Environmental Impact Statement for SpaceX Starship-Super Heavy Launch Vehicle

AT LAUNCH COMPLEX 39A AT THE KENNEDY SPACE CENTER, MERRITT ISLAND, FLORIDA

What is the National Environmental Policy Act (NEPA)?

- NEPA is a procedural statute that requires Federal agencies to consider the potential environmental impacts of proposed actions subject to federal control or responsibility before a decision is made
- The Federal Aviation Administration (FAA) considers the issuance or modification of a license to be a major federal action under NEPA
- FAA decisions to license commercial space operations and to close airspace are proposed actions subject to NEPA
- Before making a decision regarding a license, the FAA must consider:
  - A range of reasonable alternatives
  - Potential environmental or health consequences
  - Tribal, government agency, and public input
- What is the role of the FAA and other agencies in this Draft Environmental Impact Statement (EIS)?
  - The FAA is the lead agency overseeing the development of the Draft EIS
  - Cooperating Agencies include:
    - National Aeronautics and Space Administration
    - Department of the Air Force
    - U.S. Coast Guard
    - U.S. Fish and Wildlife Service Merritt Island National Wildlife Refuge
    - National Park Service Canaveral National Seashore

EIS MILESTONES

Notice of Intent (NOI)
Spring 2024

Scoping Period
Spring 2024

Draft EIS and Notice of Availability (NOA)
Summer 2025

WE ARE HERE

Draft EIS Public Review Period
Summer/Fall 2025

Final EIS and NOA
Winter 2025

Record of Decision
Winter 2025

OPPORTUNITIES FOR PUBLIC PARTICIPATION

Environmental Impact Statement for SpaceX Starship-Super Heavy Launch Vehicle

AT LAUNCH COMPLEX 39A AT THE KENNEDY SPACE CENTER, MERRITT ISLAND, FLORIDA

Role of the Federal Aviation Administration

- The Federal Aviation Administration (FAA) is involved with the project due to its:
  - special expertise in launch operations, and
  - jurisdiction by law in licensing commercial launches/reentries and approving associated airspace closures.
- FAA's Federal Action
  - Issue, modify, or renew a license or permit.
  - Approve associated airspace closures for launch and landing operations to ensure public safety.
- License Determination and the Environmental Review

FAA completes policy, location, safety, payload, and environmental review prior to all licensing determinations.

- The environmental review must be completed prior to an FAA licensing determination.

Should an FAA license be issued, any required environmental mitigations would become a condition of the license.

Successful completion of the environmental review does not guarantee that the FAA will make a license determination.

Environmental Impact Statement for SpaceX Starship-Super Heavy Launch Vehicle

AT LAUNCH COMPLEX 39A AT THE KENNEDY SPACE CENTER, MERRITT ISLAND, FLORIDA

FAA Licensing Process: Vehicle/Site

Initial Discussion

Application Acceptance

Application Determination

PRE-APPLICATION	EVALUATION	OPERATIONS
At the pace of the applicant, untimed	← 180-day Statutory Review Period →	Lasts up to 5 years, renewable
	Safety Review	Compliance Monitoring & Safety Inspections
	Policy Review	
	Environmental Review	Environmental Mitigation (Licensee)
	Airspace & Waterway Integration	
	Payload Review*	
	Financial Responsibility*	

*Vehicle Operators Only

Environmental Impact Statement for SpaceX Starship-Super Heavy Launch Vehicle

AT LAUNCH COMPLEX 39A AT THE KENNEDY SPACE CENTER, MERRITT ISLAND, FLORIDA

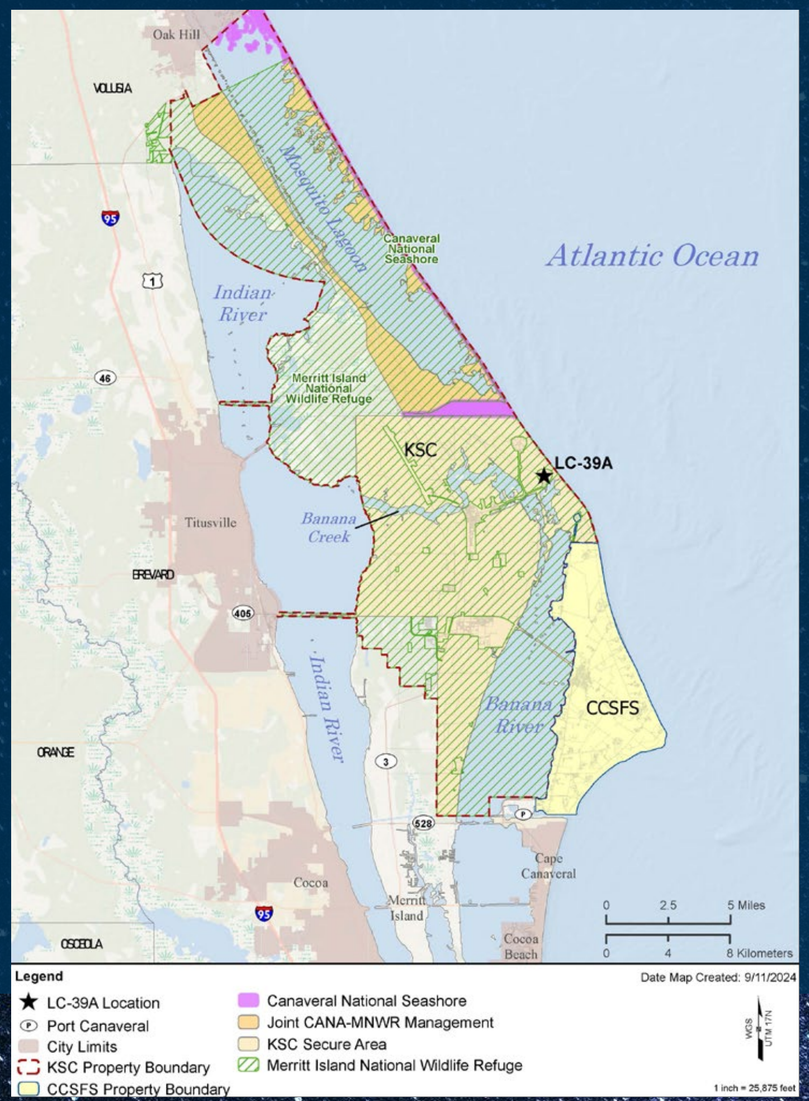
What is the Proposed Action?

The FAA is evaluating SpaceX's proposed licensing and operation of the SpaceX Starship-Super Heavy Launch Vehicle at Launch Complex 39A (LC-39A) at Kennedy Space Center (KSC) in Merritt Island, Florida which includes:

- Up to 44 Starship-Super Heavy launches per year
- Up to 44 Super Heavy landings per year, to include landings at LC-39A, landing on a droneship in the Atlantic Ocean, or expending in the Atlantic Ocean
- Up to 44 Starship landings per year, to include landings at LC-39A, landing on a droneship in the Atlantic Ocean, or soft-water or hard-water landing with expending or recovery in the Atlantic Ocean, Pacific Ocean, or Indian Ocean
- Construction of launch, landing, and other associated infrastructure at and in proximity to LC-39A

The FAA would need to authorize temporary airspace closures to accommodate launch and reentry operations at LC-39A.

What is the No Action Alternative?



- FAA would not issue a Vehicle Operator License for Starship-Super Heavy operations at LC-39A and would not approve the closure of any associated airspace
- SpaceX would not implement further improvements or launch Starship-Super Heavy from LC-39A
- NASA would not develop, implement or approve agreements with SpaceX associated with Starship-Super Heavy operations at LC-39A

Environmental Impact Statement for SpaceX Starship-Super Heavy Launch Vehicle

AT LAUNCH COMPLEX 39A AT THE KENNEDY SPACE CENTER, MERRITT ISLAND, FLORIDA

What are the Launch, Landing, and Testing Activities?

