National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, MD 20771

Reply to Attn of: 460

SUBJECT: RECORD OF ENVIRONMENTAL CONSIDERATION: Interstellar Mapping and Acceleration Probe (IMAP) National Environmental Policy Act (NEPA) Compliance

1.0 Introduction

The NEPA of 1969, as amended (42 U.S.C. 4321, et seq.), requires Federal agencies to consider the project's environmental impacts in its decision making process. To comply with NEPA and associated regulations (the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA [40 CFR Parts 1500-1508] and NASA policy and procedures [14 CFR, Part 1216, Subpart 1216.3]), NASA prepared the, "Final Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles," dated November 2011. The 2011 NASA Routine Payload Environmental Assessment (NRPEA) assessed the environmental impacts of missions launched with spacecraft that are considered routine payloads from existing launch facilities at Cape Canaveral Air Force Station (CCAFS), Florida; Vandenberg Air Force Base (VAFB), California; the United States Army Kwajalein Atoll/Reagan Test Site (USAKA/RTS) in the Republic of the Marshall Islands; NASA's Wallops Flight Facility (WFF), Virginia; and the Kodiak Launch Complex (KLC), Alaska.

Spacecraft defined as routine payloads utilize materials, quantities of materials, launch vehicles, launch sites, and operational characteristics that are consistent with normal and routine spacecraft preparation and flight activities at VAFB, CCAFS, USAKA/RTS, WFF, KLC, and Kennedy Space Center. The environmental impacts of launching routine payloads from these sites fall within the range of routine, ongoing, and previously documented impacts that have been determined not to be significant. Spacecraft within the scope of this environmental assessment (EA) meet specific criteria ensuring that the spacecraft, its operation, and decommissioning do not present any new or substantial environmental or safety concerns.

Applicability of a routine payload classification for a mission is determined through an evaluation against the criteria defined in the EA using the routine payload checklist (RPC).

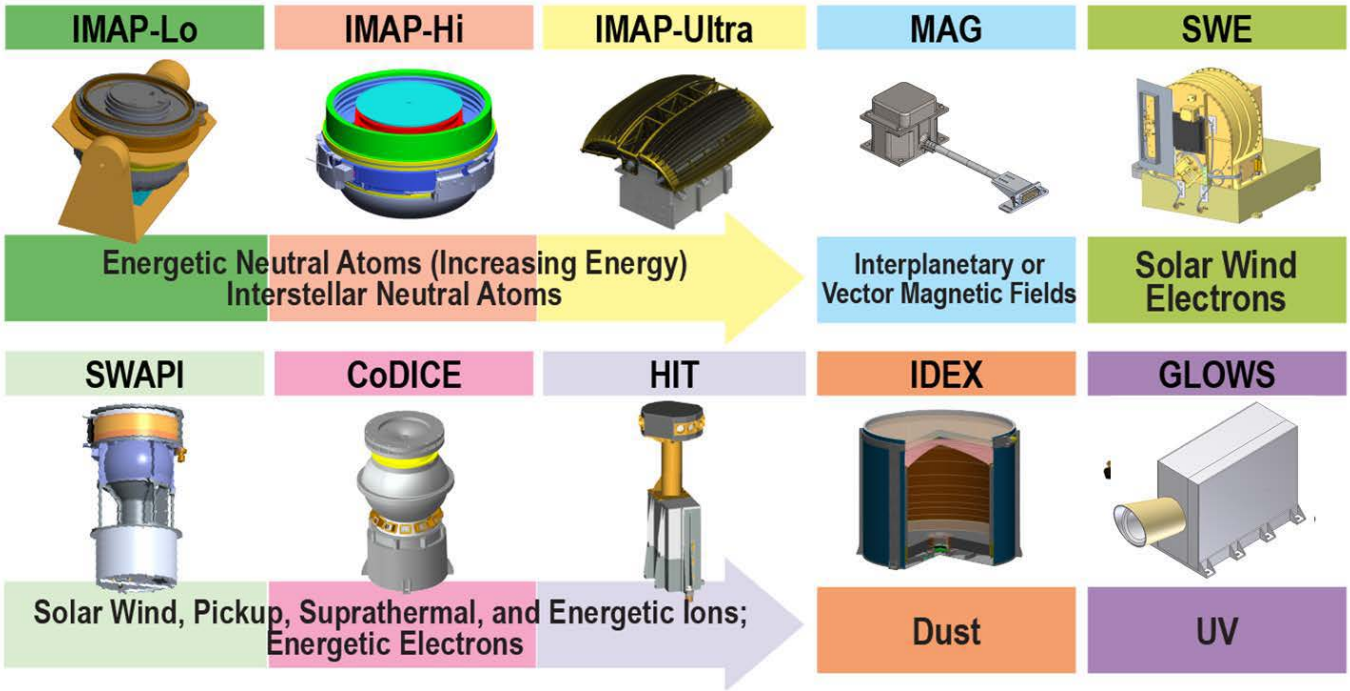
2.0 Mission Description

IMAP is a NASA Heliophysics-Science Mission Directorate (SMD) awarded spacecraft with 10 instruments. The instruments will study interactions between the heliosphere and the very local interstellar medium, elucidating how particles are energized in space environments.

The IMAP mission will help researchers better understand the boundary of the heliosphere, a sort of magnetic bubble surrounding and protecting our solar system. This region is where the constant flow of particles from our Sun, called the solar wind, collides with material from the rest of the galaxy. This collision limits the amount of harmful cosmic radiation entering the heliosphere. IMAP will collect and analyze particles that make it through. Another objective of the mission is to learn more about the generation of cosmic rays in the heliosphere. Cosmic rays created locally and from the galaxy and beyond affect human explorers in space and can harm technological systems, and likely play a role in the presence of life itself in the universe.

IMAP is a PI-led mission proposed by Princeton University. The Princeton University Principal Investigator has full responsibility and authority over the mission and has delegated IMAP development to APL where the IMAP Project Office resides. The Solar Terrestrial Probes (STP) Program Office in the Explorers and Heliophysics Projects Division at NASA/ GSFC is the managing NASA program office, and GSFC exercises the engineering and safety and mission assurance technical authority functions for IMAP. The STP Program Office supports the Heliophysics Division within the NASA Headquarters SMD.

The mission's 10 science instruments will be provided by international and domestic research organizations and universities. They include the following:



IMAP will launch from CCAFS Complex 40 on a Space X Falcon 9 vehicle in 2025. The spacecraft will be positioned about one million miles (1.5 million kilometers) away from Earth towards the Sun at what is called the first Lagrange point or L1. This will allow the probe to maximize use of its instruments to monitor the interactions between solar wind and the interstellar medium in the outer solar system.

IMAP will be accompanied by four rideshare payloads on the launch vehicle EELV Secondary Payload Adapter (ESPA). The rideshare payloads include the Space Weather Follow On at L1 (SWFO-L1), Lunar Trailblazer (LBT), Global Lyman-alpha Imagers of the Dynamic Exosphere (GLIDE), and Solar Cruiser. SWFO-L1 is a NOAA mission managed by GSFC that will monitor solar activity from the Earth-Sun Lagrange point. The data will be used for space weather predictions. LBT will pursue unanswered questions about water on the Moon, using an infrared imaging spectrometer and multispectral thermal camera. GLIDE is an ultraviolet imaging system that will study the Earth's exosphere from a Lissajous orbit around the Earth-Sun L1 point. Solar Cruiser is a technology demonstration mission for NASA SMD. The spacecraft will deploy a solar sail to demonstrate propellantless propulsion technology.

2.0 NASA Routine Payload Determination

The components utilized in the IMAP spacecraft and rideshare payloads are made of materials normally encountered in the space industry. The spacecraft and payloads will not utilize radioactive flight sources, will not carry any pathogenic organisms, and will not return samples to Earth. IMAP will not reenter the earth's atmosphere and will be compliant with NASA requirements for limiting orbital debris (NPR 8715.6 and NASA-STD-8719.14).

The IMAP mission, including the rideshare payloads, has been evaluated against the 2011 NRPEA, using the RPC (see enclosed evaluation recommendation package). The evaluation indicates that the mission meets the criteria for a routine payload and falls within the scope of the reference EA.

The IMAP mission does not present any unique or unusual circumstances that could result in new or substantial environmental impacts. Based on the foregoing and the analyses set forth in the 2011 NRPEA, GSFC has determined that the environmental impacts associated with the IMAP mission will not individually or cumulatively have a significant impact on the quality of the human environment and that a routine payload classification for the mission is applicable.

GARY LETCHWORTH Digitally signed by GARY LETCHWORTH Date: 2021.02.25 09:45:46 -05'00'

Gary Letchworth, IMAP Mission Manager

Enclosures:
Evaluation Recommendation Package

NASA Goddard Space Flight Center
RECORD OF ENVIRONMENTAL CONSIDERATION (REC)

PROJECT NAME: Interstellar Mapping and Acceleration Probe (IMAP)

1. Description of proposed action: IMAP will be a spinning spacecraft positioned at L1, with 10 instruments to study the local interstellar medium, the boundaries that surround our solar system, and how particles are accelerated to high energies in space.

Date and/or Duration of project: Launch - 2025

2. It has been determined that the above action:

☒ a. Is adequately covered in an existing EA or EIS.
Title: *Environmental Assessment for Launch of NASA Routine Payloads*
Date: November 2011

☐ b. Qualifies for Categorical Exclusion and has no extraordinary circumstances per 14 CFR 1216.304 (c) which would suggest a need for an Environmental Assessment.
Categorical Exclusion: _____

☐ c. Has no significant environmental impacts as indicated by the results of an environmental checklist and/or detailed environmental analysis.

☐ d. Is exempt from NEPA requirements under the provisions of: _____

☐ e. Will require the preparation of an Environmental Assessment.

☐ f. Will require the preparation of an Environmental Impact Statement.

