MELVINDALE'S

AQUA CARDS

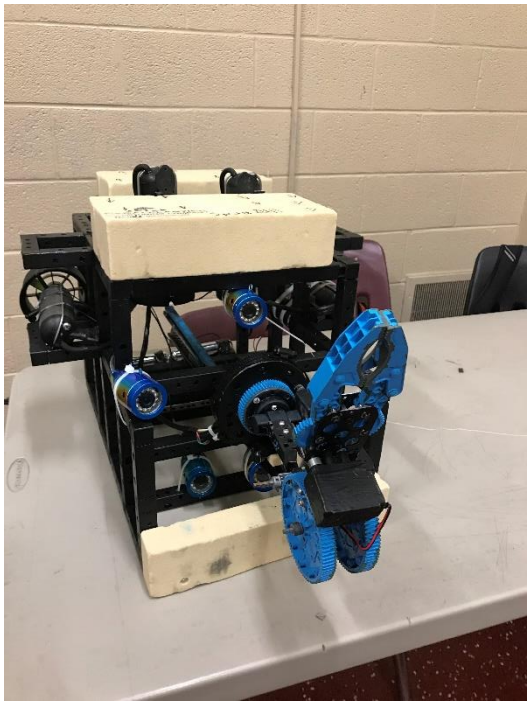
PRESENTING WALL-Y

ABSTRACT

As a team, The AquaCards have grown dedicated to building and creating an improved and capable R.O.V unit that specializes in the help of reviving and seeking new information from the vintage aircraft and the area it is located in with our unit, Wally we are able to complete these missions and understand the wreckage and what occurred.

Wally was created to allow conduct searches effectively to recover the damaged aircraft. With the assistance of a seismometer, we are able to find data in that advises us if a natural disaster such as an earthquake or volcanic eruption has occurred in that specific area. At Weyerhaeuser, Washington, we are successfully able to conduct experiments using a seismometer to exam seismic activity near the aircraft. When reviewing the area, we can determine when the aircraft was wrecked.

Wally was built with state of the art technology that allowed us to conduct these missions as efficiently as possible. With the assistance of a 360° VEX claw and other VEX products we are able to have a fully functional claw, with fish finder lenses from Innobay, we have a clear and precise image and with our trusted BTD 150 thrusters, conducting these missions precisely is no problem.



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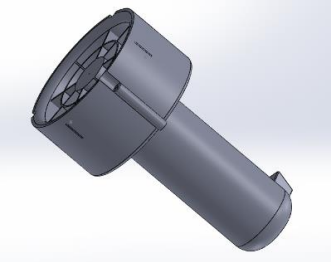
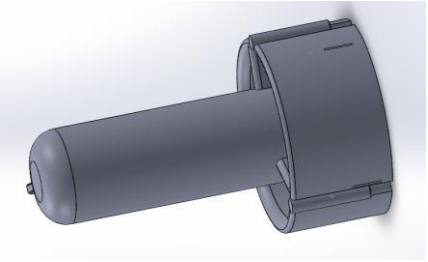
MOTORS

After much contemplation, we chose to use four BTD-150 thrusters from SeaBotix because its compact design is perfect for this project. This type of motor is a brushed electric motor, just like what you would find in an RC airplane or a quadcopter drone. The big difference is that this motor was designed for the ocean and to be placed on a ROV. The BTD-150 was made of high-strength, UV resistant polycarbonate injection molded plastic. The core of the motor is sealed and protected with an epoxy coating and uses high-performance plastic bearings instead of steel beadings that rust in saltwater. Whatever is not plastic being either aluminum or high quality stainless steel that does not corrode. The propellers and the nozzle are specifically designed to provide efficient and a powerful thrust, while active water-cooling keeps the motors cool. Unlike other thrusters, this design does not have any air or oil-filled cavities. Water flow freely through all parts of the motor while running. The motors can also handle extreme pressures. The length of one motor is 16cm in length, 9cm in width, 8.5cms in height, and a diameter of 9. 65cm.The motor propeller has two blades that are 76 mm in length. Even though this motor type is relatively small, they still pack a punch; Each motor requires 110 watts of power and they have a max of 5.8 amps or a maximum of continuous amperage of 4.25 amps. Even though this motor is also relatively small it can also pack a punch. The peak bollard thrust of each motor is 2.9 kgf and a continuous bollard thrust of 2.2 kgf





