



# ***NASA Planetary Protection Status and Response to Previous CoPP Reports***

## **Committee on Planetary Protection**

**November 30, 2021**

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# Outline

- Current Status
  - Policy – NPR 8715.24 and Draft NASA-STD 87XX.X
  - Technology and Research Highlights
  - Mission Highlights
- Response to Previous CoPP Reports
  - Planetary Protection for the Study of Lunar Volatiles
  - Evaluation of Bioburden Requirements for Mars Missions





# NASA's Planetary Protection Policy Documents

## NASA Policy Directives (NPDs)

### **NPD 8020.7G**

*Biological Contamination Control for Outbound and Inbound Planetary Spacecraft*  
(Revalidated 05/17/13 w/change 1)  
**Expiration Date:** June 19, 2022

- Documents Agency policy statements
- Describe what is required by NASA management to achieve NASA's vision, mission, and external mandates

### **NID 8715.129 ("Mars NID")**

*Biological Planetary Protection for Human Missions to Mars*  
**Expiration Date:** July 9, 2022

## NASA Interim Directives (NIDs)

- Documents an immediate, short-term statement of the Agency's policies, requirements, and identifies responsibilities for implementation
- Temporarily modify policy directives or implementation requirements

## NASA Procedural Requirements (NPRs)

### **NPR 8715.24**

Replaced NPR 8020.12D/NID 8020.109A  
*Planetary Protection Provisions for Robotic Extraterrestrial Missions*  
**Effective Date September 24, 2021**  
**Expiration Date: September 24, 2026**

- Provide detailed procedural requirements to implement policy
- Guide how policy directives are implemented in the context of specific missions

## NASA Standards

- Provide technical requirements
- Each NASA Technical Standard is assigned to a Technical Discipline

### **NASA-STD-87XX.X**

*Implementing Planetary Protection Requirements for Space Flight*  
**Expiration Date: TBD**  
**Status:** Estimated Release ~4/22

### **NASA-HDBK-6022**

*Handbook for the Microbial Examination of Space Hardware*  
**Expiration Date: N/A**  
**Status:** Revision planned. Last draft revision released Aug 17, 2010

## NASA Handbooks

- Companion documents to NPRs and NASA Standards
- Provide supporting material such as guidelines, lessons learned, procedures, and recommendations

 = New Documents

All published documents found in NODIS: <https://nodis3.gsfc.nasa.gov/> or the OPP website: <https://sma.nasa.gov/sma-disciplines/planetary-protection>

# Overview of NPR 8715.24 - Planetary Protection Provisions for Robotic Extraterrestrial Missions



## Chapter 1. Introduction

- 1.1 Overview
- 1.2 Utilization of Current Scientific Consensus Throughout the Project
- 1.3 PP Considerations for Participation in Partnered Missions
- 1.4 Delegation of Responsibilities
- 1.5 Request for Relief

## Chapter 2. Roles and Responsibilities

- 2.1 Mission Directorate Associate Administrator
- 2.2 NASA Project Manager
- 2.3 Chief, Safety and Mission Assurance
- 2.4 Planetary Protection Officer
- 2.5 Project-Level SMA Technical Authority

## Chapter 3. Planetary Protection Procedural Requirements

- 3.1 Categorization and Planning
- 3.2 Verification, Assurance, and Pre-Launch Report Activities
- 3.3 Post-Launch/End of Mission
- 3.4 Restricted Sample Return and Containment

### Chapter 1:

- Introduces risk-informed decision making
- Addresses how current scientific consensus is considered for missions
- Addresses missions with NASA partners / resources
- Baselines PP Relief using NASA General Safety Program Requirements

### Chapter 2:

- Defines the key roles and responsibilities for executing PP
  - Previously, only the PPO role was defined
  - COSPAR Interfacing
- Merges PP into the regular mission and project management structure

### Chapter 3:

- Provides the process for obtaining mission PP categorization
- Addresses PP documentation, review, and concurrence throughout the project lifecycle
- Defines independent verification/assurance activities as well as anomaly investigations
- Addresses sample return break-the-chain BTC, containment and process.