Starship-Super Heavy Launch

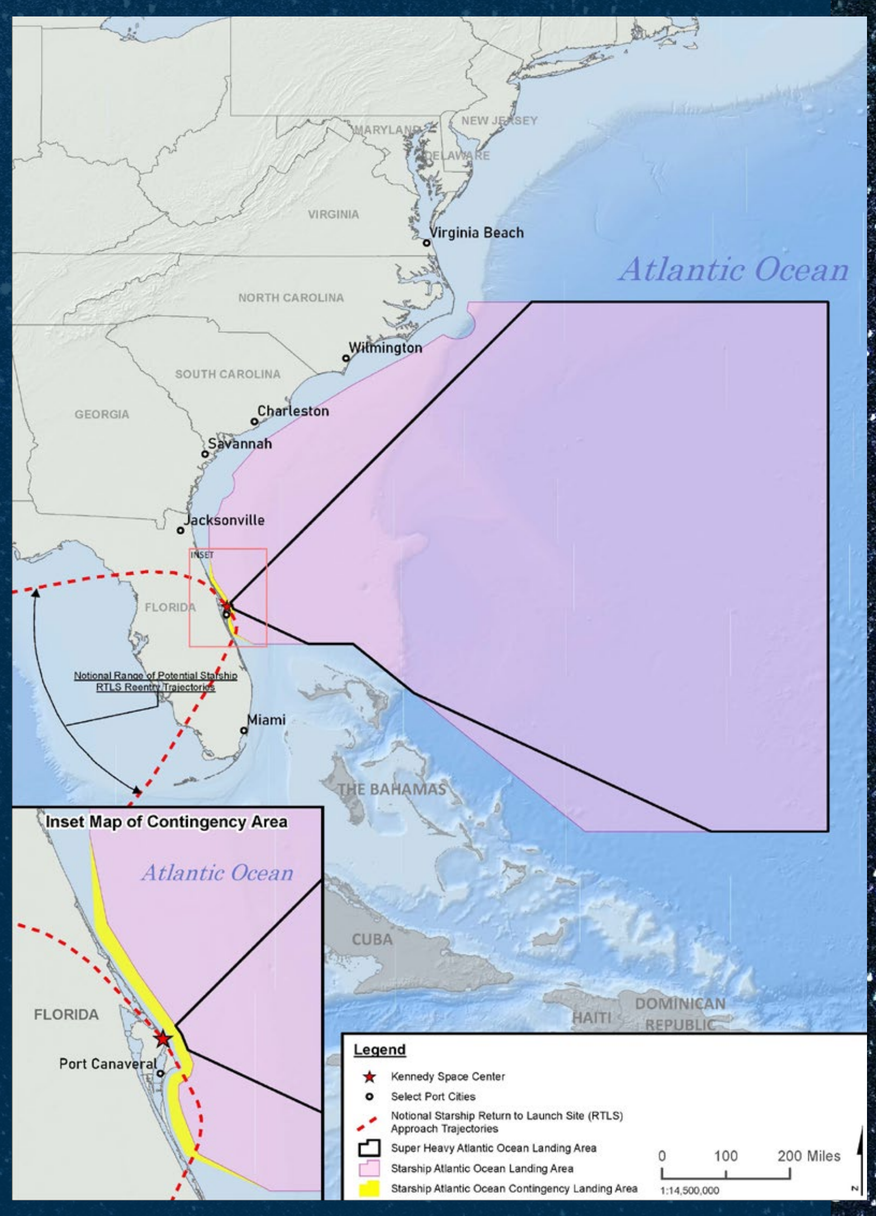
- 44 launches per year (22 daytime[1]/22 nighttime[2])

Super Heavy Landing

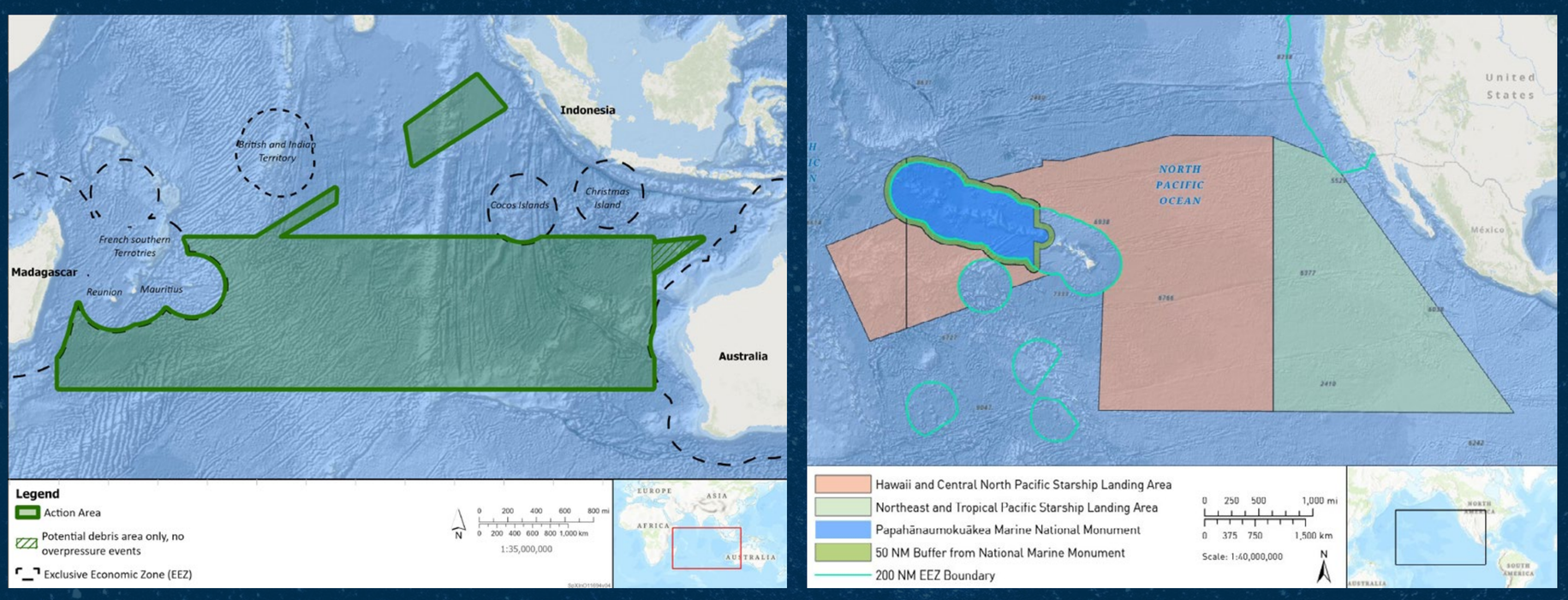
- 44 landings per year (22 daytime/22 nighttime)
  - Landing at LC-39A
  - On a droneship in the Atlantic Ocean
  - Expended in the Atlantic Ocean

Starship Landing

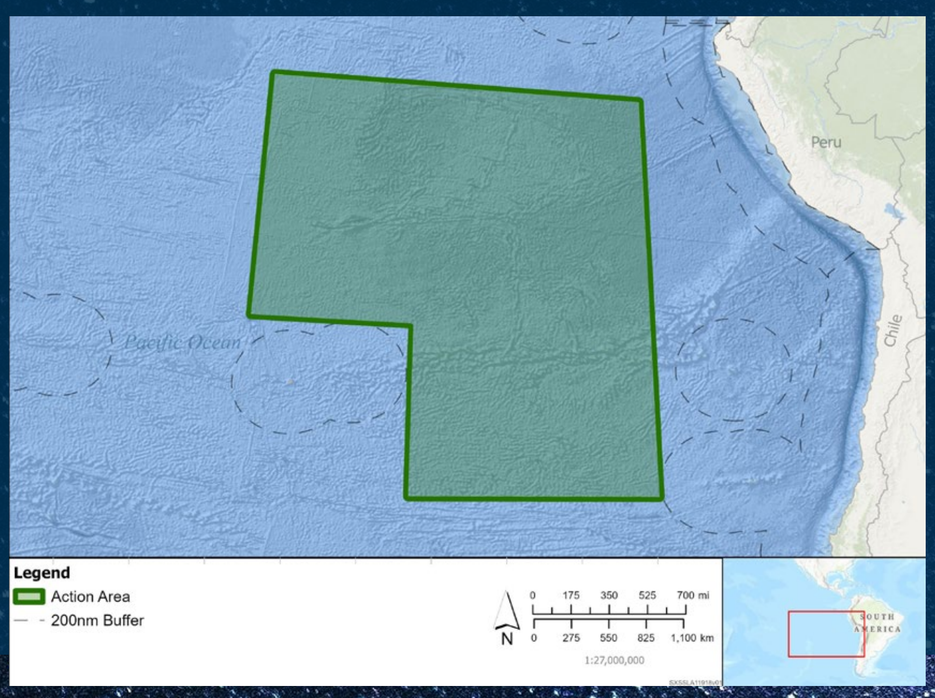
- 44 landings per year (22 daytime/22 nighttime)
  - Landing at LC-39A
  - On a droneship in the Atlantic Ocean
  - Soft-water/hard-water landing in the Atlantic, Pacific, or Indian Ocean (expended area)



STARSHIP AND SUPER HEAVY ATLANTIC OCEAN LANDING AREAS AND NOTIONAL RANGE OF STARSHIP RETURN TO LAUNCH SITE (RTLS) HEADINGS



PROPOSED STARSHIP OCEAN EXPENDED AREA



[1]Daytime refers to the hours of 7:00 a.m. to 10:00 p.m.
[2]Nighttime refers to the hours of 10:00 p.m. to 7:00 a.m.

