

# Whale Tail Dike



## Henry Foundation Drilling Inc. innovates to complete unique piling project in Nunavut

*By Olive Tailor - Piling Canada*

When Don Henry, the president of Henry Foundation Drilling Inc. (HFDI), learned his team had been awarded the contract to construct a secant pile wall in the middle of Whale Tail Lake in Nunavut, he knew the project would be unlike any other.

HFDI's winning bid combined innovative design, aggressive scheduling and competitive pricing. Although the Langley-based team anticipated the project would be tough due to the logistics of working in a remote location and the painstaking measures required to conserve the sensitive terrain and wildlife, working in temperatures that plunged to  $-50^{\circ}\text{C}$  with only two and a half hours of daylight in the middle of winter is an experience the crew will never forget.

## Project Overview

Situated approximately 130 kilometres north of Baker Lake, a hamlet known for its famous Inuit artists, the project site was right on Whale Tail Lake, specifically on a dike that split the lake in half so the lake could be dewatered and mined. Between August and December 2018, HFDI constructed an 800-metre-long secant pile wall of overlapping piles socketed into bedrock.

One thousand secant piles, one metre in diameter, were socketed into bedrock. "Pile deviation was paramount," said Henry. "Every pile had to be measured for deviation."

Due to the remote location in Nunavut, HFDI had to mobilize an onsite automated grout plant as well as mechanics and welding shops to complete the job. "Extensive planning went into ensuring that every piece of equipment and all the materials required were onsite so that the team could be self-sufficient," Henry said.

The team used conventional tools for drilling, including segmental casing, augers, core barrels and bailing buckets. Upon hitting bedrock, a 7-bit hammer was used to create a one-metre socket.

All holes were filled with grout made by HFDI. At the onsite grout plant, the team mixed cement and bentonite as well as a retarding admixture to create the final grout product. After being pumped into a vacuum truck, the mixture was transported to the dike for use. The crew used insulated pump skids to transfer the grout from the truck and placed the mixture using a tremie pipe in the pile.

### **Logistics of Working in a Remote Location**

HFDI was awarded the project in March 2018. However, since barges can only travel when the ice is melted, the team was left with a small window of three months to prepare all the equipment and support loads. Specialized containers were built for the mechanical, fabrication and other support services.

Approximately 25 loads were dispatched on the long journey to the work site. The mobilization started with a cross-country trek from Vancouver, B.C., to Becancour Port, Que., located on the south shore of the Saint Lawrence River, where the containers were loaded on a barge. The barge travelled around Newfoundland and Labrador to the mouth of the Baker River, where a mid-ocean transfer moved everything from the ocean-going barge to the river barge. The equipment and supplies were offloaded and trucked north on a gravel road that extended from Baker Lake to the mine site at Amaruq, situated 130 kilometres northwest of Baker Lake.

The sourcing of a crew to work at the remote location while the existing team members continued to work on projects during the busy 2018 season was another obstacle. Project manager, Owen Langton, hired seasoned workers from across

Canada. Under the direction of Cole Allestor, HFDI's senior superintendent for the project, the crew proved to be a hardy, competent team.

Getting the crew to the worksite also required several modes of transportation for the two-day trip. Members of the crew, who all lived in different parts of Canada, first flew to Montreal. From there, a second mine-chartered flight brought them north to the Meadowbank complex in the Kivalliq District of Nunavut, where buses and pickup trucks covered the final 50-kilometre stretch. To return, the crew took the same two-day journey in reverse. From Day 1 until the completion of the final pile, three crews worked a rotating schedule to keep equipment running 24/7.

## **Phases I and II**

Kivalliq Contractors Group (KCG), the general contractors, were responsible for the first phase of the work that involved building the berm through the middle of the lake. The berm had to be built during the summer, which left KCG with a short window of time for construction. HFDI's work could not begin until the berm was finished.

"The construction of the berm was a sizeable undertaking and it was necessary to complete this work in the summer before the lake froze over," said Langton. "KCG proved to be a very able partner in completing the work. The group had acquired the necessary skills of working through the northern winter and they were always willing and able to support HFDI in the daily challenges that presented." The Whale Tail Dike was constructed as a zoned rockfill dike with a core composed of a fine filter dynamically compacted. The construction of a cement-bentonite secant pile wall in the middle of the berm transformed it from a berm to a dam wall. The outer parts of the berm were built from a larger aggregate that protected the inner core.

