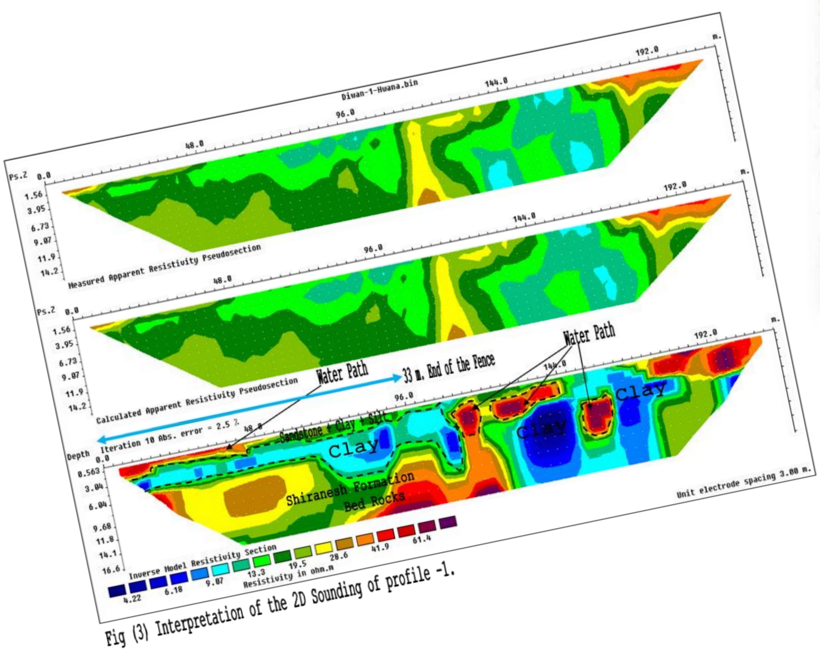
A practical Solution for Protecting Structures from underground water in Tanjaro formation soils

By: Engineer Twana Ali Soor



INTRODUCTION:

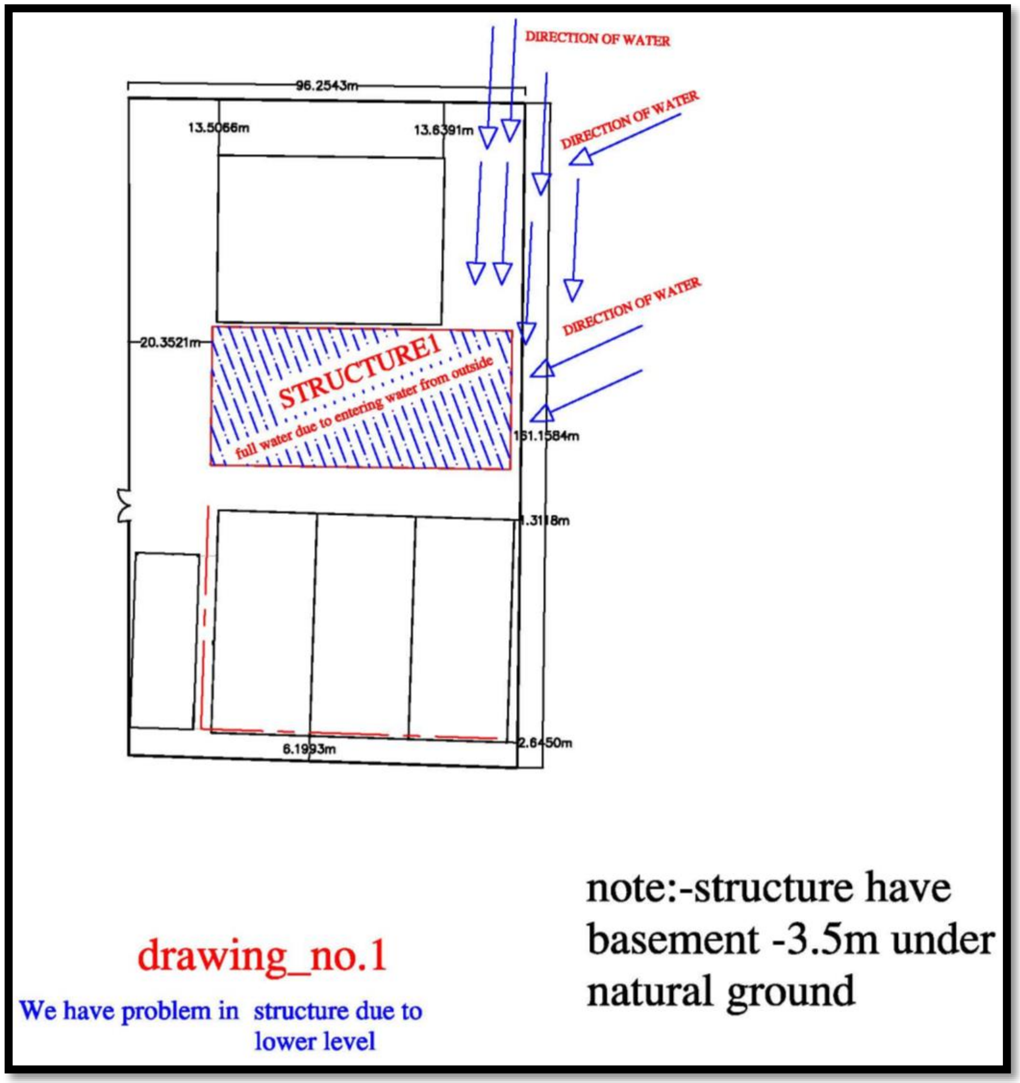
During Building some building and engineering projects some times during excavation or after construction, because of water table are high cause a damage to our structure in lower levels in N.G.L.