# NPR 8715.24 significant changes from NPR 8020.12D

- Updated policy reflects OSMA policy standards
- Risk-informed decision-making leveraged per NPR 8000.4
- Current scientific consensus used throughout the project life cycle
  - PP Category proposal
  - PP requirements – including any considerations for tailoring
  - Implementation and verification for compliance
  - Execution and oversight
- Expanded roles and responsibilities
  - Programmatic – Mission Directorate Associate Administrator, NASA Project Manager
  - SMA Technical Authority – Chief SMA, PPO, Project-Level SMA Technical Authority
- Project Categorization – proposal from Project (opposed to PPO issued Letter)
  - Lunar Categorization added
- Streamlines PP documentation approval and schedule

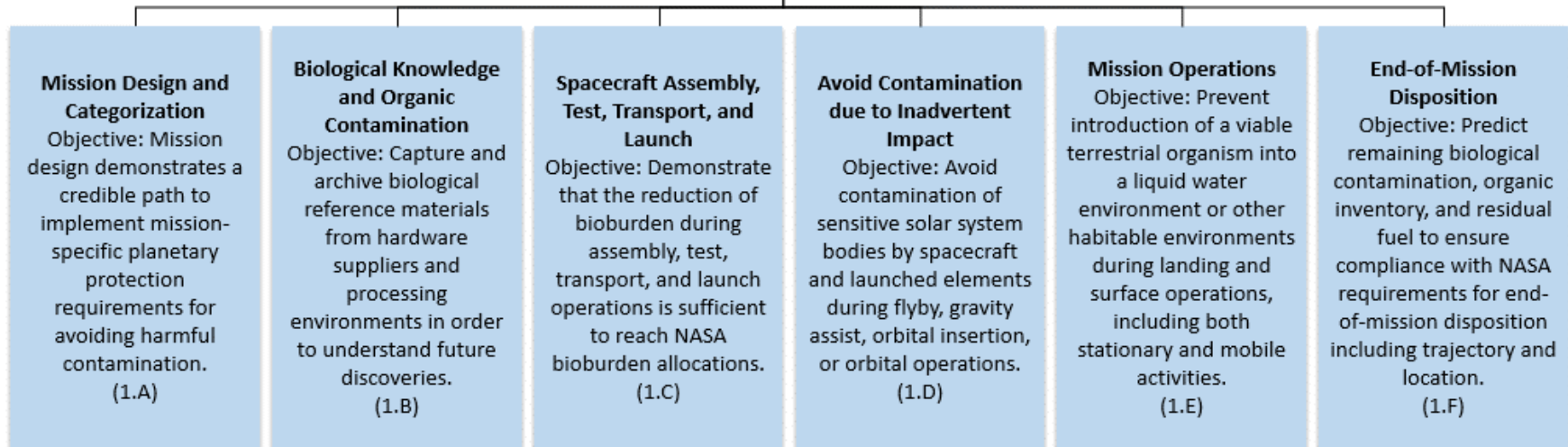
# What's next in NASA PP Policy? (1 of 2)

## NASA-STD-87XX.X Implementing Planetary Protection Requirements for Space Flight

### PP Hierarchy Strategy 1

**Strategy:** Understand and control harmful contamination of other worlds by terrestrial organisms, organic materials, and volatiles carried or released by spacecraft (referred to as forward contamination) in order to assure integrity in the search for evidence of extraterrestrial life and the study of prebiotic chemistry in the solar system for the appropriate period of biological exploration.  
(1)

