

CASE-STUDY USING A HIGH-RESOLUTION ELECTROMAGNETIC INDUCTION SYSTEM FOR DETECTION AND CHARACTERIZATION OF UNEXPLODED ORDNANCES, SEA-MINES AND DREDGING HAZARDS

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Black Tusk Geophysics (BTG), in collaboration with Gap Explosive Ordnance Detection (GapEOD) in Australia, has developed the UltraTEM® for high resolution detection and characterization of unexploded ordnance. In 2016, BTG and GapEOD commissioned the first UltraTEM® Marine system (called the SubTEM®) for Heinrich Hirdes EOD, a wholly owned subsidiary of the Dutch dredging company Boskalis. The SubTEM® system built for Boskalis comprises several transmitter loops and three component receiver cubes. The transmitters fire sequentially while the system moves over the sea-floor. The different looks provided by the transmitters, coupled with the dense distribution of three component receivers allows the SubTEM® to both detect and characterize buried metal. The system has a swath width of over 5.5 m and can detect both ferrous and non-ferrous ordnance items to depths of over three meters below the sea-bottom. Of particular concern in European waters are large German ground mines that are made of aluminum and are undetectable by the magnetometers typically employed for marine surveys. In 2016 and early 2017 the SubTEM® system was used to survey over 500 Ha at Portsmouth Harbor and 20 Ha in Dover Harbor in the United Kingdom. These harbors have been used for centuries and, particularly for Portsmouth, contain large amounts of buried subsurface metal including cables, unexploded bombs, torpedoes and sea-mines. Recovery of metal items in the marine environment is extremely expensive; hence, it is important to minimize the number of non-hazardous items that are excavated. The SubTEM® was designed with subsurface characterization in mind so that digging operations could focus on the removal of dredging hazards including large pieces of metal, cables, unexploded bombs and sea-mines. Using advanced classification, less than 5% of the more than 22,000 pieces of metal detected required excavation, and several live UXO were recovered.