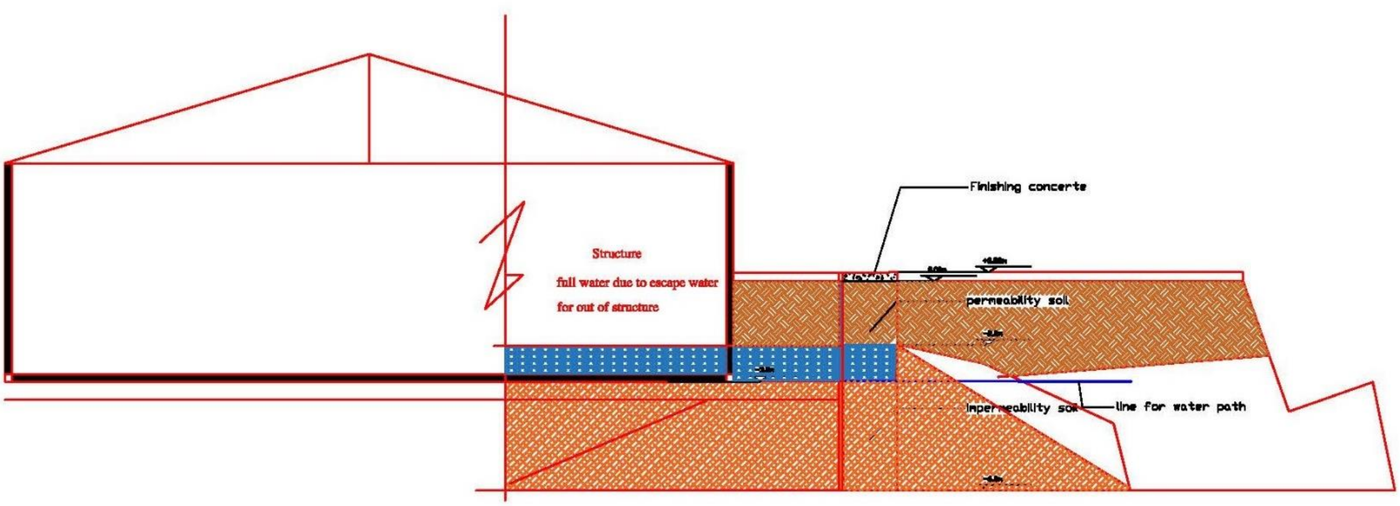
It's a best practical solution to take consider these steps which we took in our project (case study), by using (Two Dimension Resistivity) test we ensure the geological distribution of our soil layers under the structure and surround it. And the pathway of water then by building a channel and a underground pool for collecting water.

Case Study:

Our Project is building some store in Hwana Area in Sulaimaniyah, after constructing one of our store we see the amount of water entering our building which have a level (-3.5 m from N.G.L.) – See Drawings -.

After that by using 2D resistivity test, we endure that we have a impermeable layer of soil in (-6 m from N.G.L.), we excavate a trench and a pool for collecting water, as we will illustrate them.





Before engineering solution

Geomorphology

The area is characterized by high undulation and rigid topography due to exposure of Tanjero Formation that resist weathering especially the coarse material cycles such as sandstone and siltstone. In addition, several geomorphologic features are constructed such as dense dendretic pattern, hog back and Questa escarpments.

The dense erosion during the past geological time leads to occurrence of several valleys either running parallel to the strike or to the dip of the outcrops. Most of the valleys are trending NW-SE as the general strike of the structural features in the region, as illustrated in the satellite image of the area. The area is located within low folded zone so several locations were subjected to erosion during the past geological time and still are an active place of erosion due to its slope. The dip of most of the out crop rocks ranging from 10 to 20 degrees.

The great gravitational force and high rate of precipitations activity also are the main factors that continuously and strongly eroded these units and making them a source area of sediments.

Tanjero formation:

The Tanjero clastic formation was first defined by Dunnington in 1952 and it is type locality is at Sirwan valley, south east of Sulaimani (buday, 1980) the thickness of this formation is composed of shale, sandy shale, siltstone, glauconitic and marl inter bedded with hard siliceous sandstone layers. The beds weather in atypical olive green color the lower contact of the formation is usually conformable and is marked by appearance of the first siliceous sandstone layer the upper boundary is as a rule marked a well-developed break.

This succession belongs to the middle and upper parts of the Tanjero Formation which deposited during transgressive and high stand system tract marls in the middle part of Tanjero Formation (Karim and Surdashy, 2006). In many places, the intense deformation or weathering changed the marl and marly limestone to loose and porous materials with high porosity

The outcrops of Tanjero Formation are more common than that of Shiranish Formation which is exposed along the lower part of the limbs of the anticlines.

Two Dimension Resistivity

The purpose of electrical resistivity is to determine the subsurface resistivity distribution by making measurements on the ground surface. The true resistivity of the subsurface can be determined from these measurements. The ground resistivity is related to various geological parameters such as the mineral and fluid content, porosity and degree of water saturation in the rock. Electrical resistivity surveys have been used in hydrogeological, mining and geotechnical investigations. More recently it has been used for environmental surveys.

2D resistivity sections can be regarded as either a number of profiles measured along the same line with increasing electrode spacing, or a series of closely spaced sounding. The 2D imaging is widely used to map areas of moderately complex geology where conventional 1D sounding surveys are inadequate. The advent of automated data acquision and inversion in recent years has increased the practical applicability of resistivity imaging tremendously. Resistivity Imaging requires a robust fieldwork as well as higher cost than 1D.

