

Newhaven ERF

Description of Water Handling for Floating Caisson

ENERGY EUROPE

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1 Introduction

The construction of the Newhaven Energy Recovery Facility requires a 19.7m deep pit (-15.7m AOD) to accommodate the waste bunker and the boiler of the incineration plant. The dimensions of the structure are approx. 43 x 39m. As the ground conditions are very difficult due to the poor bearing capacities of the soil layers, VonRoll/HOCHTIEF (VRH) consortium has envisaged installing a circular earth retaining wall with 57m diameter to include the above mentioned structure.

A packer test has been conducted to determine the permeability of the underlying chalk layer at -27.0m AOD. The permeability was found to be very high resulting in a complex construction process. Hence, VRH developed several solutions for sealing the bottom of the earth retaining structure. Most of these solutions have been discussed with the Environment Agency (EA) as they all implied pumping of seepage water. To reduce environmental impact to a minimum, VRH has now worked out a construction scheme avoiding any pumping of groundwater. This method no longer prevents the pit from water ingress but uses water for a floating structure.

This document shall explain the concept of water handling during the excavation of the construction pit and the floating operation of the structure.

2 Contaminated Land

The contamination in the Made Ground (top 4m soil layer) is described in the "Human Health and Controlled Waters Risk Assessment" dated April 2005 and the "Environmental Site Investigation Report" dated October 2004. VRH will excavate and treat the contaminated material in accordance to the remediation strategy before start of excavation. Hence, the soil getting in contact with water is assumed to be free of contamination.

3 Construction Pit

The earth retaining structure consists of a circular diaphragm wall with an inner diameter of 57m. This will be a wall of 1.2m thickness resting in the sand gravel layer at approx. -25m AOD. Further diaphragm elements (so called barrettes) will be installed in parallel for later foundation of the building. After completion of the diaphragm wall, excavation under water using cable-operated excavators and/or dredging pumps will proceed. The excavated material will be dewatered in a bunded area and

the water will be redirected into the pit. For dredging operations VRH will install a dewatering plant to separate water from soil.

To prevent the external groundwater from seeping through the earth retaining structure into the pit, VRH will pump water from the river Ouse to keep the inner water level at +2.0m AOD. The entire volume of the construction pit is:

$$(57\text{m}/2)^2 * \pi * 17.7\text{m} = 45\,166\text{m}^3 < \mathbf{46\,000\text{m}^3}$$

Please refer to Figure 1. We have assumed to pump water during high tide only: 6 hours per cycle – 12 hours a day. As the excavation is assumed to last 9 weeks the resulting abstraction rate would be