☐ g. Is addressed under EO12114.
- ☐ Is exempt from EO12114 requirements under the provisions of: _____
- ☐ Action not included under EO12114: _____
- ☐ Qualifies for an EO12114 categorical exclusion: _____
- ☐ Is adequately covered in existing documentation: _____
- ☐ Requires an environmental summary document: _____
- ☐ Requires EO documentation IAW 2-4. (a) i, ii, iii: _____

☐ h. Is not federalized sufficiently to qualify as a major federal action.

LIZABETH MONTGOMERY Digitally signed by LIZABETH MONTGOMERY Date: 2021.02.24 17:25:16 -05'00'

Beth Montgomery GSFC-GB NEPA Manager, Code 250

GARY LETCHWORTH Digitally signed by GARY LETCHWORTH Date: 2021.02.25 09:46:19 -05'00'

Gary Letchworth IMAP Mission Manager, Code 460

EVALUATION RECOMMENDATION PACKAGE

Record of Environmental Consideration
IMAP Routine Payload Checklist
IMAP Flight Project Environmental Checklist
Rideshare Routine Payload Checklists

Enclosure

NASA Routine Payload Evaluation and Determination Process and Checklist

After a proposed spacecraft mission is sufficiently well formulated (usually the Phase B design study), the Sponsoring Entity, in coordination with the local Environmental Management Office (EMO), will prepare an environmental evaluation. An environmental evaluation is a preliminary review that determines what aspects of the proposal are of potential environmental concern. The environmental evaluation also assists in determining the appropriate level of National Environmental Policy Act (NEPA) documentation (i.e., environmental assessment [EA], or environmental impact statement [IEIS]) for the proposal. The local EMO uses a comprehensive checklist to provide a level of rigor to this early evaluation of the proposal, helping to ensure that pertinent considerations are not overlooked. Local EMO review of the Routine Payload Checklist (RPC, below) forms the basis for evaluating the applicability of a NASA Routine Payload (NRP) spacecraft classification for a proposed mission.

The local EMO uses the completed RPC (and required attachments) to evaluate the proposed mission against the NRP EA criteria. If the EMO evaluation of the RPC indicates that a NRP categorization may be appropriate, the Sponsoring Entity documents this in an Evaluation Recommendation Package (ERP). The ERP is then processed for review and approval in accordance with established National Aeronautics and Space Administration (NASA) procedures and guidelines. If approved, the ERP would be attached to a Record of Environmental Consideration (REC).

The Sponsoring Entity can then proceed with the proposal while monitoring the project activities, for changes or circumstances during implementation that could affect classification of the proposed mission as a NRP spacecraft. If a NRP spacecraft categorization is determined to be inappropriate, the local EMO will initiate plans for preparation of additional NEPA documentation.

NASA Routine Payload Checklist

Project Name:		Date of Launch:
Interstellar Mapping and Acceleration Probe (IMAP)		10/01/2024
Project Contact:	**Phone Number:**	**Mailstop:**
APL ARDES Contract NNN06AA01C, Order # 80MSFC19F0021	301-286-7588	460.0
Project Start Date:	**Project Location:**	
12/07/2018	Laurel, MD	

Project Description:
IMAP will be a spinning spacecraft positioned at L1, with 10 instruments to study the local interstellar medium, the boundaries that surround our solar system, and how particles are accelerated to high energies in space. This is a PI-led heliophysics mission.

A. Sample Return:	Yes	No
1. Would the candidate mission return a sample from an extraterrestrial body?	☐	☒
B. Radioactive Materials:	Yes	No
1. Would the candidate spacecraft carry radioactive materials in quantities that produce an A2 mission multiple value of 10 or more?	☐	☒
Provide a copy of the Radioactive Materials On Board Report as per NPR 8715.3 with the ERP submittal.	Attachment	
C. Launch and Launch Vehicles:	Yes	No
1. Would the candidate spacecraft be launched on a vehicle and launch site combination other than those indicated in Table C-1 on Page 2?	☐	☒
2. Would the proposed mission exceed the approved or permitted annual launch rate for the particular launch vehicle or launch site?	☐	☒
Comments:		
D. Facilities:	Yes	No
1. Would the candidate mission require the construction of any new facilities or substantial modification of existing facilities?	☐	☒
Provide a brief description of the construction or modification required, including whether ground disturbance and/or excavation would occur.		
E. Health and Safety:	Yes	No
1. Would the candidate spacecraft utilize batteries, ordnance, hazardous propellant, radiofrequency transmitter power, or other subsystem components in quantities or levels exceeding the EPC's in Table C-2 below?	☐	☒
2. Would the expected risk of human casualty from spacecraft planned orbital reentry exceed the criteria specified by NASA Standard 8719.14?	☐	☒
3. Would the candidate spacecraft utilize any potentially hazardous material as part of a flight system whose type or amount precludes acquisition of the necessary permits prior to its use or is not included within the definition of the Envelope Payload Characteristics?	☐	☒
4. Would the candidate mission, under nominal conditions, release material other than propulsion system exhaust or inert gases into the Earth's atmosphere or space?	☐	☒
5. Are there changes in the preparation, launch or operation of the candidate spacecraft from the standard practices described in Chapter 3 of this EA?	☐	☐
6. Would the candidate spacecraft utilize an Earth-pointing laser system that does not meet the requirements for safe operation (ANSI Z136.1-2007 and ANSI Z136.6-2005)?	☐	☒
7. Would the candidate spacecraft contain, by design (e.g., a scientific payload) pathogenic microorganisms (including bacteria, protozoa, and viruses) which can produce disease or toxins hazardous to human health or the environment beyond Biosafety Level 1 (BSL 1)[1]?	☐	☒
Comments:		

The use of biological agents on payloads is limited to materials with a safety rating of "Biosafety Level 1." This classification includes defined and characterized strains of viable microorganisms not known to consistently cause disease in healthy human adults. Personnel working with Biosafety Level 1 agents follow standard microbiological practices including the use of mechanical pipetting devices, no eating, drinking, or smoking in the laboratory, and required hand-washing after working with agents or leaving a lab where agents are stored. Personal protective equipment such as gloves and eye protection is also recommended when working with biological agents.

NASA Routine Payload Checklist (continuation)

Project Name:		Date of Launch
Interstellar Mapping and Acceleration Probe (IMAP)		10/01/2024
Project Contact:	**Phone Number:**	**Mailstop:**
APL ARDES Contract NNN06AA01C, Order # 80MSFC19F0021	301-286-7588	460.0
Project Start Date:	**Project Location:**	
12/07/2018	Laurel, MD	

Project Description:
IMAP will be a spinning spacecraft positioned at L1, with 10 instruments to study the local interstellar medium, the boundaries that surround our solar system, and how particles are accelerated to high energies in space. This is a PI-led heliophysics mission.

F. Other Environmental Issues:	Yes	No
1. Would the candidate spacecraft have the potential for substantial effects on the environment outside the United States?	☐	☒
2. Would launch and operation of the candidate spacecraft have the potential to create substantial public controversy related to environmental issues?	☐	☒
3. Would any aspect of the candidate spacecraft that is not addressed by the EPCs have the potential for substantial effects on the environment (i.e., previously unused materials, configurations or material not included in the checklist)?	☐	☒

Comments:

Table C-1. Launch Vehicles and Launch Sites

Launch Vehicle and Launch Vehicle Family	Space Launch Complexes and Pads				
	Eastern Range (CCAFS)	Western Range (VAFB)	USAKA/RTS	WFF	KLC
Athena I, IIc, III[a]	LC-46	CA Spaceport (SLC-8)	NA	Pad 0	LP-1[a]
Atlas V Family	LC-41	SLC-3	NA	NA	NA
Delta II Family	LC-17	SLC-2	NA	NA	NA
Delta IV Family	LC-37	SLC-6	NA	NA	NA
Falcon I/Ie	LC-36	SLC-4W	Omelek Island	Pad 0	LP-3[b]
Falcon 9	LC-40	SLC-4E	Omelek	Pad 0	LP-1
Minotaur I	LC-20 and/or LC-46	SLC-8	NA	Pad 0	LP-1
Minotaur II-III	LC-20 and/or LC-46	SLC-8	NA	Pad 0	LP-1
Minotaur IV[c]	LC-20 and/or LC-46	SLC-8	NA	Pad 0	LP-1
Minotaur V	LC-20 and/or LC-46	SLC-8	NA	Pad 0	NA
Pegasus XL	CCAFS skidstrip KSC SLF	VAFB Airfield	Kwajalein Island	WFF Airfield	NA
Taurus	LC-20 and/or LC-46	SLC-576E	NA	Pad 0	LP-1
Taurus II	NA	NA	NA	Pad 0	LP-3[b]
Any other launch vehicle/launch site combination for which NASA has completed or cooperated on the NEPA compliance.					

a
Athena III is currently under design.
b
LP-3 is currently under design.
c
While not explicitly listed in this table, the Minotaur IV includes all configurations of this launch vehicle, including the Minotaur IV+, which is a Minotaur IV with a Star 48V 4th stage.

Key: CA = California; CCAFS = Cape Canaveral Air Force Station; KSC = Kennedy Space Center; LC = Launch Complex; LP = Launch Pad; MARS = Mid-Atlantic Regional Spaceport; SLC = Space Launch Complex; SLF = Shuttle Landing Facility; USAKA/RTS = United States Army Kwajalein Atoll/Reagan Test Site; VAFB = Vandenberg Air Force Base; WFF = Wallops Flight Facility.