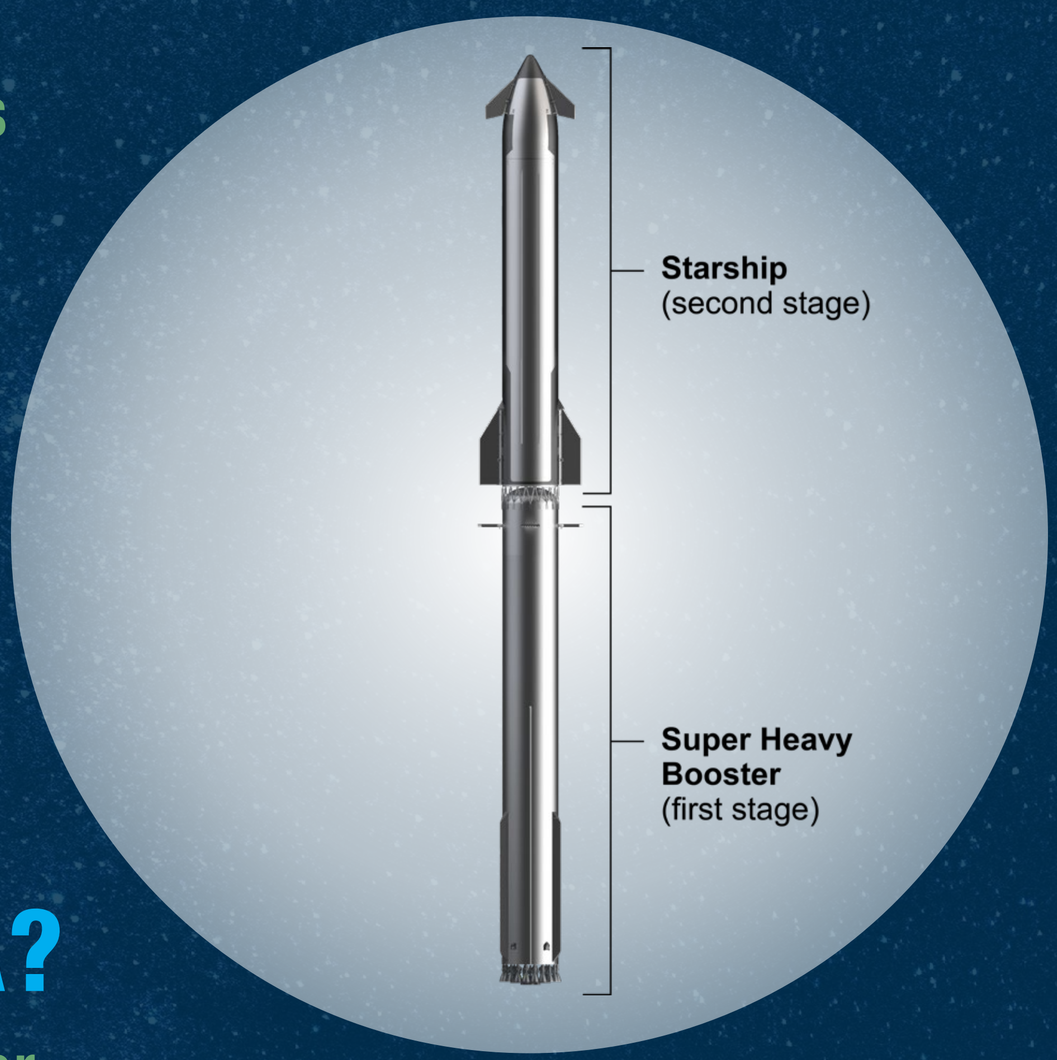
Environmental Impact Statement for SpaceX Starship-Super Heavy Launch Vehicle

AT LAUNCH COMPLEX 39A AT THE KENNEDY SPACE CENTER, MERRITT ISLAND, FLORIDA

What is the Launch Vehicle?

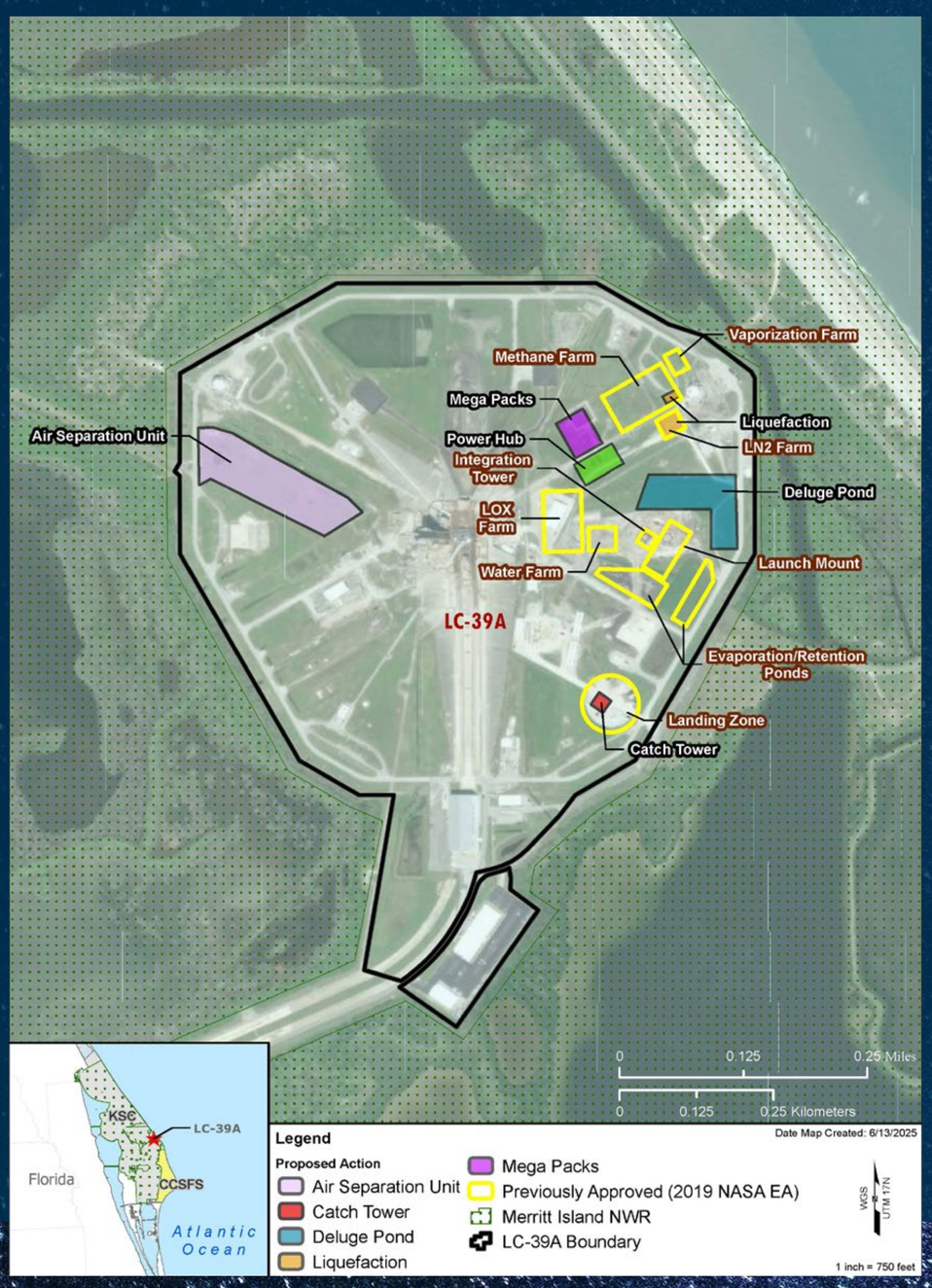
The Starship-Super Heavy Launch Vehicle has the following components:

- Starship: 9 Raptor engines
- Super Heavy: up to 35 Raptor engines
- Powered by liquid oxygen and liquid methane
- Intended to be fully reusable



What Would Be Constructed at LC-39A?

