NASAfacts

Utah Test and Training Range: The Proposed Landing Site for Mars Sample Return

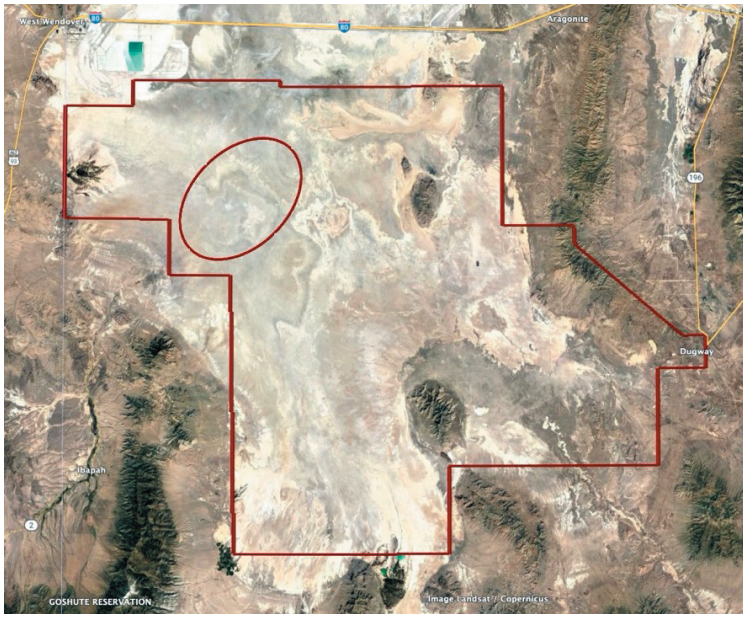
NASA has identified the Utah Test and Training Range (UTTR) in west-central Utah as the proposed landing site for samples from the surface of Mars. These samples would be gathered by a Mars Sample Return (MSR) campaign being planned jointly by NASA and the European Space Agency (ESA).

UTTR emerged as the baseline choice for the landing site for MSR after a review of more than 500 potential sites across the United States, based on more than a dozen specific selection criteria. These criteria include being a remote site on land in the United States. The site must feature restricted access and special use airspace, with a recovery area free from roads, structures, and hazardous terrain such as trees or steep hills. A landing in the ocean was considered but eliminated because losing the spacecraft during or after an ocean landing has the potential to lead to loss of sample containment.

The recovery area must offer a large, flat surface with minimal slope, and soil properties that would aid in softening the landing of the MSR Earth Entry System (EES). The site should also provide the capability to track the EES during its landing process, and then allow quick access to the EES after landing to enable its prompt recovery and secure transportation to a state-of-the-art receiving and containment facility elsewhere in the U.S.

Located primarily in Tooele County, UTTR provides the largest overland contiguous block of restricted airspace in the continental United States. This airspace covers 2,675 square miles (6,930 square kilometers) of land area. UTTR is administered and maintained by the U.S. Air Force, with some operations being conducted in conjunction with the U.S. Army at the adjacent Dugway Proving Grounds.

MSR would utilize a portion of the UTTR South Range, with a target landing zone of approximately 150 square miles (390 square kilometers) in area. The planned landing area at UTTR is predominantly a dry lakebed with seasonal variations between wet and dry conditions. It is anticipated that the MSR EES would land during the fall months of the year when the soil conditions and weather are typically favorable for recovery operations.



The proposed landing zone for the Mars sample return mission is shown in the red ellipse.

NASA has previously used UTTR as the landing site for space missions that have successfully returned samples of comet dust and the solar wind, and it is the planned location for the return of samples from the asteroid Bennu in 2023 that have been gathered by NASA's OSIRIS-REx mission.

MSR represents the first "restricted" sample return in U.S. solar system exploration since the early Apollo lunar landings over 50 years ago. Restricted sample return means that the samples come from a place with local environmental conditions that, based on scientific understanding at the time of the mission, could potentially support past or present life. Several different panels of scientific experts from around the world have found that the likelihood that samples of Mars could contain a hazard to Earth's biosphere is extremely low. For example, the Mars samples being gathered by NASA's Perseverance Mars rover for potential return are from the first few inches of a surface that is very dry and highly irradiated—these harsh conditions would inactivate all known active biology.

NASA is taking a "safety first" approach to the engineering of every step of the proposed MSR Campaign. In the current design, this includes double layers of protection around the Orbiting Sample container, and heat sterilization of any Mars dust that could remain in the joint between the two halves of the primary containment vessel.

MSR is different from recent NASA sample return missions in that it does not plan to use a parachute for landing. This approach simplifies the design of the EES and removes a potential failure point, while maintaining a significant safety margin. It is expected that the cone-shaped EES, roughly the size of a tire on a semi-trailer truck, would land at UTTR with a speed of about 90 miles per hour; simulations and ground-based testing have shown this speed would be low enough to keep the Mars rock cores intact inside the Orbiting Sample container. The landing would create a depression in the soil with a diameter about the same as the EES (four feet or 1.3 meters), with soil being ejected from the crater to a distance of approximately 50 feet (15 meters).

NASA is conducting drop tests at UTTR using realistic prototypes of the MSR EES at speeds comparable to what would occur during a actual landing event. Photo credit: U.S. Air Force/NASA

The preliminary design of the EES includes redundant layers of containment for the samples and a design that softens the effects of landing without a parachute.

The samples from Mars would be returned to Earth in the early 2030s. Prior to EES landing, several recovery teams would be staged at strategic locations surrounding the proposed landing site. Staging areas would include communications equipment and vehicles (land and/or air), and equipment for use in transport to and from the landing site. After landing, the EES would first be placed into a sterile, particle-tight bag or case, then transported within UTTR for placement into an environmentally controlled container for shipment to an off-site sample receiving facility.

The MSR Campaign team is developing specific transportation, storage, and curation protocols for the Mars samples, including transportation from the UTTR point of recovery to the yet-to-be-determined site of an MSR sample receiving facility. The ability to ensure prompt and secure transport of the contained samples to a receiving facility is another reason for the recovery area to be on land versus the ocean.

NASA, in cooperation with the U.S. Air Force and U.S. Army, is preparing a Programmatic Environmental Impact Statement (PEIS) that will analyze the environmental impact of the overall MSR program, including landing and recovery at UTTR. The purpose of the PEIS is to ensure NASA officials consider the environmental impacts of, and reasonable alternatives to, the proposed action. Decisions regarding specific methods of sample transportation from the landing site to a receiving facility will be addressed in a subsequent environmental analysis, once the requirements for such activities have been fully identified. Both decision processes will include opportunities for public review and comment.

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