FACT SHEET

GEOPHYSICS-SURVEYING UNIT
FIELD SERVICES SECTION
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PERSONNEL

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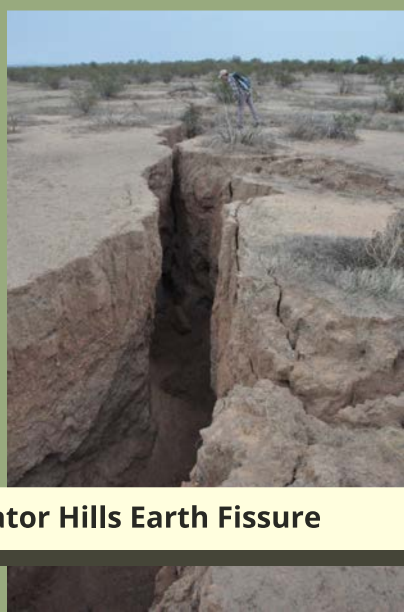
WHAT IS THE GEOPHYSICS-SURVEYING UNIT?

LAND SUBSIDENCE AND AQUIFER STORAGE MONITORING

The Arizona Department of Water Resources (ADWR) Geophysics-Surveying Unit's primary purpose is to gather, process, and interpret land subsidence and aquifer storage data to help the Department better manage the state's natural resources. The data are gathered by using survey-grade Global Navigational Satellite System (GNSS) equipment, gravity meters, and Synthetic Aperture Radar (SAR) satellites. The data consist primarily of GNSS positions and elevations at discrete points, absolute and relative gravity values at discrete points for depth to bedrock and aquifer storage modeling, and broad swaths of SAR data that cover several critical areas of the state.

The two primary programs supported by the Unit are the Land subsidence Monitoring Program (LSMP) and the Aquifer Storage Monitoring Program (ASMP). In addition, the Geophysics-Surveying Unit has performed surveys and supplied data to ADWR's WQARF program, Basic Data Unit, Transducers Unit, Modeling Section, Water Planning Division, and Water Engineering and Permits Division.



Tator Hills Earth Fissure

ADWR GNSS EQUIPMENT & SURVEYING TECHNIQUES

The Geophysics-Surveying Unit uses Trimble R10 GNSS and R8 GNSS Series survey-grade GNSS receivers. The GNSS equipment includes:

- 2 Trimble R10 GNSS Receivers & TSC3 Controllers
- 3 Trimble R8 GNSS Rover Receiver & TSC2 Controller
- 1 Trimble R8 GNSS Base Receiver & TSC2 Controller
- 1 Trimble TDL4501L UHF Radio
- 2 UHF Omnidirectional Antennas with a 5dB Gain Tip
- 4 SECO 2.000 meter Fixed Height Tripods
- 4 Seco Fixed-Height Tripods w/Collapsible Center Staff
- 3 Trimble 1.800 meter Carbon Fiber Bipods
- 3 Trimble 2.000 meter Aluminum Bipods
- Trimble Business Center Software

The Geophysics-Surveying Unit performs three primary types of GNSS surveys to determine the horizontal and vertical position of discreet points: Static surveys, Real Time Kinematic (RTK) surveys, and Post Processed Kinematic (PPK) surveys.

STATIC SURVEY

The Static survey method requires long occupation times (1 to 8 hours), multiple receivers logging data simultaneously, repeat observations, and significant post-processing to produce final results. It is the most accurate GNSS survey technique available today. The level of accuracy achieved is based on a number of factors, including equipment type, occupation time, baseline distance, satellite availability and constellation geometry, and physical receiver equipment. We primarily use the Static survey method when performing our land subsidence measurements.

REAL TIME KINEMATIC (RTK) SURVEY

The Real Time Kinematic (RTK) survey style requires very short (seconds to minutes) occupation times and no post processing of the GNSS data. However, it requires that a base station (GNSS receiver occupying a location with known coordinates) is operating and broadcasting a correction signal that can be received by the GNSS rover receiver. The RTK survey style is used to measure a large number of survey points, in a relatively small geographic area, in a short period of time. There is a decrease in accuracy as a result, but these measurements are not normally use for land subsidence monitoring.

