# STREAMING- POTENTIAL (SP)

Measurement of naturally occurring electrical potentials, termed Self-Potential (SP), provides a method for mapping subsurface groundwater flow patterns through dams and embankments. It can also provide a means of mapping groundwater flow regimes near pumping wells and other extraction systems.

To measure the self-potential distribution at the surface of the earth, a base electrode is installed in the soil at a convenient location within the survey area, and the potential at this base station is arbitrarily defined as zero. A reel holding several thousand feet of wire is connected to the base electrode and carried to the first measuring station. A second electrode is installed in the soil at the measuring station, and connected through a digital millivoltmeter to the wire reel. The potential between the base and measuring stations is then read on the millivoltmeter. This procedure is repeated at uniformly distributed points until the potential values have been mapped over the entire survey area. Electrode drift and polarization are monitored during the course of the survey. In addition, a long, fixed dipole connected to afield computer is established in the area of investigation to monitor temporal variations in the electrical field. The effects of electrode drift and temporal fluctuations are then corrected for, as necessary.

In recent years, a quantitative theory for the interpretation of self-potential measurements has been developed. However, application of this theory requires extensive knowledge of the geochemistry, mineralogy, electrical properties, and permeability distribution of the material through which flow is taking place, along with the use of a complex two- or three-dimensional computer program. For most cases, qualitative interpretation provides sufficient information to delineate groundwater seepage flow paths. The following guidelines are used for qualitative interpretation of results of self-potential surveys conducted on dams or embankments:

1) Self-potential values usually increase (become more positive) in the direction of water flow, so the top of a dam or embankment usually is negative in potential with respect to the downstream toe. Near pumping wells, SP values will uniformly increase towards the well if the lithology is homogeneous. Conversely, values will increase irregularly if lithology is heterogeneous.

2) Normal, uniform downward seepage through the core of a dam usually produces self-potential contour lines that are parallel to the longitudinal axis of the dam, become more positive in a downstream direction, and achieve their most positive values close to the drainage structure.

3) The gradient of the self-potential curve usually is proportional to the intensity of the flow.

4) Self-potential contours will be distorted in areas of abnormal seepage, with coarse-grained areas of high flow usually producing local negative anomalies, and fine-grained areas of low flow usually producing local positive anomalies.

5)  Groundwater flow paths usually are orthogonal to contours of self-potential.

6)  Depth to flowing groundwater cannot be determined unambiguously from self-potential data, but rough upper and lower limits to flow depths can be estimated using standard potential theory techniques.

7)  Buried metal structures such as rebar, pipes, cables, sheet piles, etc. often generate self-potential anomalies or distort anomalies produced by water flow.  The presence of such structures must be considered when interpreting self-potential data.

NORCAL has used SP successfully in numerous investigations involving groundwater flow paths. These include, delineating seepage paths through earth-fill dams, groundwater flow paths near seismic retro-fit projects, tracing acid mine water seepage, and delineating the path of groundwater that feeds springs.