11.1 Static display period

Each team will receive a visit from the judges during this period for the static judging. Additionally, members of the public, the press, and representatives of other organizations will be encouraged to view the vehicles and talk with team members.

Each team will have a series of visits from the judges during scheduled time periods. The judges may work together in small groups.

11.2 Practice runs

Practice time slots will be scheduled on an ad hoc basis by the technical director or the designee during the two practice days. It is our intent to provide as much practice time in the arena as is practical and to ensure minimal idle time for the arena. Each vehicle must be approved by the technical director or the designee before it will be allowed into the arena.

11.3 Time slots announced for competition runs

Competition time slots will be awarded based on standings after the static judging. The team that is in first place will have first choice, etc. Ties will be broken by a coin toss or random draw.

11.4 Preliminary round of the competition

Each team will be assigned a time slot to perform the mission. Twenty minutes before the beginning of their time slot, the team may enter the staging area near the launch site. At the beginning of their time slot, the team may move to the launching site on the dock. The first 5 minutes are for preparation. During this period, the vehicle may not be deployed in the water. When the 5-minute limit has expired (or the team has waived the balance of the preparation time), the judges will begin a 15-minute clock. These 15 minutes are for vehicle to perform the mission. Once this period has begun, the team may ask to have their vehicle placed in the water to begin its mission.

Vehicles will be put into and taken out of the water by tournament officials. The time required to do so will not count against the 15-minute limit. If a vehicle is in the water, the team may request that it be lifted onto the dock. Tournament officials will move the vehicle onto the dock and (when requested) redeploy the AUV into the water. Again, the time required to move the vehicle into and out of the water will not count against the 15-minute limit. However, time spent by the team on the dock does count against the 15-minute limit. The exception is when the vehicle is performing an autonomous survey and the clock will continue to run while retrieving and moving the vehicle.

The mission will continue until the 15-minute limit has expired, or the team captain requests the end of the mission, or the judges order the termination of the mission, or the vehicle breaches the surface. The judges may order termination of the mission at their discretion. Once the judges order the end of the mission, no further points may be scored. The judges' decisions on the termination of the run are final.

11.5 Final round of the competition

After the preliminary round, the judges will tally their scores. Teams will be accepted into the finals in rank order from the preliminary round. The judges have the discretion to select the number of teams entering the finals as they deem appropriate. We anticipate three to five teams competing in the finals. The finals round will be conducted in the same manner as the preliminary round.

12 AWARDS

Cash prizes (and serious bragging rights) of up to \$20,000 will be awarded at the discretion of the judges.

13 DIAGRAMS



Figure 1: Aerial photo of facility. The water clarity shown is typical. The bridge structure has no piers or supports in the pond and does not obstruct the water

