Guiding Principles:

• Landing site selection is critical to all aspects of 2020 mission and program success (no landing, no science)

• Final site recommendation, selection and approval is the job of the Project, 2020 Science Team, and NASA HQ, respectively.

• The broad expertise of the science community is crucial to the identification and assessment of optimal sites.

• Process is open to all and has no predetermined outcome
Basis for 2020 Site Selection:

- Site Must Meet **All** Engineering Requirements

<table>
<thead>
<tr>
<th>Site</th>
<th>EDL</th>
<th>Surface</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columbia Hills</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eberswalde</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holden</td>
<td></td>
<td></td>
<td>Likely to exceed the prime mission duration to accomplish science objectives</td>
</tr>
<tr>
<td>Jezero</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mawrth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NE Syrtis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nili Fossae</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW Melas</td>
<td></td>
<td></td>
<td>Lack of confidence in atmosphere modeling results coupled with significant terrain hazards bordering the landing ellipse raise concerns</td>
</tr>
</tbody>
</table>

*All candidate landing sites are viable; however, have some engineering concerns with Holden and SW Melas*
Basis for 2020 Site Selection:

• Focus on Workshop is Assessment of Science Merit

• Selected Sites Are Best Suited to Achieving 2020 Mission Science Objectives:
  ✓ Astrobiologically Relevant Environment
  ✓ Preserve Information to Understand Geological Record – Including Habitability and Preservation Potential
  ✓ Preserve Materials Preserve Potential Biosignatures
  ✓ Assemble Sample Cache – Include Igneous Rocks
  ✓ Consistent with “Technology” Elements

• We will vote on criteria that relate to these objectives and comprise the mission science goals

• Must be present at workshop to vote
Participants in 2020 Landing Site Selection:

- **Science Community Input**
  Broad e-mail distribution, Workshop Attendance, Websites

- **Additional Members**
  Blend Experience and Mission Involvement
  Provides for Feedback on Process

- **NASA-Appointed Landing Site Steering Committee**
  Co-chairs Grant and Golombek
  Other Members Appointed by NASA HQ
  Dave Des Marais, Brad Jolliff, Scott McLennan,
  John Mustard, Steve Ruff, Ken Tanaka

- **Mars Characterization Investigators** (MDAP, MFRP, CDP)
  Insight into Landing Site Science and Safety

- **2020 Science Team and Project:**
  Science Team helps identify and evaluate merits of sites
  Engineering teams define the engineering constraints and help analyze aspects of the surface and atmospheric environments.
  Project management and the PSG review scientific analyses of sites.

- **Headquarters and Other Ex-Officios**
  Ensures broad, relevant MEP participation
  Access to Ongoing Mission Data
  Planetary Protection Compliance

- **All Landing Site Selection Activities Documented at:**
## Draft 2020 Landing Site Selection Timeline

4-5 Workshops, 4-5 Years, Possible Selection L-2 or L-1 yr

<table>
<thead>
<tr>
<th>Date</th>
<th>Title</th>
<th>Comments/Description</th>
<th># of Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/13</td>
<td>SDT report</td>
<td>• Preliminary engineering constraints</td>
<td></td>
</tr>
<tr>
<td>5/14</td>
<td>LSW 1</td>
<td>• Sites prioritized into thirds by science merit</td>
<td>~28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Top 3rd to be characterized for safety and TRN need by LSW 2</td>
<td></td>
</tr>
<tr>
<td>6/15</td>
<td>LSW 2</td>
<td>• Identify 8 selectable sites</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Are there enough non-TRN sites of sufficient science merit?</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- If not, is TRN required? Define TRN attributes needed</td>
<td></td>
</tr>
<tr>
<td>2/17</td>
<td>LSW 3 (circled)</td>
<td>• ~Middle of Phase C</td>
<td>3-4</td>
</tr>
<tr>
<td>TBD</td>
<td>LSW 4</td>
<td>• Final planned workshop</td>
<td>1-2</td>
</tr>
<tr>
<td>TBD</td>
<td>Site selection</td>
<td>• Decision dependent on number of high priority sites, clustering of sites, programmatic factors</td>
<td></td>
</tr>
<tr>
<td>7/20</td>
<td>Launch</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Modified from Al Chen
Candidate Landing Sites on Mars: ~130 Locations

MER, MSL, 2020, MSR, Future
Where 2020 Can Land:
Elevation/Lat. Mask with Values of TES Thermal Inertia

- < 150 = dark gray (Christensen et al. 2001)
- < 100 = light gray

From Matt Golombek
Planetary Protection Considerations:

Interpretive Map of Ice and Potential Transient Surface Water on Mars

Map of Features of Relevance to Interpreting Special Regions on Mars

- **Unit 1**: Continuous Shallow Ice within 0.3 m of the surface
- **Unit 2**: Discontinuous Shallow Ice within 5 m of the surface
- **Unit 3**: Shallow ice absent, potential for ice > 5 m deep
- **Unit 4 (circles)**: Possibility of transient surface water inferred from recurring slope lineae
- **Unit 5**: No shallow ice within 5 m of the surface observed or suspected

Special Regions - Science Analysis Group 2
Preliminary results for planning/discussion and review purposes only. For internal use only.
2020 Candidate Sites at the First Workshop:

- Top 1-5
- Top 6-10

[Map showing candidate sites with latitude and longitude coordinates, elevation mask = 500m]
Eight Candidate Sites After the Second Workshop:

<table>
<thead>
<tr>
<th>Landing Site</th>
<th>Latitude (°N)</th>
<th>Longitude (°E)</th>
<th>Approx. Elev. (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columbia Hills/Gusev crater</td>
<td>-14.4</td>
<td>175.6</td>
<td>-1.94</td>
</tr>
<tr>
<td>Eberswalde crater</td>
<td>-23.0</td>
<td>327.0</td>
<td>-1.4</td>
</tr>
<tr>
<td>Holden crater</td>
<td>-26.4</td>
<td>325.1</td>
<td>-2.2</td>
</tr>
<tr>
<td>Jezero crater</td>
<td>18.5</td>
<td>77.4</td>
<td>-2.0</td>
</tr>
<tr>
<td>Mawrth Vallis</td>
<td>24</td>
<td>341.1</td>
<td>-2.3</td>
</tr>
<tr>
<td>NE Syrtis Major</td>
<td>17.8</td>
<td>77.1</td>
<td>-2.0</td>
</tr>
<tr>
<td>Nili Fossae trough (N)</td>
<td>21.0</td>
<td>74.5</td>
<td>0.6</td>
</tr>
<tr>
<td>SW Melas Chasma</td>
<td>-12.2</td>
<td>290</td>
<td>-5.0</td>
</tr>
</tbody>
</table>
HiRISE Coverage of 8 Remaining Sites:

Columbia Hills  Eberswalde  Holden  Jezero

Mawrth  SW Melas  Nili Fossae  NE Syrtis
Scientific Selection Criteria:

Criterion 1:
The site is an astrobiologically-relevant ancient environment and has geologic diversity that has the potential to yield fundamental scientific discoveries when it is a) characterized for the processes that formed and modified the geologic record; and b) subjected to astrobiologically-relevant investigations (e.g., assessment of habitability and biosignature preservation potential). (scoring: 1=lowest potential, 5=highest potential)

Criterion 2:
A rigorously documented and returnable cache of rock and regolith samples assembled at this site has the potential to yield fundamental scientific discoveries if returned to Earth in the future. (scoring: 1=lowest potential, 5=highest potential)

Criterion 3:
There is high confidence in the assumptions, evidence, and any interpretive models that support the assessments for Criteria 1 and 2 for this site. (scoring: 1=lowest confidence, 5=highest confidence).

Criterion 4:
There is high confidence that the highest-science-value regions of interest at the site can be adequately investigated in pursuit of Criteria 1 and 2 within the prime mission. (scoring: 1=lowest confidence, 5=highest confidence).

Criterion 5:
The site has high potential for significant water resources that may be of use for future exploration—whether in the form of water-rich hydrated minerals, ice/ice regolith or subsurface ice. (scoring: 1=lowest potential, 5=highest potential)
Summary of Workshop Deliverables:

- Science community assesses the merits of the 8 candidate sites, Project and PSG then prioritize.
- We’ll vote on 5 criteria (see Farley et al. talk that follows)
- Provide a list of top 3-4 sites to Project for further consideration:
  - Rank the candidate sites as green, yellow, red based relative to science selection criteria
  - **Green** = 5 points, **Yellow** = 3 points, **Red** = 1 point
  - Each person votes on each criteria for each site
  - Similar to what was done for MER and MSL and prior 2020 workshops
  - Results comprise science input to the merits of the candidate sites
- Additional factors influence identification of 3-4 remaining sites:
  - Engineer criteria (EDL and operations constraints), Planetary Protection, etc
- The list of sites emerging from the workshop may be different from that prioritized by the Project:
  - Engineers and Science Teams are here and participating and will vote
  - They will hear the same results and interpretations that we do
  - The Project will meet after the workshop (will include community representation)