Table C-2. Summary of Envelope Payload Characteristics by Spacecraft Subsystems

Structure	• Unlimited: aluminum, beryllium, carbon resin composites, magnesium, titanium, and other materials unless specified as limited.
Propulsion[a]	• Liquid propellant(s); 3,200 kg (7,055 lb) combined hydrazine, monomethyhydrazine and/or nitrogen tetroxide. • Solid Rocket Motor (SRM) propellant; 3,000 kg (6,614 lb) Ammonium Perchlorate (AP)-based solid propellant (examples of SRM propellant that might be on a spacecraft are a Star-48 kick stage, descent engines, an extra-terrestrial ascent vehicle, etc.)
Communications	• Various 10-100 Watt (RF) transmitters
Power	• Unlimited Solar cells; 5 kilowatt-Hour (kW-hr) Nickel-Hydrogen (NiH_2) or Lithium ion (Li-ion) battery, 300 Ampere-hour (A-hr) Lithium-Thionyl Chloride (LiSOCl), or 150 A-hr Hydrogen, Nickel-Cadmium (NiCd), or Nickel-hydrogen (NiH_2) battery.
Science Instruments	• 10 kilowatt radar • American National Standards Institute safe lasers (see Section 4.1.2.1)
Other	• U. S. Department of Transportation (DoT) Class 1.4 Electro-Explosive Devices (EEDs) for mechanical systems deployment • Radioactive materials in quantities that produce an A2 mission multiple value of less than 10 • Propulsion system exhaust and inert gas venting • Sample returns are considered outside of the scope of this environmental assessment

a
Propellant limits are subject to range safety requirements.

Key: kg=kilograms; lb=pounds.

GSFC Flight Project Environmental Checklist

1. Project/Program	Date:
Interstellar Mapping and Acceleration Probe (IMAP)	March 20, 2019

2. Schedule

PDR/CDR:	Launch Date:
PDR ~1/31/2021, CDR ~1/31/2022	Oct 1, 2024

3. Current Status

IMAP is currently in Phase A, with an SRR/MDR planned in Dec 2019.

4. Project Description

a. Purpose:
Advance understanding of 1) The composition and properties of the local interstellar medium, 2) How magnetic fields interact from the Sun through the local interstellar medium, 3) How the solar wind and interstellar medium interact through the boundaries of our heliosphere, 4) How particles are accelerated to high energies throughout the solar system.

b. Spacecraft:
Sun-pointed spin-stabilized spacecraft located at L1. Estimated dimensions of 2.02 meters diameter by 0.71 meters tall. Dry mass of ~465 kg with 93 kg of onboard propellant provides >5 years of operation. Solar powered. X or S band transmit/receive.

c. Instruments:
There are 10 science instruments and a study is being conducted for an additional technology development instrument. 3 instruments will measure energetic neutral atoms which provide insights on interstellar particles. 5 instruments will measure components of the solar wind (energetic particles and magnetic fields). 1 instrument will measure dust. 1 instrument will measure UV radiation.

d. Launch Vehicle:
Not yet determined, but candidates are the Atlas 401 and Falcon 9 FT.

e. Launch Site:
KSC (or CCAFS)

f. NASAs Involvement/Responsibility: (include other NASA Centers)
GSFC STP Program Office in Code 460 oversees development and manages the APL contract task order for IMAP, the Princeton contract, and the LANL IA. GSFC is also developing one of the science instruments. GSFC may provide observatory test facilities. NASA HQ/SMD, Heliophysics Division, provides direction to the GSFC STP Program.

g. Participants/Locations:
PI: Princeton University. Project Office, spacecraft development: Johns Hopkins University Applied Physics Lab (APL). Payload Mgt, SwRI. Instruments: HIT, GSFC. SWAPI, Princeton. IMAP-Hi and SWE, LANL. IMAP-Lo, UNH. IMAP-Ultra, APL. MAG, UCLA. CoDICE, SwRI. IDEX, LASP. GLOWS, Polish Academy of Sciences. Potentially SPICES, UMich. Science support from various institutions.

h. End-of-Mission Plan: Planned Re-entry (controlled/uncontrolled?)
This mission will be in a Lissajous orbit at L1. An ODAR has not yet been written but will be for SRR/MDR in Dec 2019.

5. Is there anything controversial or unique about the mission, spacecraft or instruments? If yes, Explain. Yes ☐ No ☒

6. Is the mission compliant with NASA requirements for limiting orbital debris (NPR 8715.6, and NASA Standard 8719.14? Explain non-compliances. Yes ☒ No ☐

7. During any phase, does the mission/project include or involve: Check yes for all that apply. If uncertain, check the corresponding box. For all that apply, provide an explanation	Yes	No	Uncertain
A. Fuels	☒	☐	☐
B. Ionizing Radiation Devices/Sources	☒	☐	☐
C. Explosives	☒	☐	☐
D. Hazardous Materials/Substances/Chemicals	☒	☐	☐
E. Lasers (Class, Earth Pointing)	☐	☒	☐
F. Disease Producing Pathogenic Microorganisms/Biological Agents	☐	☒	☐
G. Discharges/Venting of any Substances into Air, Water, or Soil	☐	☒	☐
H. Hazardous Waste Generation	☒	☐	☐
I. High Noise Levels	☒	☐	☐
J. Sample Return to Earth	☐	☒	☐
K. Radio Frequency Communications	☒	☐	☐
L. Construction/Modification/Demolition of a Facility/Lab (onsite - offsite)	☐	☒	☐
M. Land Disturbance, Tree Clearing, Removal of Vegetation	☐	☒	☐
N. Impact on Threatened or Endangered Species	☐	☒	☐
O. Impact/Destruction of Sensitive Wildlife Habitat	☐	☒	☐
P. Impact on Cultural Resources	☐	☒	☐
Q. Impact on Local Social or Economic Conditions (Increase in Traffic, Employment, etc.)	☐	☒	☐
R. Impact on Minority or Low Income Populations	☐	☒	☐
S. New or Foreign Launch Vehicle	☐	☒	☐
T. Other Issues of Potential Environmental Impact	☐	☒	☐
U. Environmental Permits	☐	☒	☐

Additional Information:
The answers for the above included for processing and testing purposes, and do not necessarily mean that they are present at the time of launch or for on-orbit operations. Hazardous waste generation will be under existing permits.

8. What Safety Hazards are associated with the mission?

Because IMAP is early in Phase A, hazard analyses have not yet been conducted. However, the following safety hazards are likely: structural failure (of spaceflight hardware or GSE) during lifting and testing, Li ion battery rupture or ignition, electric shock, electrical short causing heating or ignition, exposure to RF from antennas, hydrazine exposure, hydrazine system or ground dewar explosive rupture, HV, inadvertent mag boom release, exposure to ionizing radiation (ground test sources), excessive exposure to cleaning chemicals, GSE tip over.

9. Summary of Subsystem Components

Propulsion (Include fuel type, amount, tank size, materials, dimensions	Hydrazine, 93kg, tank not yet designed
Communications	Trade study underway to determine whether to have X- or S-band transmit/receive.
Structural Materials	Primary structure will be aluminum honeycomb panels and aluminum. There may be titanium or carbon composite parts as well.
Power	Body-mounted solar array, ~2.6 m2, generating ~500W BOL. With lithium-ion battey.
Science Instruments	There are 10 science instruments and a study is being conducted for an additional technology development instrument. See 4.c above for a brief description.
Hazardous components (radioactive materials, lasers, chemicals, etc.)	Radioactive materials, lasers, and hazardous chemicals are only using for ground processing and testing with the exception of hydrazine propellant. See Section 8 above for a list of possible hazards.
Other (include dimensions and weight of s/c)	Estimated spacecraft dimensions of 2.02 meters diameter by 0.71 meters tall. Dry mass of ~465 kg with 93 kg of onboard propellant.

GSFC Flight Project Environmental Checklist

Project Manager Printed Name:	Signature Field		
Andrew Peddie (Mission Manager)	ANDREW PEDDIE Digitally signed by ANDREW PEDDIE Date: 2019.03.20 12:54:32 -04'00'		
Project Name:	**Date:**	**Phone Number:**	**Org Code:**
Interstellar Mapping and Acceleration Probe (IMAP)	Mar 20, 2019	301-286-7588	460.0

Comments:

NASA Routine Payload Evaluation and Determination Process and Checklist

After a proposed spacecraft mission is sufficiently well formulated (usually the Phase B design study), the Sponsoring Entity, in coordination with the local Environmental Management Office (EMO), will prepare an environmental evaluation. An environmental evaluation is a preliminary review that determines what aspects of the proposal are of potential environmental concern. The environmental evaluation also assists in determining the appropriate level of National Environmental Policy Act (NEPA) documentation (i.e., environmental assessment [EA], or environmental impact statement [IEIS]) for the proposal. The local EMO uses a comprehensive checklist to provide a level of rigor to this early evaluation of the proposal, helping to ensure that pertinent considerations are not overlooked. Local EMO review of the Routine Payload Checklist (RPC, below) forms the basis for evaluating the applicability of a NASA Routine Payload (NRP) spacecraft classification for a proposed mission.

The local EMO uses the completed RPC (and required attachments) to evaluate the proposed mission against the NRP EA criteria. If the EMO evaluation of the RPC indicates that a NRP categorization may be appropriate, the Sponsoring Entity documents this in an Evaluation Recommendation Package (ERP). The ERP is then processed for review and approval in accordance with established National Aeronautics and Space Administration (NASA) procedures and guidelines. If approved, the ERP would be attached to a Record of Environmental Consideration (REC).

The Sponsoring Entity can then proceed with the proposal while monitoring the project activities, for changes or circumstances during implementation that could affect classification of the proposed mission as a NRP spacecraft. If a NRP spacecraft categorization is determined to be inappropriate, the local EMO will initiate plans for preparation of additional NEPA documentation.

NASA Routine Payload Checklist

Project Name:		Date of Launch:
Space Weather Follow On at L1 (SWFO-L1)		March 2025
Project Contact:	**Phone Number:**	**Mailstop:**
Jim Morrissey	301-789-8464	Code 411.1
Project Start Date:	**Project Location:**	
July 2019	Goddard Space Flight Center	

Project Description:
SWFO-L1 is a NOAA mission managed by GSFC that will monitor solar activity from the Earth-Sun Lagrange point. Data will be used for space weather predictions.