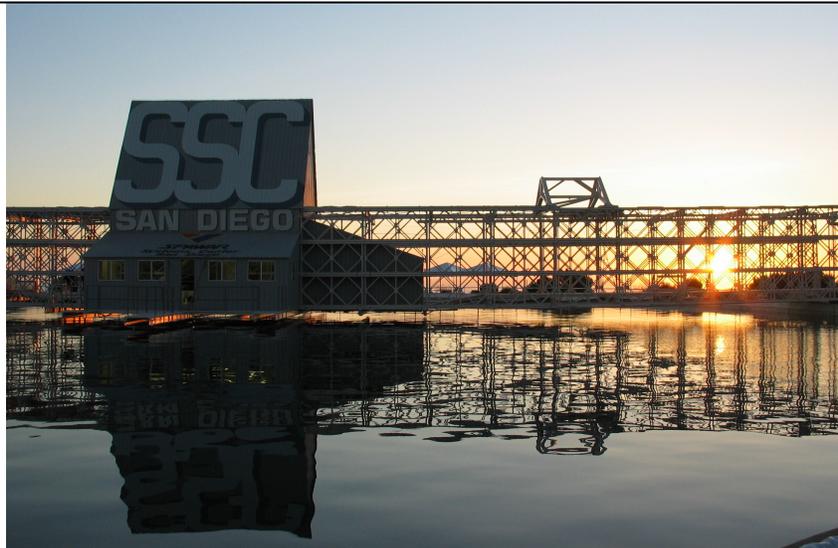


Figure 2: Artsy photo of bridge across the pond

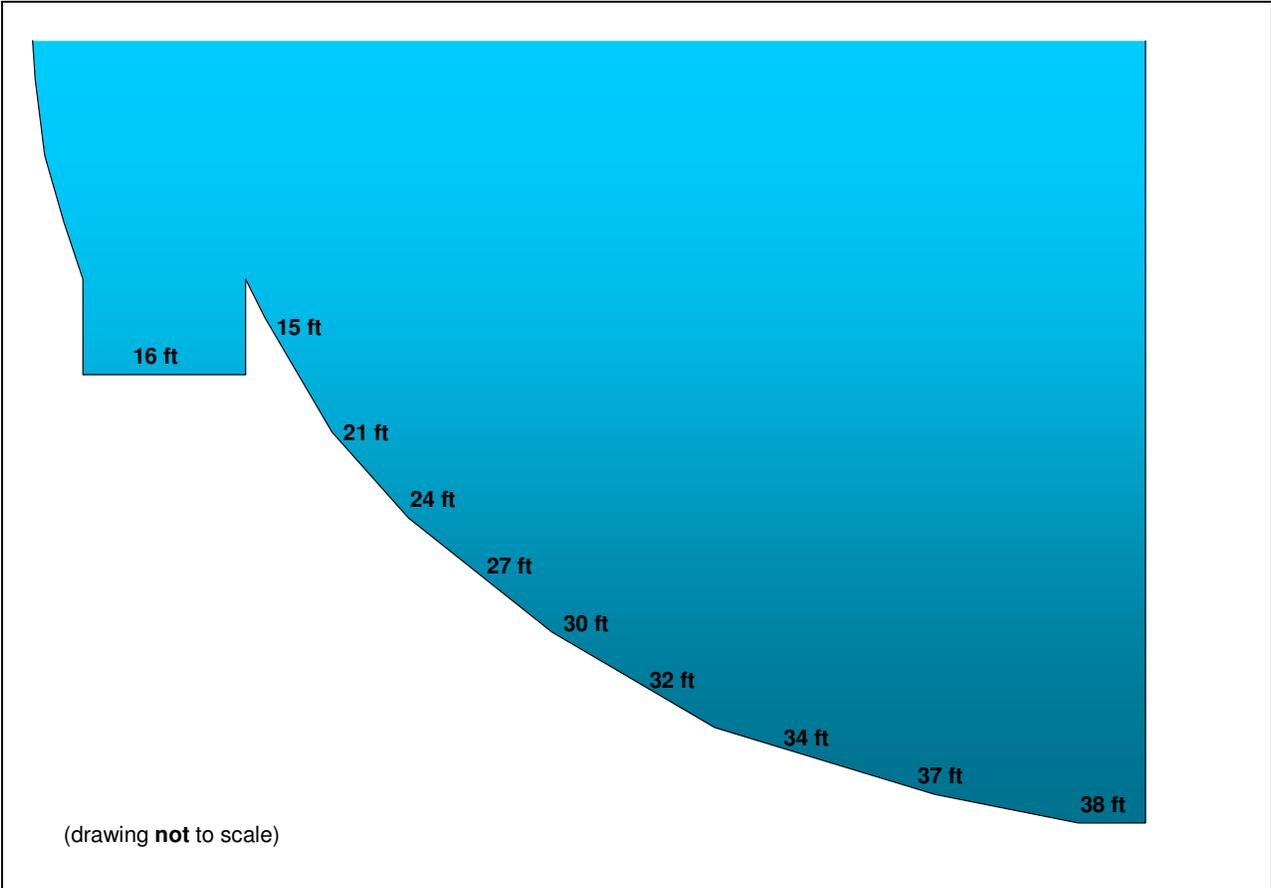


Figure 3: Cross section of arena showing the depth profile in feet. Note that the acoustic trap (the 16 ft deep section around the perimeter) varies in width around the pond (Figure 1).

