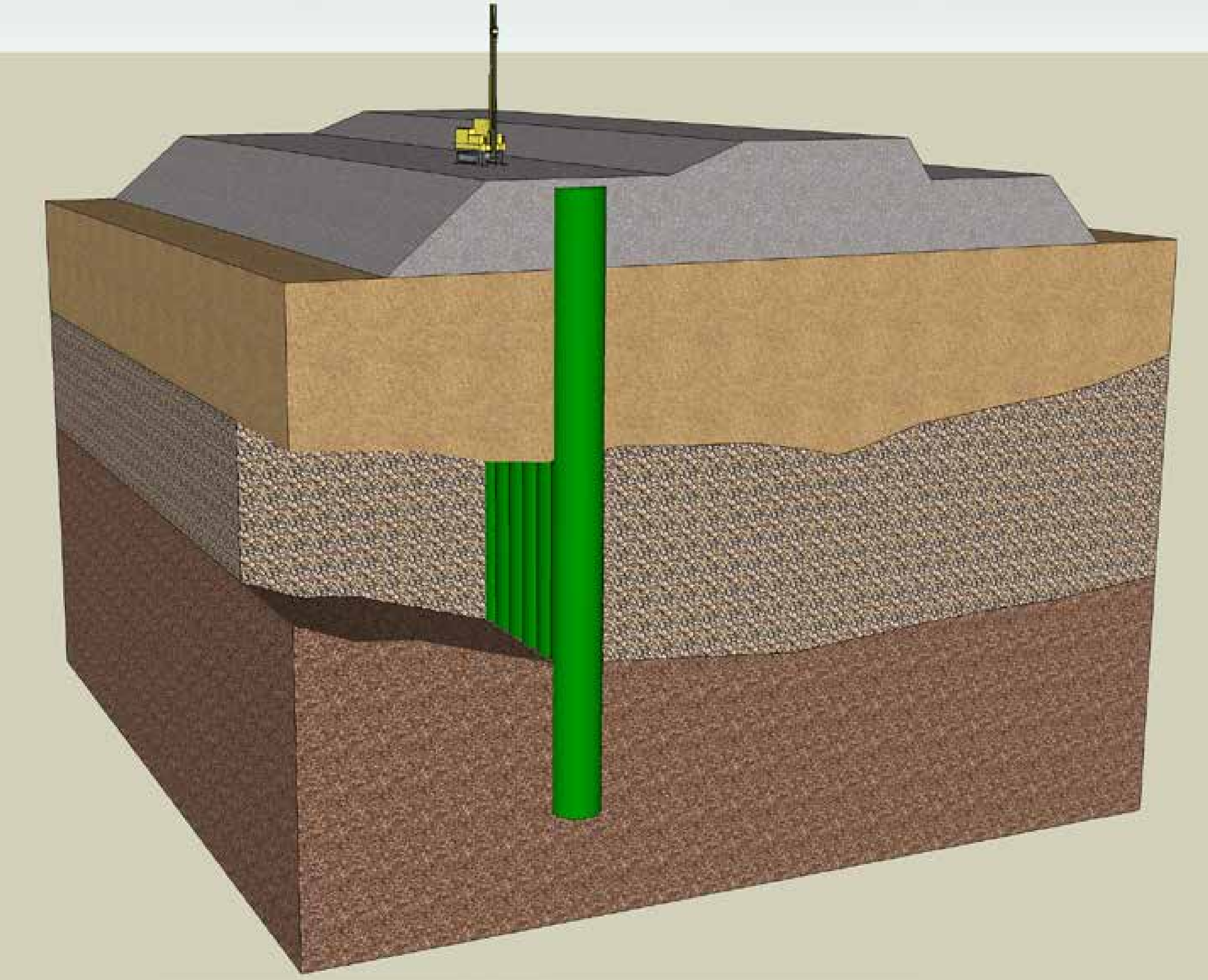
DRILL PAC

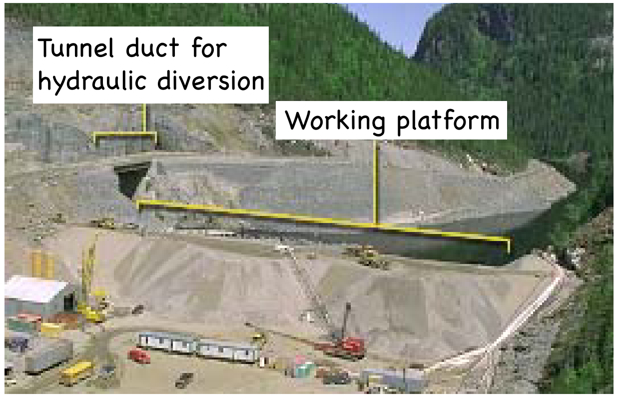
www.drillpac.com

PACCHIOSI DRILL

ROCK - SOIL TECHNOLOGY AND EQUIPMENTS

WATERPROOFING





SEPT ILES (QUEBEC – CANADA)

SEPT ILES (QUEBEC – CANADA)

PROJECT:

Installation of a waterproof Jet Groutingdiaphragm for the construction of the Sainte Marguerite 3 hydroelectric complex.

PERIOD OF EXECUTION:

October 1995 – July 1997

CLIENT:

Hydro Quebec / Neilson Excavation

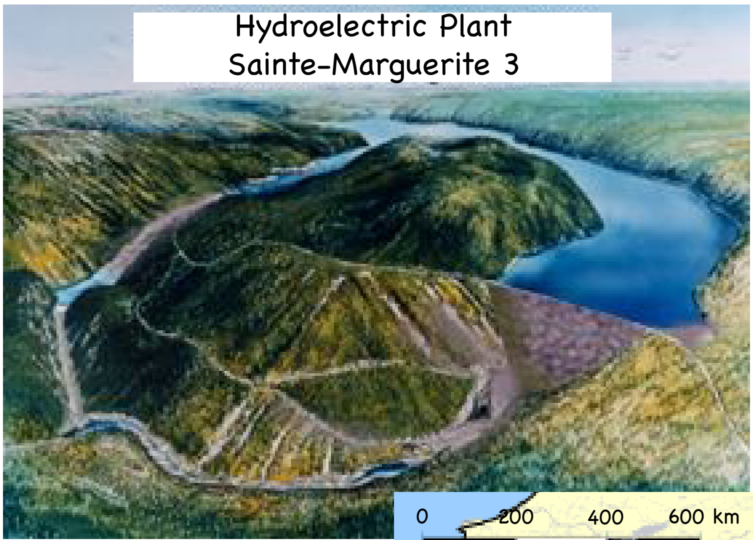


