

# Methodical guidelines for using of ground penetrating radars



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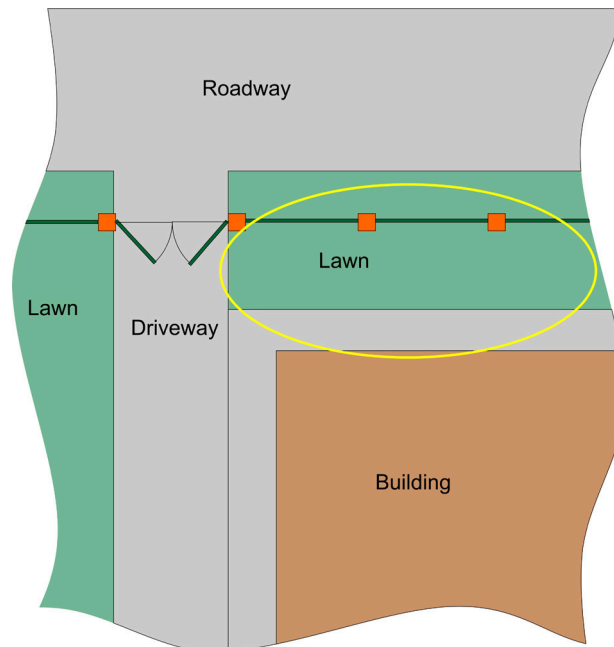
## Option 1. The Express Search

These are the guidelines which are to be advised. Application methodology of GPRs are constantly developing and changing. Each enterprise which uses GPR has its own way of appliance regarding the range of issues that is needed to be solved, staff qualification and availability of extra equipment.

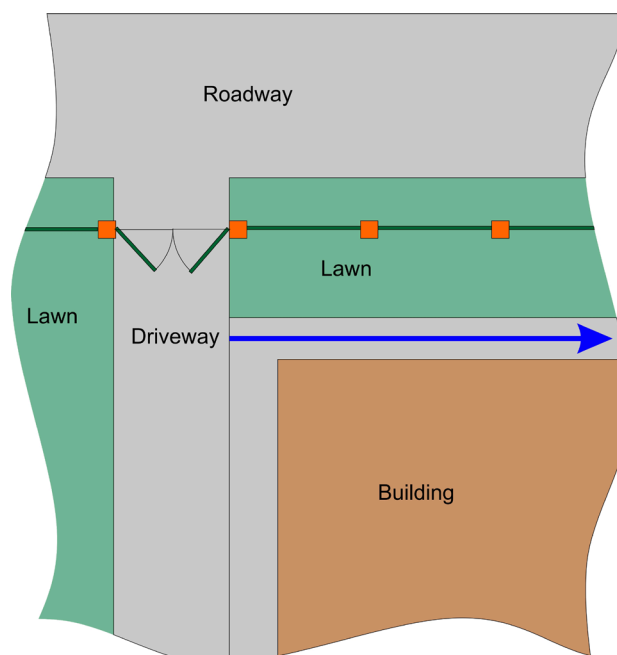
GPR can be used in several ways

### Option 1. The Express Search

Most frequently this method applies to specify the location of underground communications. That is necessary in a case one needs to clarify the location and the depth of the underground communication.



For instance: one needs to locate the gas pipe under the road, which lies through the highway up to the building. The metal pipe which is approximately 2 inches in diameter allegedly goes through the territory that marked with a yellow line. To localize the pipe, create a GPR profile along the trajectory marked with a blue line.