**Context:** Understand mission science objectives relative to contamination sensitivity of destination



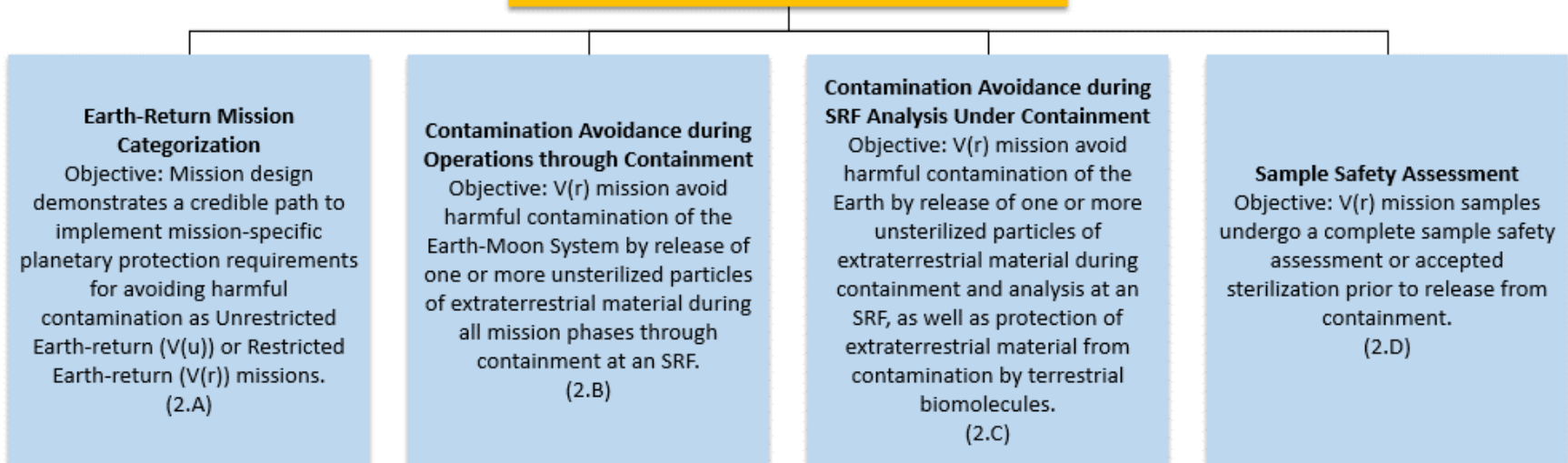
# What's next in NASA PP Policy? (2 of 2)

## NASA-STD-87XX.X Implementing Planetary Protection Requirements for Space Flight

### PP Hierarchy Strategy 2

Strategy: Rigorously prevent harmful biological contamination of the Earth-Moon system by potential extraterrestrial life and bioactive molecules in returned samples from habitable worlds (referred to as backward contamination).  
(2)

Context: Prevent microorganisms and bioactive molecules present at the destination from uncontrolled release into the Earth-Moon System.