Fig. 1. Graphic reconstruction of the zone involved in construction of the dam.

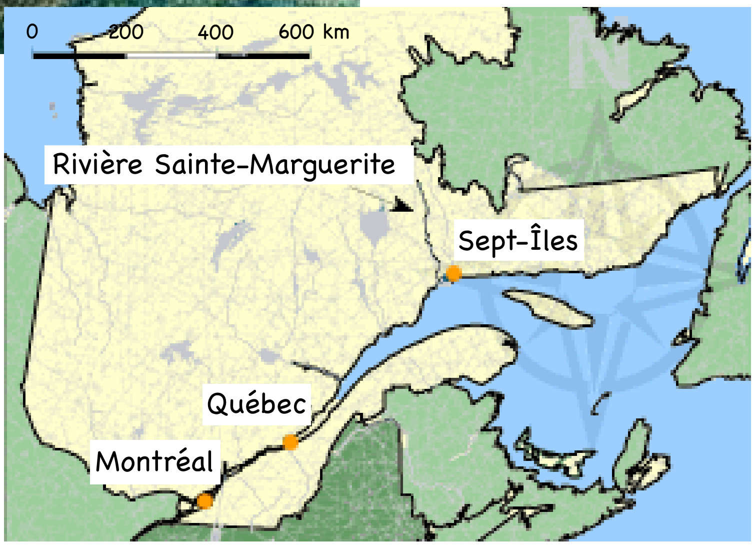


Fig. 2. Geographical localization of worksite.

Purpose of the work, difficulties encountered and solutions applied.

The Sainte Marguerite 3 (SM3) hydroelectric complex (Fig. 1), built on the river of the same name, is located 90 km north of the port of Sept-Iles, Quebec (Canada) (Fig. 2).

The dam was built in a zone where the river at the Sainte-Marguerite 3 hydroelectric complex runs through an ancient canyon covered with alluvial deposits.