- An additional Super Heavy catch tower within the LC-39A fence line to support landing operations
- Onsite facilities for propellant generation and propellant storage
- A methane liquefier to super cool pretreated natural gas into a liquid state for storage and transportation to the launch vehicle



- An air separation unit within the LC-39A fence line to generate liquid nitrogen and liquid oxygen to support launch activities
- Additional stormwater/deluge ponds, if needed, to manage water associated with deluge and stormwater within LC-39A

Environmental Impact Statement for SpaceX Starship-Super Heavy Launch Vehicle

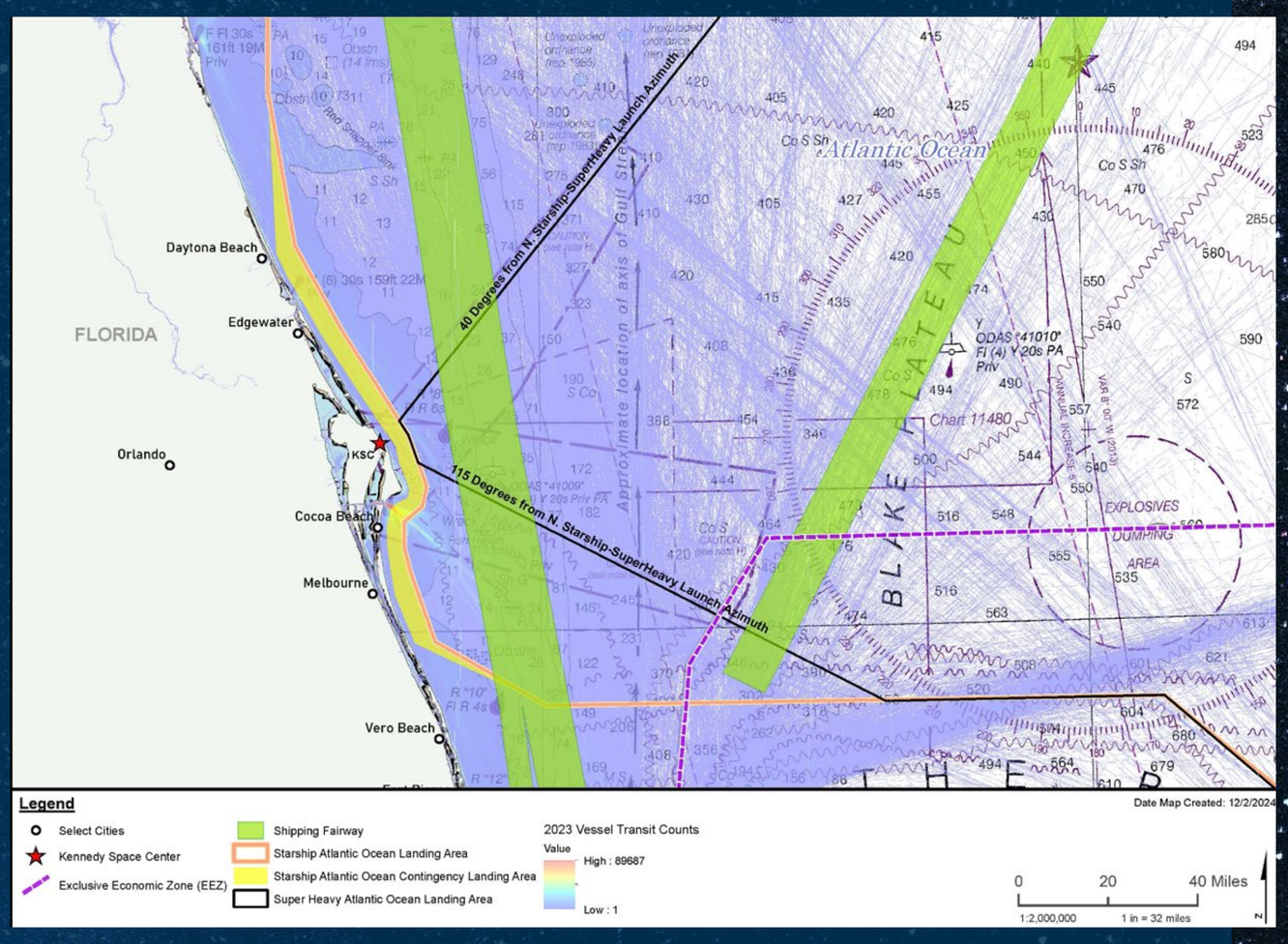
AT LAUNCH COMPLEX 39A AT THE KENNEDY SPACE CENTER, MERRITT ISLAND, FLORIDA

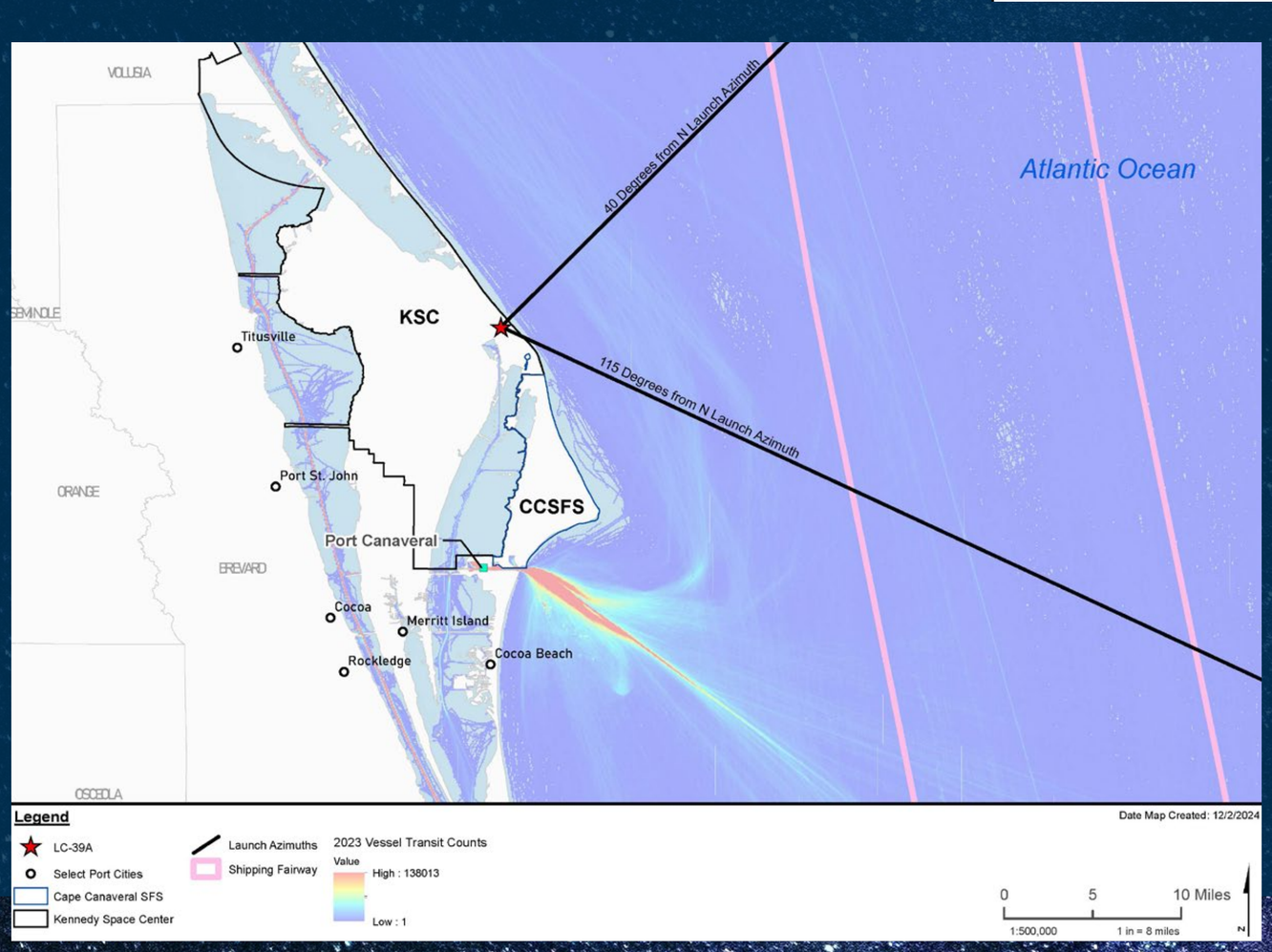
What are the Environmental Impacts?

