LOWER CHURCHILL PROJECT

MUSKRAT FALLS NORTH SPUR

1999 TO 2011

Technical Note

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nalcor energy
LOWER CHURCHILL PROJECT

1. Purpose

The purpose of this technical note is to summarize the work undertaken at the Muskrat Falls North Spur since 1999.

2. Description

In 1999, a Final Feasibility Study report was completed for the generation facility at Muskrat Falls. This report outlined details of previous investigations, soil stratigraphy and properties, groundwater conditions, hydrogeology, stability analyses and a conceptual design for potential stabilization measures.

In 2007, a field program was carried out to assess the condition of the pumpwell system that had been installed in 1981 in order to prevent continued regression of the slopes of the North Spur due to potential landslide activity. The report on the 2007 program, Assessment of Existing Pumpwell System (MF1260) in July 2008, made several recommendations to extend the life of the existing system and ensure its continued operation for the next 10 years. The recommendations included the cleaning and inspection of the 22 wells to enable an assessment of the condition of the system, and the installation of new piezometers to further assess groundwater conditions in the area of the North Spur.

In 2009, a well inspection program was carried out which included cleaning and condition assessment of all 22 wells, their pumps, intake screens, sensors and risers. The operation of all hardware was checked and defective components were replaced. The report on the 2009 program, Evaluation of Existing Wells, Pumps and Related Infrastructure in the Muskrat Falls Pumpwell System (MF1271) in March 2010, described this program and made several recommendations for well assessment, upgrades and continued monitoring.

Also in 2009, a drilling program was carried out for the installation of 8 new piezometers. A report on this program, Installation of New Piezometers in the Muskrat Falls Pumpwell System (MF1272) in April 2010, described this program and made recommendations for future monitoring, including upgrading the data acquisition system.

In 2010, Nalcor installed new telecommunications equipment for the Muskrat Falls site, to improve the reliability of the pump data that is transmitted from site. In addition, Nalcor continues to monitor the overall performance of the system by collecting water level data from the piezometers and performing required maintenance on the system.

The long term stability of the North Spur will be further addressed during the current detailed design phase of the Lower Churchill Project. The conceptual design outlined in the 1999 Study will be analyzed and further developed based on current information and additional geotechnical information that will be obtained in a site investigation program planned for 2012.

3. Reference Reports

For further details, a one to two page description of each of the following reports is included in the Appendix:

MF1260 - Assessment of Existing Pumpwell System
MF1271 - Evaluation of Existing Wells, Pumps and Related Infrastructure in the Muskrat Falls Pumpwell System
MF1272 - Installation of New Piezometers in the Muskrat Falls Pumpwell System

Appendix

MF1260 – Assessment of Existing Pumpwell System

The purpose of this study was to determine the suitability of the pump well system installed on the north spur at the Muskrat Falls site. The scope of this study included an on-site inspection of the system to determine the present physical condition and operational characteristics.

The final report based on this study was submitted to the NE-LCP group in July 2008.

Major Findings

Information obtained from the inspections was compared to historical data from prior investigations to assess the performance of the pump well system.

The dewatering system has operated continuously since 1981 and there has been no major landslide activity on the spur since. However, the system is currently 27 years old, and some rehabilitation work is required to ensure its continued operation for the next 10 years.

The original piezometers were struck by lightning in 1983. Seven (7) new standpipe piezometers were installed in 1997, but one is out of order.

Three (3) of the pumps (W-1, W-2, and W-22) have been decommissioned, and several of the remaining pumps operate less than 100 minutes per annum, while some wells are very active.

It was noted that the main 600 V AC line exiting the control shelter was divided into four (4) runs of 600 V AC. The 600 V AC cable powers three groups of six (6) motors and one group of four (4) motors in series.

Conclusions and Recommendations

It was recommended that data acquisition and automatic data transformation for all piezometers be installed, along with four (4) new standpipe piezometers, in the narrowest section of the spur.

To maintain and improve the dewatering system, the following recommendations were made:

- The wells should be flushed by a qualified company with experience in well drilling, as one well (W-4) was seen to be discharging silt and fine sand;
- A television camera should be used to inspect the screen and confirm its integrity;
- Pumps should be installed in wells W-1, W-2 and W-22;
- A down-hole test called a Radiation Absorption or Density test should be used to inspect any possible voids behind and within the filter;
- Piezoelectric elevations should be recorded on a more frequent basis;
- All pumps, risers and level sensors should be pulled, inspected, and cleaned. All specifications and details of pumps, motors and sensor positions should be recorded and all sensors and relays tested;
- Seven (7) new wells should be installed in three (3) blocks to replace the existing system and maintain the maximum lowering of the groundwater in the area;
- Consideration should be given to the installation of a flow monitoring device at the collector pipe outlet; the output would be transmitted to Goose Bay with pump function data.

In addition, it was recommended that all electrical components from the control panel be tested to ensure the electrical infrastructure was not deteriorating. Back-up power should be provided in the event of a power outage.