$$< \mathbf{60\text{m}^3/\text{h}}$$

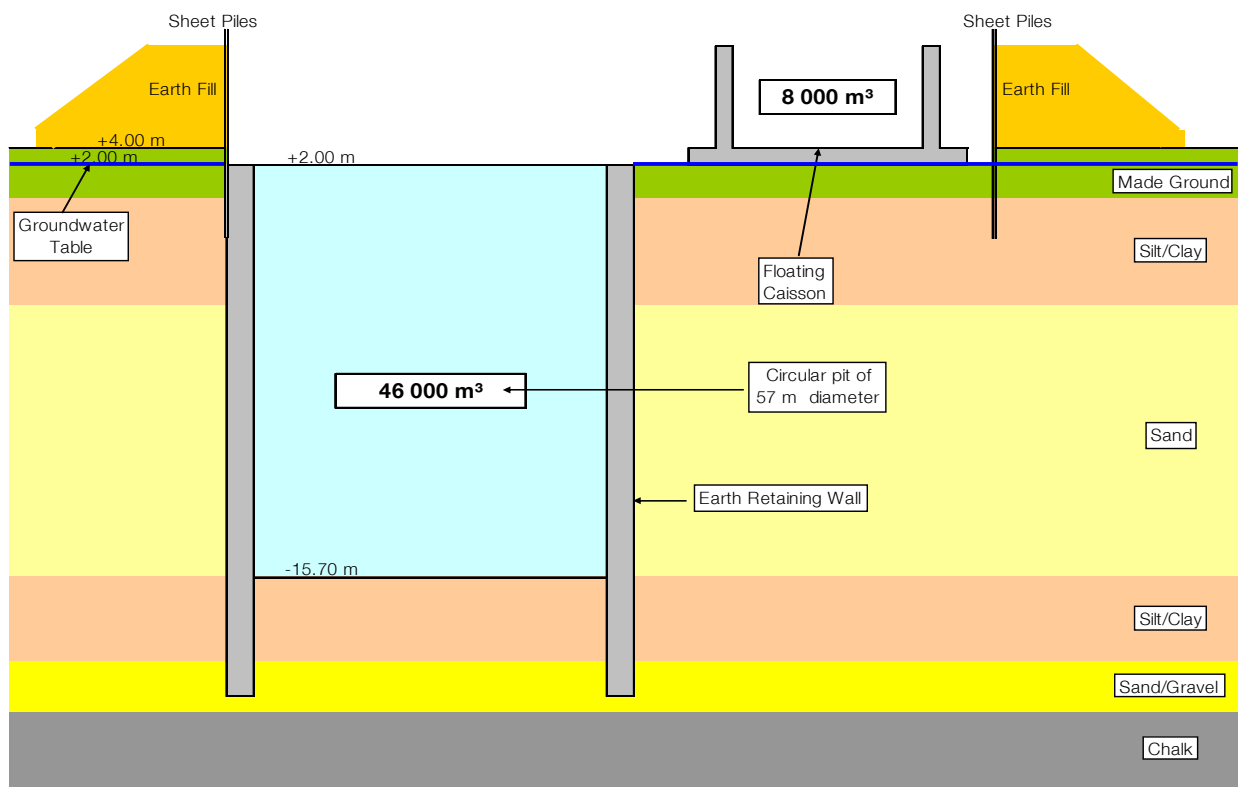


Figure 1: Underwater Excavation of the Construction Pit

In parallel to these works, the final structure for the bunker and boiler will be constructed adjacent to the circular pit in a so called dry dock. This structure will be built up to a height of approximately 8.0m surrounded by a bund. The bund will comprise of a sheet pile wall backfilled with earth to prevent it from overturning.

4 Launching the Caisson

For the floating operation, the dry dock will be flooded up to a height of +8.5m AOD. In order to attain this, VRH will take 24 000m³ of water from the river Ouse (please refer to Figure 2.) As this activity is on the critical path of the programme, VRH would like to pump the water continuously.

With pumping for an assumed period of 4 days the flow rate would be:

$$24\ 000 / (4\text{days} * 24\text{h}) = 250\text{m}^3/\text{h} \approx 0.07\ \text{m}^3/\text{s}.$$