Fieldwork

The resistivity measurements of the ground are normally carried out by transmitting a controlled current (I) into the ground through two current electrodes (C1 and C2), and measuring the result voltage (V) values between two other electrodes. Direct current (DC) or an alternating current (AC) of a very low frequency is used, and the method is often called DC-resistivity.

The calculated resistivity value is not the true resistivity of the subsurface, but an apparent value, which is the resistivity of a homogenous ground. In homogeneous ground the apparent resistivity will be equal to the true resistivity, but will normally be a combination of all contributing strata. Thus, the geometrically corrected quantity is called apparent resistivity.

- **Selecting suitable array type**

According to surface geology and structural situation the targets have to be mapped are composed mostly of horizontal layering and/or horizontal lenses of coarse materials as well as the possibility of existence of vertical faults. So both resolutions (horizontal and vertical) are required for mapping the area.

So Wenner-Schlumberger array was used for carrying out the 2D imaging survey for the soundings within the area under consideration.

- **Data points density**

To get the best result, the measurements in a field survey should be carried out in a systematic manner so that, as far as possible, all the possible measurements are made. This will affect the quality of the interpretation model obtained from the inversion of the apparent resistivity measurements (Dahlin and Loke, 1998).

Rely on the (Aziz, 2010) as well as several previous studies in the region data density ranging from 110 to 265 datum points is most suitable for the electrode spread 5 and 10 m.

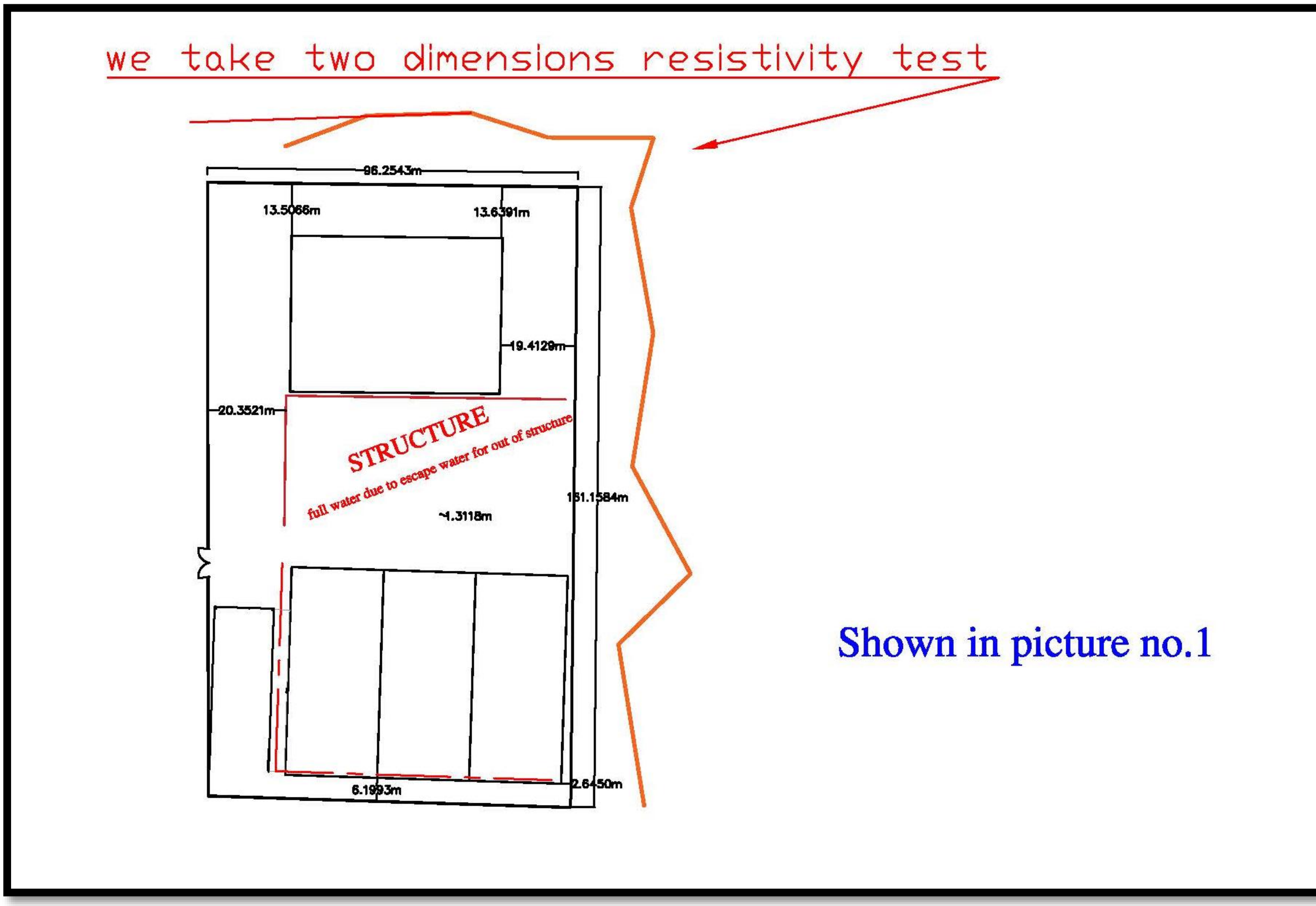
To plot the data from a 2-D imaging survey, the pseudosection contouring method is normally used. In this case, the horizontal location of the point is placed at the mid-point of the set of electrodes used to make that measurement. The vertical location of the plotting point placed at a distance that is proportional to the separation between the electrodes.