Transportation

Maritime

- Vessel traffic is high to and from Port Canaveral
  - Closures mostly affect northbound traffic and only the southeast launch hazard area potentially affects southbound traffic
  - Located near an active spaceport, Port Canaveral is familiar with scheduling for launch RNAs
- Temporary water restrictions would occur more frequently, and interested parties would be notified via Notices to Mariners (NOTMARs)
- The USCG issues NOTMARs to alert the maritime community of potential hazards in navigable waterways. These notifications do not alter or close shipping lanes, but ensure that mariners can plan around temporary disruptions





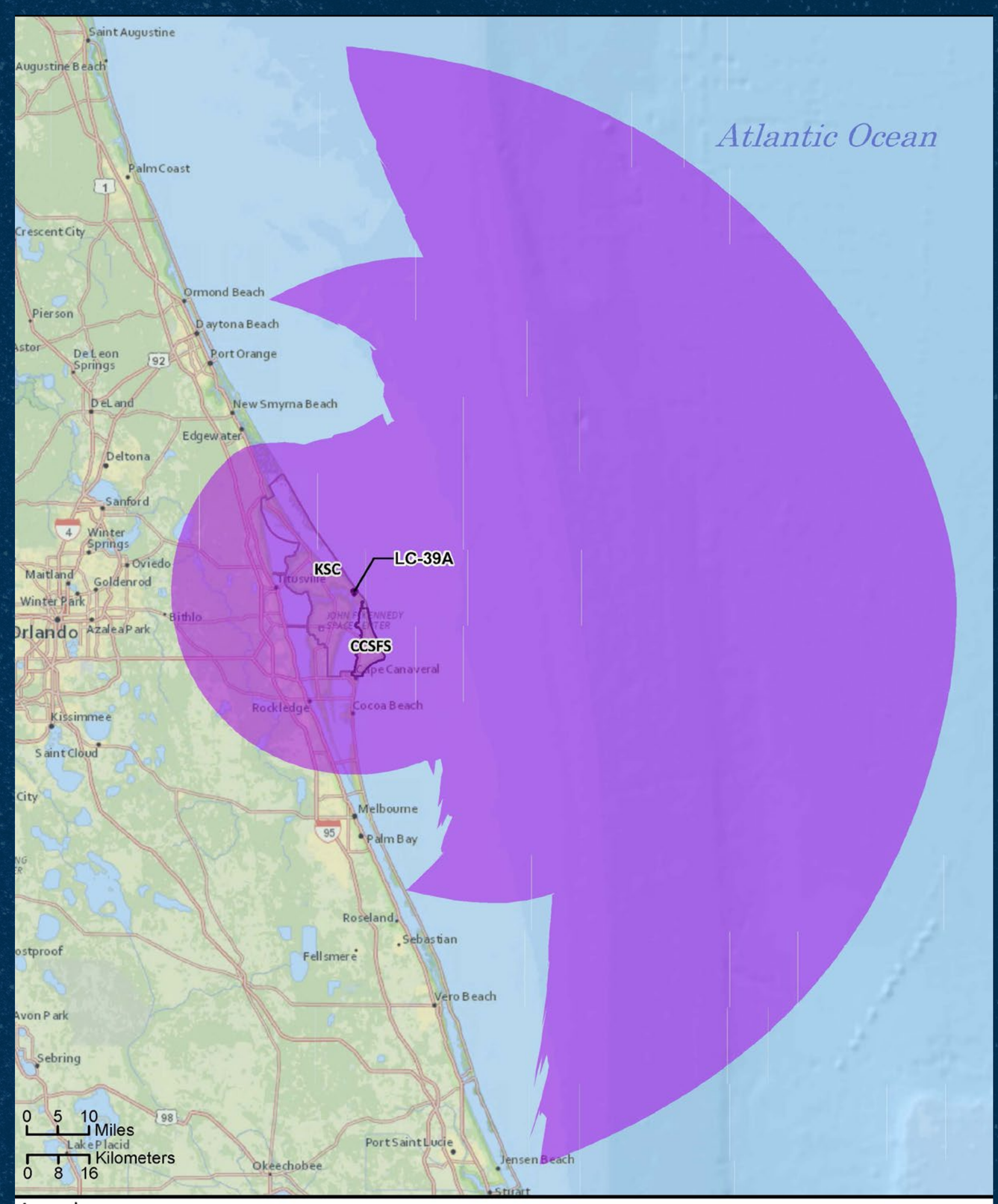
Environmental Impact Statement for SpaceX Starship-Super Heavy Launch Vehicle

AT LAUNCH COMPLEX 39A AT THE KENNEDY SPACE CENTER, MERRITT ISLAND, FLORIDA

What are the Environmental Impacts?

Biological Resources

- Includes native vegetation, wildlife, and habitats. Considers protected species, invasive species, and non-native species
- In the study area, there are:
  - 48 federally listed species
  - Designated critical habitat for 4 species
  - Proposed critical habitat for 4 species
- NASA is conducting formal consultation with the U.S. Fish and Wildlife Service to determine whether the Proposed Action may affect Endangered Species Act (ESA)-listed species and critical habitat
- The FAA is conducting formal consultation with the National Marine Fisheries Service to determine whether the Proposed Action may affect ESA-listed marine species or designated critical habitat



BIOLOGICAL RESOURCES
LAUNCH STUDY AREA

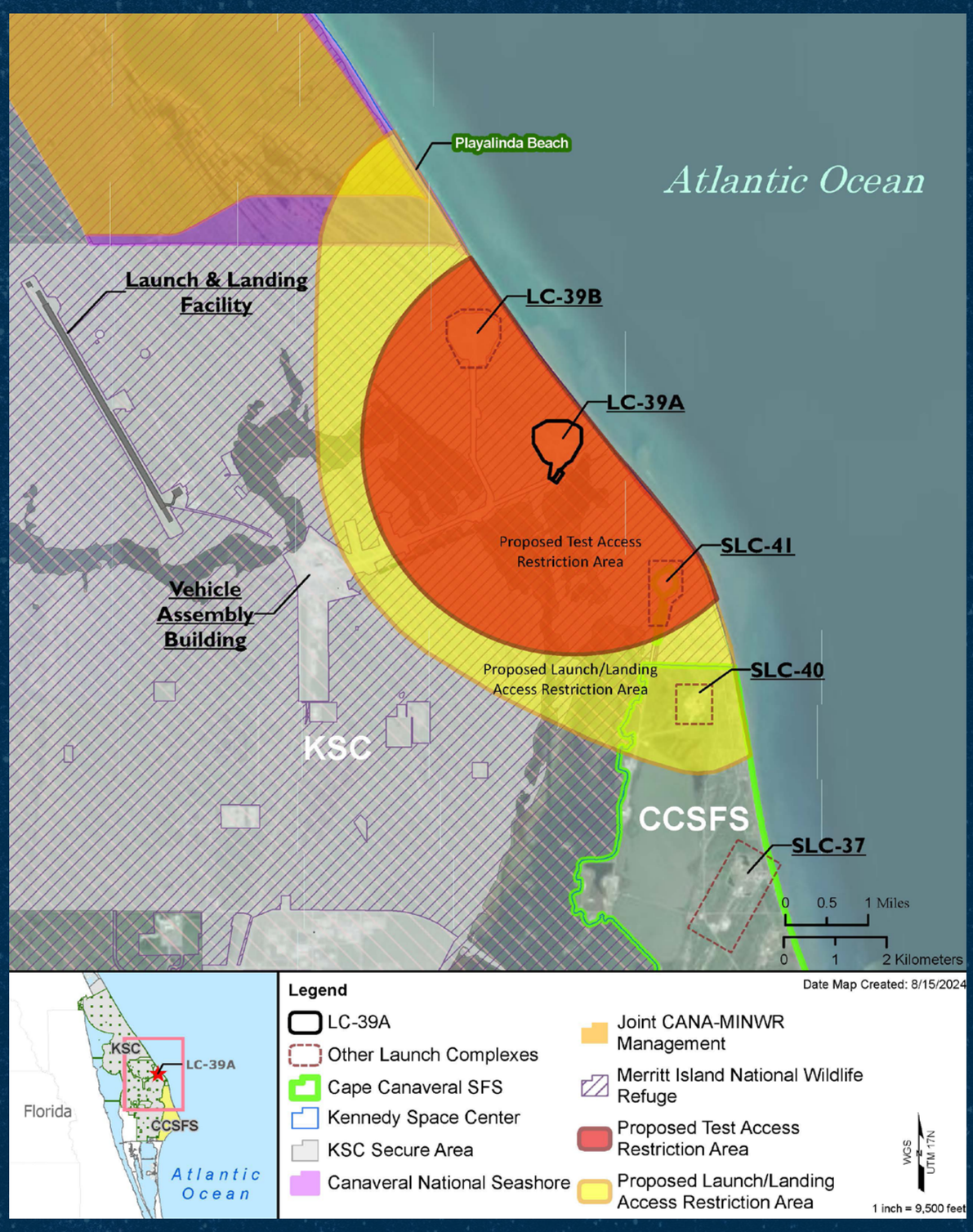
Environmental Impact Statement for SpaceX Starship-Super Heavy Launch Vehicle

AT LAUNCH COMPLEX 39A AT THE KENNEDY SPACE CENTER, MERRITT ISLAND, FLORIDA

What are the Environmental Impacts?