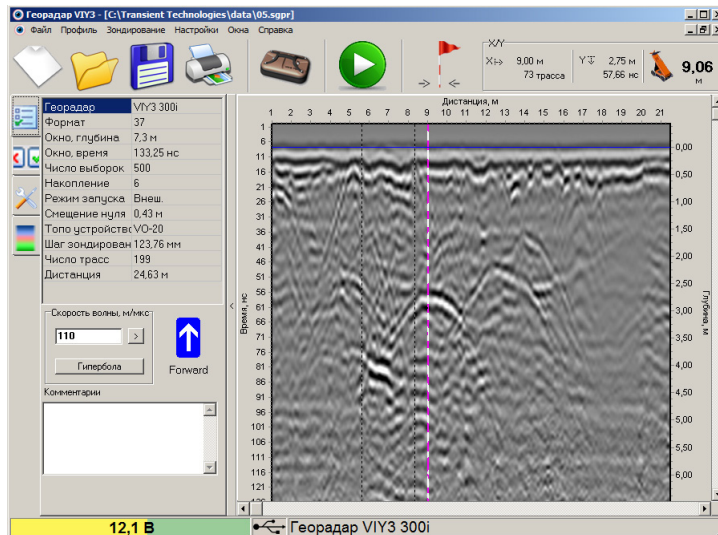
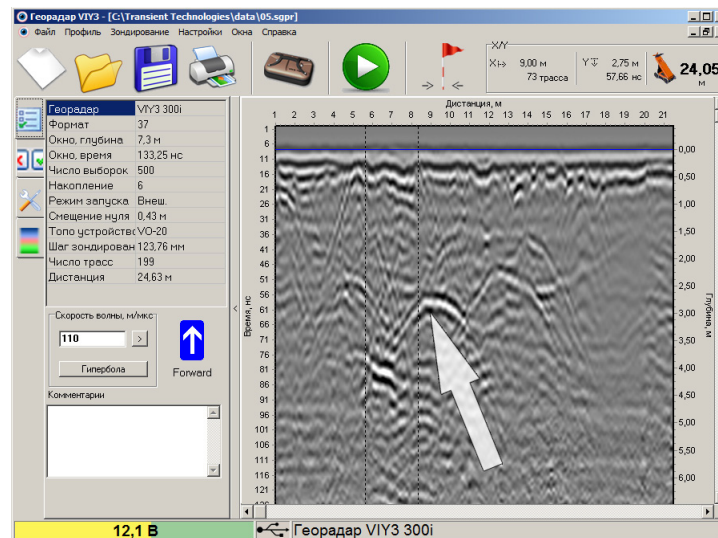
### Use GPR and GPR's Trolley Cart-36 for Probing

Adjust the trolley with GPR at the starting point, create a new profile, and launch the probing. Move the trolley along the planned trajectory. Stop the probing; the GPR's profile is processing automatically. Find the curve element on the profile

(pic.3).

By moving the trolley combine the cursor (vertical marker) till it's been matched with a top of the curve.

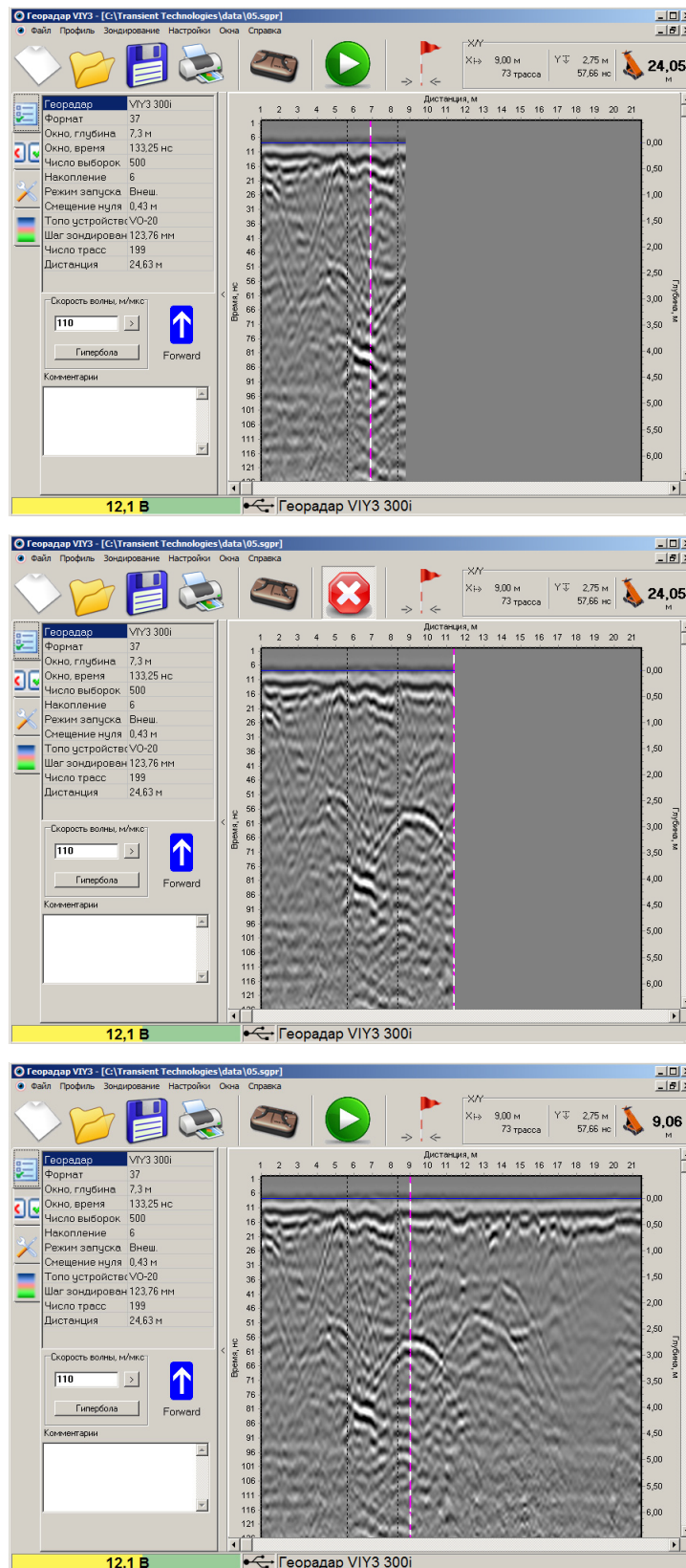
The centre of the GPR's antenna will be on the top of the underground object.