Results

The 2D model interpretation was performed using the last new version of software package "RES2DINV" version 3.54.53.

Profile-1 (213 m, 3 m spacing) , Profile-2 (213 m, 3 m spacing), Profile -3 (213 m , 5 m spacing).

- The top surface layer has a wide range of resistivity ranging from 6 to more than 25 Ohm.m, the wide range is refer to different components materials of the top layer. It is composed mainly of coarse materials such as sand, gravel of recent sediments as well as sandstone, siltstone and Tanjero Formation. In several locations fine soft materials such as silty clay has been detected. The Thickness of this layer is ranging from 2 to 6 m.
- Two distinct zones have been identified within the Tanjero Formation. The first zone is of high range of resistivity, this range of resistivity represents the location of dense sandstone and Siltstone, and the second zone is a low resistivity represents silty clay.



Picture 1 - Take resistivity Test

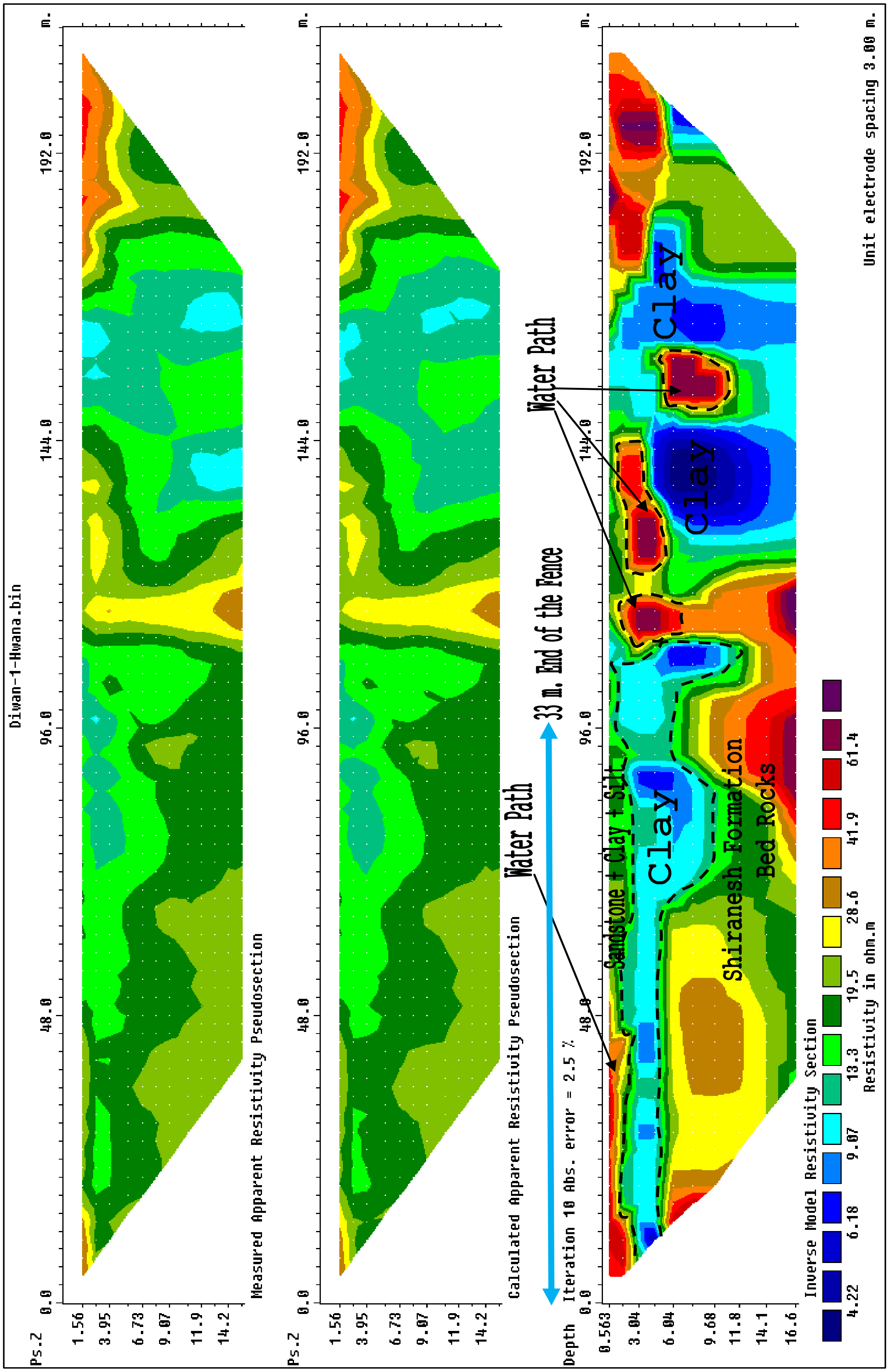


Fig (3) Interpretation of the 2D Sounding of profile -1.