Land Use

- Land uses at and in the vicinity of KSC would not change
- Effects to recreational land use in the surrounding study area would occur due to increased noise events, public exposure, access restrictions, and closures
- Pre-launch and closure-related procedures would be implemented to establish a safe and secure environment for launches
- Closures (e.g., beach) would be temporary



Department of Transportation Section 4(f)

- Construction activities would not involve use of any Section 4(f) property
- Operation would not result in constructive use[1] of any Section 4(f) property
- The Proposed Action would not result in substantial impairment of resources protected under Section 4(f)
- The FAA is applying the Joint Use Planning exemption for the seashore and refuge
- The FAA sent letters to officials with jurisdiction over the Section 4(f) properties within the study area. The letters included a copy of the Section 4(f) Use Determination Report which identified Section 4(f) properties within the study area and an analysis of the effects of the Proposed Action on the Section 4(f) resources

[1]Constructive use occurs when the impacts of a project on a Section 4(f) property are so severe that the activities, features, or attributes that qualify the property for protection under Section 4(f) are substantially impaired.

Environmental Impact Statement for SpaceX Starship-Super Heavy Launch Vehicle

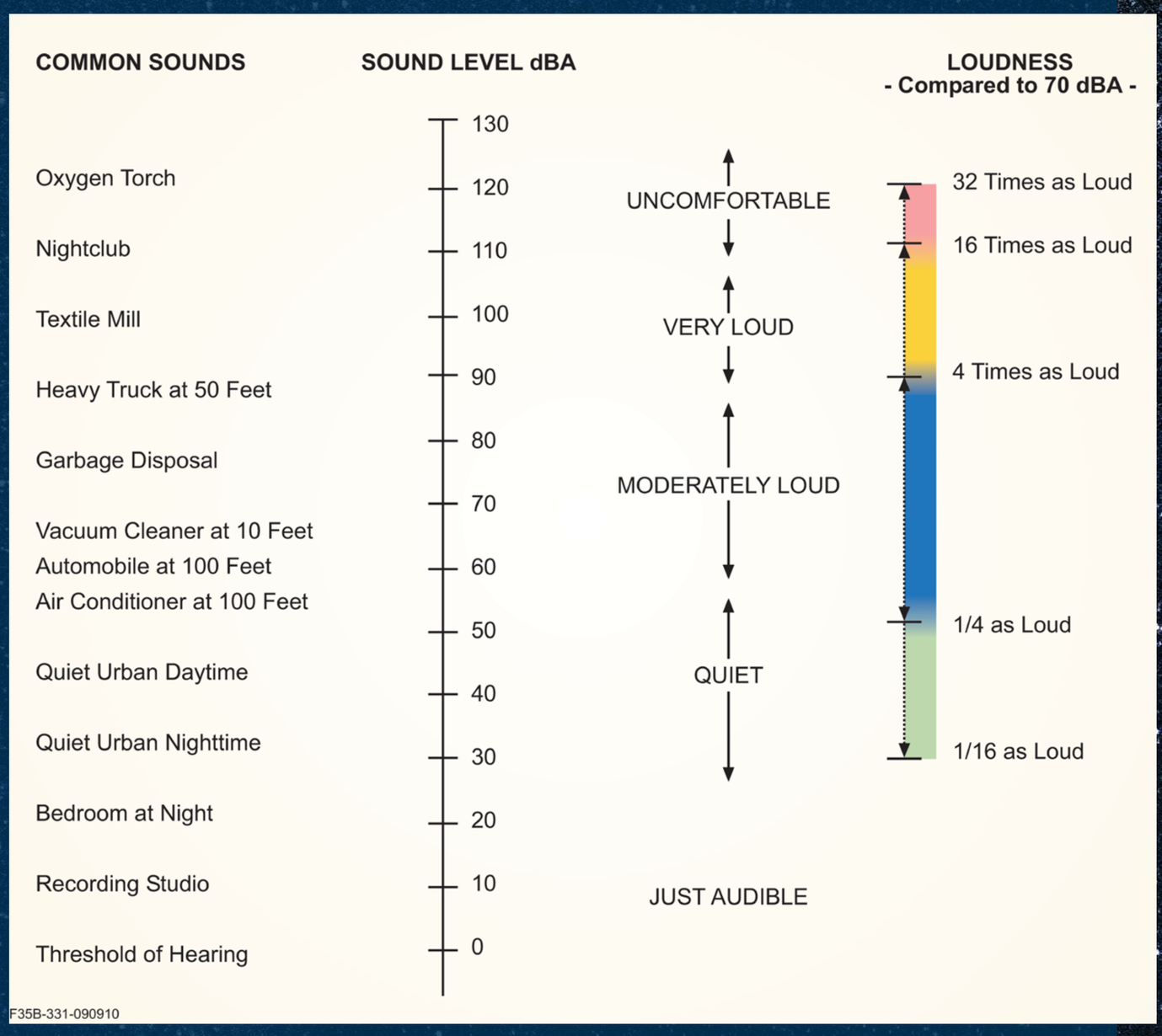
AT LAUNCH COMPLEX 39A AT THE KENNEDY SPACE CENTER, MERRITT ISLAND, FLORIDA

What are the Environmental Impacts?

Noise

Perception and evaluation of sound involves three basic physical characteristics:

- **Duration** Length of time the sound can be detected
- **Magnitude** Acoustic energy, which is expressed in terms of sound pressure, in decibels (dB)
- **Frequency** Number of cycles per second the air vibrates, in hertz



Decibel Sound level of 0 dB is approximately the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB

Weighted Decibel Sound levels that have been adjusted to account for frequencies heard best by the human ear are designated A-weighted dB (dBA) levels

Maximum Noise Level (L_{max}) Highest sound level measured during a single event in which the sound level changes with time (e.g., a rocket launch)

A-Weighted Sound Exposure Level (ASEL) Used to assess the total energy of a sound event, allowing for a standardized comparison of noise exposure

Sound Exposure Level (SEL) Represents both the magnitude of a sound and its duration by stating total noise energy of an event as if the event occurred within a single second

Day-Night Average Sound Level (DNL) The dB-averaged sound level measured over a 24-hour period, with a 10dB penalty assigned to noise events occurring between 10:00 p.m. and 7:00 a.m. to account for added intrusiveness of late-night noise

C-Weighted Day-Night Average Sound Level (CDNL) CDNL metric is a version of the DNL metric described above calculated based on dBC levels

Peak Particle Velocity (PPV) Metric can be used to describe the vibratory motion of objects. The PPV metric is used in assessments of the potential for effects to structures

Sonic Boom Overpressure measured in Pounds per Square Foot (psf) A sonic boom is a pressure wave created when an object moves through air faster than the speed of sound. The psf metric is useful for describing listener experiences and assessing potential structural damage

Environmental Impact Statement for SpaceX Starship-Super Heavy Launch Vehicle

AT LAUNCH COMPLEX 39A AT THE KENNEDY SPACE CENTER, MERRITT ISLAND, FLORIDA

What are the Environmental Impacts?

Noise

Noise associated with Starship-Super Heavy at LC-39A would result from construction, facility operation, static fire tests, launches, and landings

- Extensive off-installation land use incompatibility with CDNL
- High predicted percent sleep disturbance from primarily sonic booms
- Hearing loss risk is low and managed through existing programs on KSC and CCSFS
- Launches and landings would occur in the daytime[1] and nighttime[2]
  - 22 daytime launches, 22 daytime landings (per vehicle) per year
  - 22 nighttime launches, 22 nighttime landings (per vehicle) per year
- Static fire tests would only occur during the daytime
  - 44 Super Heavy Booster static fire tests per year
  - 44 Starship static fire tests per year
  - Each test planned to last for 15 seconds
- Highest noise levels caused by Starship-Super Heavy launches would occur within
  - Titusville
  - Port Saint John
  - Merritt Island
  - Cape Canaveral
  - and others

[1]Daytime refers to the hours of 7:00 a.m. to 10:00 p.m. [2]Nighttime refers to the hours of 10:00 p.m. to 7:00 a.m.