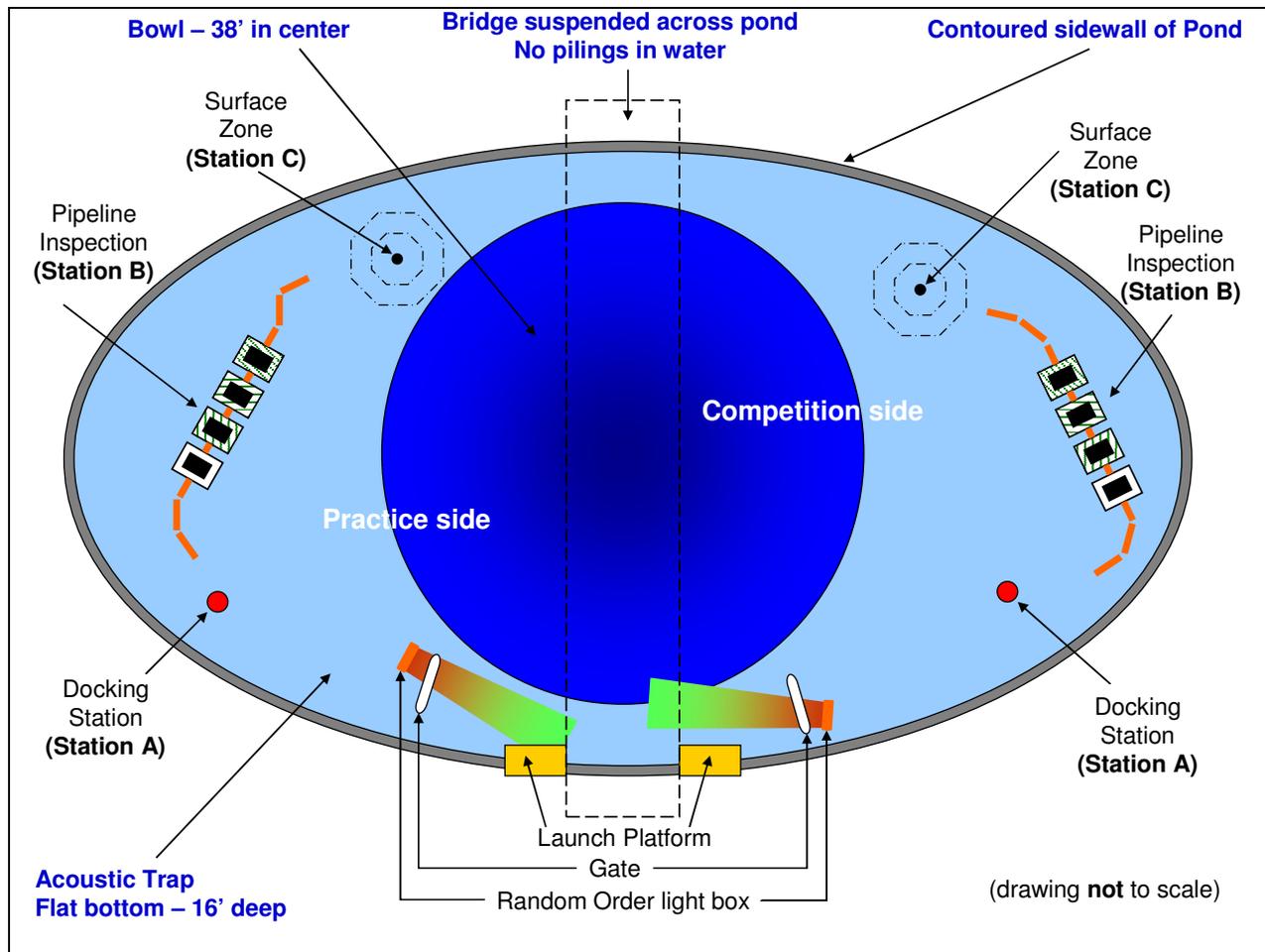


Figure 4: General Layout of the arena. The arena is split into a competition side (right half of this view) and a practice side (left half). No three components (Gate, Station A, Station B, Station C) will be aligned along a line.