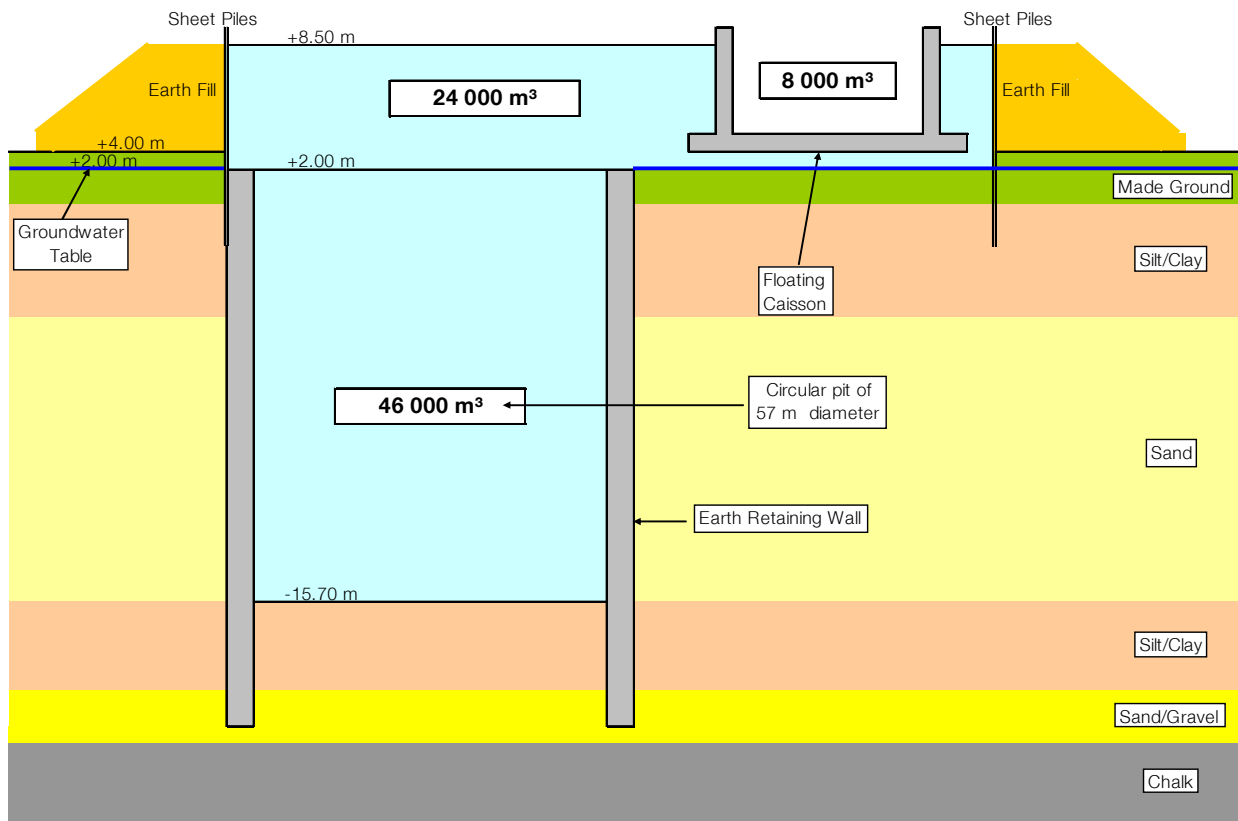


Figure 2: Floating of the Dry Dock

Data from the CEH website (Centre of Ecology & Hydrology) show a mean flow of the river Ouse to be 3.79 m³/s. Hence, the quantity of abstraction would be less than 2% of the flow rate. Therefore, VRH assumes that the environmental impact on the river will be negligible.

To prevent any fish being forced by the flow, VRH will install a wired cage around the intake to increase the area and thereby reduce the velocity of the flow.

5 Floating Operation

The next step of the floating operation is shifting of the structure into the final position as shown in Figure 3.