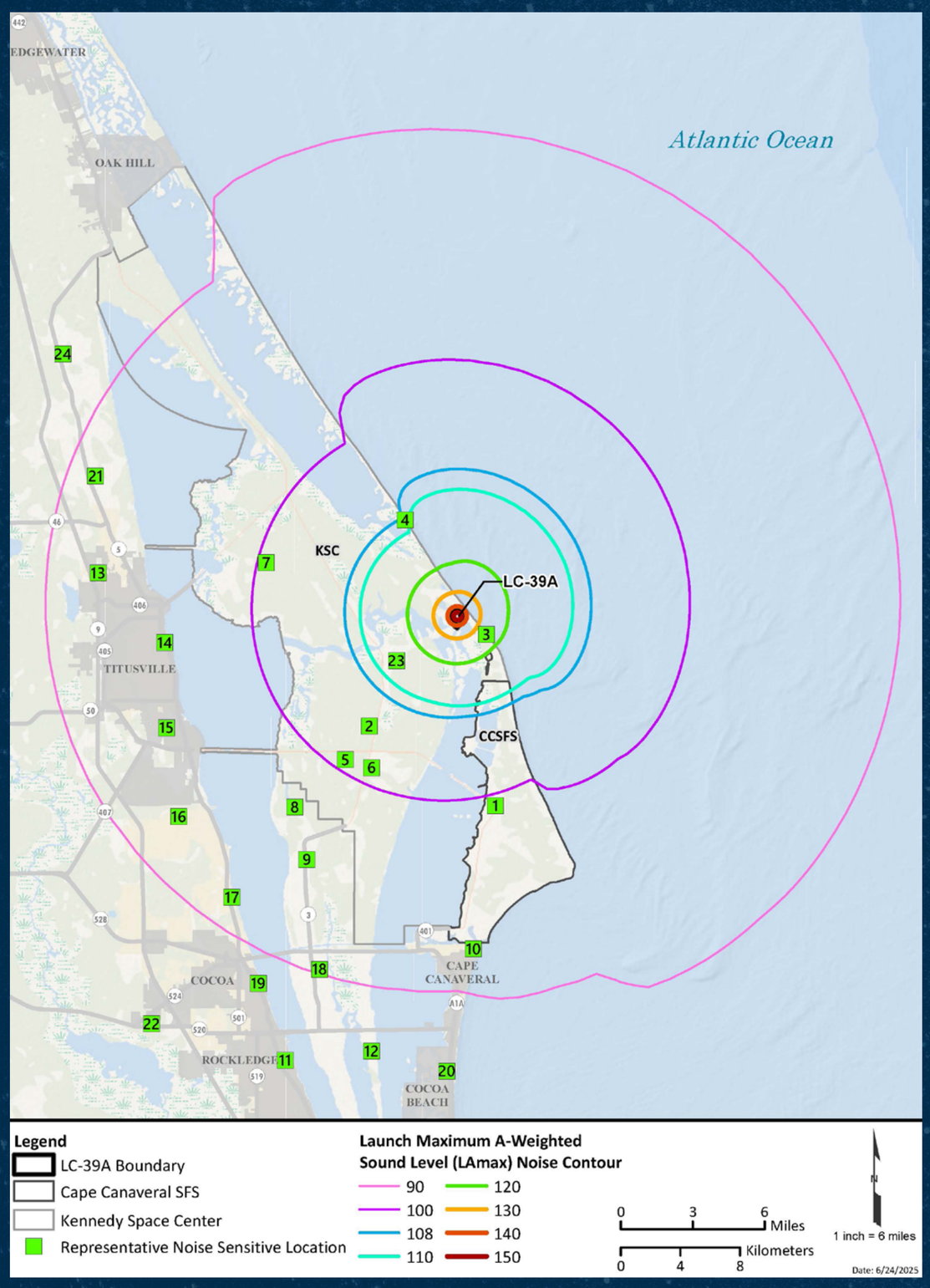
Environmental Impact Statement for SpaceX Starship-Super Heavy Launch Vehicle

AT LAUNCH COMPLEX 39A AT THE KENNEDY SPACE CENTER, MERRITT ISLAND, FLORIDA

What are the Environmental Impacts?

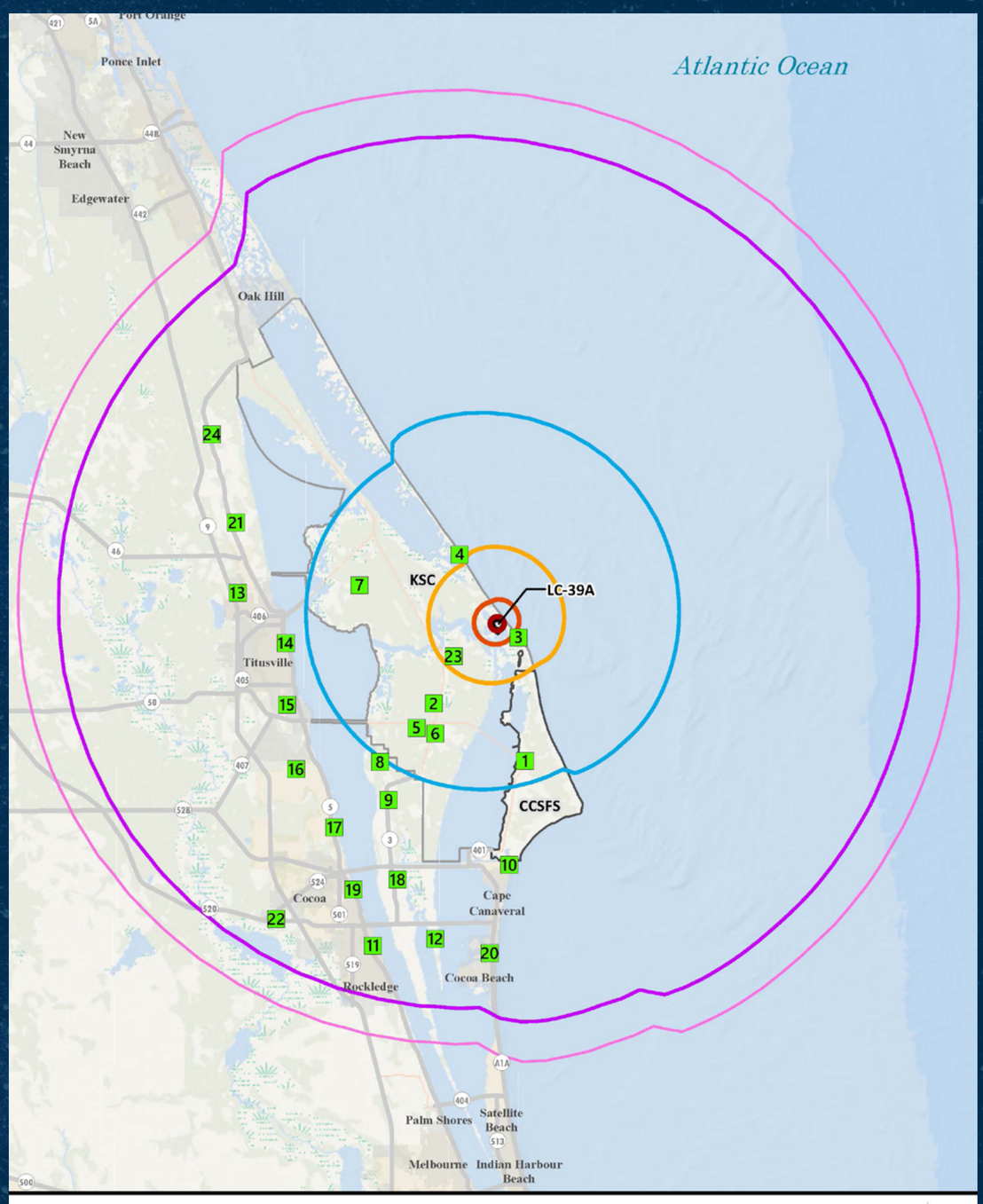
Noise and Noise-Compatible Land Use Effects

STARSHIP LAUNCH A-WEIGHTED SOUND LEVEL (LA_{MAX})



LA_{max} represents the highest A-weighted decibel measure of the sound level at any given time during the event. A-weighting approximates the natural range and sensitivity of human hearing.