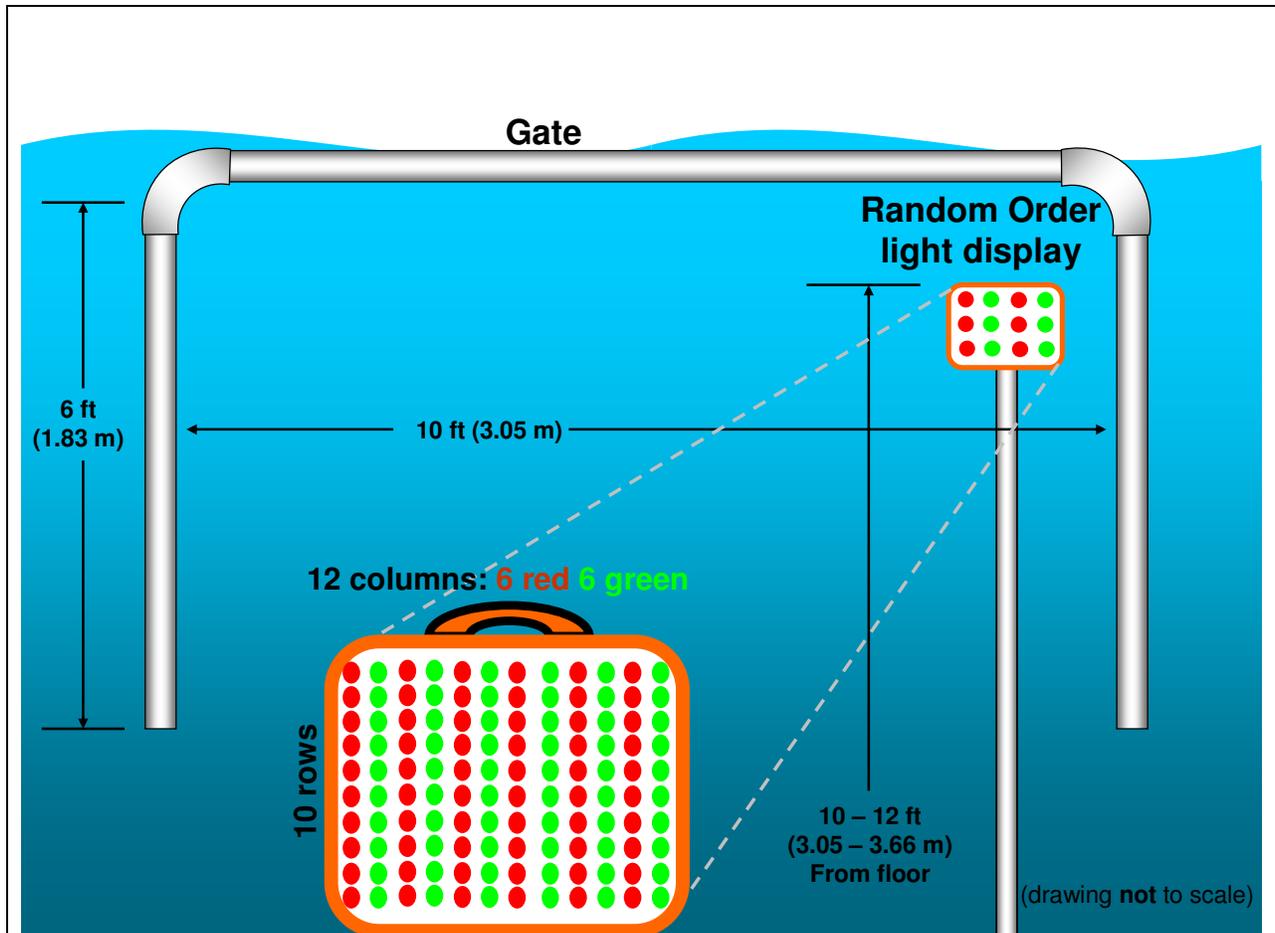