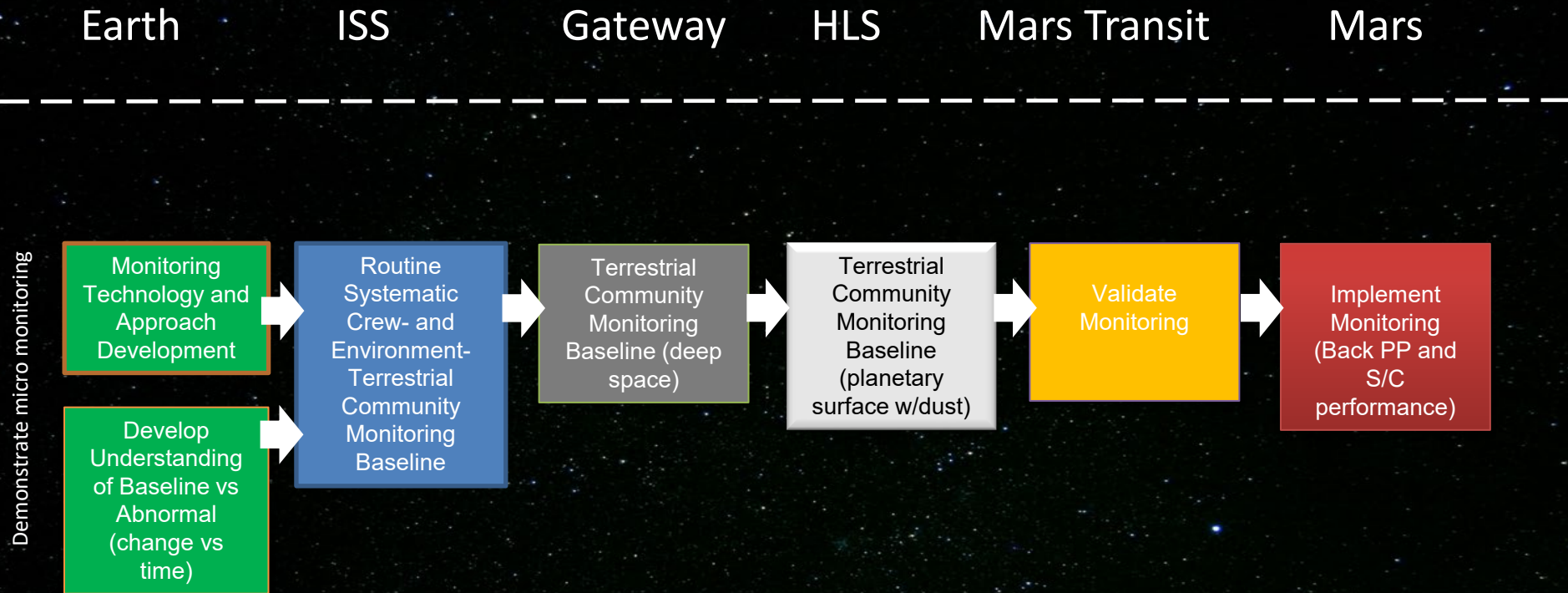




# Technology and Research Highlights

- NASA Federated Board supporting the Office of Planetary Protection for Science Mission Directorate, Space Technology Mission Directorate and Human Exploration and Operations Mission Directorate coordination.
  - Concurred on integrated roadmaps and identified technology gaps for planetary protection.
  - Helped to balance and ensure funding responsibilities across the stakeholders.
  - Monitor PP technology progress and serve as a forum to resolve issues.
- COSPAR PP Knowledge Gaps for Crewed Mars Missions
  - Microbial and Human Health Monitoring
  - Natural Transport of Contamination on Mars
  - Technology and Operations for Contamination Control

# Cross-Program Technology Strategy for PP



# Establishing Microbial Management Integration Team

- Office of Planetary Protection to organize and lead Microbial Management Integration Team with SMD (PSD and BPS), HEOMD (SE&I and HMTA) and STMD participants.
  - Technical interface for coordination and integration of activities related to microbial management and control, particularly as related to planetary protection of crewed Moon-to-Mars activities.
  - Report and exchange information of ongoing and/or planned activities related to the PP Capability Gap areas, as well as other PP-relevant R&TD tasks

# Mission Highlights (1 of 4)

- Artemis
  - Issued Artemis-1 clarification letter to Mission Directorate Associate Administrator to provide an update on NASA PP Lunar Policy
  - Concurred on Artemis-1 PP Plan revisions
  - Started to receive organic reporting forms and pre-launch reports on secondary payloads
  - Artemis-II starting to engage team for PP Categorization / requirements
- Gateway
  - Issued clarification letter to Program Safety and Mission Assurance Manager to provide update and guidance on NASA PP Lunar Policy
  - Power and Propulsion Element (PPE) and Habitation and Logistics Outpost (HALO) launch no earlier than May 2024 on a Falcon Heavy.
- HLS
  - Adopted updated requirements
  - Continuing to work technology gaps and incorporation of PP requirements into ground rules and assumptions for hardware design



***All 10 secondary payloads have been installed in the Space Launch System (SLS) rocket's Orion stage adapter.***

## Mission Highlights (2 of 4)

- Mars Sample Return Campaign – Category III, IVa, and V(r)
  - Continued engagement with ESA for Planetary Protection for the Flight Elements of the MSR Campaign as per the NASA/ESA MOU
  - MSR Campaign PP Categorization Proposal currently being drafted
  - Sample Retrieval Lander (SRL) Mission System Requirement Review / Mission Design Review – Dec 2021
  - MSR Campaign System Requirements Review Feb 2022 (PP Splinter Jan 2022)

Image: NASA's Perseverance rover on Sept. 7, 2021, PDT (Sept. 8, EDT), shows two holes where the rover's drill obtained chalk-size samples from rock nicknamed "Rochette."  
Credit: NASA/JPL-Caltech