COMPANY INFO

Adeeb Deiri: 2019: Project Manager/ Pilot

Abel Barraza: 2019: Tether operator/ Co- Project Manager

Hunter Drys: 2019: Lead Technical Writer

Yusif Affara: 2020: Safety Specialist

Sonya Khan: 2019: Technical Writer

Omar Pena: 2019: Co-Pilot/ Lead Designer

Mohammed Arfan: 2019: Lead Electrician

Albino Barraza: 2019: Technician

Omar Sandoval: 2019: Technician

Cesar Escobedo:2019: Technician

Gustavo Escobedo:2019: Electrician

Ethan Rodriguez:2018: Frame Design

Rashad Arfan:2019: Safety Inspector

Samantha Sandoval:2018: Technical Writer

MISSION THEME

Aircrafts

There are many aircraft wreckages in the oceans that have not been properly searched and located. Some of the aircraft are of vintage quality, others have important cargo. The aircraft metals quickly rust away because of the ions in the salt water which increase the electrolysis reactions. The aircrafts underwater can have hazardous materials that affect the ocean life. The vintage aircrafts are made from valuable materials. These aircrafts leak fluid overtime which also affect the ocean life in a negative way. These aircrafts carry cargo that can contribute to water pollution, which is only getting worse. One example of this is “The Great Big Garbage Patch”, this patch is now three times the size of France; moreover, this is why we constructed the ROV, to retrieve important cargo/material, and to reduce all of the harm that is implemented on ocean life.

Seismometer

A seismometer is an instrument that measures motion of the ground which can be caused by: an earthquake, a volcanic eruption, or the use of explosives. The reason this is significant is for knowledge, warnings, geography, activity, etc. The way it does this is it picks up seismic waves and earth’s seismic waves shift. The way the seismometer picks up these seismic waves are by the sensors. These sensors are placed on bedrock to get a great advantage. They are also placed underwater. The ROV can help put these sensors on the ocean floor. The ROV can have multiple sensors and can be placed exactly where needed with little trouble. This helps the seismometer get data more efficiently and frequently with little interference.

Energy

Obtaining energy is crucial which the ocean can produce a significant amount of. One way we can do this is by installing tidal turbines. Tidal turbines acquire energy from the change in tides, it is then converted into electricity. The ROV helps with these tidal turbines by taking parts down and helping to repair it. It also can scope out the area surrounding it and can help determine where the best place there is to put it. A way to discover a spot for the tidal turbines is to use certain tools or instrumentations. These help us observe the ocean and its environment. The ROV helps with this by not acquiring people to get into the water. The ROV can also place these instruments in the correct location(s) and can also repair them. This helps with acquisitions of energy.

PROJECT MANAGEMENT AND SCHEDULING

The project commenced in September 2017 at the beginning of the school year. Seven students from the Underwater ROV class joined and met together to commence the journey of this project. The team, which is made up of four seniors, and three juniors who have been part of the underwater ROV class for more than two years decided it was time to put their skills to work. While different members have different jobs we all managed to work together effectively. Members were broken into groups, one set of a group was in charge of looking for basic material and the other was in charge of finding the price point for the materials. The unit was designed on the idea of all the members; we chose aluminum due to the lightweight and durability. After countless hours of working on the unit, it was complete. After wiring, mounting and connecting the unit to become usable, we went to Seitz Middle School in Riverview, MI to commence the practices.

Weekly Schedule						
Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Work Day (3:00-5:30)	Work Day (3:00-5:30)	Practice at Sietz (3:00-5:30)	Practice at Sietz (3:00-5:30)	Work Day (5:30-7:30)	Practice at Sietz (11:30-6:00)	No Practice No Work

SAFETY AND WATERPROOFING

Safety is AquaCards first priority, as we identify possible risks in all tasks and take the necessary precautions to insure that no one gets injured in any way. In order to remain safe at all times, we have set strict rules on our team while working. First off, members are required to wear closed toe shoes, long pants, and pulled up hair at all times while working on the ROV. Secondly and most importantly, everyone who is in the working area is required to wear safety goggles, this does not matter if you are working or not, you are still required to wear them in the working area. All new additions to the team are trained on how to safely use all tools and substances that are provided and are in the workspace. We also require workers to wear safety gloves while using any hazardous or potentially hazardous substances. Our team is always focused on improving the safety environment of our workspace, one way we try to improve is by having a safety meeting once a week to try to improve our safety guidelines. During this time, we construct shelves for any new equipment that has been acquired by the team, as well as tables to expand our workspace. With more workspace and storage, the safety is greatly improved as there is little to no clutter and everyone has a safe surface to work on.