The project called for removal of the alluvial deposits and installation of the dam on the rock underneath. To do this, it was necessary to build a tunnel, to deviate the course of the river (Fig. 3), and a waterproof diaphragm on the floodwaters upstream of the zone involved in the excavations. This made it possible to remove the water from the material to be excavated, thereby creating the construction site for the dam on dry land and absolutely safe conditions.

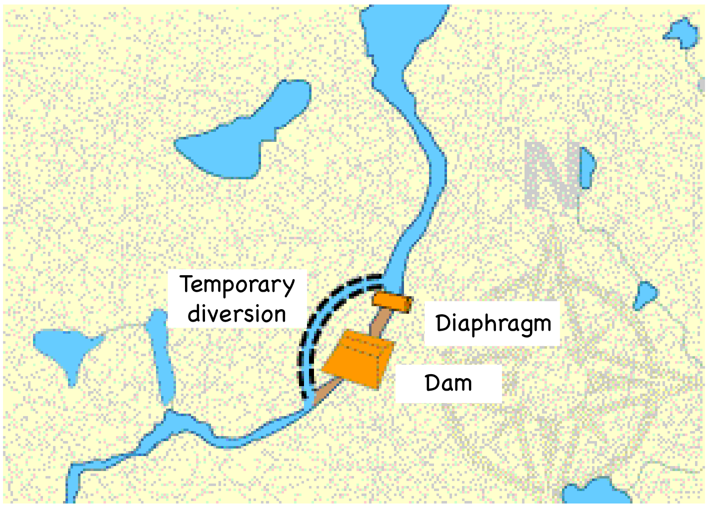


Fig. 3. Map showing the temporary tunnel necessary to deviate the Sainte Marguerite river.

The waterproof diaphragm was built using the Jet–Grouting technique. The treatment, performed on a mound of soil built along the entire width of the river, involved soil with an estimated permeability on the order of 10 m/sec. The purpose of the works was to create a waterproof screen with a minimum thickness of 80 cm, with a maximum permeability of $1x10^{-8}$ m/sec and a resistance to simple compression between 1.5 and 2 Mpa.