If the profile has just a part of the curve and the top of the curve did not get to be on the profile, one needs to continue the profile. To do so, move the trolley in a way that the cursor remains inside the profile, switch on the probing and move the trolley the way you need it, further or backwards. The profile increases in a particular direction. After the probing has stopped, new part of the profile will be processed.

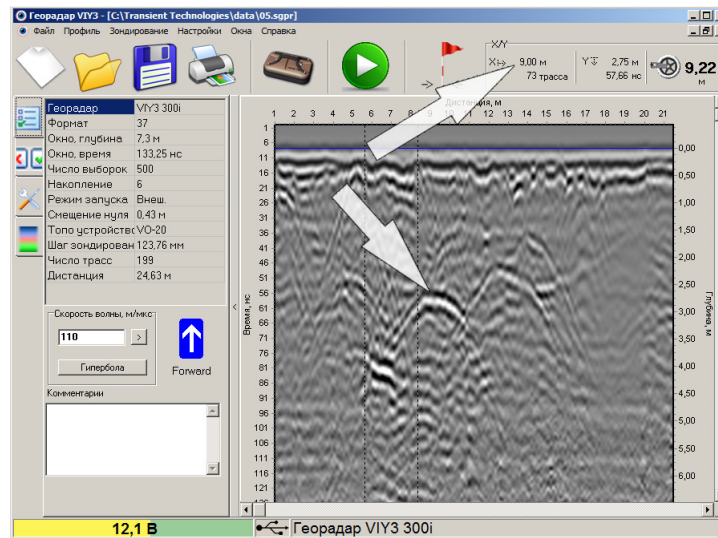
Afterwards, move the trolley to make sure that the profile cursor matches the top of the curve. Centre of antenna matches the object location.

## Option 1. The Express Search



### Using GPR & Measuring Wheel VO-20 for Probing

VO-20 measuring wheel doesn't allow tracing the direction of antenna moves. Moreover, it doesn't allow moving antenna backwards with transportation belt. Therefore, to locate the underground object one needs to have a ruler. Adjust the antenna on the start point and mark it on the territory. Create a new profile, switch on probing and move the antenna along the marked trajectory. After the probing has stopped, the profile will be processed. Find the curve element on the profile (pic.3). Measure the distance to the top of the curve with a mouse mark and a top scale profile.



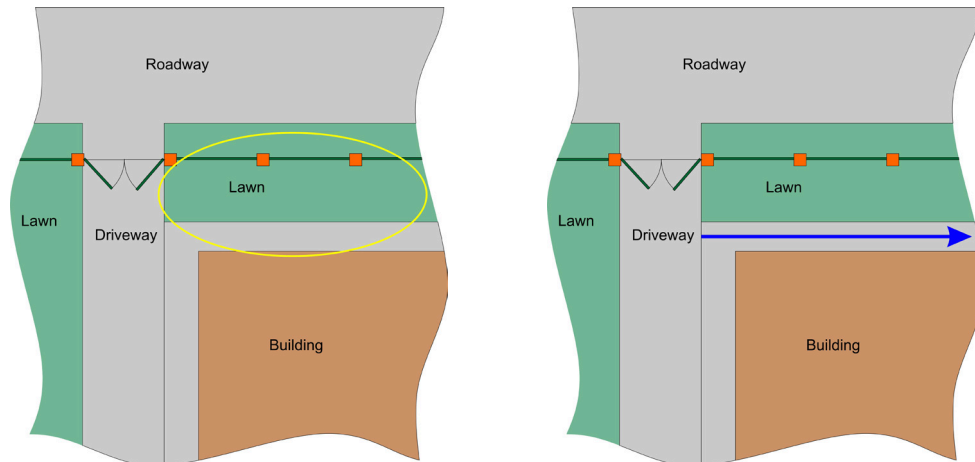
Use ruler to measure the distance on the territory. The object is localized.