Safety Check List

During Construction Checklist

- Closed-toed shoes
- Long pants
- Tied back hair
- No loose clothing

and

- Safety glasses worn during Construction
- Proper air ventilation at all times
- Dust masks when working
- Proper work behavior
- Proper training of all power tools
- All flammables stored in flammables cabinet

Pre-Mission Checklist

- All items on ROV are properly secure
- No exposed wiring or propellers
- All wiring is secured
- Tether is secured to both ROV control box
-Tether is uncoiled and untangled
- Crew has hair tied back and wearing closed-toed shoes and long pants
- Main power switch is off until all electrical connections have been connected and checked
-Main power switch is powered on once All crew members say “Ready”

CLAW AND CAMERAS

When the decision came to choose what kind of claw our R.O.V unit would be equipped with various kits that were purchased from VEX Robotics, these kits include a turntable bearing which allows the claw to move a complete 360 degrees, a linear motion kit was also purchased which allows for retracting of the claw up to 8" outwards and lastly gear kits were purchased to allow the claw to move in an upward and downward motion and allow the claw to open and close. All of these kits were chosen with thought to make tasks simpler when operating the unit. These kits couldn't be operated without the use of servos which were also purchased from Vex Robotics.

Four 2 wire servos were used to allow full functionality of the kits and they were implemented onboard the claw. A problem faced while using the servos underwater was that they didn't come waterproof from factory production, in order to fix this problem, the liquid electrical tape had to be used to cover the servos to prevent water from seeping in. Finally, all of these wires from the servos were soldered into the tether and were ran onboard the control box where they would be connected to switches.

When it was time to choose the cameras that would be used on the ROV Unit, the Innobay Fish Finder Camera was chosen and was purchased on Amazon for $169.00. These cameras were chosen because they came with a 7-inch monitor that would display color image from the camera. The 3 cameras that were bought were placed in upper left and right-hand positions to help the driver gain a specific point of view of their desire. In addition, a camera was placed in the middle front of the unit so when it became time to use the claw the could have a good point of view when operating it. The cameras were integrated directly into the power system so when it became time to connect them they would not need an external battery pack.

FRAME AND BUOYANCY

The frame started being designed in September 2016 by the team members. Many designs were thought about, but the rectangular prism was chosen as the frame. The team started building the frame with aluminum. Aluminum was chosen because of its lightweight and durability. Because the aluminum came in with no holes to allow water to pass through holes were drilled in every single part of aluminum. Plastic connectors with a “T” shape was used to connect the parts of the unit to make it a whole unit. Alongside with the frame we had to focus on buoyancy, Buoyancy was our biggest issue that took two hours to get right. Our first year we put two ballasts. These ballasts worked, it not as well as we had needed. In many of the competitions that we competed in, there were many different currents and depths that hit and affected our ROV buoyancy. The different currents would push the ROV and ballast causing our buoyancy to be rather poor. Without virtuous buoyancy it is hard to successfully control the ROV to complete our assigned missions. The buoyancy also affects the water visibility, which makes it either easier or harder for the driver to maneuver the ROV. What we did to overcome these obstacles was to balance the weight. This is why we have one floaty on the left and another on the right. We also placed our onboard equipment in a certain way to keep the ROV buoyant. After last year, we have been trying and testing out the buoyant system. We started doing research and we decided to use the sub-sea buoyant foam. The foam had to be shaped and molded to make it less water resistant. We bought two buoyancy foams at a price of about $200. The foam helps with the buoyancy, which will bring our buoyancy up to another level and take AquaCards to regionals.

