

# Protecting our lunar legacy



▲ The Apollo 15 landing site with rover tracks, astronaut footprints and equipment will be much the same today as when the crew departed in July 1971.

**Five decades after Neil Armstrong and Buzz Aldrin landed on the Sea of Tranquillity, we finally know that we are going back to the Moon. But this time it will be done differently. And amid the excitement of our new explorations, we must not forget to protect what was left behind the first time around: human-created artefacts including flags and footprints that are a part of our history and point to our future.**



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Our relationship with space has changed greatly since the last time man set foot on the Moon. Quite apart from anything that NASA and other state actors may do, there will be commercial operators on the Moon. Initially it will be robotic spacecraft but they will eventually be followed by landers carrying new lunar explorers and space tourists.

We already have the example of Yusaku Maezawa, the Japanese billionaire, and six of his artist friends, who have signed up for a circum-lunar flight with SpaceX scheduled for 2023. But first, there will be rovers and hoppers, some of which are legacy craft from the Google Lunar XPRIZE (GLXP), the competition which, after a decade, ended in March 2018 without anyone claiming the US\$30 million prize purse.

The idea of the GLXP was to encourage non-governmental teams to land a craft on the Moon, have it travel 500 metres, and then send back high definition images, thus kick-starting a low-cost 21st century approach to accessing the lunar surface. Some of the teams got very close – and some are

continuing today even without the prize incentive. They see landing on the Moon and delivering payloads to the surface as a commercial proposition.

The first of these attempted lunar landings will be from the former GLXP team SpaceIL from Israel, which was launched and deployed from a SpaceX Falcon on 21 February 2019 with an anticipated landing on the lunar surface some weeks later after a series of manoeuvres en route.

## Judgement of history

The GLXP competition rules included an incentive to land near lunar legacy sites. They would certainly be an attractive target for hi-definition imagery. And once lunar surface tourism begins, it would seem highly probable that the lunar legacy sites, Apollo and others, would represent the 'must-see' destinations of a trip to the Moon.

We know that at present the sites are in a pristine state, just as the first explorers left them. But just how long would that magnificent desolation remain after a few rovers, hoppers, or tourists have been back to visit them? Going back could provide important



scientific and engineering knowledge about what happens after 50 years sitting on the lunar surface. There is no wind or rain, but there is radiation, and there are Moonquakes and micro-meteor impacts. We need to understand that science better.

Also, the sites represent a cultural resource that preserves elements of life on Earth at the beginning of the Space Age. There will even be Earth bacteria in some of the discarded containers left by the Apollo moonwalkers. We would love to know what has happened to them. And there are some radioactive devices which will need careful attention. There are some 67 sites of former hard or soft landings on the Moon today. And, in the case of Apollo, there can be up to 100 individual artefacts around any given landing site, plus all the boot prints and rover tracks.

So, there seems to be a good argument for some kind of conservation effort related to these first sites of human exploration on the Moon. It may seem a bit premature to consider this, but nowadays 46,000 tourists go to Antarctica annually – something which would have certainly surprised Amundsen and Scott!

The details, even the balance of priorities, still need to be thought out, but clearly there is a case for some kind of protection of some of the historical sites and associated objects. It would be unrealistic to attempt to save all evidence of those first Moon landings, but perhaps we could try to protect some of the boot prints, rover tracks and space hardware that was left behind? It would not serve us well in the judgement of history if we made no effort to preserve some of the early lunar exploration record.

## Smithsonian approach

The Smithsonian Institution's National Air and Space Museum (NASM) first became concerned about these issues when the Google Lunar XPRIZE was announced, in 2007. If there was ever going to be a Smithsonian on the Moon, something would need to be done to preserve the historical artefacts of the first explorations that were already sitting there. It began to work with NASA to come up with some frame of reference for addressing the problem.

The main issue would be disturbing of lunar dust at the sites, either by rover tracks, engine exhaust or even eventually, new footprints. Tests were done on the way the lunar regolith is disturbed in different controlled conditions. A 93-page document emerged from these studies with the title 'Recommendations to Space-Faring Entities: How to Protect and Preserve the Historic and Scientific Value of US Government Lunar Artifacts', dated 20 July 2011.