## Option 2. Difficult Condition Searches

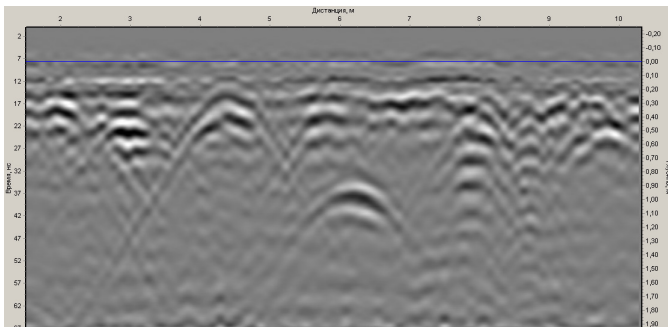
### Option 2. Difficult Condition Searches

Usually underground environment has a vast variety of reflections of different kind from objects on different depths. For example, there is a need to localize a gas pipe that adjacent to the building.

The GPR's profile has been created. It shows more than one curve.



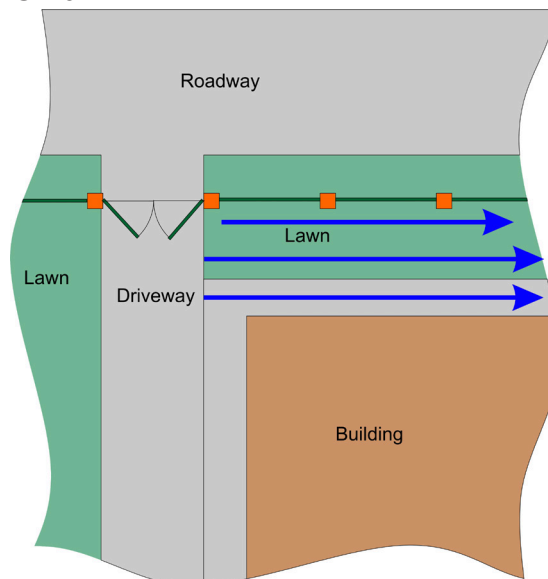
In this case one needs to create several parallel profiles.



### GPR & GPR's Trolley Cart-36

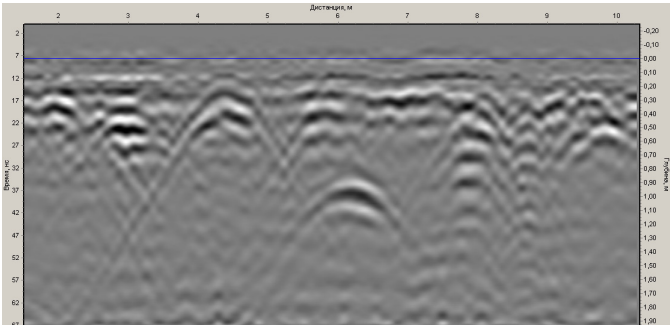
Using GPR's trolley allows us to make marking of located objects right on the ground with no extra devices. Create first GPR's profile; stop the probing. While moving the trolley match the cursor with all the tops of the curves that have been located on the profile. Mark these objects on the ground. Shift 0, 5-1 meter aside from the first profile and create a second profile. Mark on the ground the located objects. As far as the ground allows create a few more parallel profiles. The required pipe will be visible on the ground with several marks which are located along a one line.