TETHER AND CONTROL BOX

The wire of our choice to be used for our tether was purchased at Home Depot, it was the 100 FT Burial Sprinkler System Wire, it was purchased for $43.57. This wire was chosen because the wire came with a thick heavy duty waterproof jacket that would conceal the 7-strand wire. Two 100ft tethers had to be used to allow all our connections to run from our ROV unit to our control box. All of our connections were soldered, shrink wrapped and were coated with liquid tape. Also, these wires were connected to Molex connectors that were purchased online from Amazon for $20.00. The reason why these were purchased was for easy transportation of the ROV unit. This allowed us to disconnect the tether from the control box. The tether wires were zipped tied together to ensure we wouldn't have any loose wires and pool noodles were zip tied onto the unit for buoyancy. When it came time to assemble our control box we didn't want to have an ordinary plastic box, so we went to our local Home Depot and purchased a RIGID toolbox. It was priced at $29.00. The price was split equally among team members. Assembly of the control box had to be conducted to make sure that switches for the controls and wires could be safely installed. To make sure of this, wires were put into terminal blocks that were placed onto the control box, also a piece of Lexan was installed into the control box as a platform for switches and was secured with nuts and bolts. Likewise, a piece of PVC board was installed into the lid of the box, so it could house our monitors that would be used in our unit, and wires were run behind the PVC board. At the end of the assembly of the control box, holes were drilled into the back, so power wires could be placed inside the unit. After allowing the cables to connect controls switches are placed to allow control the movement of the unit, the claw is also inserted. Each switch is given a small label to represent their functions in an example: Up, Down, Left, Right, and close. The last step is to attach the 7-inch LCD HD monitors that allow us to view the ROVs surroundings. By attaching the monitors to the control box, we are allowed to have extra space for extra materials

TEAMWORK

AquaCards is a returning competitor in the MATE competition. This team has operated for 2 ongoing years with the same members for both years. Our team has 7 members returning to continue in the competition. Last year our team came in first at the state competition and third place at the regional competition. After this team was created in 2016, AquaCards tested many different forms of leadership and management structures. This year, our team is a basic management structure, to balance independence and cooperation to minimize bureaucracy and maximize efficiency. Our project manager and the rest of our team lead us to our success over the last two years, as well as keeping us focused and informed on the progress of our project. Everyone on our team helped construct the ROV: whether it was by building or wiring the ROV, it completed the task at hand. Some individuals also worked on wiring up the monitors we use to see where the ROV is. AquaCards is and will always will be in close communication with one another. This helps us stay in focus on any task that is in front of us. Certain individuals take charge of specific areas of product development and communication and help guide the team in order to complete major or minor tasks.

TECHNICAL AND NONTECHNICAL CHALLENGES

During the duration of facilitating the R.O.V Unit's many technical challenges were encountered by the team. Motors and cameras could not be installed onto the until a later date, because of shipping complications. Alongside that when the motors were installed onto unit at their original locations they were not receiving enough water flow because of that small square shelves were built and were added to the side of the frame. Next, to the square sections, extra aluminum shelves were made for the front of the unit for the claw because it didn't have enough support when extended. One of the biggest challenges that the team had to face was finding the buoyancy on the unit. During last year's competition, an issue with air canisters was introduced during the 2017 Ohio Regional MATE Competition, when attempting the missions, the pressure inside the air canisters was not equal with the depth pressure in the pool environment, because of this the ROV Unit couldn't make its ascension to the top. Just like any team we also faced many types of Non-Technical Challenges. During the duration of building our ROV, some members of the ROV team couldn't come to meetings because they had to attend work, sports, and other after-school programs. Another problem that we faced during the duration of the build was some members did not have a ride to the pool where our practices were conducted, one of the last problems we faced was the inconvenience of having to coordinate with other groups and agree on a fair schedule for allowed turns with the workspace at school.

INTERPERSONAL CHALLENGES

The interpersonal lessons we faced over the years during the project were mainly centered on trust, cooperation, and communication. At the beginning of the project, many of us were strangers to each other were strangers with only one person being acquainted with all of us. This was problematic in a sense that we had no foundation for trust and teamwork. Plenty of times if any of us needed help we would only ask our team leader, for the reason that he was the recognizable figure, even if he wasn't the best source for help with a specific problem or concern we still went to him in fear of not knowing each other. During the beginning, there was a lot of disagreements on the design of the ROV because everyone was set on their vision of how the ROV was going to be built, but eventually, after many team building activities, we got to know each other. We grew as a team and we were able to acknowledge our strengths and flaws which allowed us to gain the trust we needed. We have encountered and overcame multiple technical challenges. These have helped us on improving our ROV and our mentality. On May of 2017 in Ohio we came up three points shy of 3rd place at the competition. The reasoning behind this was because of the lack of information in the technical report. This is why this year we are primarily focused heavily on the report. Last competition, we completed the tasks with ease and achieved to be the best at the competition. This year we are determined to change and fix our mistakes.