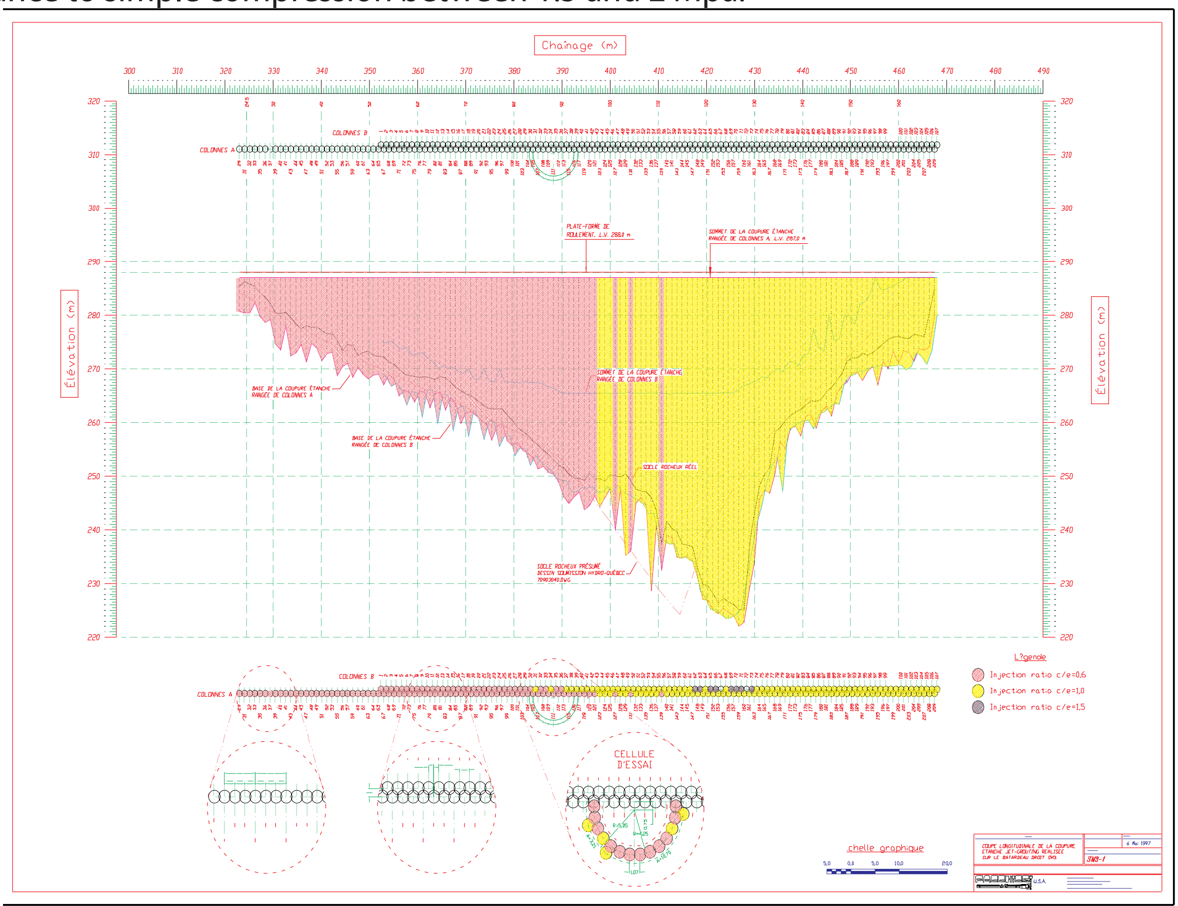


Fig. 4. Graph illustrating the characteristics of the Jet Grouting columns.

Stratigraphic profile of the material treated.

- Build-up soil: 15%;
- Alluvial deposits consisting of medium-fine sand: 20%;
- Coarse alluvial deposits with pebbles and blocks: 50%;
- Granite: 15%.

Description of works.

The works were constructed using the Pacchiosi Jet Grouting PS3 system. Before starting the works, field tests were performed and it was found that columns having a diameter greater than 2.20 m could be produced on all the soil types involved in the procedure. Moreover, the performance of a pumping test within the perimeter of the test field made it possible to ascertain that soil treated with Jet Grouting had reduced permeability in line with the values required for the project (Fig. 4).

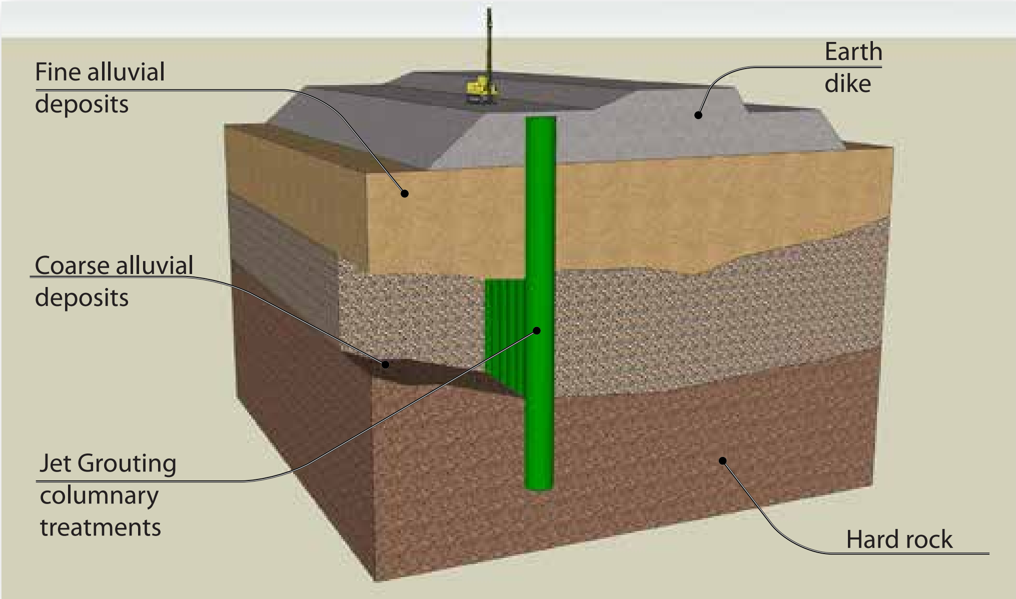


Fig. 5. 3D sketch of works.

