***** First Landing Site Workshop For the 2020 Mars Rover Mission *****
***** May 14-16, 2014 Washington, DC *****

Dear Colleagues:

You are invited to participate in the First Landing Site Workshop for the 2020 rover mission to Mars. The workshop is expected to be held May 14-16, 2014, in the Washington, DC, area (exact dates and venue TBC).

An Overview of Workshop Objectives:

The purpose of the first 2020 Landing Site Workshop will be to: 1) begin to identify and evaluate potential landing sites best suited to achieving science objectives of the 2020 Rover Mission within the constraints imposed by engineering requirements, planetary protection requirements, and the necessity of ensuring a safe landing; and 2) provide input to NASA and the 2020 Project at JPL on the relative importance of including any enhanced EDL capabilities on the mission. The desired product of this workshop is: 1) a list of all known sites that meet the threshold science criteria; 2) for those sites, an assessment of what landing capability is required, choosing from 3 categories: MSL-only, MSL + Range Trigger (smaller ellipse), and MSL + Range Trigger + Terrain Relative Navigation (tolerant of isolated hazards in ellipse; see detailed criteria); and 3) for each category of landing capability, a ranking of the sites using the qualifying geological criteria. At the end of this workshop we should have a good idea of a) how many sites exist in each category, b) how much "better" are the sites that require landing enhancements, and c) insight to where we need to invest additional energy in site characterization.

A NASA-appointed Landing Site Steering Committee will use the results of the first workshop as the basis for establishing a list of potential landing sites for study. Community consensus with respect to high priority sites will also be solicited. It is expected that candidate sites will be ranked (high, medium, low priority) based on presentations made at the workshop and that these rankings will be used to guide imaging priorities of the sites after the workshop. The goal will be to build up robust image data sets while orbital assets are still operating for as many high priority sites as possible, thereby enabling comprehensive discussion of relative science merits and safety at subsequent workshops.

Mission Science Objectives:

The Mars 2020 rover mission will explore the geology of a once habitable site, seek signs of past life, fill a returnable cache with the most compelling samples, and demonstrate technology for future human exploration of Mars. As described in the Mars 2020 Announcement of Opportunity (AO;http://nspires.nasaprs.com/external/solicitations/summary.do?method=init&solId={C49E4810-6DE9-9509-E896-EBC006101A9E}&path=open/) and Science Definition Team (SDT) report (Mustard *et al.*, 2013; found at http://mars.jpl.nasa.gov/mars2020/), these goals include deciphering the geological history of the landing site and determining whether past environmental conditions were favorable for microbial life and for preserving signs of life, had it existed. The search for signs of past life would combine: 1) use of the rover instruments on Mars for visual, mineralogical and chemical analysis down to a microscopic scale to identify candidate

features that may have been formed by past life; with 2) collection and packaging of carefully selected samples for possible return to Earth by a future mission, thereby enabling a broad range of investigations and more definitive analysis by laboratories on Earth. The mission would also demonstrate technologies for advancing toward human missions to Mars.

The AO for 2020 investigations lists four objectives, with the first three considered the threshold objectives for the mission. Achieving the objectives requires both orbital and ground observations and the first three objectives have strong synergy, as they are linked by the need to decipher the geological processes and history of an "astrobiologically relevant ancient environment", a place once capable of either supporting life as we know it, or sustaining pre-biological processes leading to an origin of life.

A. Characterize the processes that formed and modified the geologic record within a field exploration area on Mars selected for evidence of an astrobiologically-relevant ancient environment and geologic diversity.

B. Perform the following astrobiologically-relevant investigations on the geologic materials at the landing site:

1. Determine the habitability of an ancient environment.
2. For ancient environments interpreted to have been habitable, search for materials with high biosignature preservation potential.
3. Search for potential evidence of past life using the observations regarding habitability and preservation as a guide.

C. Assemble a returnable cache of samples for possible future return to Earth.

1. Obtain samples that are scientifically selected, for which the field context is documented, that contain the most promising samples identified in Objective B and that represent the geologic diversity of the field site.
2. Ensure compliance with future needs in the areas of planetary protection and engineering so that the cache could be returned in the future if NASA chooses to do so.