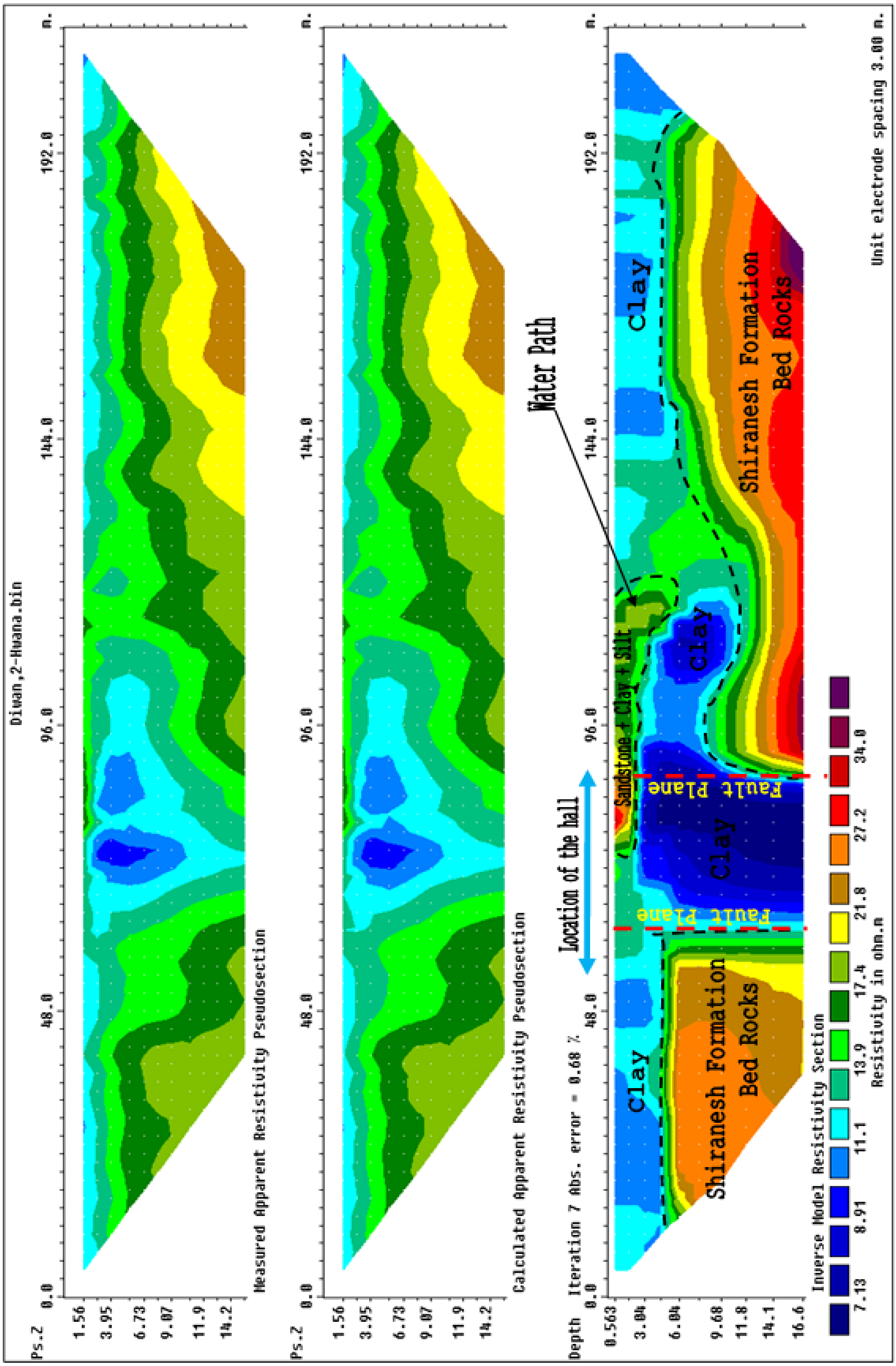


Fig (4) Interpretation of the 2D Sounding of profile -2.