A. Sample Return:	Yes	No
1. Would the candidate mission return a sample from an extraterrestrial body?	☐	☒
B. Radioactive Materials:	Yes	No
1. Would the candidate spacecraft carry radioactive materials in quantities that produce an A2 mission multiple value of 10 or more?	☐	☒
Provide a copy of the Radioactive Materials On Board Report as per NPR 8715.3 with the ERP submittal.	Attachment	
C. Launch and Launch Vehicles:	Yes	No
1. Would the candidate spacecraft be launched on a vehicle and launch site combination other than those indicated in Table C-1 on Page 2?	☐	☒
2. Would the proposed mission exceed the approved or permitted annual launch rate for the particular launch vehicle or launch site?	☐	☒

Comments:

D. Facilities:	Yes	No
1. Would the candidate mission require the construction of any new facilities or substantial modification of existing facilities?	☐	☒

Provide a brief description of the construction or modification required, including whether ground disturbance and/or excavation would occur.

E. Health and Safety:	Yes	No
1. Would the candidate spacecraft utilize batteries, ordnance, hazardous propellant, radiofrequency transmitter power, or other subsystem components in quantities or levels exceeding the EPC's in Table C-2 below?	☐	☒
2. Would the expected risk of human casualty from spacecraft planned orbital reentry exceed the criteria specified by NASA Standard 8719.14?	☐	☒
3. Would the candidate spacecraft utilize any potentially hazardous material as part of a flight system whose type or amount precludes acquisition of the necessary permits prior to its use or is not included within the definition of the Envelope Payload Characteristics?	☐	☒
4. Would the candidate mission, under nominal conditions, release material other than propulsion system exhaust or inert gases into the Earth's atmosphere or space?	☐	☒
5. Are there changes in the preparation, launch or operation of the candidate spacecraft from the standard practices described in Chapter 3 of this EA?	☐	☒
6. Would the candidate spacecraft utilize an Earth-pointing laser system that does not meet the requirements for safe operation (ANSI Z136.1-2007 and ANSI Z136.6-2005)?	☐	☒
7. Would the candidate spacecraft contain, by design (e.g., a scientific payload) pathogenic microorganisms (including bacteria, protozoa, and viruses) which can produce disease or toxins hazardous to human health or the environment beyond Biosafety Level 1 (BSL 1)[1]?	☐	☒

Comments:
The SWFO-L1 spacecraft will contain a maximum of 62 Kg of High Purity (Anhydrous) Hydrazine at launch.

The use of biological agents on payloads is limited to materials with a safety rating of "Biosafety Level 1." This classification includes defined and characterized strains of viable microorganisms not known to consistently cause disease in healthy human adults. Personnel working with Biosafety Level 1 agents follow standard microbiological practices including the use of mechanical pipetting devices, no eating, drinking, or smoking in the laboratory, and required hand-washing after working with agents or leaving a lab where agents are stored. Personal protective equipment such as gloves and eye protection is also recommended when working with biological agents.

NASA Routine Payload Checklist (continuation)

Project Name:		Date of Launch
Space Weather Follow On at L1 (SWFO-L1)		March 2025
Project Contact: Jim Morrissey	**Phone Number:** 301-789-8464	**Mailstop:** Code 411.1
Project Start Date: July 2019	**Project Location:** Goddard Space Flight Center	

Project Description:
SWFO-L1 is a NOAA mission managed by GSFC that will monitor solar activity from the Earth-Sun Lagrange point. Data will be used for space weather predictions.

F. Other Environmental Issues:	Yes	No
1. Would the candidate spacecraft have the potential for substantial effects on the environment outside the United States?	☐	☒
2. Would launch and operation of the candidate spacecraft have the potential to create substantial public controversy related to environmental issues?	☐	☒
3. Would any aspect of the candidate spacecraft that is not addressed by the EPCs have the potential for substantial effects on the environment (i.e., previously unused materials, configurations or material not included in the checklist)?	☐	☒

Comments:

Table C-1. Launch Vehicles and Launch Sites

Launch Vehicle and Launch Vehicle Family	Space Launch Complexes and Pads				
	Eastern Range (CCAFS)	**Western Range** (VAFB)	**USAKA/RTS**	**WFF**	**KLC**
Athena I, IIc, III[a]	LC-46	CA Spaceport (SLC-8)	NA	Pad 0	LP-1[a]
Atlas V Family	LC-41	SLC-3	NA	NA	NA
Delta II Family	LC-17	SLC-2	NA	NA	NA
Delta IV Family	LC-37	SLC-6	NA	NA	NA
Falcon I/Ie	LC-36	SLC-4W	Omelek Island	Pad 0	LP-3[b]
Falcon 9	LC-40	SLC-4E	Omelek	Pad 0	LP-1
Minotaur I	LC-20 and/or LC-46	SLC-8	NA	Pad 0	LP-1
Minotaur II-III	LC-20 and/or LC-46	SLC-8	NA	Pad 0	LP-1
Minotaur IV[c]	LC-20 and/or LC-46	SLC-8	NA	Pad 0	LP-1
Minotaur V	LC-20 and/or LC-46	SLC-8	NA	Pad 0	NA
Pegasus XL	CCAFS skidstrip KSC SLF	VAFB Airfield	Kwajalein Island	WFF Airfield	NA
Taurus	LC-20 and/or LC-46	SLC-576E	NA	Pad 0	LP-1
Taurus II	NA	NA	NA	Pad 0	LP-3[b]
Any other launch vehicle/launch site combination for which NASA has completed or cooperated on the NEPA compliance.					

a
Athena III is currently under design.
b
LP-3 is currently under design.
c
While not explicitly listed in this table, the Minotaur IV includes all configurations of this launch vehicle, including the Minotaur IV+, which is a Minotaur IV with a Star 48V 4th stage.

Key: CA = California; CCAFS = Cape Canaveral Air Force Station; KSC = Kennedy Space Center; LC = Launch Complex; LP = Launch Pad; MARS = Mid-Atlantic Regional Spaceport; SLC = Space Launch Complex; SLF = Shuttle Landing Facility; USAKA/RTS = United States Army Kwajalein Atoll/Reagan Test Site; VAFB = Vandenberg Air Force Base; WFF = Wallops Flight Facility.

Table C-2. Summary of Envelope Payload Characteristics by Spacecraft Subsystems

Structure	• Unlimited: aluminum, beryllium, carbon resin composites, magnesium, titanium, and other materials unless specified as limited.
Propulsion[a]	• Liquid propellant(s); 3,200 kg (7,055 lb) combined hydrazine, monomethyhydrazine and/or nitrogen tetroxide. • Solid Rocket Motor (SRM) propellant; 3,000 kg (6,614 lb) Ammonium Perchlorate (AP)-based solid propellant (examples of SRM propellant that might be on a spacecraft are a Star-48 kick stage, descent engines, an extra-terrestrial ascent vehicle, etc.)
Communications	• Various 10-100 Watt (RF) transmitters
Power	• Unlimited Solar cells; 5 kilowatt-Hour (kW-hr) Nickel-Hydrogen (NiH_2) or Lithium ion (Li-ion) battery, 300 Ampere-hour (A-hr) Lithium-Thionyl Chloride (LiSOCl), or 150 A-hr Hydrogen, Nickel-Cadmium (NiCd), or Nickel-hydrogen (NiH_2) battery.
Science Instruments	• 10 kilowatt radar • American National Standards Institute safe lasers (see Section 4.1.2.1)
Other	• U. S. Department of Transportation (DoT) Class 1.4 Electro-Explosive Devices (EEDs) for mechanical systems deployment • Radioactive materials in quantities that produce an A2 mission multiple value of less than 10 • Propulsion system exhaust and inert gas venting • Sample returns are considered outside of the scope of this environmental assessment

a
Propellant limits are subject to range safety requirements.

Key: kg=kilograms; lb=pounds.

National Aeronautics and
Space Administration
Mission Support Directorate

NASA Management Office
180-801
4800 Oak Grove Drive
Pasadena, CA 91109-8099

Reply to Attn of: LP040

DATE November 19, 2020

SUBJECT: Lunar Trailblazer Mission

MEMORANDUM FOR RECORD

This is a Record of Environmental Consideration (REC) for the Lunar Trailblazer Small Innovative Missions for Planetary Exploration (SIMPLEx) Mission which would launch as a secondary payload on NASA's Interstellar Mapping and Acceleration Probe (IMAP) Mission on a Falcon 9 Full Thrust launch system from Cape Canaveral Air Force Station (CCAFS) no earlier than October 2024. This proposed action has been reviewed against the National Environmental Policy Act, the implementing regulations of the Council on Environmental Quality, and the implementing regulations of NASA. Following my review of the proposed action described by the supporting documentation at JPL, the Lunar Trailblazer spacecraft meets the envelope payload criteria for the spacecraft as described in the NASA 2011 *Final Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles*. Because the Lunar Trailblazer mission is currently manifested as one of several component payloads on the IMAP launch, the NASA environmental review for the launch of the consolidated IMAP payload is the responsibility of the launching Center environmental management office, Goddard Space Flight Center (GSFC). The Center NEPA Manager at GSFC has stated in writing that GSFC will include Lunar Trailblazer when preparing the IMAP Mission NASA Routine Payload Environmental Assessment Tier 2 NEPA document.

My signature on this document constitutes a written record of this decision.

Steve Slaten
Environmental and Facilities Manager
NASA Management Office

Attachments

Jet Propulsion Laboratory
California Institute of Technology
MS 301-370
4800 Oak Grove Drive
Pasadena, California 91109-8099

November 19, 2020

Mr. Steven Slaten
NASA Management Office
Jet Propulsion Laboratory MS 180-801
4800 Oak Grove Drive
Pasadena, CA 91109

Environmental Evaluation and Recommendation for a Record of Environmental Consideration for the *Lunar Trailblazer Mission (LTB)*

1. Description and location of proposed action:

Lunar Trailblazer (LTB) was selected by NASA's Science Mission Directorate (SMD) Planetary Science Division (PSD) Small Innovative Missions for Planetary Exploration (SIMPLEx) Program as one of three Step 1 proposal finalist SmallSats missions in July 2019. The project would report to PSD but be funded through the Exploration Science Strategy and Integration Office (ESSIO).

LTB would be a Class D Principal Investigator (PI)-led small satellite (SmallSat) mission pursuing unanswered questions about water on the Moon. Using an infrared (IR) imaging spectrometer and multispectral thermal camera, LTB would: a) directly detect and distinguish water ice, water (H_2O), and hydroxide (OH) to test the water content of different lunar rocks and soils as a function of temperature; b) peer into permanently shadowed regions to quantify ice content; and, c) map the spatial and temporal variability of water across the sunlit surface.