## Mission Highlights (3 of 4)

- Martian Moons eXploration (MMX) – Category III, V(u)
  - Continued engagement with JAXA for Planetary Protection Requirements as an International partner delivering the P-Sampler
  - Flight unit shipped to JAXA in 2022
- The Escape and Plasma Acceleration and Dynamics Explorers (EscaPADE), Category III
  - Dual-spacecraft mission to study ion and sputtered escape from Mars, <90kg mass, solar powered
  - Approved PP Plan August 2021, Critical Design Review ~Mar/April 2022
- Dragonfly, Category II
  - Robotic rotorcraft to surface of Titan with a 2027 launch
  - Mission drafting PP Categorization Proposal



## Mission Highlights (4 of 4)

### ■ Europa Clipper, Category III

- Assembly, Integration and Testing phase underway
  - Hardware biological cleanliness performance remains within specification. Mission has bioassayed ~45m<sup>2</sup> of hardware surfaces to-date
  - Independent verification assays from Office of PP continue to demonstrate alignment with PP process. Sampled over >18m<sup>2</sup> in 4 key events.
- Flacon Heavy launch vehicle selected
- October 2024 Launch



Credit: Johns Hopkins APL/Ed Whitman

**Mihaela Ballarotto samples Europa Clipper's propulsion module for planetary protection cleanliness prior to harness installation.**<sup>15</sup>

# NASA PP Policy for the Moon

- NASA has adopted the COSPAR Policy on Planetary Protection prepared by the COSPAR PPP and approved by the COSPAR Bureau on 3 June 2021.
  - Incorporated II, IIa, and IIb PP requirements into NPR 8715.24 and NASA-STD-87XX.X
  - Updated commercial payload voluntary information
  - Organic inventory reporting requirements will be captured in the NASA Standard Implementing Requirements PP for Space Flight
- Communicating and engaging applicable missions (e.g., Artemis, Gateway, HLS) to adopt new requirements.
  - Given new policy updates are not completed we are working this on mission-by-mission basis until detailed reporting requirements are captured in the published standard.
- Organic inventory reporting has been streamlined to a template
  - First deliveries from this process from Artemis-I secondary payloads.



# PP Categories



Appendix C. Provisional Mission Planetary Protection Categories

Planetary Target Priority	Mission Type	Planetary Protection Category (see Note 1 and Note 2)	Example Target Bodies
Not of direct interest for understanding the process of chemical evolution or where exploration will not be jeopardized by terrestrial contamination. No protection of such planets is warranted, and no requirements are imposed.	Any (Flyby, Orbiter, Lander)	I	<ul style="list-style-type: none"> <li>Undifferentiated, metamorphosed asteroids</li> <li>Io</li> </ul>
Of significant interest relative to the process of chemical evolution but only a remote chance that contamination by spacecraft could compromise future investigations.	Any (Flyby, Orbiter, Lander)	II	<ul style="list-style-type: none"> <li>Earth's Moon (Cat. IIa &amp; IIb)</li> <li>Venus</li> <li>Comets</li> <li>Asteroids (excluding undifferentiated, metamorphosed asteroids)</li> <li>Jupiter; Jovian Satellites (excluding Io, Ganymede and Europa)</li> <li>Saturn; Saturnian Satellites (excluding Titan and Enceladus)</li> <li>Uranus</li> <li>Uranian Satellites</li> <li>Neptune</li> <li>Neptunian Satellites (excluding Triton)</li> <li>Kuiper-Belt Objects &lt;1/2 the size of Pluto</li> </ul>
		II* (See note 3)	<ul style="list-style-type: none"> <li>Jovian Satellites: Ganymede</li> <li>Saturnian Satellites: Titan</li> <li>Neptunian Satellites: Triton</li> <li>Pluto/Charon</li> </ul>