### GPR & Measuring Wheel VO-20

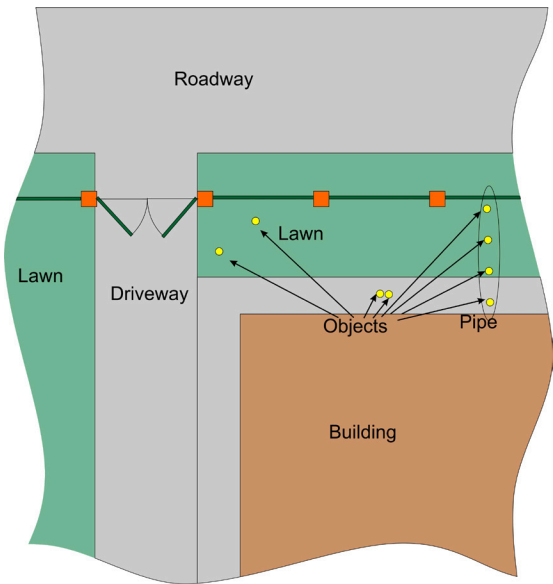
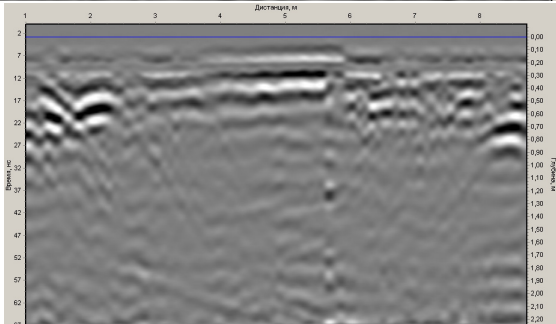
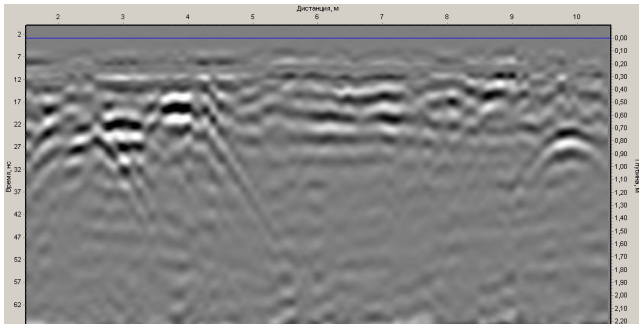
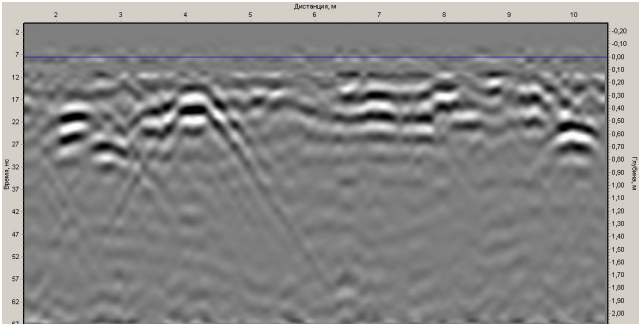
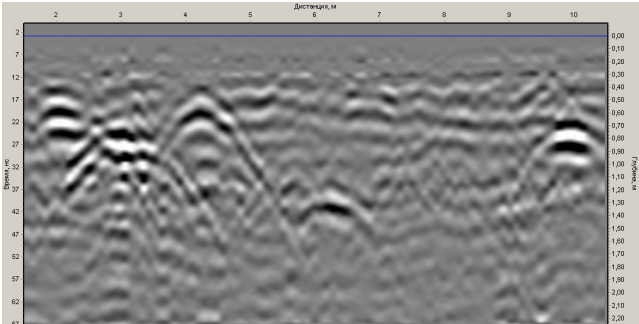


### Option 3. General-Purpose

To use a measuring wheel you would need a ruler to mark the located objects on the ground. Mark the beginning of each new profile on the ground and, afterwards, using a ruler measure the distance from the profile and make the land marks. The required pipe will be visible on the ground with several marks which are located along one line.