LTB would be one of four secondary payloads to launch as a rideshare with NASA's Interstellar Mapping and Acceleration Probe (IMAP) Mission on a Falcon 9 launch vehicle from Cape Canaveral Air Force Station (CCAFS) no earlier than October 2024. NASA has included an Evolved Expendable Launch Vehicle (EELV) Secondary Payload Adapter (ESPA) Grande ring on the launch services contract for the IMAP launch vehicle. Also ride-sharing on the ESPA ring would be the National Oceanic and Atmospheric Administration's (NOAA's) Space Weather Follow On-Lagrange 1 (SWFO-L1) mission, and two heliophysics missions which NASA has yet to select. The ESPA Grande ring dispenser/services would be procured by NASA through the Kennedy Space Center (KSC) Launch Services Program (LSP).

The LTB spacecraft would be a box-shaped bus roughly 122 x 64 x 69 centimeters (cm) (44 x 25 x 27 inches), with two solar arrays which form two wings on opposite sides of the spacecraft. LTB would weigh up to 320 kilograms (kg) (640 pounds). Communication would be through the Deep Space Network (DSN) using a version of the X-Band Iris transponder.

LTB would have the goal of understanding the form, abundance, and distribution of water on the Moon and the lunar water cycle via four objectives:

1. Determine the form, abundance, and distribution of water (H_2O) and hydroxide (OH) across targeted areas in sunlit portions of the Moon, including variability by latitude, soil maturity, lithology.
2. Test for and measure the possible temporal variations and mobility of H_2O and OH.
3. Determine the form and abundance of ice, bound H_2O, and OH in permanently shadowed regions (PSRs) using terrain scattered light.
4. Understand how localized gradients in albedo and surface temperature affect ice and OH/H_2O concentration, including the potential identification of new, small cold traps.

Lunar Trailblazer would also perform exploration zone reconnaissance for landed missions and mapping crust lithologic composition.

The Lunar Trailblazer spacecraft would be deployed from the ESPA Grande at the Earth-Moon LaGrangian-1 (L1) point and maneuver to its lunar polar orbit propelled by a hydrazine propellant system. After Lunar Orbit Insertion, LTB would provide coverage at 3 times of day for select targets.

LTB would carry two instruments to meet its science objectives:

1) JPL's High-resolution Volatiles Mineral Moon Mapper (HVM^3) would be a short wavelength IR (SWIR) pushbroom (along-track) imaging spectrometer. With four times better spectral resolution in the region of OH/H_2O absorption bands, HVM^3 would resolve outstanding questions about the form of hydrated species. High spatial resolution and repeat coverage would enable detailed mapping as a function of local geology and time-of-day.
2) The Lunar Thermal Mapper (LTM), a multichannel imaging thermal radiometer, provided by the University of Oxford, would have 11 bands to provide an independent measure of silicate mineralogy. LTM temperatures would assist in validating HVM^3 data calibration and identification of less than 100-meter (m) (328-foot) pixel scale cold traps. Simultaneous temperature from HVM^3 and LTM would allow thermal correction for abundance determination.

Under subcontract to Caltech, Lockheed Martin Space (LMS) would perform spacecraft development and flight system integration and test (I&T), integrate the JPL HVM^3 and Oxford University-provided LTM instruments, and perform all test and commissioning operations for the spacecraft. LMS would place the spacecraft in storage in October 2022 and deliver it to the payload integrator approximately four months prior to launch. Per the NASA-Caltech contract, all formal deliverables to NASA are to be delivered through the Principle Investigator (PI). JPL would provide inputs to the PI for reporting to NASA, as well as documents such as the HVM^3 Calibration Plan and the Safety and Mission Assurance Requirements (SMAR).

In addition to supplying the HVM^3 instrument and required documentation, JPL would be responsible for Project Management, Project Systems Engineering, Safety and Mission Assurance, Mission Design/Navigation, and Deep Space Network (DSN) support. The Lunar Trailblazer Project Manager at JPL would support the Principle Investigator (PI) from California Institute of Technology (Caltech).

1.1. Milestones:

a. Conduct a Preliminary Design Review (PDR), completed October 23, 2020.
b. Key Decision Point-C, scheduled for November 2020.
c. Start of Phase C, scheduled for December 2020.
d. Project Critical Design Review (CDR), scheduled for July 2021.
e. Deliver the HVM^3 instrument to LMS for integration, scheduled for July 2022. (JPL)
f. Complete flight software and flight system assembly, scheduled for August 2022. (LMS)
g. Complete functional and environmental testing, scheduled for October 2022. (LMS)
h. Start of the storage period, scheduled for October 2022. (LMS)
i. Complete Ground Science and Operations Software, scheduled for April 2024. (Caltech/LMS)
j. Deliver the flight system with all required documentation for integration with launch deployer, scheduled for no earlier than July 2024. (LMS)
k. Operations Readiness Review (ORR), scheduled for no earlier than September 2024.
l. Support the IMAP launch, scheduled for no earlier than October 2024.

1.2. Deliverables:

a. Lunar Trailblazer Project Plan. (JPL to Caltech)
b. Monthly report/presentation to NASA SIMPLEx Program Office.
c. Lunar Trailblazer HVM^3 Calibration Plan. (JPL to Caltech)
d. Lunar Trailblazer Safety and Mission Assurance Requirements. (JPL to Caltech)

2. Anticipated start date and duration of proposed action (estimated):

Start Date: August 15, 2019
Duration: Through November 30, 2024

3. Assessment

The Lunar Trailblazer SmallSat appears to meet the envelope payload criteria for the spacecraft as described in the NASA 2011 *Final Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles* (NASA NRP EA Checklist is attached). Because the Lunar Trailblazer mission is currently manifested as one of several component payloads on NASA's IMAP launch vehicle, the NASA environmental review for the launch of the consolidated payload is the responsibility of the launching Center environmental management office, Goddard Space Flight Center (GSFC). The Center NEPA Manager at GSFC has stated in writing that GSFC will include Lunar Trailblazer when preparing the IMAP Mission NASA Routine Payload Environmental Assessment Tier 2 NEPA document.

Signed:

E-SIGNED by Mark Phillips
on 2020-11-23 17:24:31 GMT

J. M. Phillips, Manager
Launch Approval Engineering
Office

Evaluation Checklist for Applicability of the NASA Routine Payload Environmental Assessment (NRP EA)

PROJECT NAME: Lunar Trailblazer (LTB) **LAUNCH DATE:** NET October 2024

PROJECT CONTACT: Calina Seybold **PHONE:** 818) 354-8685 **E-MAIL:** Calina.C.Seybold@jpl.nasa.gov

PROPOSED ACTION DESCRIPTION: LTB would be a Class D Principal Investigator (PI)-led small satellite mission pursuing unanswered questions about water on the Moon. Using an infrared (IR) imaging spectrometer and multispectral thermal camera. NASA would launch LTB with the GSFC-managed IMAP mission and several other auxiliary payloads on a Falcon 9 vehicle from KSC/CCAFS.

Note: "YES" responses require explanation in the comment field at the end of each section, and may require the conduct of additional studies or preparation of additional NEPA compliance documentation.	YES	NO
A. Sample Return:		
Would the candidate mission return a sample from an extraterrestrial body?	☐	☑
Comment:		
B.		
Would the candidate spacecraft carry radioactive materials in quantities that produce an A2 mission multiple value of 10 or more?	☐	☑
Comment:		
C. Launch Site and Launch Vehicles:		
1. Would the candidate spacecraft be launched on a vehicle and launch site combination other than those listed in Table 1 of this checklist?	☐	☑
2. Would launch of the proposed mission exceed the approved or permitted annual launch rate for the particular launch vehicle or launch site?	☐	☑
Comment:		
D.		
Would the candidate mission require the construction of any new facilities or substantial modification of existing facilities? (If YES, provide a brief description below of the construction or modification required, including whether ground disturbance and/or excavation would occur)	☐	☑
Comment:		
E. Health and Safety:		
1. Would the candidate spacecraft utilize batteries, ordnance, hazardous propellant, radiofrequency transmitter power, or other subsystem components in quantities or levels exceeding the Envelope Payload Characteristics (EPCs) in Table 2 of this checklist?	☐	☑
2. Would the expected risk of human casualty from spacecraft planned orbital reentry exceed the criteria specified by NASA Standard 8719.14?	☐	☑
3. Would the candidate spacecraft utilize any potentially hazardous material as part of a flight system whose type or amount precludes acquisition of the necessary permits prior to its use or is not included within the definition of the Envelope Payload Characteristics (EPCs)?	☐	☑
4. Would the candidate mission, under nominal conditions, release material other than propulsion system exhaust or inert gases into the Earth's atmosphere or space?	☐	☑
5. Are there changes in the preparation, launch or operation of the candidate spacecraft from the standard practices described in Chapter 3 of the *Final Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles* dated November 2011?	☐	☑
6. Would the candidate spacecraft utilize an Earth-pointing laser system that does not meet the requirements for safe operation (ANSI Z136.1-2007 and ANSI Z136.6-2005)?	☐	☑

Evaluation Checklist for Applicability of the NASA Routine Payload Environmental Assessment (NRP EA)

PROJECT NAME: Lunar Trailblazer (LTB) **LAUNCH DATE:** NET October 2024

PROJECT CONTACT: Calina Seybold **PHONE:** 818) 354-8685 **E-MAIL:** Calina.C.Seybold@jpl.nasa.g

PROPOSED ACTION DESCRIPTION: LTB would be a Class D Principal Investigator (PI)-led small satellite mission pursuing unanswered questions about water on the Moon. Using an infrared (IR) imaging spectrometer and multispectral thermal camera. NASA would launch LTB with the GSFC-managed IMAP mission and several other auxiliary payloads on a Falcon 9 vehicle from KSC/CCAFS.