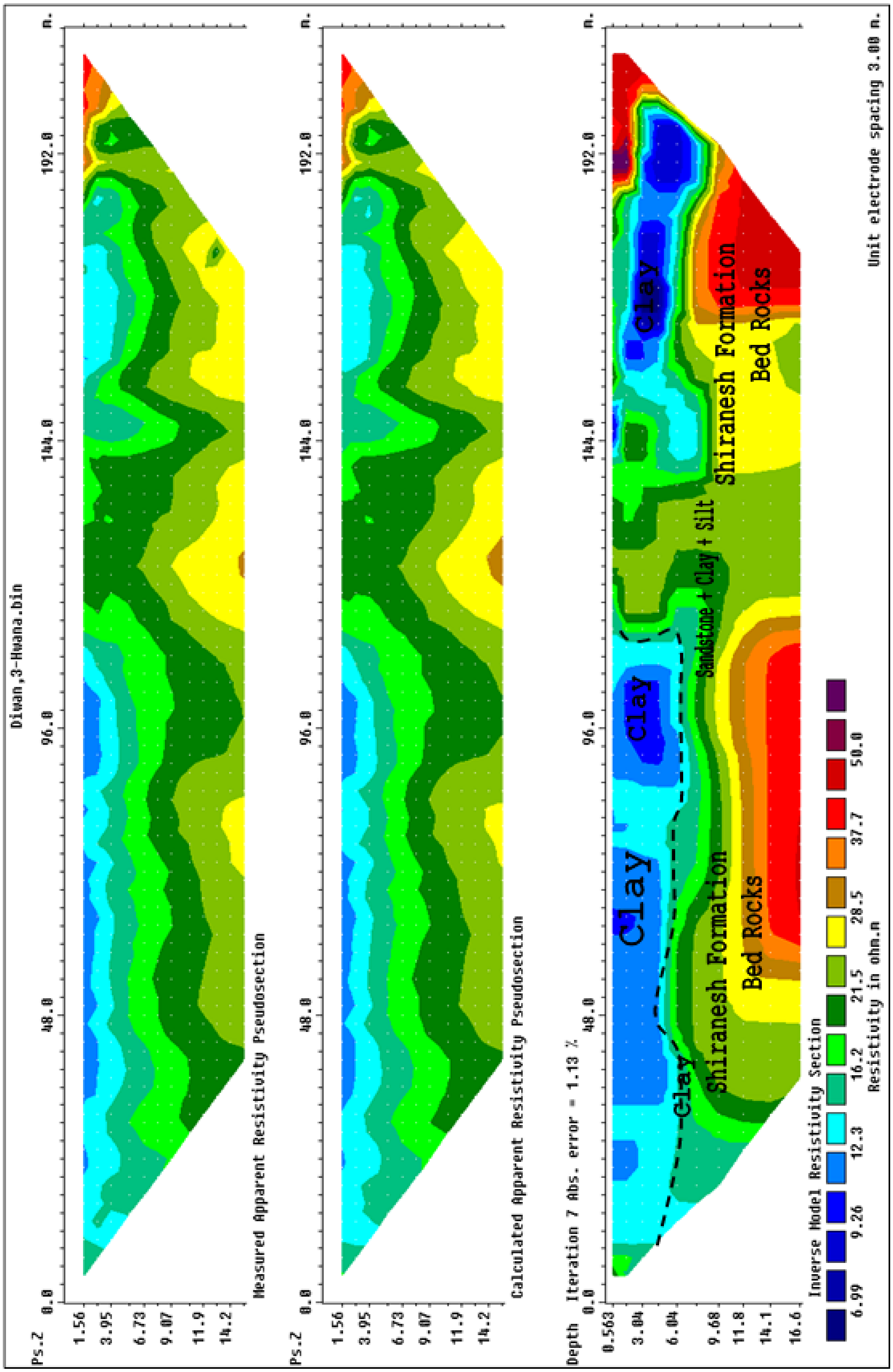
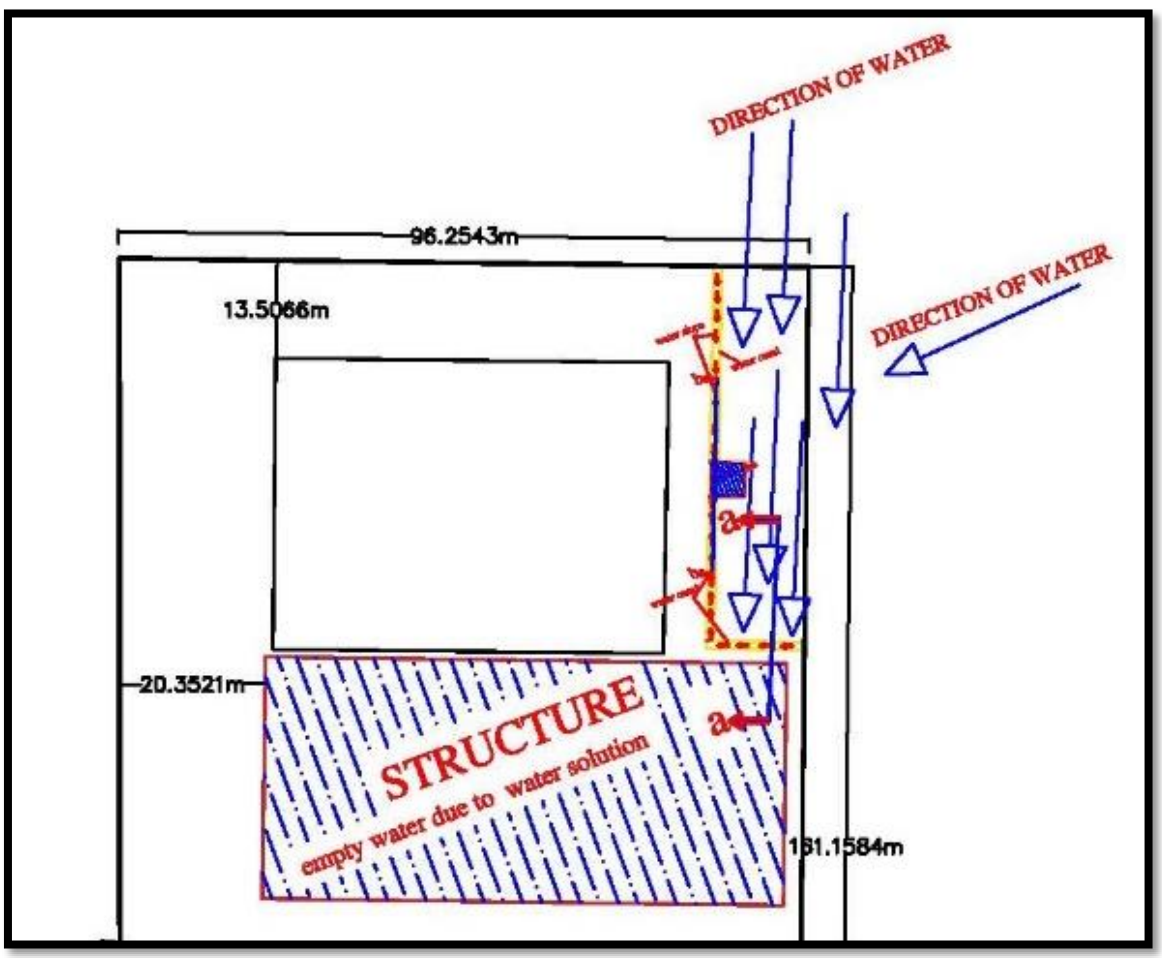


Fig (5) Interpretation of the 2D Sounding of profile -3.

