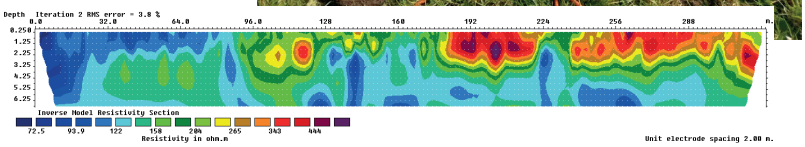
# Dike Inspection and Monitoring

*From ground level and with drones*

**High water levels and floods increasingly show the importance to properly monitor the condition of our dikes. With geophysical research, deformations and weak spots in a dike can be detected quickly and efficiently. This can be done from ground level but also from the air using a drone.**

## *Geo-electrical measurements*

Geo-electrical measurements (resistance measurements) are an electrical research technique that determines the resistance of the subsurface in a non-destructive way. This technique can be used in dike inspections if the subsurface has to be accurately mapped in order to record geological structures with a high resistance or a resistance that deviates from the surroundings. The depth range of the measurements varies from a few meters to a depth of more than 500 meters.

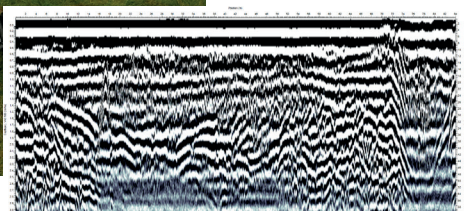



### Measuring principle

Electrical resistance measurements are based on a contrast in electrical resistance between the research objective and its surroundings. Geoelectric measurements can be used to map the soil structure of a dike. For example, clay layers have a low resistance (blue area), while sandy soil has a high resistance (red/purple area).

## *Ground Penetrating Radar (GPR)*

GPR is an electromagnetic reflection technique which quickly and accurately maps the the top meters of the subsurface in a non-destructive manner. This geophysical technique is used for very precise location of soil layers and objects.



### Measuring principle

Ground Penetrating Radar (GPR) sends electromagnetic waves into the ground via a transmitting antenna. These waves are reflected in the subsurface or a structure when the material properties change. The reflected waves are recorded using a receiving antenna. In this way, the different soil layers and the groundwater level can be accurately mapped.

## *IR Thermography*

Under normal circumstances, every water barrier or dike lets water seep through. If a dike is overloaded due to extreme conditions, more water will seep through than normal. When the dike is soaked with water, the temperature of the surface changes. An Infrared (IR) thermography camera measures these temperature fluctuations and converts them into different colors.

**Measuring principle**

T&A Survey Drone Services conducts dike inspections using a drone equipped with an IR thermography camera. The IR thermography camera provides a thermogram, a visual representation of the temperatures on the object of measurement, with different colors indicating different temperatures. Weak spots in dikes are often not visible to the eye, but can easily be recognized on thermography images. It is therefore important to have the GPS coordinates of each recording, in order to accurately locate weak spots.

## *LiDAR*

With a LiDAR (Laser Imaging Detection And Ranging) attached to a drone, T&A Survey Drone Services can register the geometry of dike bodies in detail. The LiDAR sensor measures the distance to a point in the surroundings using a laser pulse. This results in a point cloud of millions of points, each with a position (x, y, z) and a reflection value. The end result is a very accurate 3D image of the surface of the dike.

**Measuring principle**

By comparing the geometry of the dike at different times, deformations, an important parameter for dikes, can be recorded. Deformation measurements with a Drone LiDAR camera provide crucial information about a dike in stressfull conditions, enabeling us to detect weak spots long before a possible dyke breach could take place.

## *Photogrammetry*

Photogrammetry is the creation of maps using digital aerial photographs made by a special, high-resolution photo camera. By attaching this lightweight camera to a drone, high-resolution digital 3D aerial photographs are generated which are then processed with special software.

**Measuring principle**

With drone photogrammetry, dikes can be visualized in 3D and distances, surface areas and volumes can be calculated. With current technology, T&A Survey Drone Services can create 3D elevation models with a resolution and vertical accuracy of more than a few centimeters. The end results of photogrammetry are maps, geo-information, digital orthophotos, 3D elevation models, high-density point clouds and ortho mosaics.

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