TECH LESSON

Many errors found in the design of the frame were first noticed by members of the team which allowed members to be more aware of the problems. Many sharp tools were used in the process of making the frame and putting parts together, therefore team members made it a habit to wear safety goggles and even gloves in order to get the job done accurately and safely. Some parts had to be soldered which was another skill that had to be learned, every team member was able to learn this particular skill. Drills were also used during the process of drilling holes into the aluminum frame for buoyancy. Safety goggles were critically used throughout the building stages to ensure no damage was done to the one member's eyes.

FUTURE IMPROVEMENTS

In the future we would like to upgrade WALL-y and allow the unit to be controlled through a controller such as an XBOX controller. We believe that upgrading to XBOX controller will allow the drivers to have a more familiar setting that allows us to complete mission easier and quicker. For other improvements we would like to add new and more efficient cameras and faster motors, such as the T1000. If time allows we would like to expand the R.O.V and make it bigger allowing us to explore larger areas.

BUDGET

School Name:	Melvindale High	Production Period
Instructor/Mentor	Randy Thomas	From: 9/10/17
Income(project funds)		To: 4/14/18

Source	Amount
Square One Educatonal Network	$2,000.00
Vex Robtics	$150.00
Melvindale Community	$100.00
Anonymus Donation	$200.00
Lexus Donation	$1,000.00
Melnap School District	$250.00
Seitz Middle School	Practice facility
Personal Exspense	$200.00

Expenses

Category	Description	Type	Amount	Cost
Motors	T100 Thruster	Bought	x4	$476.00
Frame	Aluminum Connectors	Bought	2ft, 20 connectors	$33.14
Tether	Wire, Molex Connectors	Reused	100ft wire, 5 connectors	$54.56
Hardware	Nuts, Bolts, Liquid Tape, Terminal Blocks, Crimps	Bought	2 terminal blocks, 1 liquid tape bottle , 1 crimp box	$42.35
Claw	Claw kit, Gears, Servos, Linear Motion Kit,	Bought	2 kits, 1 bearing, 4 servos, 5 gears	$142.93
Travel	Hotel,Car Rental	Donated		$
Electronics	Motor Commander, 25 amp speed controller	Bought	2 Commanders, 4 speed controllers holder, fuses	$147.96
Control box	Lexan 12"x22", 25 amp switches RIGID Organizer	Reused	lexan piece, 4 switches, 1 organizer	$73.97
Cameras	Fish Finder Cameras	Bought	3 Fish Finder Cameras	$362.97

Total Expenses:	$1,333.88
Total Donations:	$3,900.00
Total of Reuses:	$128.53

AquaCards had an open-ended budget. With an open-ended budget we were able to cover the material costs to build our ROV, we also had to figure out a cost for our traveling expenses. We each had to cover our own traveling costs for both regional and international competition. Our form of transportation to regionals is a charter bus. This charter bus will cost us $150 and hour or $1,000 per day. We took this and multiplied it by the number of days we are going to stay in Ohio to get an average cost of $3,000. We took this expense and used our fundraiser money to help pay for some of the cost. We were then left with $1,500 and we divided this by how many people are going which is 21. We then got an average cost per person of $70 for transportation. Our Fish Finder underwater camera was the most expensive attachment for our ROV. These cameras were $120 each and we purchased three of them. This gave us a total cost of $360. The T100 Thrusters were close to pricing with the underwater cameras, which also gave us the cost of $360. All of the claw gear gave a sum of $40. It was necessary to have dimension angles on our ROV, so the overall cost was around $110. The black solid wire that helped the control system for the ROV costed an exact amount of $4,357. These were the products that were the most expensive and had a great toll on our budget. We had many other small necessities on our ROV that were cheap, but when combined the price was a total of $1,658.20. When adding these two numbers we got a total cost of $2,531.77.