Solution

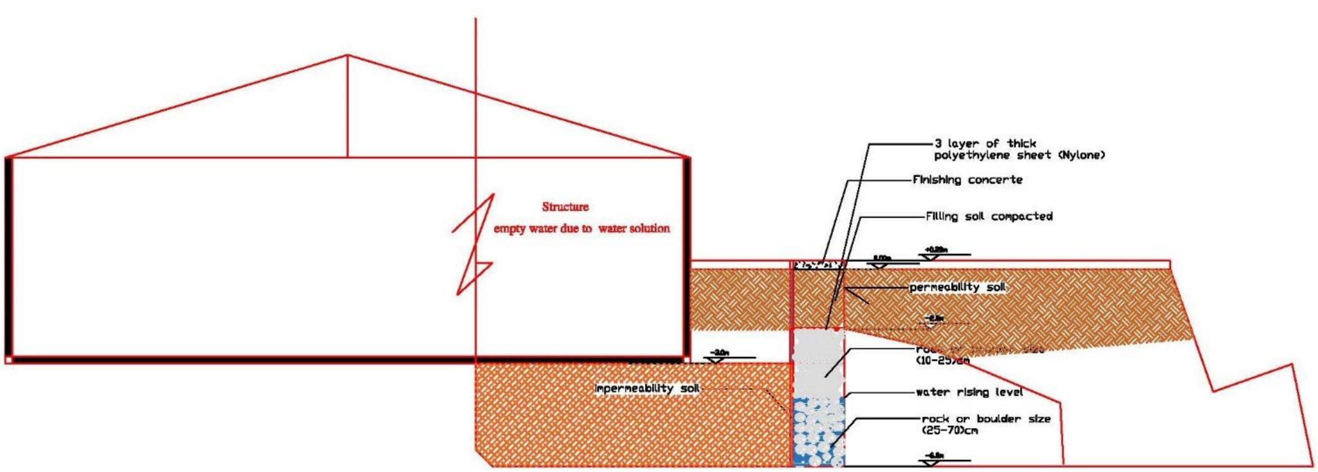
The 2D test show that in (-6 m from N.G.L.), we have an impermeable layer. And the water table rise by time, our solution done this procedure:

1. Make a channel by slope in impermeable layer. – See drawings -
2. Fill the channel by boulder and filters until (size 25 – 70 cm and 10 – 25 cm) until level (-2 m from N.G.L.). – See pictures -
3. Add a Nylon sheet – to prevent locking filters - then filling by granular material.
4. Dig a pool in impermeable layer to collect the water in channel. – As shown in drawings and pictures – covering by Concrete slab.
5. Put the Pumps collect the water and using for irrigation, discharge of water during June to September 3000 Liter. /Day, and other seasons 75000 liter. /Day.



Picture 2 – Excavating Channel

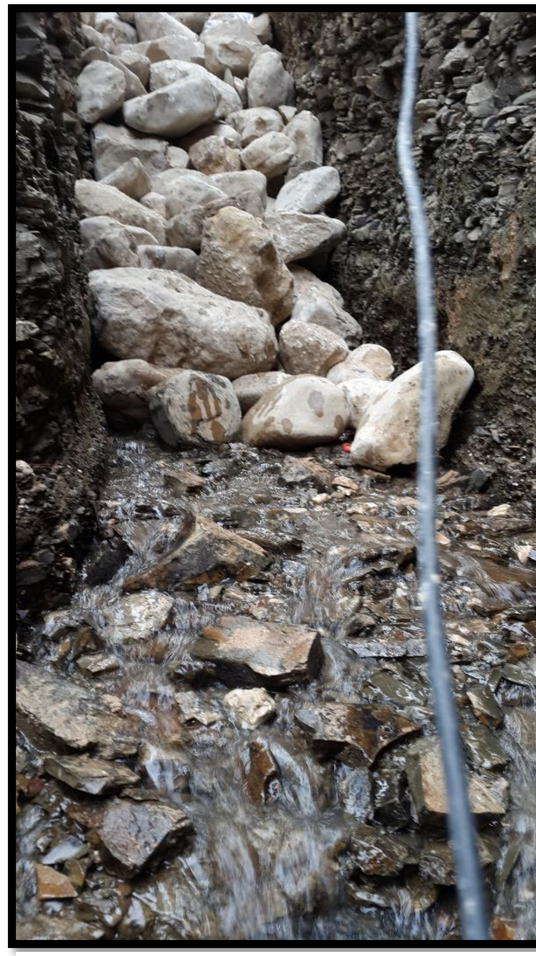
Picture 3 – Filling Excavating Channel by Boulder