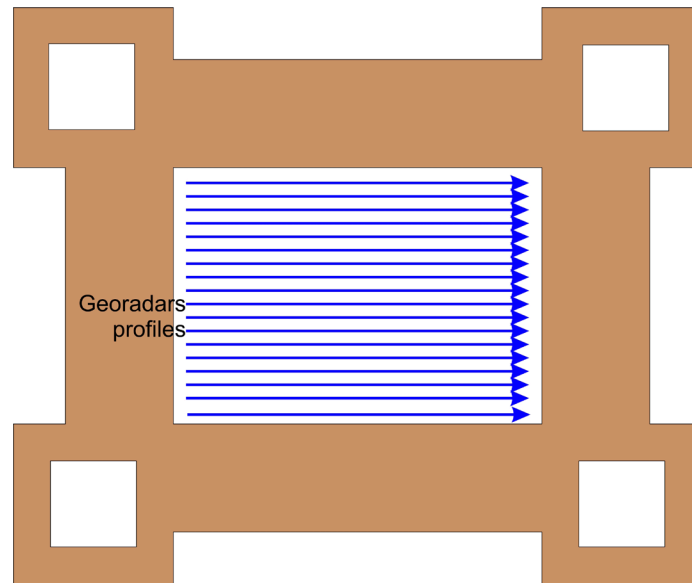


### Option 3. General-Purpose

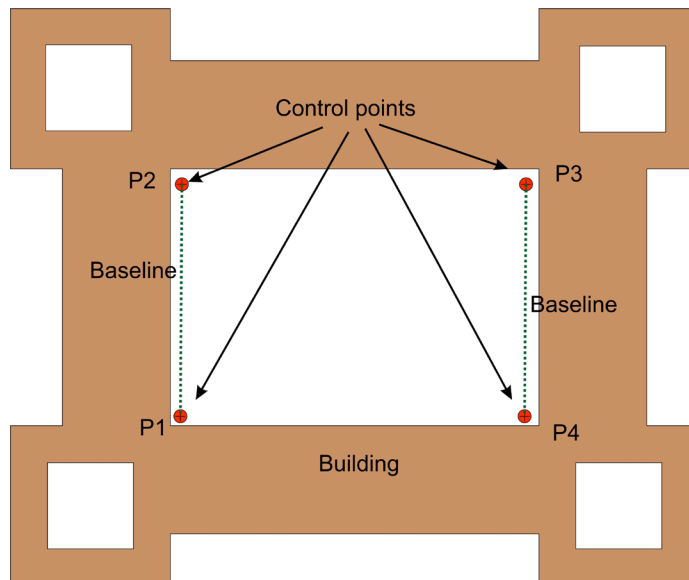


### Option 3. General-Purpose

This method is used to show every object that has been found on the studied land. For instance, one needs to research the territory of historical object before doing the reconstruction to localize objects that have historical significance. In this case, the first thing one need to have before doing the job is a topographic map of researching territory. Ideally the map should have the known underground objects: supply pipelines, collectors etc. One should create profile grids on the territory of interest with a constant step between the profiles.



The step between profiles chooses according to the necessary detail research. Indicate four control points. Do the through biding terrain of these points to the local objects using a ruler. If there is no such a possibility do the topographic binding of the control points using GPS. Stretch out two rulers between the control points P1, P2, P3 and P4. In a case there are no rulers one can use a thin rope or a cord. Hence, we have two baselines between which the probing will take place.



Stretch the cord line between the control points P1 and P4. Do the probing from control point P1 to control point P4 along the cord line. Move the cord line along the cord lines using the chosen step. Set the shift aside that equals the distance from P1 point to the beginning of the profile. If steps are even, the shift equals

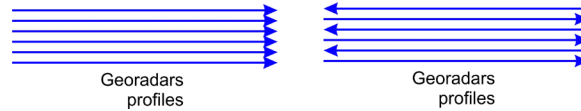
$$\text{Shift aside} = (\text{step between the profiles}) * (n-1);$$

Where n is profile number.

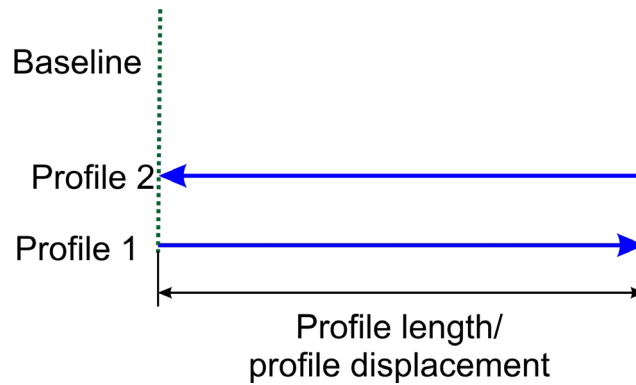
Do the probing along the guideline.



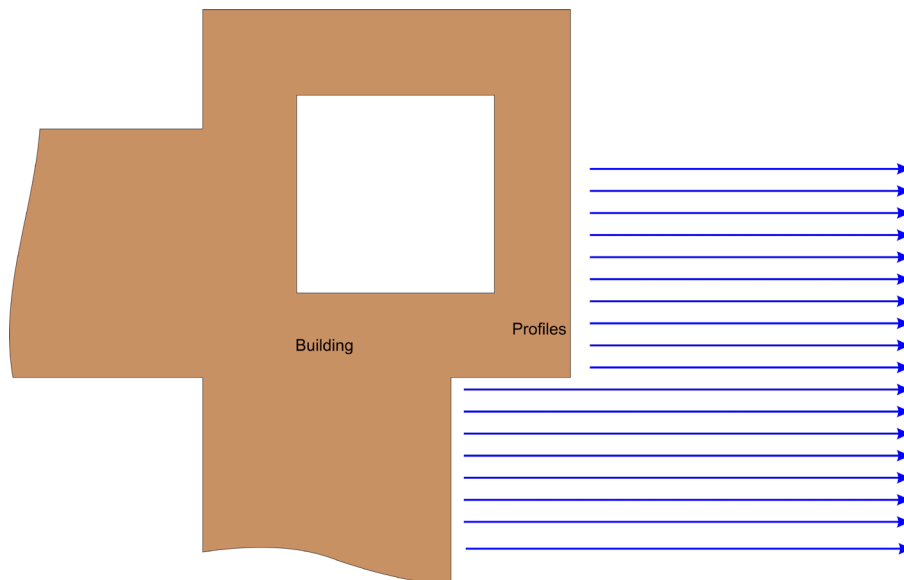
The probing direction can be either one way, or forward and backwards alternately.



