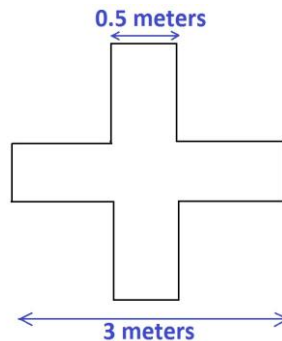


Overview of target requirements:

Three to four unambiguous ground survey targets, recognizable in the satellite photo, are requested. The survey points may be evenly distributed over the mapping area or focused in the primary area. At least one control point should be located close to the northern edge of the image and one point close to the southern edge of the image. The elevation mapping is registered to the most important or most clearly defined ground survey point and the remaining survey points are evaluated for consistency.

If ground control targets will be placed on the ground for capture in the stereo satellite photos, they should be a colour that contrasts with the surrounding ground cover. White targets generally provide the best contrast. A suggested target is an X with a diameter that is at least four times the size of the resolution of the photos. Where laying targets is impractical, PhotoSat can suggest control points from the satellite imagery after it has been collected.

i.e. If the resolution of the satellite photos is 50cm, a suggested target size is:



The targets should be on areas of level ground at least 20m from buildings, trees and abrupt changes of terrain elevation and identifiable to within ± 25 cm horizontally on the satellite photos. The elevation measured at the survey point should be accurate to at least 10cm using a differential GPS, and represent the mean elevation of the ground within 3m of the survey point. All survey coordinates should be referenced to the same reference system; elevation above sea level (a.k.a. orthometric height) or elevation above a specified ellipsoid. The difference between orthometric elevations and ellipsoid elevations for the same area can be several tens of meters. Points should be surveyed in the same projection and datum as requested for the mapping project. The coordinates of the benchmark used for the differential GPS should also be surveyed and provided.

The most reliable way to relate the survey coordinates to the satellite photos is to take photographs of the GPS unit while the point is being surveyed, from three different directions.

The absolute accuracy of stereo satellite photos are significantly better than hand held GPS units, therefore using a differential GPS is essential. The relative accuracy of the stereo satellite photos is significantly better than most dual frequency time averaged GPS measurements.

In this document we show examples of four very good ground control targets and one poor one.

PhotoSat requests the following ground control point information:

- A spreadsheet of the coordinates of the surveyed points, including columns for the northing, easting and elevation. One column of the spreadsheet should include a detailed description of what the point is, even if it is simply 'centre of tarp target'. Be sure to include the coordinates of the benchmark as well.
- The projection and datum of the coordinates, which should be the same coordinate system as the project will be delivered in.
- Digital photos of the GPS unit while the point is being surveyed, preferably 3 photos from 3 different directions for each point. Each photo should be named with a point number that matches the corresponding point number in the spreadsheet. It is useful to include the direction from which the photo was taken in the name:
e.g. yukon_point1_from_SW.jpg
- The elevation reference system used, either elevation above sea level (a.k.a. orthometric height) or elevation above a specified ellipsoid.
- Any other relevant information that will assist in locating the surveyed point on the satellite photo.

Examples of ground control targets and corresponding satellite images

Example 1:



Figure 1a: This target is effective because it was created on even terrain, away from buildings and trees, it contrasts the ground colour, and the GPS unit is in the photo.



Figure 1b: The target is clearly visible in the 50cm resolution satellite photo.

Example 2:



Figure 2a: This target is effective because it was created on even terrain, away from buildings and trees, and it contrasts the ground colour.

Improvements: The accuracy could be improved if the photo included the GPS equipment on the target. The dirt that is weighing down the tarp could blow over and cover the tarp in strong winds. Rocks are recommended when possible.



Figure 2b: The target is clearly visible in the 50cm resolution satellite photo.

Example 3:



Figure 3a: This target is effective because it is away from buildings and trees, it contrasts the ground colour, and is made from solid, painted rocks that will not blow away or easily be destroyed.

Improvements: It would improve the accuracy if the photo included the GPS equipment on the target. Also, the arms of the target could have been longer to make a clearer X on the satellite image.



Figure 3b: The target is visible on the 50cm resolution satellite image.

Example 4:



Figure 4a: This target is effective because it was created on even terrain, contrasts the ground colour, and is made from painted rocks that will not blow away or easily be destroyed. The target is clearly visible on the 50cm greyscale satellite image.

Improvements: We recommend that monuments or other features are not used under the GPS equipment to improve the accuracy of the elevation reading, however including the GPS unit in the photo helps PhotoSat understand any elevation discrepancies.

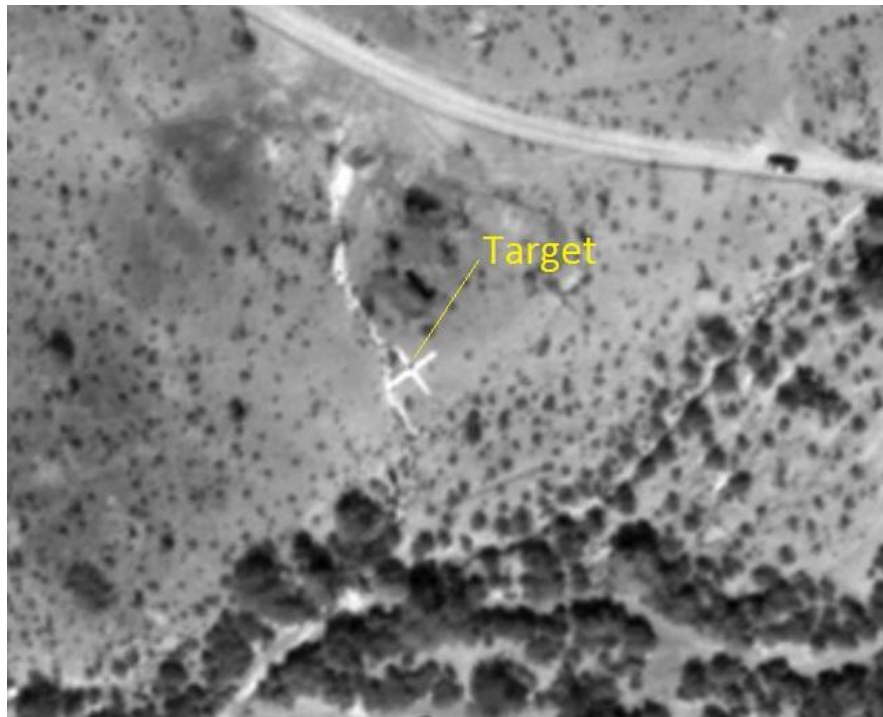


Figure 4b: The target is clearly visible on the 50cm greyscale satellite photo.

Example 5 - A poor target:



Figure 5a: This target appears clearly in the digital photo, but the contrast between the orange material and brown earth is not very strong.



Figure 5b: The exact location of the target is not clear on the 50cm satellite photo because the orange colour blends into the brown background. A white target would have been more effective.