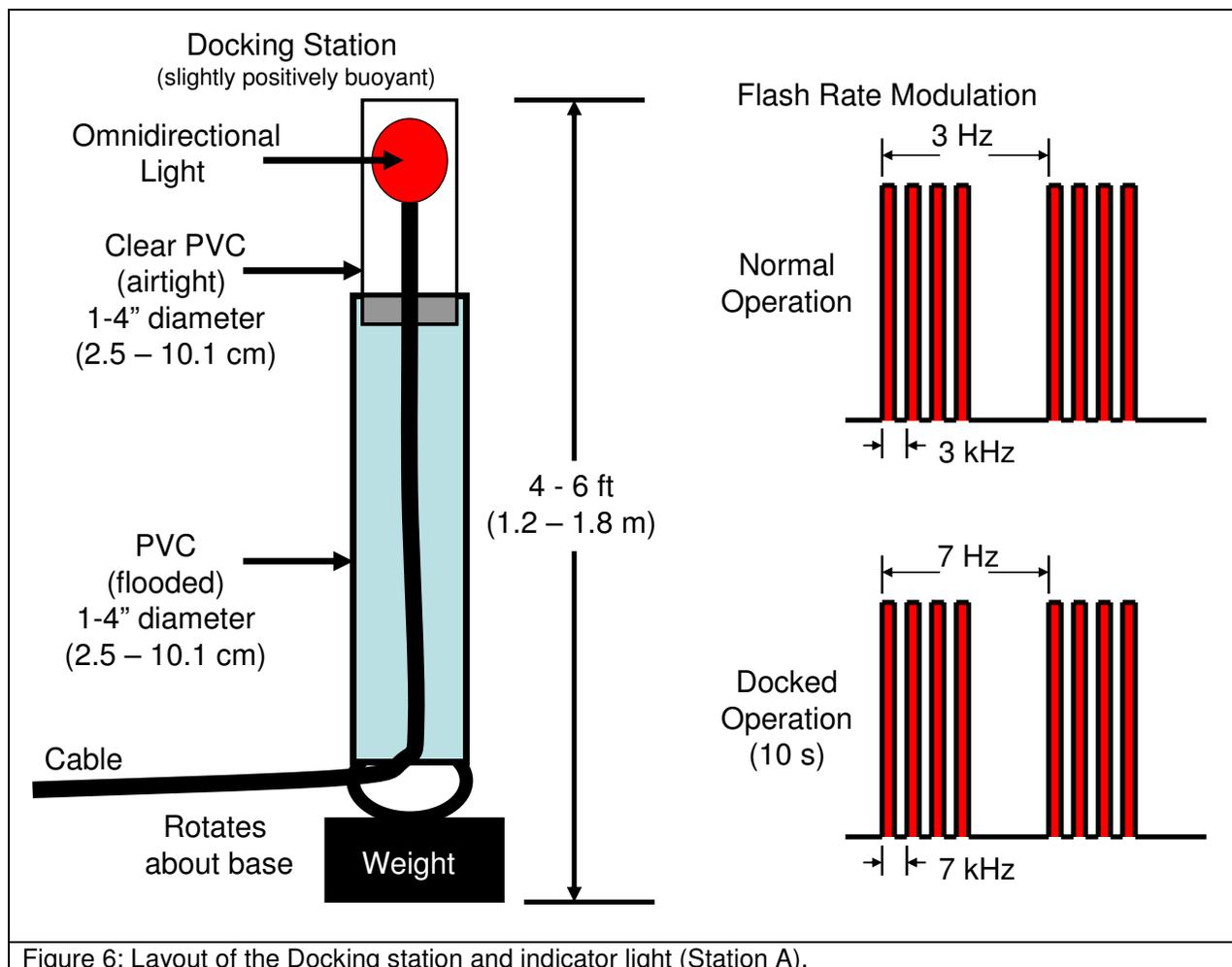