Phase II began in the middle of August. HFDI crews constructed workshops and laydown areas. Next, equipment was assembled and tested. "All the innovative ideas that had seemed so bulletproof in the warmth of the office in Vancouver met the reality of the Canadian North," said Henry. "Things didn't always go as we thought they would."

Even though the HFDI crew brought significant expertise in secant pile construction to the project, every pile required a one metre rock socket, which translated into nearly 10 per cent of the 10,000 linear metres that were drilled being rock. The schedule did not afford the team sufficient time for the rock sockets to be cored using traditional drilling tools.

The crew realized that to complete the required 1,000 piles before the Christmas Day 2018 deadline, they needed to come up with another strategy. "Centre Rock provided two cluster drills and considerable know-how, which combined with Don

Henry's fertile imagination, lead to the creation of a hybrid system in which the drills could as easily pick up the rock hammers as an auger," said Langton.

An air hard line was built that could be broken down and moved as the construction progressed. The hard line enabled the drills to stay connected to the bank of compressors that powered the rock hammers.

### **Environmental Precautions**

From the outset of the project, environmental concerns were addressed concomitantly with operational planning. To protect the pristine water, two rows of silt curtains were installed in the lake, both upstream and downstream, of the construction area. All fish were removed in the areas between the silt curtains and the construction area; potential adverse impacts of vibrations created by construction activities on the fish were carefully monitored.

During the project, all refueling was undertaken with the utmost care and hydraulic oils in the drills were swapped for environmentally friendly equivalents. Refuelling always occurred off the dike.

To assess the risk of permafrost thawing, extensive geotechnical analyses, including thermal analysis, were conducted over multiple years with the objective of determining the effect of the construction of the dike on the thermal regime in the foundation. The engineering team concluded that most of the core of the dike should stay frozen during the lifetime of the structure.

"There were no spills or incidents throughout the project," said Henry. "All equipment and supplies were safely removed when the project was complete."

### **Innovative Solutions to Overcome Obstacles**

Throughout the project, the crew innovated and adapted to overcome obstacles. For instance, a grout plant needed to be built that could produce sufficient volumes of the specialized design of cement and bentonite required to build the cutoff wall. It was not an easy feat with the time constraints and crews still doing final assembly as the containers were being loaded, but the plant's production capacity allowed the team to stay on schedule.

The crew was thrown another curveball when the production of the grout-bentonite mixture clogged up pumps and lines. "On the ground, mechanical and software changes were implemented as everybody got on board to help resolve issues presented by the never-before-used grout-bentonite mix," said Langton.

HFDI constructed Portable Agitation Tanks (PAT). The PATs were designed to be carried on the forks of the large front-end loaders that were available at the mine site. The PATs were intended to be used to transport the cement-bentonite mixture from

the plant to the piles. When this approach proved flawed, the team re-engineered and implemented an alternative delivery system using a tanker truck.

At every phase of the construction, the extreme cold caused issues. For instance, a heated tent had to be constructed for the grout plant to operate in with an adjoining tent that held the cement hopper. The design helped manage the dust that was generated when cement bags were opened. A screw conveyor system linked the two areas.

"KCG's expertise in the North proved invaluable as a multitude of obstacles were addressed and overcome," said Langton. "An innovative solution provided hot water for the grout plant and site."

Preventing the workers from getting frostbite was another ongoing concern. The team received extensive training about working safely in such extreme weather. No crew member had to be treated for frostbite and the project had an impeccable safety record.

"This was the kind of project that brings the best out in a company. HFDI personnel rose to the occasion and despite tough conditions, which included the cold, numerous equipment failures and the need to innovate methodologies on the ground," said Henry. "All this and a host of other issues that can only be presented by one of the harshest terrains in the world and we were able to bring the project in ahead of schedule and on budget."

Taylor, O. (2019). *Whale Tail Dike*. Piling Canada .

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