

## CEE-USV™ Used for Hazardous Mine Site Surveys

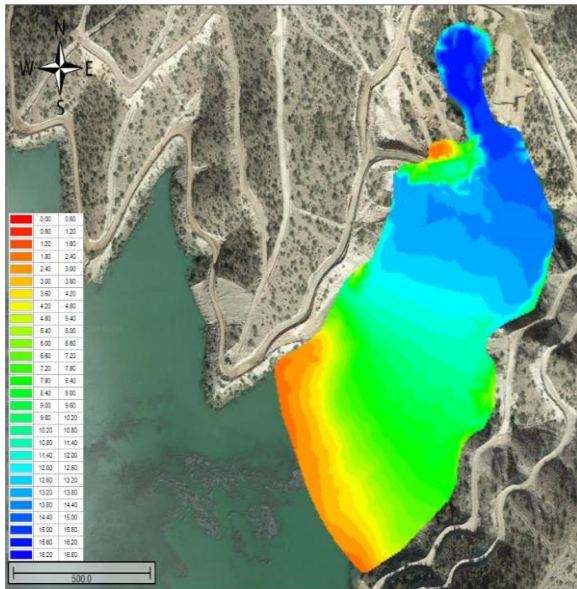
*The CEE-USV™ demonstrated its ruggedness and suitability for harsh industrial environments while being transported around a large open pit copper mine on haul roads and dirt trails, followed by surveying in corrosive acidic leach pad reservoirs and the tailings storage facility.*

Mine engineers developing site-wide water balance models need the available water volumes in the various reservoirs on site. The largest reservoir is typically the tailings storage facility (TSF) where crushed rock fines are sent for storage, water removal and eventual reclamation back to dry land. Without knowledge of the bathymetry of the TSF, engineers do not know the amount of free water in the reservoir. Periodic hydrographic surveying of the TSF allows accurate water volume estimates and an ongoing survey

program ensures the water resource is always well understood. For small to medium sized TSF impoundments, the CEE-USV™ is an attractive solution. With no need to have personnel on the water, eliminating the associated stand by and recovery safety procedures, the feasibility of a bathymetry survey effort increases substantially. Other site reservoirs may benefit from periodic surveys once the site has the capability to undertake surveys on request.

At the Ray copper mine in Arizona, USA the CEE-USV™ was used to gather the first ever bathymetric survey of the Elder Gulch tailings impoundment. With a convenient high vantage point for controlling the boat on the 700m x 300m (2300' x 980') pond, the Ray TSF is an ideal location for a USV survey.

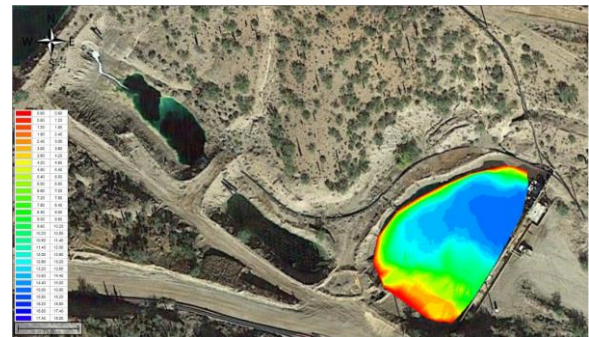
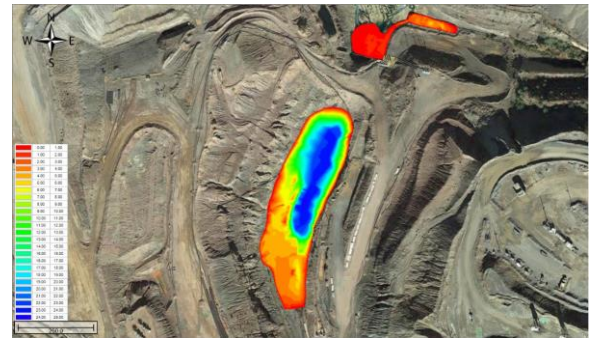




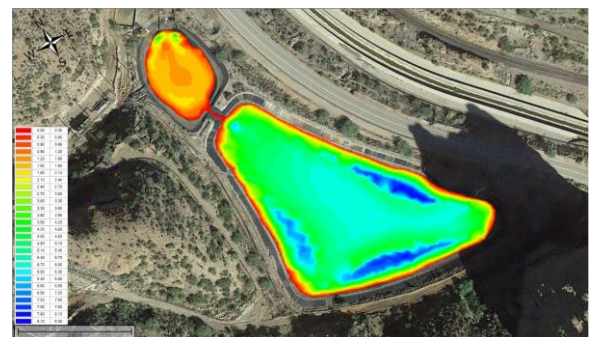
**Tailings Impoundment.**

In addition to the TSF, several leach pad reservoirs were surveyed. While it is feasible (but inconvenient), to survey the TSF on a manned boat, the acidic leach ponds present a much greater safety hazard for personnel so manned boat surveys are out of the question. Therefore, a USV is an ideal solution for these ponds. Reliability and redundancy is key as there was no way to easily recover a stranded survey boat from an acid pond! Care was taken navigating around the pipes and structures in the ponds, with the USV's unusual ability of being able to turn 180 degrees on its own axis proving useful on several occasions.

With the volume calculations and stage to volume curves provided by Hydromagic software, the mine was able to get the water volumes within an hour of completing the surveys. Once the bathymetry is established, water volumes may subsequently be inferred by a single water level measurement.



**Sulfuric acid leach ponds.**



**Process water storage.**

The site also has a deep pit lake that is used to store acid leachate. In this case, the extreme absorption of sonar energy by the dissolved constituents of the leachate greatly decreases the penetration of echo sounder energy such that it cannot reach the bottom. At over about 10m (33ft) essentially all the emitted 200kHz energy is absorbed – a factor of ten greater than seawater. This limits the application of standard echo sounding technology to deep pits of this nature.