POST PROCESSED KINEMATIC (PPK) SURVEY

The Post Processed Kinematic (PPK) survey style requires an occupation time of at least thirty seconds. This method is similar to the RTK style, but it does not use the broadcasting correction signal from the base station. It uses the static survey data from the base station to post process the initial point data.

WHO WORKS WITH THE GEOPHYSICS-SURVEYING UNIT?

The Geophysics-Surveying Unit has worked with a number of outside groups that are mutually beneficial to all participants, including:

- Community Water Company
- Arizona Geological Survey
- Metro Water
- City of Phoenix
- Neva Ridge Technologies
- Maricopa Dept. of Transportation
- Pinal County Flood Control Dist.
- Salt River Project
- Central Arizona Project
- City of Scottsdale
- Arizona Dept. of Transportation
- Arizona State University
- Arizona State Land Department
- National Geodetic Survey
- United States Geological Survey
- NASA
- Center for Space Research
- City of Glendale
- AMEC Foster Wheeler
- Cochise County

ADWR GRAVITY METERS

The geophysics-Surveying Unit uses two Scintrex CG-3M and one Scrintrex CG-5 Autograv gravimeters to perform gravity surveys. The CG-3M and CG-5 are fully automated relative microgravity meters with a reading resolution of 0.001 mgal (milligals). They are lightweight, portable, and easy to use.

RELATIVE GRAVITY METERS

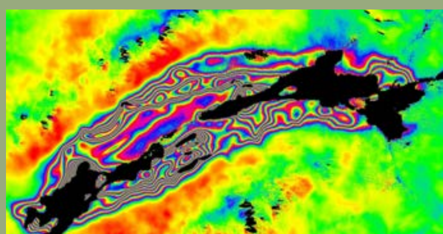
Relative meters measure only gravity differences between stations. Gravity values are obtained at unknown stations by first measuring a station where the absolute gravity value is known, and then measuring the unknown point. This is called a gravity "tie". Relative gravity meters are used because they are easier and faster to use in a fieldwork setting than absolute gravity meters.

AUTOGRAV METERS

The Autograv uses a sensing element based on a fused quartz elastic system. An electrostatic restoring force and a spring are used to balance the gravitational force on the proof mass. Changes in gravity alter the position of the mass. DC voltage is applied to capacitor plates to produce an electrostatic force on the mass, restoring it to a null position. This feedback voltage is a measure of the relative value of gravity.

Earth Fissure on the Northwest corner of Happy Road and 195th St. in Queen Creek

ADWR SYNTHETIC APERTURE RADAR (SAR) PROGRAM



Synthetic Aperture Radar (SAR) is a side-looking, active (produces its own illumination) radar imaging system that transmits a pulsed microwave signal towards the earth and records both the amplitude and phase of the back-scattered signal that returns to the antenna. Interferometric SAR (InSAR) is a technique that compares the amplitude and phase signals received during one pass of the SAR platform over a specific geographic area with the amplitude and phase signals received during a second pass of the platform over the same area but at a different time. InSAR techniques, using satellite based SAR platform data, can be used to produce land surface deformation products with cm-scale vertical resolution, 30-m pixel resolution, and covering areas 100 km x 100 km (in standard beam modes). ADWR has been using InSAR since 2002 to determine the spatial extent, deformation rates, and time-series history of twenty-seven land subsidence features, covering an area greater than 3,400 square miles within the Phoenix, Pinal, and Tucson Active Management Areas (AMAs), and several groundwater basins outside AMAs in Maricopa, La Paz, Cochise, and Navajo counties. With funding and technological help from outside agencies, ADWR has developed an application to perform long-term monitoring of land subsidence within Arizona for water resource management.