Doing the forward/backwards probing one needs to specify the direction of each profile and the initial profile displacement along the course.



For the “profile 2” one needs to state the negative shift along the course that equals the distance between the control lines.

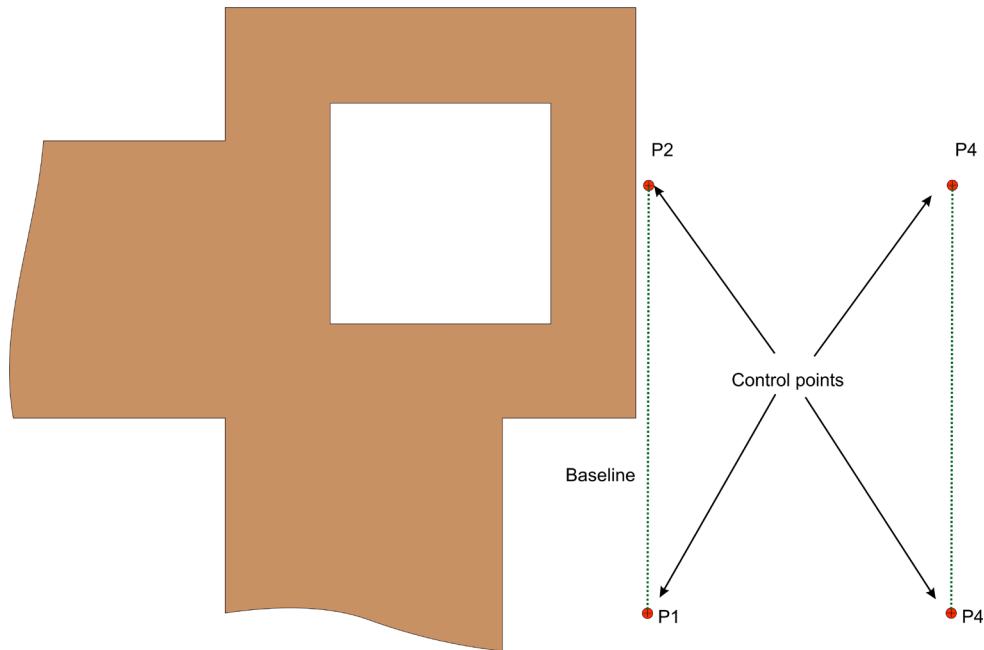


Using GPR with GPR's trolley there is no need in setting profile direction. Trolley's measuring wheel defines the direction and the program changes the direction of GPR's profile automatically.

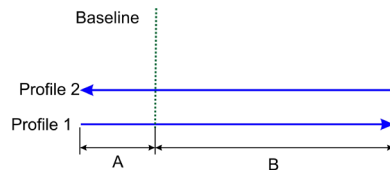
### Option 3. General-Purpose

If the researching territory is not rectangular:

Basis points and baselines are setting up in a rectangular shape as the picture shows.



For the first eight profiles the negative shift sets up along the course. Moreover, doing probing in a forward/backwards way for the profiles with a direction backwards there is a need to consider this shift.