The work was done (Fig. 5) with two rows of columns spaced 0.80 m apart. The columns, set at a distance of 1.07 m, had to overlap laterally to ensure the continuity of the diaphragm. All the columns were pushed into the rocky substrate from a minimum of 2 to a maximum of 5 m, to seal any cracks and/or fissures in the rock roof. The columns in the downstream row were made on the entire area of the diaphragm, while the columns in the upstream row were interrupted 20 m below the working surface.

The perforation was done using a down the hole hammer with reverse air circulation. This method served to obtain excellent performance in the forward speed, in both sand and in the granite substrate, without raising or breaking the soil involved in the treatment, much less the soil that served as the work plane, and capable or maintaining the deviation of the hole from vertical within absolutely acceptable limits. Registration of the perforation parameters with the **Pacchiosi PRS3 data recording system** made it possible to determine the exact depth of the rocky substrate, as well as the degree of fracturing of the rock. This made it possible to optimize the original project in order to better comply with the real conditions of the ground in place.

The systematic measurement of the deviation of the hole from vertical made it possible to optimize the injection parameters to obtain columns with a suitable diameter to ensure the minimum thickness required for the diaphragm.

Fig. 6. View of the worksite.

The maximum screen depth was over 65 m.

The screen thickness varies from a minimum of 0.90 m, in the sections with a single row of columns, to over 1.60 m, in the sections with two rows of columns. The consolidated soil samples drawn from the screen gave values of resistance to compression between 1.5 and 2.3 Mpa. The columns reached diameters up to 2.5 m. The screen seal was tested with the excavation of soil for installation of the main dam. A differential jamb was created between the upstream and downstream sides, between the two faces of the screen, for over 40 m of water column, which made it possible to estimate the permeability of the lower screen at $1x10^{-8}$ m/sec. No further word was necessary to correct possible flaws in screen construction.

The works were carried out to a large extent during the winter, with temperatures as low as –30°C due to the delay in construction of the deviation tunnel (Fig. 6).

This made it necessary to use special equipment and systems specifically designed to function

Fig. 7. P 1500 drill rig with removable cover for cold protection.

Fig. 8. P 1500 drill rig with rod-charger.

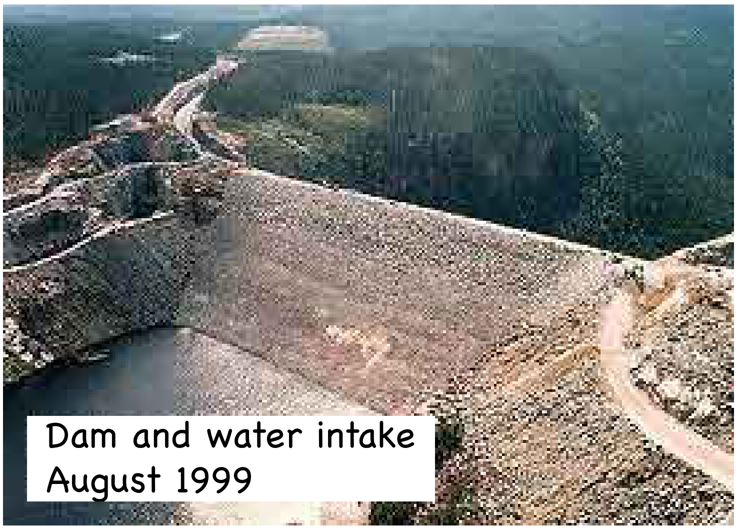


Fig. 9. Final view of the dam..

ROCK - SOIL TECHNOLOGY AND EQUIPMENTS

DRILL PAC

COMPANY WITH
QUALITY SYSTEM
CERTIFIED BY DNV GL
= ISO 9001:2015 =

Branches

AMERIQUE DU NORD PACCHIOSI INC, Canada

PACCHIOSI DRILL USA INC, USA

Drill Pac S.r.l. – Società soggetta a direzione e coordinamento di Ghella S.p.A
Sede Legale: Via Pietro Borsieri, 2/a - 00195 Roma (RM)
Tel. +39 06 45603.1 – Fax +39 06 45603040 – e-mail: info@drillpac.com
Sede Operativa: Frazione Borgonovo, 22 – 43018 Sissa Trecasali (PR)
Tel. +39 0521 379003 – Fax +39 0521 879922 - **Sito web:** www.pacchiosi.com