Note: "YES" responses require explanation in the comment field at the end of each section, and may require the conduct of additional studies or preparation of additional NEPA compliance documentation.	YES	NO
7. Would the candidate spacecraft contain, by design (e.g., a scientific payload) pathogenic microorganisms (including bacteria, protozoa, and viruses) which can produce disease or toxins hazardous to human health or the environment beyond Biosafety Level 1 (BSL 1)[1]?	☐	☑
Comment:		
F. Other Environmental Issues:		
1. Would the candidate spacecraft have the potential for substantial effects on the environment outside the United States?	☐	☑
2. Would launch and operation of the candidate spacecraft have the potential to create substantial public controversy related to environmental issues?	☐	☑
3. Would any aspect of the candidate spacecraft that is not addressed by the Envelope Payload Characteristics (EPCs) have the potential for substantial effects on the environment (i.e., previously unused materials, configurations or material not included in the checklist)?	☐	☑
Comment:		
G. Applicability of the NASA Routine Payload Environmental Assessment (NRP EA):		

Pending approval by NASA, the NASA Routine Payload Environmental Assessment (NRP EA) ☑ does ☐ does not provide adequate coverage for the proposed action as currently described.

Additional considerations, if any:

Individual Completing Checklist: Janis Graham

Institutional Launch Approval Engineer

Date of Completion: 10/5/2020

Concurred by NMO NEPA Manager:

Date: 10/26/2020

[1] The use of biological agents on payloads is limited to materials with a safety rating of "Biosafety Level 1." This classification includes defined and characterized strains of viable microorganisms not known to consistently cause disease in healthy human adults. Personnel working with Biosafety Level 1 agents follow standard microbiological practices including the use of mechanical pipetting devices, no eating drinking, or smoking in the laboratory, and required hand-washing after working with agents or leaving a lab where agents are stored. Personal protective equipment such as gloves and eye protection is also recommended when working with biological agents.

Data Tables from NASA "Final Environmental Assessment For Launch Of Nasa Routine Payloads On Expendable Launch Vehicles", November 2011

Table 1. Launch Vehicles and Launch Sites

Launch Vehicle and Launch Vehicle Family	Space Launch Complexes and Pads				
	Eastern Range (CCAFS)	Western Range (VAFB)	USAKA/RTS	WFF	KLC
Athena I, IIc, III[a]	LC-46	CA Spaceport (SLC-8)	N/A	Pad 0	LP-1
Atlas V Family	LC-41	SLC-3	N/A	N/A	N/A
Delta II Family	LC-17	SLC-2	N/A	N/A	N/A
Delta IV Family	LC-37	SLC-6	N/A	N/A	N/A
Falcon 1/1e	LC-36	SLC-4W	Omelek Island	Pad 0	LP-3[b]
Falcon 9	LC-40	SLC-4E	Omelek	Pad 0	LP-3[b]
Minotaur I	LC-20 and/or LC-46	SLC-8	N/A	Pad 0	LP-1
Minotaur II-III	LC-20 and/or LC-46	SLC-8	N/A	Pad 0	LP-1
Minotaur IV	LC-20 and/or LC-46	SLC-8	N/A	Pad 0	LP-1
Minotaur V	LC-20 and/or LC-46	SLC-8	N/A	Pad 0	LP-1
Pegasus XL	CCAFS skidstrip, KSC SLF	VAFB Airfield	Kwajalein Island	WFF Airfield	N/A
Taurus	LC-46 and/or LC-20	SLC-576E	N/A	Pad 0	LP-1
Taurus II/Antares[c]	NA	NA	N/A	Pad 0	LP-3[b]
Any other launch vehicle/launch site combination for which NASA has completed or cooperated on the NEPA Compliance					

[1] Athena III and LP-3 are currently under design

[b] While not explicitly listed in this table, the Minotaur IV includes all configurations of this launch vehicle, including the Minotaur IV+, which is a Minotaur IV with a Star 48V 4th stage.

[c] The Taurus II LV was renamed Antares after publication of the *Final Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles* in November 2011.

Key: CA=California; CCAFS=Cape Canaveral Air Force Station; KSC=Kennedy Space Center; LC=Launch Complex; LP=Launch Pad; MARS=Mid-Atlantic Regional Spaceport; SLC=Space Launch Complex; SLF=Shuttle Landing Facility; USAKA/RTS=United States Army Kwajalein Atoll/Reagan Test Site; VAFB=Vandenberg Air Force Base; WFF=Wallops Flight Facility.

Table 2. Summary of Envelope Payload Characteristics (EPCs) by Spacecraft Subsystems

Structure	• Unlimited: aluminum, beryllium, carbon resin composites, magnesium, titanium, and other materials unless specified as limited.
Propulsion[a]	• Liquid propellant(s); 3,200 kg (7,055 lb) combined hydrazine, monomethylhydrazine and/or nitrogen tetroxide. • Solid Rocket Motor (SRM) propellant; 3,000 kg (6,614 lb) Ammonium Perchlorate (AP)- based solid propellant (examples of SRM propellant that might be on a spacecraft are a Star-48 kick stage, descent engines, an extra-terrestrial ascent vehicle, etc.)
Communications	• Various 10-100 Watt (RF) transmitters
Power	• Unlimited Solar cells; 5 kilowatt-Hour (kW-hr) Nickel-Hydrogen (NiH_2) or Lithium ion • (Li-ion) battery, 300 Ampere-hour (A-hr) Lithium-Thionyl Chloride (LiSOCl), or 150 A-hr Hydrogen, Nickel-Cadmium (NiCd), or Nickel-hydrogen (Ni-H_2) battery.
Science Instruments	• 10 kilowatt radar • American National Standards Institute safe use of lasers (see Section 4.1.2.1, Final Environmental Assessment for Launch of NASA Routine Payloads on Expendable Launch Vehicles, November 2011)
Other	• U. S. Department of Transportation (DoT) Class 1.4 Electro-Explosive Devices (EEDs) for mechanical systems deployment • Radioactive materials in quantities that produce an A2 mission multiple value of less than 10 • Propulsion system exhaust and inert gas venting • Sample returns are considered outside of the scope of this environmental assessment

[1] Propellant limits are subject to range safety requirements.

Key: kg=kilograms; lb=pounds.

Facility Environmental Evaluation Checklist

This checklist is to be completed by the EAPO in coordination with the JPL program/project manager who proposes on-site activities. This checklist will become part of the environmental impact assessment. No work is to be conducted until this form and any environmental impact assessment has been completed and approved by NASA.

Title of Proposed Action: **Lunar Trailblazer (LTB)**	**EAPO ID#** **21EIA01**

Description of Proposed Action:

The proposed Lunar Trailblazer (LTB) is a NASA Small Innovative Mission for Planetary Exploration (SIMPLEx) mission for understanding the Moon's water and water cycle by detecting and mapping water on the lunar surface at key targets. LTB would include two capable, high heritage science instruments: the High resolution Volatiles and Minerals Moon Mapper (HVM3), and the Lunar Thermal Mapper (LTM). JPL is contributing the HVM3 instrument, the mission level Safety and Mission Assurance (SMA), Mission Design and Navigation (MD/Nav), and Deep Space Network (DSN) support. JPL would deliver the HVM3 instrument to Lockheed Martin Space (LMS), which is building the spacecraft, integrating the instruments and performing ATLO.

Start Date and Duration: Sept 3, 2019	**Today's Date:** Nov 5, 2020
Name of Prog/Project Manager: Calina Seybold (HVM3 Mgr Walton Willia	**Phone:** (818) 393-5260
Facility Location: ☑ JPL Oak Grove ☐ GDSCC ☐ TMF	**Proposed Action Bldg/Room:** TBD

Environmental Impacts *(Check appropriate box and provide sufficient details for assessment. Explain any "Yes" and "Maybe" responses in the Assessment field on page 3.)*	**Yes**	**No**	**May be**
A. **Geologic**			
1. Would the proposed action induce erosion (Water/Wind) either on- or off-site?	☐	☑	☐
2. Would the proposed action affect surface stability?	☐	☑	☐
3. Would the proposed action affect agricultural lands?	☐	☑	☐
B. **Water**	**Yes**	**No**	**May be**
1. Would the proposed action affect a natural body of water?	☐	☑	☐
2. Would the proposed action alter storm water flow?	☐	☑	☐
3. Would the proposed action result in a >10% change of facility potable water use (>250GPM)?	☐	☑	☐
4. Would the proposed action impact chemical quality (pH, dissolved solids, organics, etc.) of wastewater or stormwater?	☐	☑	☐
5. Would the proposed action impact physical quality (temperature, suspended solids, etc.) of wastewater or stormwater?	☐	☑	☐
6. Would the proposed action require a modification to the existing stormwater permit?	☐	☑	☐
7. Would the proposed action require a modification to the existing industrial wastewater permit?	☐	☑	☐
C. **Air**	**Yes**	**No**	**May be**
1. Would the proposed action generate objectionable odors?	☐	☑	☐
2. Would the proposed action release toxic substances?	☐	☑	☐
3. Would the proposed action release particulates?	☐	☑	☐
4. Would the proposed action be classified as either a New Source Emission or a major modification to an existing source (SCAQMD Regulation XIII)?	☐	☑	☐
D. **Natural Resources**	**Yes**	**No**	**May be**
1. Would the proposed action affect an undisturbed natural area?	☐	☑	☐
2. Would the proposed action affect game animals and fish?	☐	☑	☐