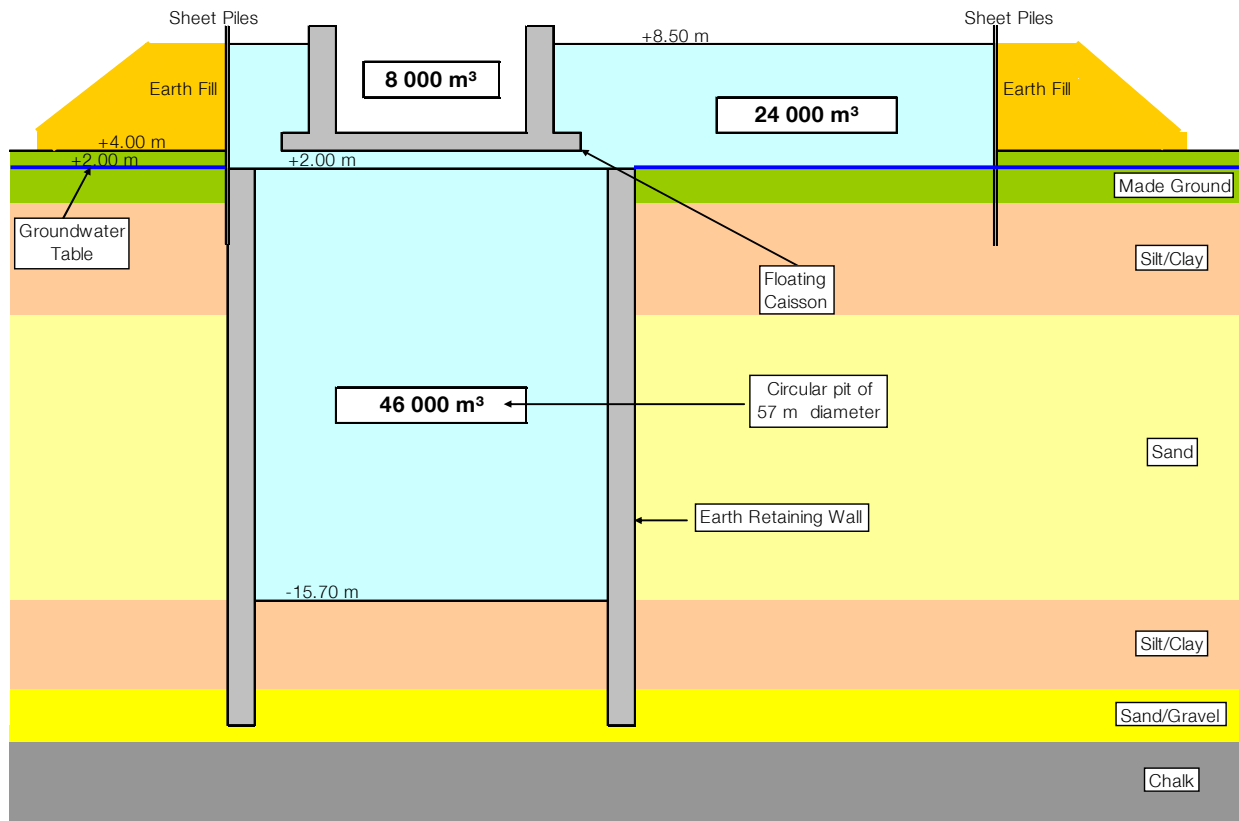


Figure 3: Shifting of the Caisson into final position

This shifting operation is assumed to last for two days. During this time it will be mandatory to keep the water level inside the dock at +8.5m AOD to guarantee an smooth shifting process. As the water pressure inside the dock will be 6.5m higher than the surrounding groundwater table, we have to take some seepage into account. To account for this seepage, VRH has assumed to pump **22m³/h** continuously from the river Ouse. The quantity of water whilst 4 days of filling (presuming that the average level of water is half) the dry dock and 2 days of floating operation this will sum up to:

$$11\text{m}^3/\text{h} * (4\text{days} * 24\text{h}) + 22\text{m}^3/\text{h} * (2\text{days} * 24\text{h}) \approx \mathbf{2\ 000\text{m}^3}$$

6 Emptying the Dock

As soon as the caisson is placed in the final position, the water level inside the dock is lowered down to +2.0m AOD. The river water that has been pumped in will then be pumped out into the river. The water inside the earth retaining structure will be displaced by the volume of the caisson as shown in Figure 4. Hence, the volume of water to be pumped will be