Updated Lunar Categories based on COSPAR Policy, June 3, 2021

Planetary Target Priority	Mission Type	Planetary Protection Category (see Note 1 and Note 2)	Example Target Bodies
Of significant interest relative to the process of chemical evolution and/or the origin of life and for which scientific opinion provides a significant chance that contamination by spacecraft could compromise future investigations	Flyby, Orbiter	III	<ul style="list-style-type: none"> <li>Mars</li> <li>Europa</li> <li>Enceladus</li> <li>Others to be determined</li> </ul>
	Lander, Probe	IV	<ul style="list-style-type: none"> <li>Mars (Cat. IVa, IVb &amp; IVc)</li> <li>Europa</li> <li>Enceladus</li> <li>Others to be determined</li> </ul>
Any Solar System Mission	All Earth Return	V(r): Restricted Earth Return	Restricted Earth Return: <ul style="list-style-type: none"> <li>Mars</li> <li>Europa</li> <li>Enceladus</li> <li>Others to be determined</li> </ul>
		V(u): Unrestricted Earth Return	Unrestricted Earth Return: <ul style="list-style-type: none"> <li>Earth's Moon</li> <li>Venus</li> <li>Most asteroids and comets (e.g., Bennu, Ryugu)</li> <li>Others to be determined</li> </ul>

Notes:

- 1) Indicative of current scientific consensus and subject to administrative change
- 2) Although there is only one planetary protection category assigned to a mission, missions that target or encounter multiple planets, may have more than one set of planetary protection requirements for different parts of the mission.
- 3) Category II\* is only a solar system target, not a category that is assigned to a mission. Missions targeting Category II\* locations will be assigned a final categorization of II if the remote potential of contamination is demonstrated; otherwise, they will be assigned Category III or IV depending on mission intent.



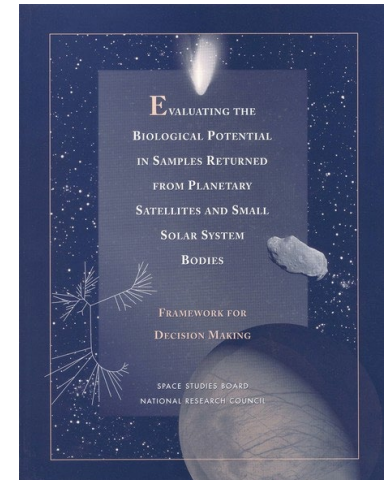
# Planetary Protection in the Commercial Payload Review Process

- NASA supports FAA in the commercial payload review process to ensure planetary protection is appropriately addressed for each mission prior to launch.
- FAA has regulatory authority in the commercial payload review process.
- Updated PP Information to Expedite Review in July 2021.
- <https://www.nasa.gov/recommendations-commercial-space-operators/>
  1. Description of the energetic potential of the primary launch vehicle, second stage, cruise stage, and additional independent propulsion systems on primary and secondary payloads.
  2. Description of trajectory including flybys or gravity assists of celestial objects and orbital insertion or landing at the destination.
  3. Assessment of biological contamination risk and associated mitigation strategy for celestial objects along the trajectory and at the orbiting or landed destination.
  4. For missions to the surface of the Moon, an inventory of propulsion products released into the lunar environment. Additionally, for missions to permanently shadowed regions (PSRs) or the lunar poles, an inventory of organics.

- Report Series on the Committee of Planetary Protection released 7 October 2021.
- NASA is still synthesizing this report.
- Detailed report on the current understanding of environmental conditions on Mars relevant to terrestrial organisms' survival, transport and proliferation.
  - These could be leveraged as key modeling parameters in the risk decision making process, as relevant, on a mission-by-mission basis.
- NPR 8715.24 and NASA-STD-87XX.X incorporates risk-informed decision-making as a viable approach for PP.
- Evaluating impact of technology roadmaps regarding surface/atmospheric transport and lethality of the Mars environment.

## Looking ahead...

- As demand for missions to small bodies increase, the current scientific rationale and approach for forward planetary protection should be reviewed and evaluated as a proactive approach in continuing to protect and enable small body exploration.
  - 1998 report of the US National Research Council's Space Study Board was the last detailed review and evaluation for small bodies.
- Envisioned that a small body study could be the catalyst for further conversations (e.g., COSPAR PPP and NASA) on forward PP policy.





# Questions?