3. Would the proposed action affect threatened or endangered species?	☐	☑	☐
4. Would the proposed action affect nesting birds?	☐	☑	☐
5. Would the proposed action affect a critical habitat?	☐	☑	☐
6. Would the proposed action affect protected trees (e.g.: oak)?	☐	☑	☐
E. Land Use	**Yes**	**No**	**May be**
1. Would the proposed action affect floodplains/wetlands?	☐	☑	☐
2. Would the proposed action affect off-site land use?	☐	☑	☐
3. Would the proposed action affect on-site land use?	☐	☑	☐
4. Would the proposed action affect aesthetics?	☐	☑	☐
F. Cultural Resources	**Yes**	**No**	**May be**
1. Would the proposed action affect NRHP-Listed Properties?	☐	☑	☐
2. Would the proposed action affect properties eligible or potentially eligible for the NRHP?	☐	☑	☐
3. Would the proposed action affect known historic landmarks?	☐	☑	☐
4. Would the proposed action affect known and/or potential archeological areas?	☐	☑	☐
G. Socio-Economic/Environmental Justice	**Yes**	**No**	**May be**
1. Would the proposed action affect regional employment?	☐	☑	☐
2. Would the proposed action disproportionally affect low income or minority populations?	☐	☑	☐
H. Noise	**Yes**	**No**	**May be**
1. Would the proposed action expose people to severe noise levels (>80dBA)?	☐	☑	☐
2. Would the proposed action increase existing community noise contours?	☐	☑	☐
I. Health and Safety	**Yes**	**No**	**May be**
1. Would the proposed action generate ionizing or non-ionizing radiation?	☐	☑	☐
2. Would the proposed action use pesticides, insecticides, herbicides, fungicides, or rodenticides?	☐	☑	☐
3. Would the proposed action require entry into a confined space?	☐	☑	☐
4. Would the proposed action include the use, acquisition, or storage of toxic or hazardous substances?	☐	☐	☑
5. Would the proposed action generate medical, hazardous, toxic, or radiological waste?	☐	☐	☑
J. CERCLA	**Yes**	**No**	**May be**
1. Would the proposed action affect existing CERCLA infrastructure (e.g.: wells)?	☐	☑	☐
2. Would the proposed action be located in an area of known future CERCLA activity?	☐	☑	☐
3. Would the proposed action result in exposure or disturbance of contaminated soil or groundwater?	☐	☑	☐
K. Activity/Systems	**Yes**	**No**	**May be**
1. Would the proposed action reduce parking?	☐	☑	☐
2. Would the proposed action affect access to utility or infrastructure support systems?	☐	☑	☐
3. Would the proposed action affect roadway transportation systems?	☐	☑	☐
4. Would the proposed action increase hazards to motor vehicles or pedestrians?	☐	☑	☐
5. Would the proposed action require the acquisition or storage of solid waste storage containers?	☐	☑	☐

Assessment:

I. Health and Safety #4 and #5 - The LTB project is currently in phase B. Any on-site integration and test (I&T) for the High-resolution Volatiles Mineral Moon Mapper (HVM3) instrument would not take place until sometime in the spring 2021, at the earliest. As is typical during I&T, hazardous substances would be used and hazardous waste would likely be generated. JPL has established processes and procedures in place to comply with the associated health and safety requirements. In addition, a Systems Safety Engineer has been assigned to LTB's HVM3 instrument and they would be responsible for performing the required systems safety surveys.

Signature of Program/Project Manager: Walton R. Williamson Date: Nov 13, 2020

Environmental Analysis Determination

Title of Proposed Action: Lunar Trailblazer (LTB)

Description of Proposed Action:

The proposed Lunar Trailblazer (LTB) is a NASA Small Innovative Mission for Planetary Exploration (SIMPLEx) mission for understanding the Moon's water and water cycle by detecting and mapping water on the lunar surface at key targets. LTB would include two capable, high heritage science instruments: the High resolution Volatiles and Minerals Moon Mapper (HVM3), and the Lunar Thermal Mapper (LTM). JPL is contributing the HVM3 instrument, the mission level Safety and Mission Assurance (SMA), Mission Design and Navigation (MD/Nav), and Deep Space Network (DSN) support. JPL would deliver the HVM3 instrument to Lockheed Martin Space (LMS), which is building the spacecraft, integrating the instruments and performing ATLO.

It has been determined that the above action (choose one):

☑	Qualifies for one or more Categorical Exclusions pursuant to 14 CFR 1216.304(d) and the current NASA Policy Requirement (NPR) which suggests no need for an Environmental Assessment (EA) or Environmental Impact Statement (EIS). List applicable Categorical Exclusion(s): (3)(i) Research, development, and testing in compliance with all applicable Federal, Federally recognized Indian tribe, State, and/or local law or requirements and Executive Orders.
☐	Is exempt from NEPA requirements under the provisions of the (cite superseding law):
☐	Is adequately covered in the following Environmental Assessment (EA) or Environmental Impact Statement (EIS): and dated:
☐	Has no environmental impact as indicated by the result of an existing environmental checklist or analysis (attach checklist or analysis).

Prepared by: Faustino Chirino (JPL EAPO) **Signature:** Faustino Chirino **Date:** Nov 16, 2020

Approved by: Steve Slaten (Environmental and Facilities Manager, NASA Management Office, JPL) **Signature:** SSlaton **Date:** 11/16/2020

NASA Routine Payload Evaluation and Determination Process and Checklist

After a proposed spacecraft mission is sufficiently well formulated (usually the Phase B design study), the Sponsoring Entity, in coordination with the local Environmental Management Office (EMO), will prepare an environmental evaluation. An environmental evaluation is a preliminary review that determines what aspects of the proposal are of potential environmental concern. The environmental evaluation also assists in determining the appropriate level of National Environmental Policy Act (NEPA) documentation (i.e., environmental assessment [EA], or environmental impact statement [IEIS]) for the proposal. The local EMO uses a comprehensive checklist to provide a level of rigor to this early evaluation of the proposal, helping to ensure that pertinent considerations are not overlooked. Local EMO review of the Routine Payload Checklist (RPC, below) forms the basis for evaluating the applicability of a NASA Routine Payload (NRP) spacecraft classification for a proposed mission.

The local EMO uses the completed RPC (and required attachments) to evaluate the proposed mission against the NRP EA criteria. If the EMO evaluation of the RPC indicates that a NRP categorization may be appropriate, the Sponsoring Entity documents this in an Evaluation Recommendation Package (ERP). The ERP is then processed for review and approval in accordance with established National Aeronautics and Space Administration (NASA) procedures and guidelines. If approved, the ERP would be attached to a Record of Environmental Consideration (REC).

The Sponsoring Entity can then proceed with the proposal while monitoring the project activities, for changes or circumstances during implementation that could affect classification of the proposed mission as a NRP spacecraft. If a NRP spacecraft categorization is determined to be inappropriate, the local EMO will initiate plans for preparation of additional NEPA documentation.

NASA Routine Payload Checklist

Project Name:		Date of Launch:
GLIDE		Jan 1, 2025
Project Contact:	**Phone Number:**	**Mailstop:**
William Craig - PM	(925) 658-2351	
Project Start Date:	**Project Location:**	
01/04/2021	University of California, Berkeley - Space Sciences Laboratory	

Project Description:
GLIDE is an ultraviolet imaging system that will study the Earth's exosphere from a Lissajous orbit around the Earth-Sun L1 point. GLIDE is a rideshare on the IMAP ESPA Grande.

A. Sample Return:	Yes	No
1. Would the candidate mission return a sample from an extraterrestrial body?	☐	☒
B. Radioactive Materials:	Yes	No
1. Would the candidate spacecraft carry radioactive materials in quantities that produce an A2 mission multiple value of 10 or more?	☐	☒
Provide a copy of the Radioactive Materials On Board Report as per NPR 8715.3 with the ERP submittal.	Attachment	
C. Launch and Launch Vehicles:	Yes	No
1. Would the candidate spacecraft be launched on a vehicle and launch site combination other than those indicated in Table C-1 on Page 2?	☐	☒
2. Would the proposed mission exceed the approved or permitted annual launch rate for the particular launch vehicle or launch site?	☐	☒
Comments:		
D. Facilities:	Yes	No
1. Would the candidate mission require the construction of any new facilities or substantial modification of existing facilities?	☐	☒
Provide a brief description of the construction or modification required, including whether ground disturbance and/or excavation would occur.		
E. Health and Safety:	Yes	No
1. Would the candidate spacecraft utilize batteries, ordnance, hazardous propellant, radiofrequency transmitter power, or other subsystem components in quantities or levels exceeding the EPC's in Table C-2 below?	☐	☒
2. Would the expected risk of human casualty from spacecraft planned orbital reentry exceed the criteria specified by NASA Standard 8719.14?	☐	☒
3. Would the candidate spacecraft utilize any potentially hazardous material as part of a flight system whose type or amount precludes acquisition of the necessary permits prior to its use or is not included within the definition of the Envelope Payload Characteristics?	☐	☒
4. Would the candidate mission, under nominal conditions, release material other than propulsion system exhaust or inert gases into the Earth's atmosphere or space?	☐	☒
5. Are there changes in the preparation, launch or operation of the candidate spacecraft from the standard practices described in Chapter 3 of this EA?	☐	☒
6. Would the candidate spacecraft utilize an Earth-pointing laser system that does not meet the requirements for safe operation (ANSI Z136.1-2007 and ANSI Z136.6-2005)?	☐	☒
7. Would the candidate spacecraft contain, by design (e.g., a scientific payload) pathogenic microorganisms (including bacteria, protozoa, and viruses) which can produce disease or toxins hazardous to human health or the environment beyond Biosafety Level 1 (BSL 1)[1]?	☐	☒
Comments:		

The use of biological agents on payloads is limited to materials with a safety rating of "Biosafety Level 1." This classification includes defined and characterized strains of viable microorganisms not known to consistently cause disease in healthy human adults. Personnel working with Biosafety Level 1 agents follow standard microbiological practices including the use of mechanical pipetting devices, no eating, drinking, or smoking in the laboratory, and required hand-washing after working with agents or leaving a lab where agents are stored. Personal protective equipment such as gloves and eye protection is also recommended when working with biological agents.

NASA Routine Payload Checklist (continuation)

Project Name: GLIDE		Date of Launch: Jan 1, 2025
Project Contact: William Craig - PM	Phone Number: (925) 658-2351	Mailstop:
Project Start Date: 01/04/2021	Project Location: University of California, Berkeley - Space Sciences Laboratory	

Project Description:
GLIDE is an ultraviolet imaging system that will study the Earth's exosphere from a Lissajous orbit around the Earth-Sun L1 point. GLIDE is a rideshare on the IMAP ESPA Grande.