$$24\ 000\text{m}^3 + 8\ 000\ \text{m}^3 = \mathbf{32\ 000\ \text{m}^3}$$

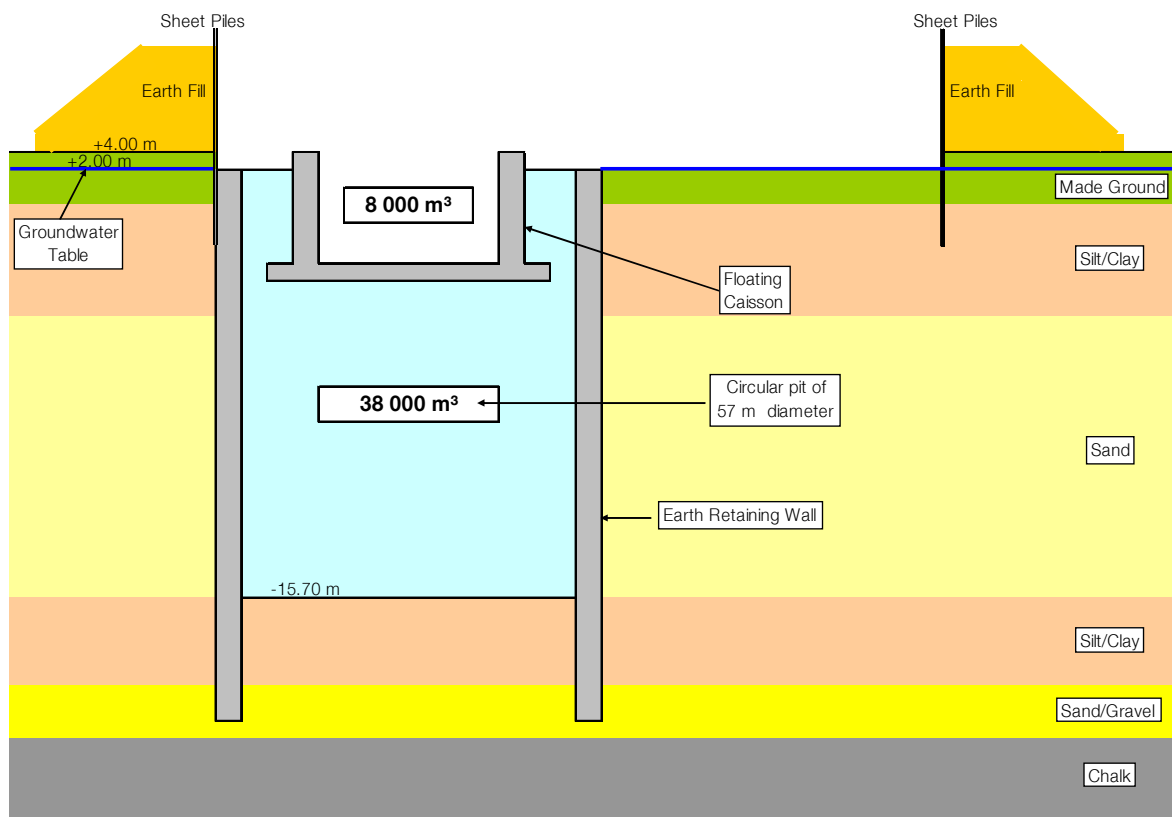


Figure 4: Lowering the water table inside the dock to +2.0m AOD

VRH propose a flow rate of **250m³/h** during high tide to keep the environmental effects to a minimum. Presuming this, the dewatering process will last

$$32\ 000\text{m}^3 / (250\text{m}^3/\text{h} * 12\text{h}/\text{day}) \approx \mathbf{11\ \text{days}}$$

7 Construction under Floating Conditions

The construction of the bunker and boiler will then continue under floating conditions. As the weight of the structure will continuously increase, the caisson will sink into the pit. Nevertheless, VRH will have to fill the volume inside e.g. with water already available in the pit as shown in Figure 5. Without this ballasting the caisson would rise too high and the floating stability would decrease.