D. Contribute to the preparation for human exploration of Mars by making significant progress towards filling at least one major Strategic Knowledge Gap (SKG). The highest priority SKG measurements that are synergistic with Mars 2020 science objectives and compatible with the mission concept are (in priority order):

1. Demonstration of In-Situ Resource Utilization (ISRU) technologies to enable propellant and consumable oxygen production from the Martian atmosphere for future exploration missions.
2. Characterization of atmospheric dust size and morphology to understands its effects on the operation of surface systems and human health.
3. Surface weather measurements to validate global atmospheric models

Additional details for the Mars 2020 mission can be found at http://mars.jpl.nasa.gov/mars2020/ and http://marsnext.jpl.nasa.gov/. The latter includes additional details on threshold geological and potential qualifying geological criteria, details on the engineering constraints, enhanced EDL capabilities, planetary protection guidelines and information required for potential landing sites. A summary of NASA's Mars exploration strategy is at http://mars.jpl.nasa.gov/ and additional information can be viewed at http://mepag.nasa.gov/index.cfm. Web tools for visualizing and analyzing relevant Mars data are available at http://marsoweb.nas.nasa.gov/landingsites/and http://webgis.wr.usgs.gov/, which also includes a web based GIS interface for relevant Mars data. Finally, a specific 2020 Mars Rover version of JMars has been developed that has areas that meet the engineering constraints, suitably sized ellipses for placing landing sites, and shows existing image data is available at http://jmars.mars.asu.edu/jmars2020/ along with tutorials.

Mission Engineering Constraints:

Because the ability to ensure a successful landing for the Mars 2020 mission is paramount, consideration of landing sites must include comprehensive assessment of limitations imposed by mission engineering constraints. Although these constraints continue to be established and refined, a description of preliminary values related to allowable locations, elevation, and surface properties can be found at http://marsnext.jpl.nasa.gov/ and a summary follows.

The Mars 2020 rover will use the successful, as-applied Mars Science Laboratory (MSL) Entry, Descent, and Landing (EDL) system to reach the surface of Mars. Hence, the constraints imposed by this EDL system on the MSL site selection effort are broadly similar to those for the 2020 mission (e.g., a 25 km by 20 km landing ellipse, access to latitudes between 300N and 300S, details on all constraints can be found at http://marsnext.jpl.nasa.gov/ and in *Grant et al.*, 2011 and *Golombek et al.*, 2012). An important difference, however, relates to an allowable elevation for the landing site of +0.5 km (with respect to the MOLA geoid) due to the higher atmospheric density expected at the season the 2020 rover arrives at Mars.

The SDT report (see *Mustard et al.*, 2013) also describes several possible enhanced EDL capabilities that could be included in 2020 and might grant access to somewhat smaller landing ellipses and/or ellipses characterized by increased topography relative to what was acceptable for the MSL EDL system (as flown). These capabilities include: Range Trigger and Terrain Relative Navigation (TRN). Proposers are urged to review these capabilities in *Mustard et al.* (2013), but Range Trigger could enable a smaller ellipse on order of 18 km by 14 km and TRN could enable some hazards up to ~300 m across to be avoided within the ellipse. Proposers should consider whether the addition of one or more would potentially enhance or enable consideration of their candidate site.

It is expected that all candidate sites for the 2020 mission will be vetted by the science community at a first workshop tentatively scheduled for the week of May 12-16, 2014, in the Washington, D.C. area. Proposed targets should be chosen that will help strengthen the science rationale of the sites as well as assist in evaluating the nature and distribution of potential hazards to landing that can inform the desire for any enhanced EDL capability.

All persons planning to participate in the workshop should review the science, engineering, and planetary protection constraints carefully, as only those landing sites that meet these constraints will be accepted for presentation at the workshop.

How to participate:

All members of the scientific community are encouraged to participate in this important activity. Persons wishing to make a presentation at the workshop are urged to carefully review the mission science objectives and engineering constraints at http://marsnext.jpl.nasa.gov/ and http://mars.jpl.nasa.gov/mars2020/.

Most of the workshop will be devoted to submitted papers describing: (1) the overall types of sites for Mars 2020 based on associated scientific and programmatic rationale and suitability for safe landing and roving; and (2) individual landing sites on Mars and their scientific merit and safety. Talks advocating an individual site must summarize the science merits and demonstrate that the proposed location satisfies the mission science and engineering requirements. A clear statement of the rationale for continued consideration as a possible landing site should also be included. A program will be prepared from the submitted topics and will be posted along with logistical information in April, 2014.

Persons wishing to participate should submit the proposed title for their talk that includes the candidate site and a list of authors by April 1st, 2014 to both Matt Golombek (mgolombek@jpl.nasa.gov) and John Grant (grantj@si.edu)

Logistics for the Workshop:

The workshop is expected to be held in the vicinity of Washington, DC, and there will not be a registration fee. In order to get a sense of the number of people likely to attend the workshop, interested individuals should indicate their intent to attend via http://marsnext.jpl.nasa.gov/ by April 1st, 2014. We anticipate mostly oral presentations. Additional logistical information about the workshop will be distributed to the community in subsequent announcements and will be posted at: http://marsnext.jpl.nasa.gov/.

Input from the science community is critical to identification of optimal landing sites for the Mars 2020 mission. We look forward to your involvement in these activities!

Regards,

John Grant and Matt Golombek, Co-Chairs,
Mars Landing Site Steering Committee