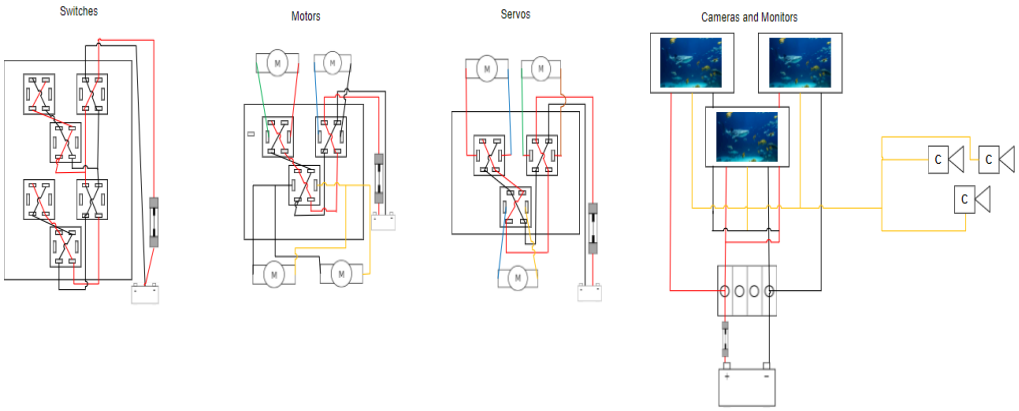
ONBOARD ELECTRONICS

Onboard the ROV we have the different types of motors. The motors have the electronic speed controllers (ESC). This allows us to gradually slow down or speed up our ROV. The ESC is in the control box but the wires run through the tether. We got the ESC from Blue Robotics and they used a twelve-volt battery. We got thruster commander to allow us to have an exact amount of power. The ESC is connected to the thruster commander which guides it. The thruster commander also gives the direction of the ROV. When we give an input to the thruster commander it will do it in a precise manner. We also have Savox Servos that we got from Vex Robotics. We got three servos, which allow the claw to move vertically up or down. This also allows the claw to move in a 360-degree manner, and it also allows it to open and close. When we flip the switch the servos recognize the signal and decide what to do with the claw based off the information that is given.

COMPANY EVAULATION

Our R.O.V team has been competing for several years. We have learned from our own mistakes and behaviors. We have been to many competitions and faced many teams and from those events we evaluated our performance. Last competition, we completed the tasks with ease and achieved to be the best at the competition. This year we are determined to change and fix our mistakes. We also had an issue with buoyancy. In a pool with a depth of 17 feet our floaties compressed which affected our buoyancy. We realized that we needed a better solution to the problem. We then did our research and experimented. The decision was made to then use subsea buoyancy foam which we got from Blue Robotics. This foam is expensive but is malleable which then allowed us to do many new things while having better buoyancy. We bought two subsea foams and shaped it up for the areas that were needed to help us with buoyancy. We also realized that communication and effort is key. When everyone is on the same page the team then functions correctly and looks flawless. This decreases our chances of making errors. Having good team chemistry is a healthy attribute to have. This is good because knowing each other strengthens the team. We also realized that sometimes things are not always about ROV. We look at our team as a family rather than just partners. We are one unit that have to be supporting one another and we have to get along with each other. We also learned that just because some things are not working right, this does not mean that everything is over or there is no solution. We have to find new ways and new ideas. A good thing about having a team is having people to bounce ideas off of. There are many life changing things you get from ROV and we are thankful for these changes because they do not just make us a better team, they shape us to become better individuals overall and help us conquer our future.

Wiring Schematics



ACKNOWLEDGEMENTS

No good project can be completed without thanking those who helped the most. This is for them. We'd like to acknowledge the help of our mentors who helped us overcome the obstacles we faced throughout the building stages and writing stages for our unit and reports. Without the help of our mentor, Mr. Thomas, building our unit would have been harder than we thought it already was, thank you for helping us experience this. Mr. Papas for helping us during the creative stages of our R.O.V and reports. We also thank our sponsors, and Melvindale Hardware for assisting us during the building stages and allowing us to receive the materials we needed. Lastly but surely, Seitz Middle School for allowing us to use their facility for our long practices and making us feel at home, MATE for giving us an incredible opportunity to explore new fields and allowing us to compete this year and making our dream come true one step at a time. Without the help of the individuals named above we couldn't have done it without your support. We thank you sincerely.

REFRENCES

- ● **http://www.boydski.com/diving/wreck_dives.htm**
- **http://kuow.org/post/whats-bottom-lake-washington-planes-trains-and**
- **http://www.crew.org/earthquake-information/history-of-earthquakes-in-cascadia**
- **https://pnsn.org/outreach/earthquakesources/csz**
- **http://depts.washington.edu/nnmrec/**
- **http://www.apl.washington.edu/project/project.php?id=seafloor_tidal_power**
- **https://www.bluerobotics.com/**