Figure 5: Validation gate. The gate is constructed of 4 inch inner diameter white PVC pipe. It is 10 feet (3.05 m) wide and each leg is 6 feet (1.83 m) long. It will be buoyant, and will be anchored to the bottom by lines. The Random Order light display is near the right leg, just beyond the gate



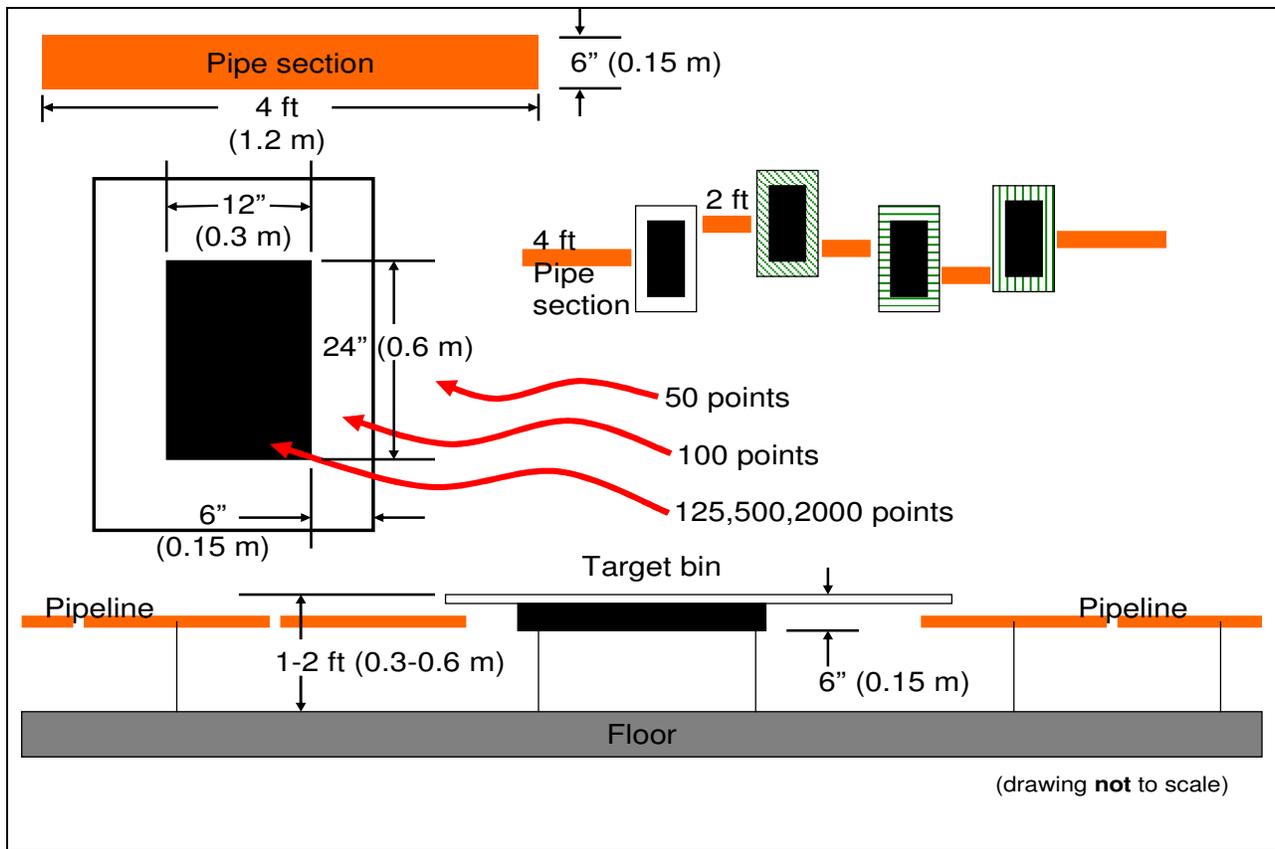


Figure 7: General layout for pipeline inspection and target bin (Station B)