The main idea introduced in the NASA/NASM document was the concept of designated exclusion zones around the 60-plus sites of former hard or soft landings, including the Surveyors, the Apollo sites, Russian, Chinese, Japanese and European sites. There would be some measure of historic importance which would be used to determine the dimensions of the exclusion zone for each site.

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▼ What an Apollo site may look like today.





▲ Images of the Spacell lunar lander/hopper. An early concept (left) and the flight model prior to its planned February 2019 launch.

▼ Site of Apollo 16 landing, showing tracks and artefacts left behind by Young and Duke after the 1972 mission. Image taken from the orbiting lunar satellite LRO, 40 years later, in 2012.

This document makes an important contribution to the conservation task, but it carries no legal weight. It does not even imply obligations for future US lunar operators, let alone any international regulatory agreement. Legally, at present, there are no protections for any of the artefacts left on the Moon, or any of the features of the landing sites. But this document was a good start, and it served its purpose, as we shall see.

### First test

After the GLXP competition got underway, there was some consideration given within the GLXP

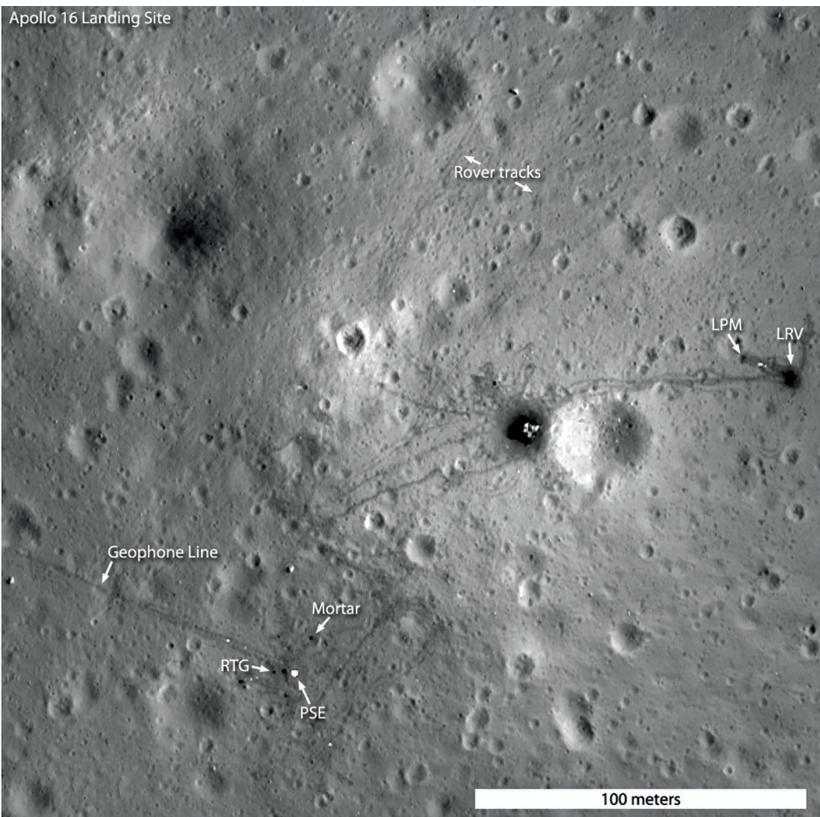
organisation concerning the protection of the lunar legacy sites, the more especially since there was a US\$4 million ‘Heritage Prize’ incentive to encourage a team to land beside such a site. The XPRIZE foundation set in place a panel of nine international independent judges to monitor the competition, and one element that they had to consider was the protection of legacy sites.

The judges reviewed the NASA/NASM document and determined that by following its recommendations a team would still be able to attempt to win a Heritage Prize, and so steps were taken to ensure that it became a requirement for the teams to follow the NASA/NASM recommendations.

Furthermore, so that the judges could make a determination whether a team had indeed taken the necessary steps, a Mission Plan Review process was put in place, which included, amongst other matters, a review of the legacy site protection protocols. This Mission Plan, including the protections, was made subject to judges’ approval before the teams could move on to the final stage of the competition.