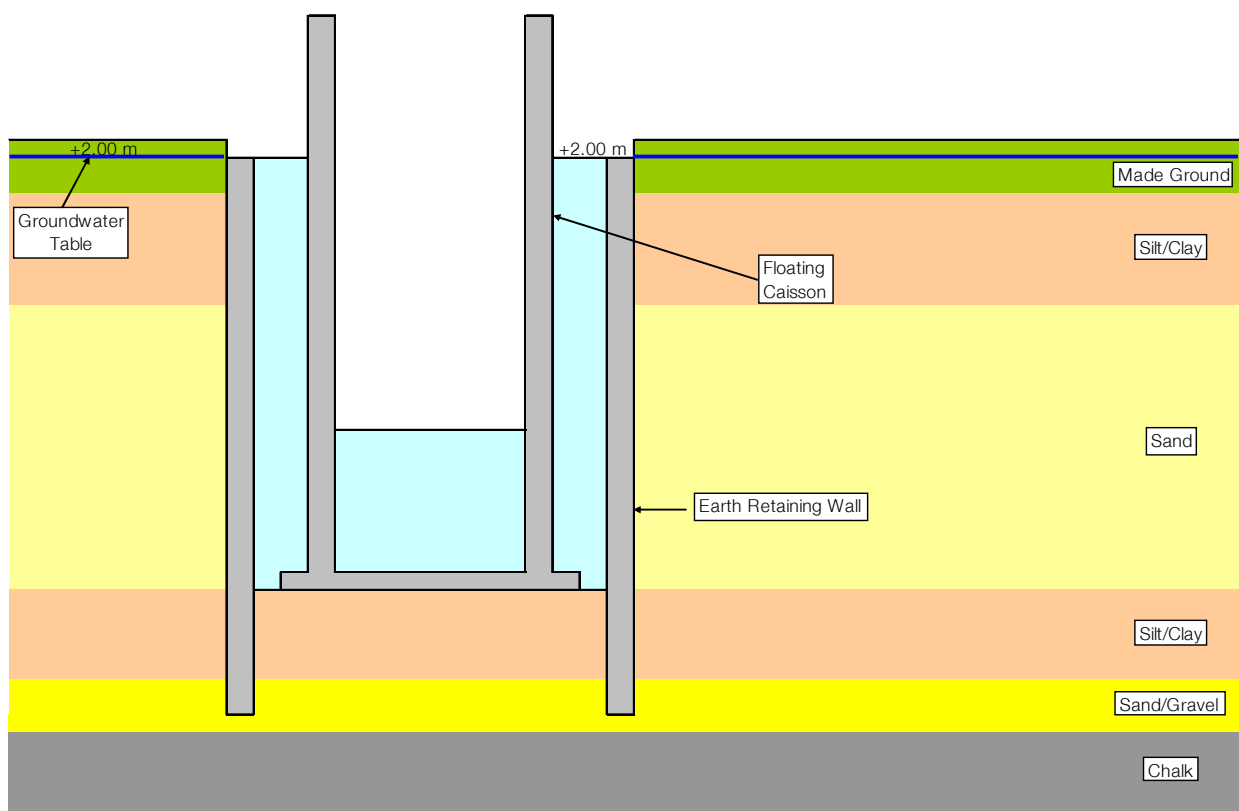


Figure 5: Construction and Lowering of the Bunker/Boiler

During the construction of the bunker/boiler, the excess water will be pumped out of the pit. The remaining 38 000m³ will be discharged into the river over a period of approximately 10 months, including the refill described in paragraph 8. This would result in an average flow rate of less than 10.5m³/h during high tide. To meet the construction requirements and to allow for a certain flexibility, VRH have assumed to limit the flow rate below **50m³/h**.

8 Backfill

Finally, the space between the earth retaining wall and the completed construction will be backfilled as shown in Figure 6. The excess water will be continuously pumped out into the river Ouse as described in paragraph 7. After completion of these works no more water handling will be required for the construction of the bunker/boiler.

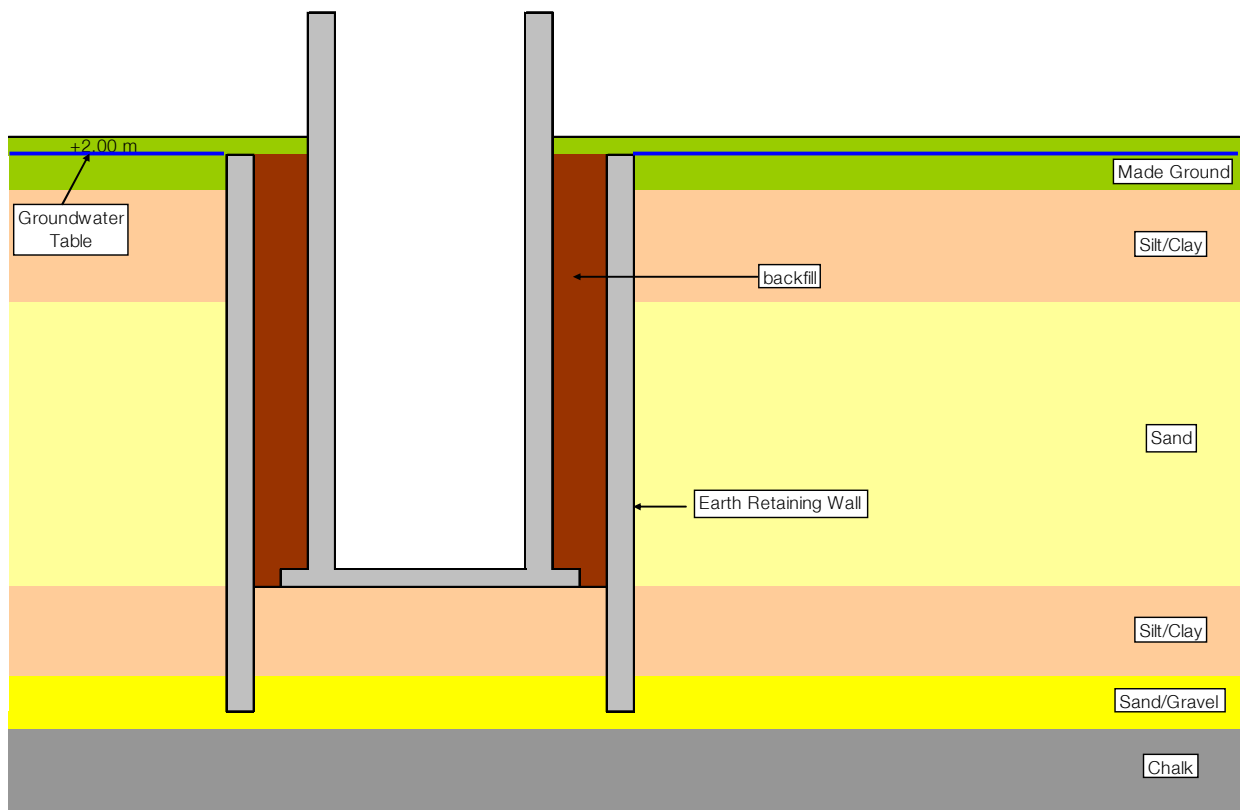


Figure 6: Backfill of the construction pit