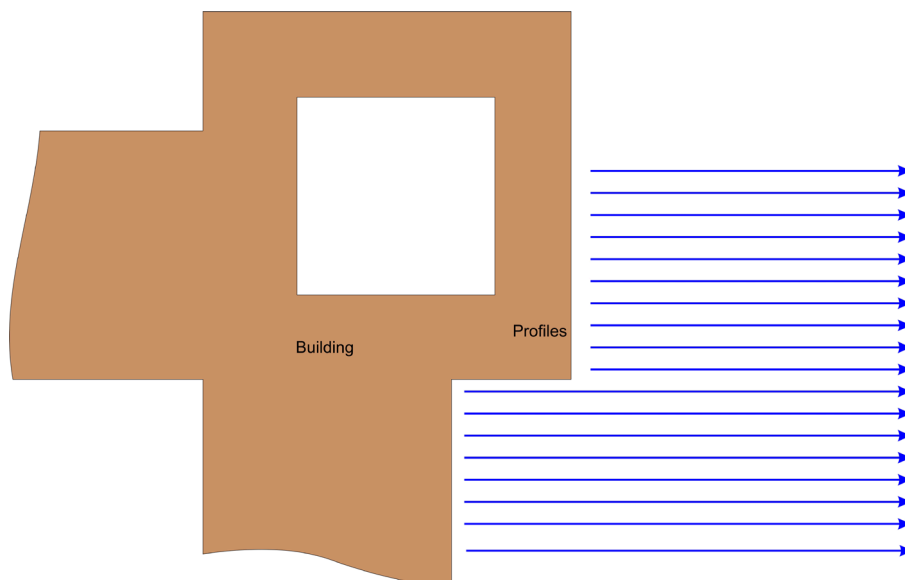


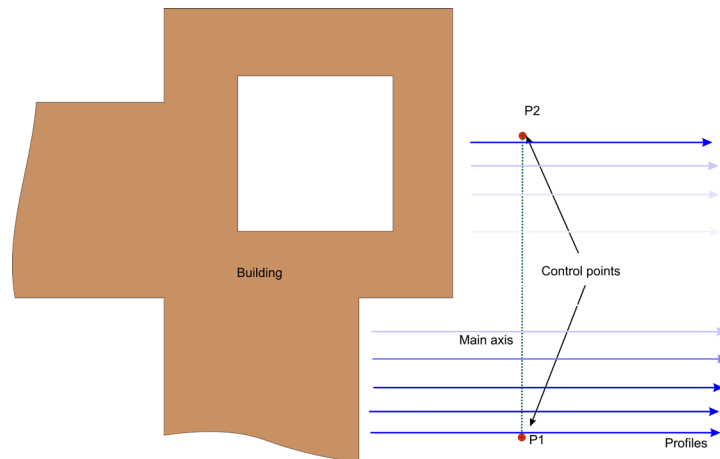
For the “profile 1” one needs to set up the direction FORWARD and a negative shift along the way that equals A. For the “profile 2” there is a need to set the direction BACKWARDS and a positive shift that equals A+B.

### The Profile Grid without Use of Ruler


In the Synchro3 software starting out from the 3.6.2.1 version there is an option to set displacements along the course during probing. Thus, this displacement sets up right during probing regardless whether the displacement has set along the course before probing or not.

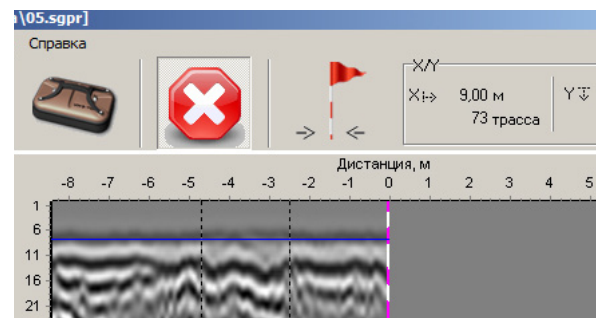
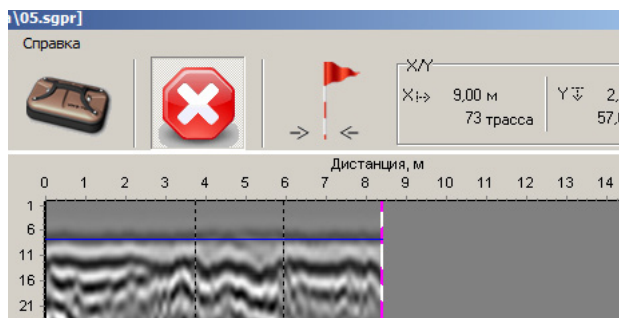
Let’s examine the case of nonrectangular landfill.







To mark a landfill it is enough to mark two control points and stretch a cord between them marking the main axis of the landfill. One can locate the main axis in any part of the landfill. It is required that the main axis must cross all the profiles at the right angle.

Create a first GPR's profile; there is no need for the initial displacement. At the moment when the device centre crosses the main axis of the landfill press a button  on the tools panel or the button **Ins** on the laptop keyboard. Thus, the current point on the horizontal profile axis becomes a zero coordinate and the displacement along the course will be set up automatically



Moreover, one can set zero on the horizontal scale during probing or after. While moving trolley forward/backwards, match the antenna centre to the main landfill axis and press  button.

- ✓ Using measuring wheel VO-20 it is not allowed for antenna to move backwards, therefore, it is allowed to set zero on a horizontal scale during the probing only.

After the first profile is completed, move the trolley on the given step aside and start the probing by moving the trolley backwards. At the moment it crosses antenna centre with a main axis press a  button.



- ✓ If you have deployed a trolley while going backwards or you use a measuring wheel VO-20 while setting the GPR, set the direction before the probing.

Displacement along the course will be set automatically.

### Option 3. General-Purpose

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After the profiles grid has been completed, they could be analyzed with a Slicer program and build horizontal incisions this particular territory on a different depth.