The judges considered both planned and unplanned incursions on Heritage Sites. During the review process, the judging panel reviewed test and/or simulation data on approach path, landing accuracy, mobility path on the lunar surface, distance measurement and error, planned wheel speed for rovers, flyby path for hoppers, and contamination prevention protocols.

So, how did it work out? As it turned out, only two of the GLXP teams reached the stage in their developments where they were ready to mount a Mission Plan Review in front of the GLXP judging panel. These two leading teams were Team Indus, from India, having both a lander and a rover, and Team Hakuto, from Japan, with a rover being carried as a passenger on the Team Indus lander. In October 2017, the Mission Plan Reviews took place in the Team Indus Mission Control Room



in Bangalore, followed by Japanese rover tests in November 2017.

For the record, both teams satisfied the judges regarding their heritage site protection plans, although they had not been intending to attempt a Heritage Prize in any event. None of the other GLXP teams had reached the stage where a Mission Plan Review was arranged, so were not subject to a review by the judges.

We can say therefore that the process that was followed did ensure that for the GLXP, the heritage protections were in place, and the GLXP judges were able to act as a kind of watchdog for this activity. On 31 March 2018 the competition was closed, and the judging panel was disbanded.

### Now what?

These GLXP arrangements worked but they were informal. Formal international regulation, including monitors, will be needed. International law is currently silent on the issue and needs to be engaged to provide a reliable set of protections for the way forward. We may note, in passing, that not much is being done regarding space debris mitigation after decades of discussion. So maybe it is opportune on the upcoming 50th anniversary of the first Moon landings to make a call for action on the lunar legacy site protection issue.

The non-profit For All Moonkind organisation, which was formed in 2017, has taken up this challenge, setting up a series of volunteer boards covering legal as well as archaeological and science aspects. Currently this organisation is creating a Registry of the Lunar Legacy Sites, as well as working on a 'Do No Harm' pledge aimed at the former GLXP teams who are continuing to strive for a Moon landing. The group is seeking observer status at the UN's Committee on the Peaceful Uses of Outer Space (UN COPUOS). They will be aiming to build on the protocols suggested in the July 2011 NASA/NASM document seeking international perspectives and concurrence and taking into account the views of archaeologists and other conservation experts.

Key questions remain to be answered. Which sites should be protected? Is the exclusion zone concept workable? If so, what should be the dimensions of the exclusion zone boundaries for these sites? How should historic importance be determined? How can access be permitted for legitimate science to study the record of the half-century of benign neglect, and for cultural purposes? Who should be responsible for policing this activity, taking over the watchdog role undertaken by the GLXP judges?

We only get one chance to get this right. We have some obligation to succeeding generations to be able



◀ The international independent Judging Panel for the Google Lunar XPRIZE competition monitors tests during the mission plan review for Team Indus, Bangalore, India, October 2017.

to hand over to them in situ at least a significant part of the historic record of the first human explorations of the Moon.

We need to go back to the Moon to inspire a new generation of explorers and honour those who risked their lives to go the first time around – there were 24 of them and 12 were still alive at the start of 2019. I am sure they would love to see these sites again through the lenses of a new generation who are bringing space exploration one step forward. As we launch ourselves into our space future, to further explore and perhaps even colonise the Moon, we must do our utmost to safeguard the lunar heritage sites – our grandchildren will thank us. ■

### About the author

**Derek Webber**, a former space systems engineer and executive in the satcoms business, is founder of Spaceport Associates, USA, and worked to establish the marketing and regulatory aspects of the private spaceflight business. He is currently proposing a space tourism hotel in geostationary orbit, known as Gateway Earth, designed to furnish revenues to support a new interplanetary exploration initiative. He was Vice Chair of the independent international judging panel for the Google Lunar XPRIZE, is a Leadership Board member of the non-profit, For All Moonkind, and is the author of three books about the history and development of space exploration and business.

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▼ An obligation to protect our lunar legacy. Some kind of conservation effort is needed - or we could end up with this...