F. Other Environmental Issues:	Yes	No
1. Would the candidate spacecraft have the potential for substantial effects on the environment outside the United States?	☐	☒
2. Would launch and operation of the candidate spacecraft have the potential to create substantial public controversy related to environmental issues?	☐	☒
3. Would any aspect of the candidate spacecraft that is not addressed by the EPCs have the potential for substantial effects on the environment (i.e., previously unused materials, configurations or material not included in the checklist)?	☐	☒

Comments:

Table C-1. Launch Vehicles and Launch Sites

Launch Vehicle and Launch Vehicle Family	Space Launch Complexes and Pads				
	Eastern Range (CCAFS)	Western Range (VAFB)	USAKA/RTS	WFF	KLC
Athena I, IIc, III[a]	LC-46	CA Spaceport (SLC-8)	NA	Pad 0	LP-1[a]
Atlas V Family	LC-41	SLC-3	NA	NA	NA
Delta II Family	LC-17	SLC-2	NA	NA	NA
Delta IV Family	LC-37	SLC-6	NA	NA	NA
Falcon I/Ie	LC-36	SLC-4W	Omelek Island	Pad 0	LP-3[b]
Falcon 9	LC-40	SLC-4E	Omelek	Pad 0	LP-1
Minotaur I	LC-20 and/or LC-46	SLC-8	NA	Pad 0	LP-1
Minotaur II-III	LC-20 and/or LC-46	SLC-8	NA	Pad 0	LP-1
Minotaur IV[c]	LC-20 and/or LC-46	SLC-8	NA	Pad 0	LP-1
Minotaur V	LC-20 and/or LC-46	SLC-8	NA	Pad 0	NA
Pegasus XL	CCAFS skidstrip KSC SLF	VAFB Airfield	Kwajalein Island	WFF Airfield	NA
Taurus	LC-20 and/or LC-46	SLC-576E	NA	Pad 0	LP-1
Taurus II	NA	NA	NA	Pad 0	LP-3[b]
Any other launch vehicle/launch site combination for which NASA has completed or cooperated on the NEPA compliance.					

a
Athena III is currently under design.
b
LP-3 is currently under design.
c
While not explicitly listed in this table, the Minotaur IV includes all configurations of this launch vehicle, including the Minotaur IV+, which is a Minotaur IV with a Star 48V 4th stage.

Key: CA = California; CCAFS = Cape Canaveral Air Force Station; KSC = Kennedy Space Center; LC = Launch Complex; LP = Launch Pad; MARS = Mid-Atlantic Regional Spaceport; SLC = Space Launch Complex; SLF = Shuttle Landing Facility; USAKA/RTS = United States Army Kwajalein Atoll/Reagan Test Site; VAFB = Vandenberg Air Force Base; WFF = Wallops Flight Facility.

Table C-2. Summary of Envelope Payload Characteristics by Spacecraft Subsystems

Structure	• Unlimited: aluminum, beryllium, carbon resin composites, magnesium, titanium, and other materials unless specified as limited.
Propulsion[a]	• Liquid propellant(s); 3,200 kg (7,055 lb) combined hydrazine, monomethyhydrazine and/or nitrogen tetroxide. • Solid Rocket Motor (SRM) propellant; 3,000 kg (6,614 lb) Ammonium Perchlorate (AP)-based solid propellant (examples of SRM propellant that might be on a spacecraft are a Star-48 kick stage, descent engines, an extra-terrestrial ascent vehicle, etc.)
Communications	• Various 10-100 Watt (RF) transmitters
Power	• Unlimited Solar cells; 5 kilowatt-Hour (kW-hr) Nickel-Hydrogen (NiH_2) or Lithium ion (Li-ion) battery, 300 Ampere-hour (A-hr) Lithium-Thionyl Chloride (LiSOCl), or 150 A-hr Hydrogen, Nickel-Cadmium (NiCd), or Nickel-hydrogen (NiH_2) battery.
Science Instruments	• 10 kilowatt radar • American National Standards Institute safe lasers (see Section 4.1.2.1)
Other	• U. S. Department of Transportation (DoT) Class 1.4 Electro-Explosive Devices (EEDs) for mechanical systems deployment • Radioactive materials in quantities that produce an A2 mission multiple value of less than 10 • Propulsion system exhaust and inert gas venting • Sample returns are considered outside of the scope of this environmental assessment

a
Propellant limits are subject to range safety requirements.

Key: kg=kilograms; lb=pounds.

NASA Routine Payload Evaluation and Determination Process and Checklist

After a proposed spacecraft mission is sufficiently well formulated (usually the Phase B design study), the Sponsoring Entity, in coordination with the local Environmental Management Office (EMO), will prepare an environmental evaluation. An environmental evaluation is a preliminary review that determines what aspects of the proposal are of potential environmental concern. The environmental evaluation also assists in determining the appropriate level of National Environmental Policy Act (NEPA) documentation (i.e., environmental assessment [EA], or environmental impact statement [IEIS]) for the proposal. The local EMO uses a comprehensive checklist to provide a level of rigor to this early evaluation of the proposal, helping to ensure that pertinent considerations are not overlooked. Local EMO review of the Routine Payload Checklist (RPC, below) forms the basis for evaluating the applicability of a NASA Routine Payload (NRP) spacecraft classification for a proposed mission.

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The Sponsoring Entity can then proceed with the proposal while monitoring the project activities, for changes or circumstances during implementation that could affect classification of the proposed mission as a NRP spacecraft. If a NRP spacecraft categorization is determined to be inappropriate, the local EMO will initiate plans for preparation of additional NEPA documentation.

NASA Routine Payload Checklist

Project Name:		Date of Launch:
Solar Cruiser		Feb 15, 2025
Project Contact:	**Phone Number:**	**Mailstop:**
Jared Dervan	256-544-3424	MSFC: EE05
Project Start Date:	**Project Location:**	
Jan 15, 2021	NASA Marshall Space Flight Center; Huntsville, AL 35812	

Project Description:
Solar Cruiser is a technology demonstration mission for NASA Science Mission Directorate. The spacecraft will deploy a solar sail to demonstrate propellantless propulsion technology. Solar Cruiser is manifested on the IMAP mission as a rideshare payload.

A. Sample Return:	Yes	No
1. Would the candidate mission return a sample from an extraterrestrial body?	☐	☒
B. Radioactive Materials:	Yes	No
1. Would the candidate spacecraft carry radioactive materials in quantities that produce an A2 mission multiple value of 10 or more?	☐	☒
Provide a copy of the Radioactive Materials On Board Report as per NPR 8715.3 with the ERP submittal.	Attachment	
C. Launch and Launch Vehicles:	Yes	No
1. Would the candidate spacecraft be launched on a vehicle and launch site combination other than those indicated in Table C-1 on Page 2?	☐	☒
2. Would the proposed mission exceed the approved or permitted annual launch rate for the particular launch vehicle or launch site?	☐	☒
Comments:		
D. Facilities:	Yes	No
1. Would the candidate mission require the construction of any new facilities or substantial modification of existing facilities?	☐	☒
Provide a brief description of the construction or modification required, including whether ground disturbance and/or excavation would occur.		
E. Health and Safety:	Yes	No
1. Would the candidate spacecraft utilize batteries, ordnance, hazardous propellant, radiofrequency transmitter power, or other subsystem components in quantities or levels exceeding the EPC's in Table C-2 below?	☐	☒
2. Would the expected risk of human casualty from spacecraft planned orbital reentry exceed the criteria specified by NASA Standard 8719.14?	☐	☒
3. Would the candidate spacecraft utilize any potentially hazardous material as part of a flight system whose type or amount precludes acquisition of the necessary permits prior to its use or is not included within the definition of the Envelope Payload Characteristics?	☐	☒
4. Would the candidate mission, under nominal conditions, release material other than propulsion system exhaust or inert gases into the Earth's atmosphere or space?	☐	☒
5. Are there changes in the preparation, launch or operation of the candidate spacecraft from the standard practices described in Chapter 3 of this EA?	☐	☒
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7. Would the candidate spacecraft contain, by design (e.g., a scientific payload) pathogenic microorganisms (including bacteria, protozoa, and viruses) which can produce disease or toxins hazardous to human health or the environment beyond Biosafety Level 1 (BSL 1)[1]?	☐	☒
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The use of biological agents on payloads is limited to materials with a safety rating of "Biosafety Level 1." This classification includes defined and characterized strains of viable microorganisms not known to consistently cause disease in healthy human adults. Personnel working with Biosafety Level 1 agents follow standard microbiological practices including the use of mechanical pipetting devices, no eating, drinking, or smoking in the laboratory, and required hand-washing after working with agents or leaving a lab where agents are stored. Personal protective equipment such as gloves and eye protection is also recommended when working with biological agents.

NASA Routine Payload Checklist (continuation)

Project Name: Solar Cruiser		Date of Launch: Feb 15, 2025
Project Contact: Jared Dervan	Phone Number: 256-544-3424	Mailstop: MSFC: EE05
Project Start Date: Jan 15, 2021	Project Location: NASA Marshall Space Flight Center; Huntsville, AL 35812	

Project Description:
Solar Cruiser is a technology demonstration mission for NASA Science Mission Directorate. The spacecraft will deploy a solar sail to demonstrate propellantless propulsion technology. Solar Cruiser is manifested on the IMAP mission as a rideshare payload.

F. Other Environmental Issues:	Yes	No
1. Would the candidate spacecraft have the potential for substantial effects on the environment outside the United States?	☐	☒
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Communications	• Various 10-100 Watt (RF) transmitters
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Science Instruments	• 10 kilowatt radar • American National Standards Institute safe lasers (see Section 4.1.2.1)
Other	• U. S. Department of Transportation (DoT) Class 1.4 Electro-Explosive Devices (EEDs) for mechanical systems deployment • Radioactive materials in quantities that produce an A2 mission multiple value of less than 10 • Propulsion system exhaust and inert gas venting • Sample returns are considered outside of the scope of this environmental assessment

a
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Key: kg=kilograms; lb=pounds.