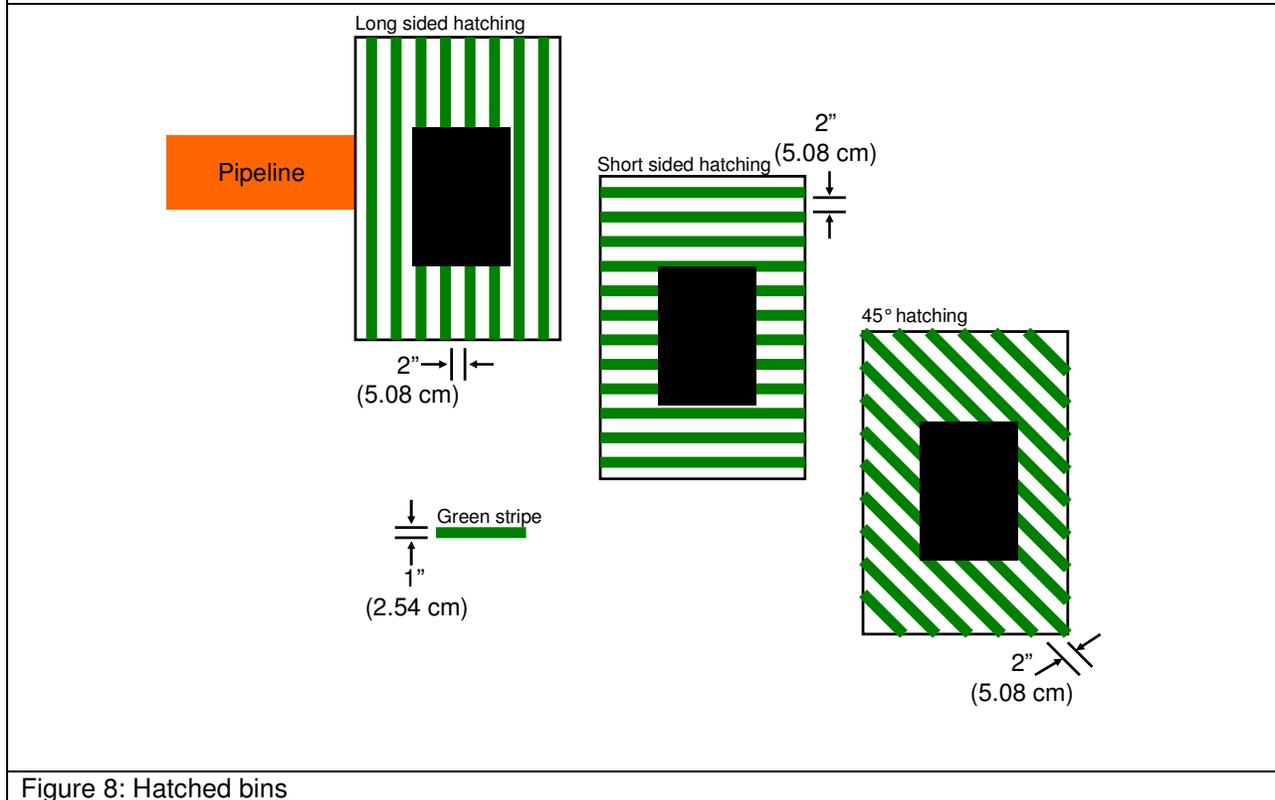


Figure 8: Hatched bins

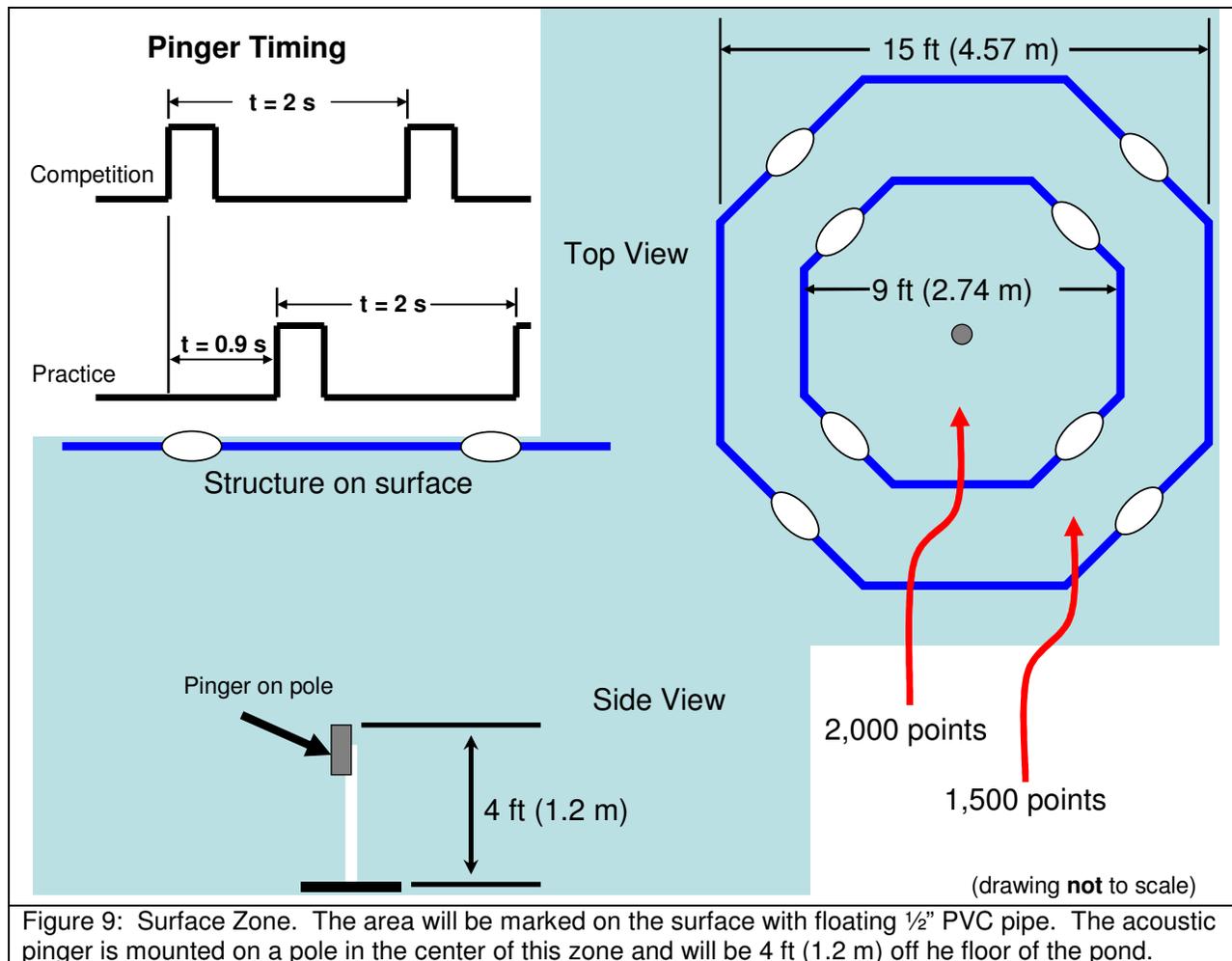


Figure 9: Surface Zone. The area will be marked on the surface with floating $\frac{1}{2}$ " PVC pipe. The acoustic pinger is mounted on a pole in the center of this zone and will be 4 ft (1.2 m) off the floor of the pond.