An investigation as to the cause of the problematic data, with a review of all overload relays and sensors, should be completed. The remote terminal unit should undergo self testing. This data would then be compared with the transmitted data to determine whether the errors were caused by the monitoring or the radio transmission components of the system.

Due to the unreliability of the transmission components, it was recommended that the following options for data transmission be explored:

- Satellite technology;
- Fibre optic/communications cable along the existing pole line to HVGB;
- Data Transmission over existing power lines;
- Additional upgrades to VHF system.

It was also recommended that the following activities be carried out to assist with the ongoing dewatering operations:

- Implement procedures for responding to high-level alarms;
- Provide back-up pump and motor capability at facilities in HVGB;
- Clear trails to all piezometers and weirs while installing safety hand lines as appropriate;

- Re-bury the exposed portion of the outfall pipe and re-grade the slope to prevent further erosion;
- Replace and/or repair the outfall heater.

MF1271 – Evaluation of Existing Wells, Pumps and Related Infrastructure in the Muskrat Falls Pump well System

The purpose of this study was to present the findings of the 2009 inspection and cleaning program of the pump well system installed on the north spur at the Muskrat Falls site. The scope of work included removal of pumps, risers, and electrical components from the wells, down hole camera inspections, well cleaning, and component inspection and reinstallation.

The second draft of this report was submitted to the NE-LCP group in January 2010.

Major Findings

The wells in the system were operating satisfactorily and wells screens were generally in good condition, with the exception of wells W-1, W-2, W-15 and W- 18. It was expected that W-15 could be readily repaired at the control panel. Wells W-1, W-2 and W-18 may no longer be viable.

The bottom riser, just above the pump, of most of the wells was covered in silt, iron and Manganese deposits and in some cases was corroded. The bottom riser was replaced in 11 wells.

The valves and piping in the area of the pitless adaptor were frequently in poor condition, in particular in well W-4 and well W-9. The couplings at Well W-3 were also in poor condition and were replaced.

Historically, a 3 mm hole was drilled in the bottom riser of all wells to allow for drainage of excess water and as a means of preventing the pipes from freezing. It was possible that spray water from the hole caused moderate build up of iron staining in the screen and high turbidity levels in the area of the pump intake.

In wells W-3, W-5, W-6, W-7, W-8, W-17, W-18 and W-20, the sensors may be set high in relation to the top of the pump and in wells W-5 and W-6, the low sensor is set higher than the measured water level. With the sensors at the current levels, the pumps would not come on frequently in these wells unless the water level rose significantly. Water levels were monitored in the piezometers prior to and throughout the well inspection program. The water levels did not vary more than 0.3 m to 0.6 m from water levels recorded when the well dewatering system was in full operation.

The electrical components of the system continue to be problematic.

Conclusions and Recommendations

The dewatering system has operated continuously since November 1981 and there has been no further major landslide activity on the spur. The purpose of the installation has, therefore, been fulfilled. Rehabilitation work recommended in previous reports has been completed.

MF1272 – Installation of New Piezometers in the Muskrat Falls Pump well System (2009)

Following a field investigation in November 2007, it was recommended in the July 2008 report that eight (8) new piezometers be drilled at four (4) locations to further assess groundwater conditions in the area of the dewatering system. The purpose of this study was to summarize the piezometer installation program that took place in 2009.

The first draft of this report was submitted to the NE-LCP group in October 2009.

Major Findings

The installation of eight (8) new piezometers was completed at Muskrat Falls. Daily field reports were compiled and have been attached to the report.

A total of five (5) boreholes were drilled at four (4) sites using a skidder-mounted CME-55 drill rig provided by Lantech of Dieppe, NB. Borehole depths ranged between 35.4 m and 58.5 m below existing ground surface. Piezometers were then installed in the completed boreholes.

Monitor well Nos. 2009 P1A and P1B, 2009 P3A and P3B, and 2009 P4A and P4B each comprise of two (2) 25 mm ID nested piezometers, installed at different depths. Monitor well Nos. 2009 P2A and P2B each comprise of a single 50 mm ID piezometer. All screens were installed using a coarse slag material as a filter pack and fill material. They were then isolated, top and bottom, with coated bentonite pellets and, with the exception of 2009 P2A and P2B, were fitted with a geosock material and were grouted to near ground surface using a volclay grout.

Conventional split spoon sampling was carried out in borehole 2009 P2B and at selected locations within the other boreholes to identify more permeable soils for the installation of the screens.

Initial water level readings were obtained from each piezometer, with the exception of 2009 P4A and P4B.

Conclusions and Recommendations

Actual locations of the boreholes were modified due to site constraints. In order for this

component of the project to remain on budget, it was decided that two (2) smaller piezometers would be nested within each borehole instead of the original plan to install one (1) piezometer in each borehole.

A falling head test was performed at piezometer P2-A and P2-B by adding approximately 45 litres of water to each piezometer and recording the water level variations until the piezometer water elevation stabilized (approximately 60 to 90 minutes).