Michaela Barnes – Self-Directed Learning Award Application

Growing up in small town Newfoundland, I have always been surrounded by water. In my family history, the most respected members were those who braved the seas every morning to provide for their loved ones. As a child I often wondered how it would feel to stand on a vessel and see nothing but water surrounding me, knowing I'm miles away from land. In the eighth grade, I took up an interest in ocean technology by joining my school's remotely operated vehicle (ROV) team. I continued to fuel this interest all the way through high school, eventually going on to compete in two international ROV competitions and even winning one. I knew going in to university that I wanted to combine my love for the ocean, ocean technology, and scientific discovery. For that reason, just two months before I started my education, I switched from general studies on the St. John's Campus to the Ocean Mapping Program at the Marine Institute. While I still didn't know a lot about the program or whether I'd enjoy this style of career, I took a leap of faith in a quest to find my passion.

After the first two semesters, I still felt as if I didn't have a grasp on exactly what this program entailed and how I could use this education to excel my passions. During my first six week technical session, I was able to spend a couple days surveying in Holyrood with a multibeam echosounder. Those few days, as short as they were, reaffirmed my decision to continue on with the Ocean Mapping program at the Marine Institute. Being on the water, chatting and laughing with my classmates and instructors, all the while watching bathymetry of the seafloor roll in was absolutely fascinating to me. I knew that this was an activity I wanted to pursue more, but unfortunately after my six weeks were up, I wouldn't have the opportunity to survey for another year.

That summer I met up with a friend, Anthony Randell, who grew up on the west coast of Newfoundland. He showed me some data he had collected on Grand Lake, showing depths of over 200 m. This was particularly interesting since Gander Lake, which was previously believed to be the deepest lake in Newfoundland, was 287 m. After doing some research, we found publications from the 1900s from a survey completed by a company who had operated a mine on Glover Island, a 40 km long island on the southern end of the lake. In this publication, the greatest depth was listed as 420 m. With this in mind, we gathered a group of marine technology specialists and began a plan to find a point of Grand Lake that was deeper than Gander Lake, to once and for all prove that Grand Lake is the deepest lake in Newfoundland.

By examining the landscape of Grand Lake we estimated that the deepest location was likely on the south west side of Glover Island. This was because looming mountains on either side of the lake indicated the nearly vertical cliffs likely continued down under the water. Limited resources meant we would be conducting the survey with a single beam echosounder in an aluminum 16 ft boat. For context, a single beam echosounder will only read one depth value at a time, while a multibeam echosounder will read anywhere from 200-250 depths at a time. This means that our sounder, compared to the technology mainly in use today, would cover an extremely small area. It's comparable to colouring in a painting with a pen versus a wide paintbrush. I created some general survey lines in order to maximize over coverage of what we predicted would be the deepest areas. Before the survey, I took the initiative to become

licensed to drive a pleasure craft such that I could drive our survey vessel. In early September 2017, I was back fueling my new found passion for surveying. Over the course of two days, we launched the boat every morning in the North end of the lake and motored down to the southern end for nearly an hour. After hours of surveying, what we found blew us out of the water (not literally of course). Not only was Grand Lake the deepest lake in Newfoundland, but it was the third deepest in Canada at 475 m.

With freezing temperature over the winter months, we had to suspend any further surveys to the upcoming spring. Our surveying team took this time to do more research on Grand Lake and its history. James Howley, one of the first explorers to map and document the area surrounding Grand Lake between 1868 and 1911, had written a series of reminiscences. By reading these documents, we discovered that in the early 1900s a bridge once ran across a northern section of Grand Lake. The bridge had been flooded during the construction of a hydro station dam. The water level had risen by 11 m, burying large portions of the shorelines and all structures that stood on them. With this new fascinating information, I went to the Interim Head of the School of Ocean Technology, Paul Brett, looking for advice and resources. He offered our group a combination single beam and side scan sonar, with the catch that he believed the side scan to be broken. I spent the next few months before the spring time trouble shooting and testing the side scan sonar, which is used for capture photographic-like images of the seafloor. I discovered that the side scan was in fact working, and that the previous user had used the wrong settings when attempting to collect data. During this period I was able to apply the theory of side scan I was learning in class to a real sonar, helping me connect the dots in a real world situation. This experience taught me that troubleshooting is the of the most tedious, but crucial elements of surveying.

The group decided that with our new resources at hand, we were going to attempt to complete a full survey of all the flooded area of Grand Lake. This would entail mapping all the coast line that was 12 m or shallower. I created a survey plan, using the knowledge of the vessel's survey speed and the capabilities of our new sonars. Over the areas we expected to find the bridge, I created extra and smaller spaced lines. Creating this plan was one of the most valuable pieces of this endeavour, as it forced me to consider all aspects of the survey and how they come together. It also helped me learn to work with a team of people and how to constructively discuss options to get the best possible end result. We once again headed out to the west coast during July of 2017 with all the hope and excitement that comes along with new discoveries. While surveying, we picked up some odd shapes on our single beam sonar that indicated irregularities in the seafloor. We then set up the side scan and ran lines over this area to find that there was indeed a structure down there. With glee and excitement we recorded our findings and spent the rest of the day capturing the best possible image of the structure.

Upon returning home, we compared our side scan images with the pictures taken by James Howley of the bridge. We noticed that the number of pillars in our image did not match the number of pillars in Howley's image. After digging for a few more days, we discovered that during the construction of the main hydro dam, a smaller dam had been constructed to control water flow. The images of the structure we discovered were actually the dam, not the bridge! I created another survey plan that was slightly upstream from the dam structure we discovered.

Remarkably, during our next survey we discovered the structure of the bridge. We spent hours collecting images of the two structures. Through this survey, I realized just how important having a stable platform is to collect high resolution images. Although the original survey did not go to plan, the end result was much better than we dreamed of. Not finding the bridge in the first run is what helped us discover the flooded dam. It goes to show that embracing mistakes is what helps us grow and create even better end products.

After completing these two surveys, we came back and presented our data to the School of Ocean Technology and gave a presentation at the Johnson Geo Centre. Now that we had found these pieces of sunken history, we aimed to bring awareness to the public of how important conservation is in our waters. The dam and the bridge were a forgotten part of Newfoundland's history that help create a better image of what Newfoundland's past and formation looked like. We then went on to publish an article in the Journal of Ocean Technology, with myself as the primary author. The article aimed to describe our discoveries, while also providing inspiration to other young students with a passion for science and research. Though this part of the project, I learned how to share my findings with the public and how to engage the community in science for the sake of science.

While this study and passion for mapping Grand Lake did take up a large portion of my free evenings and weekends, it was by far the most valuable project I have undertaken in my studies. I set out with the goal to improve my knowledge and experience in surveying, but I had no idea just how many skills (both tangible and intangible) I would gain. With our limited resources, I learned to be creative and inventive to achieve the results we wanted. With this came the outcome of becoming a more confident leader. The surveying skills and knowledge I gained is not something that can be taught in a lecture. This project reaffirmed my love for ocean technology, the water, and scientific curiosity that I had created as a young child. After all, to have a passion, formulate a plan, see it through, and get the results is truly the most rewarding and satisfying experience.