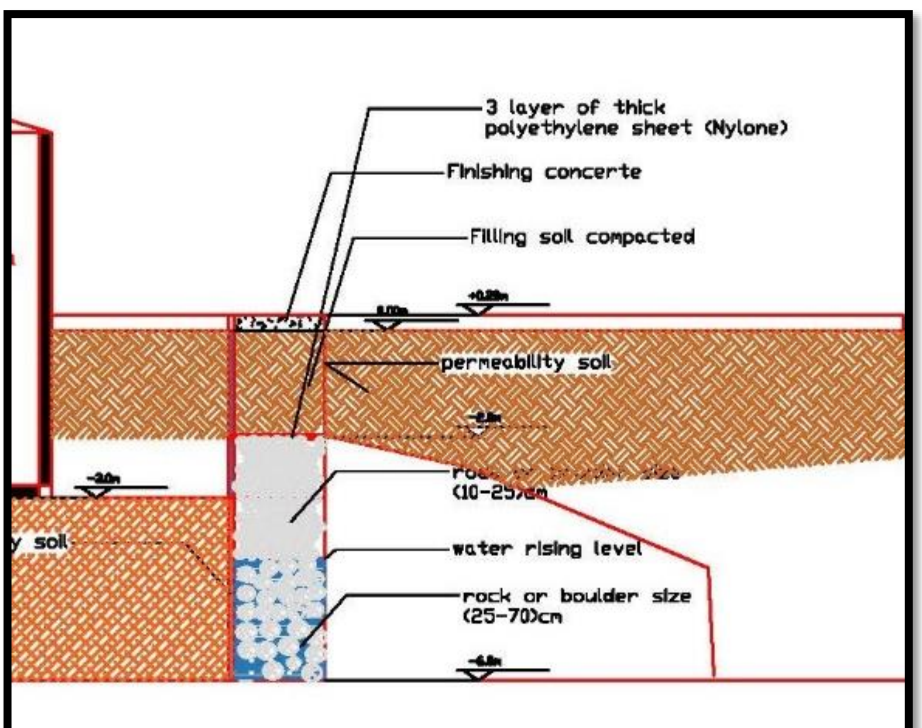
After engineering solution

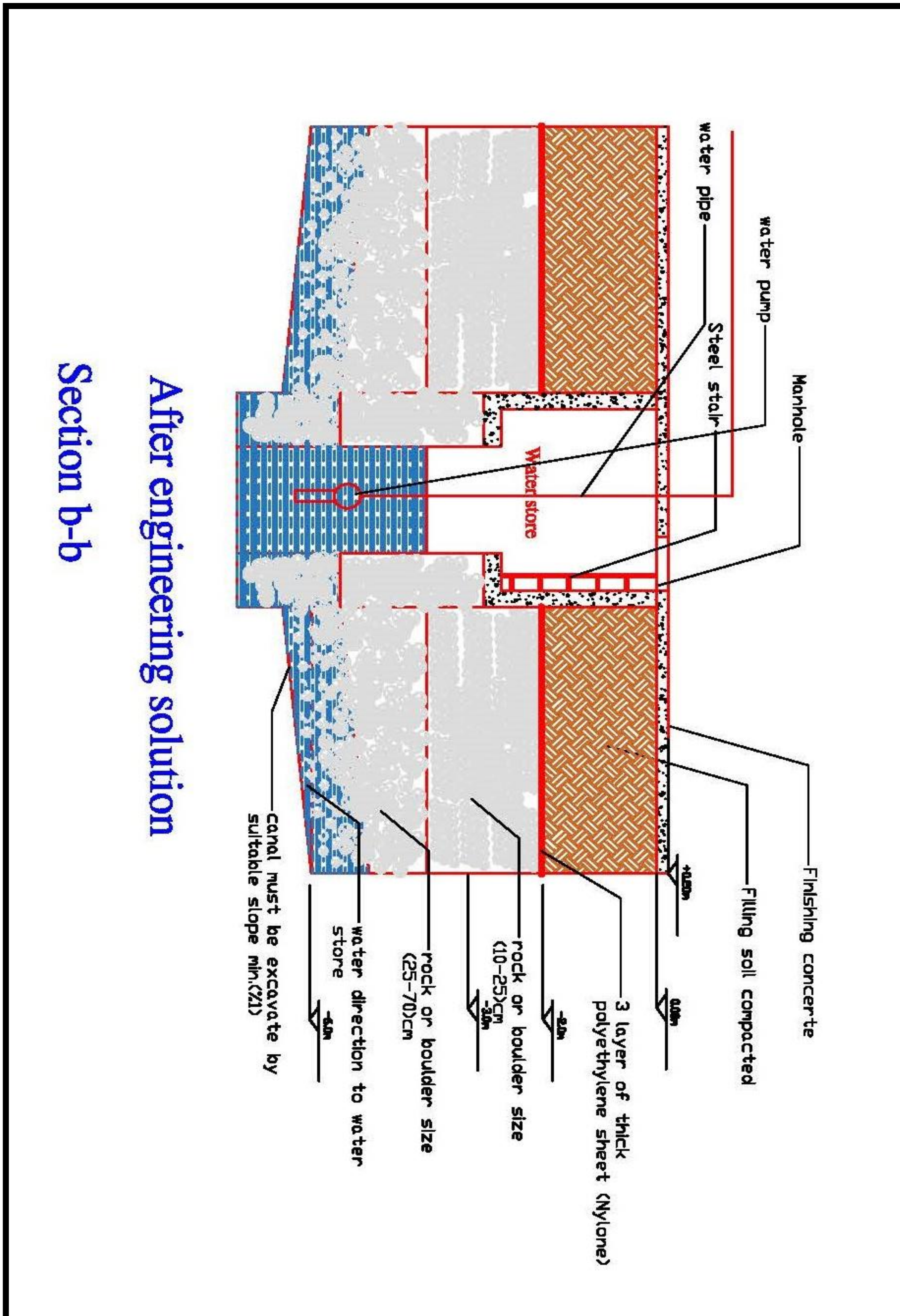
Section a-a

Picture 4 – size of channel



Picture 5 – Filled channel by boulder




After engineering solution
Section b-b
Finishing concerte
Filling soil compacted
3 layer of thick polyethylene sheet (Nylone)
rock or boulder size (10-25)cm
rock or boulder size (25-70)cm
water direction to water store
canal must be excavate by suitable slope min.(%1)
Manhole
Steel stair
water pump
water pipe
Water store

Picture 6 - Building a pool for collecting water and back filling by boulder.

Picture 7 - Building a pool for collecting water and back filling by boulder.

Picture 8 – Finishing Pool

Picture 9 - Pool