STARSHIP LAUNCH MAXIMUM UNWEIGHTED SOUND LEVEL (L_{MAX})

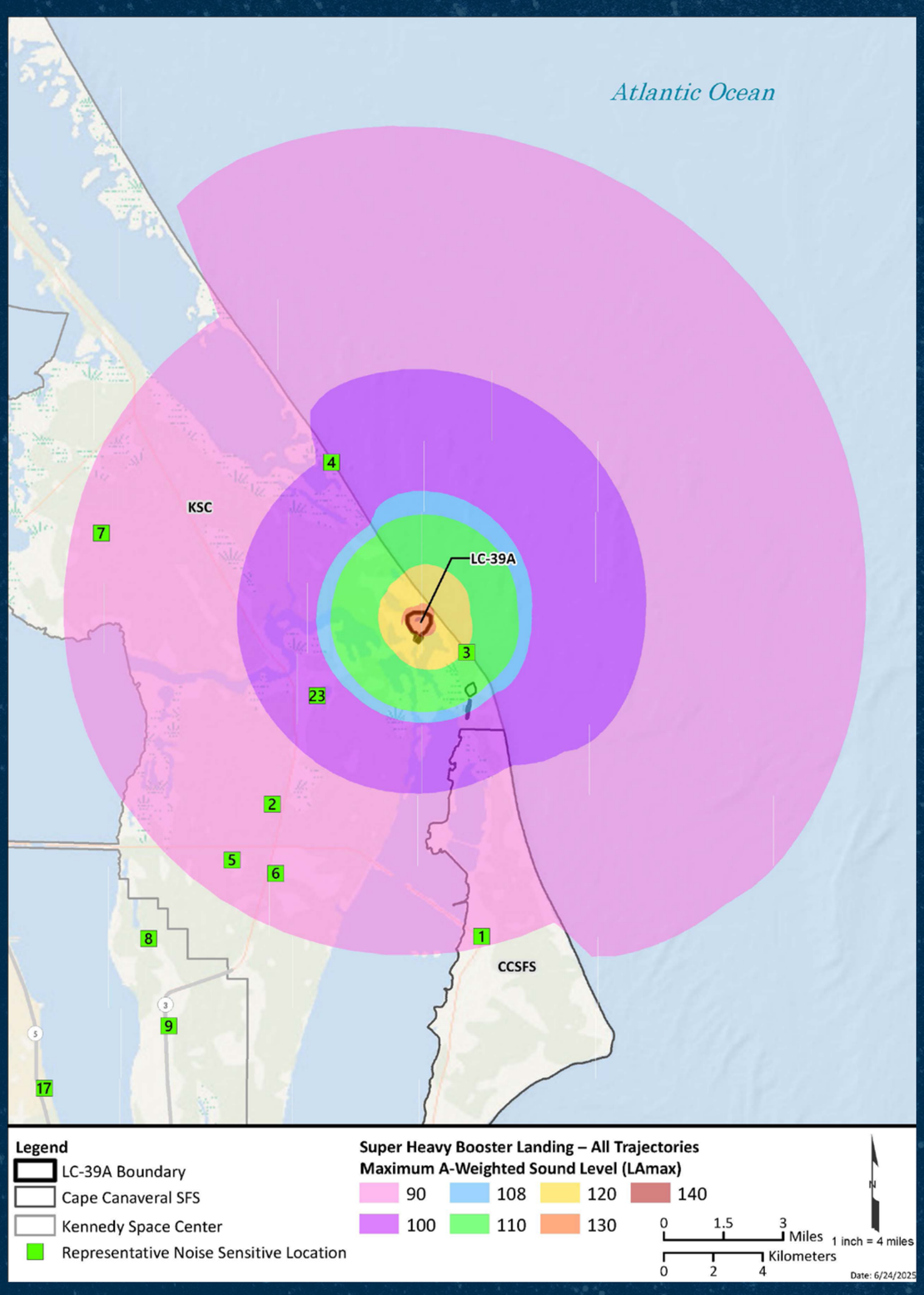


Environmental Impact Statement for SpaceX Starship-Super Heavy Launch Vehicle

AT LAUNCH COMPLEX 39A AT THE KENNEDY SPACE CENTER, MERRITT ISLAND, FLORIDA

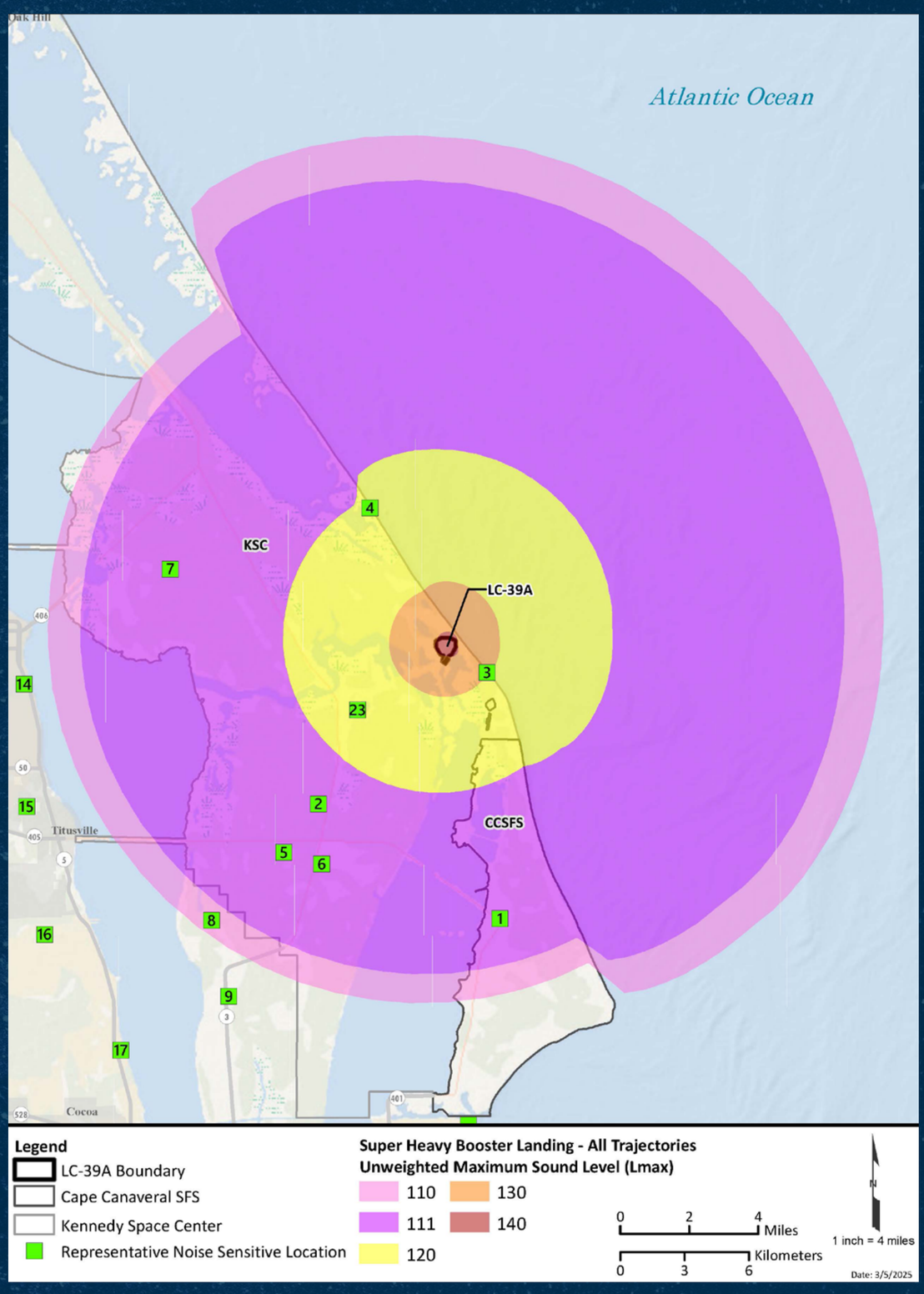
What are the Environmental Impacts?

Noise and Noise-Compatible Land Use Effects



SUPER HEAVY BOOSTER LANDING MAXIMUM A-WEIGHTED SOUND LEVEL (LA_{MAX})

LA_{max} represents the highest A-weighted decibel measure of the sound level at any given time during the event. A-weighting approximates the natural range and sensitivity of human hearing.



SUPER HEAVY BOOSTER LANDING UNWEIGHTED MAXIMUM SOUND LEVEL (L_{MAX})

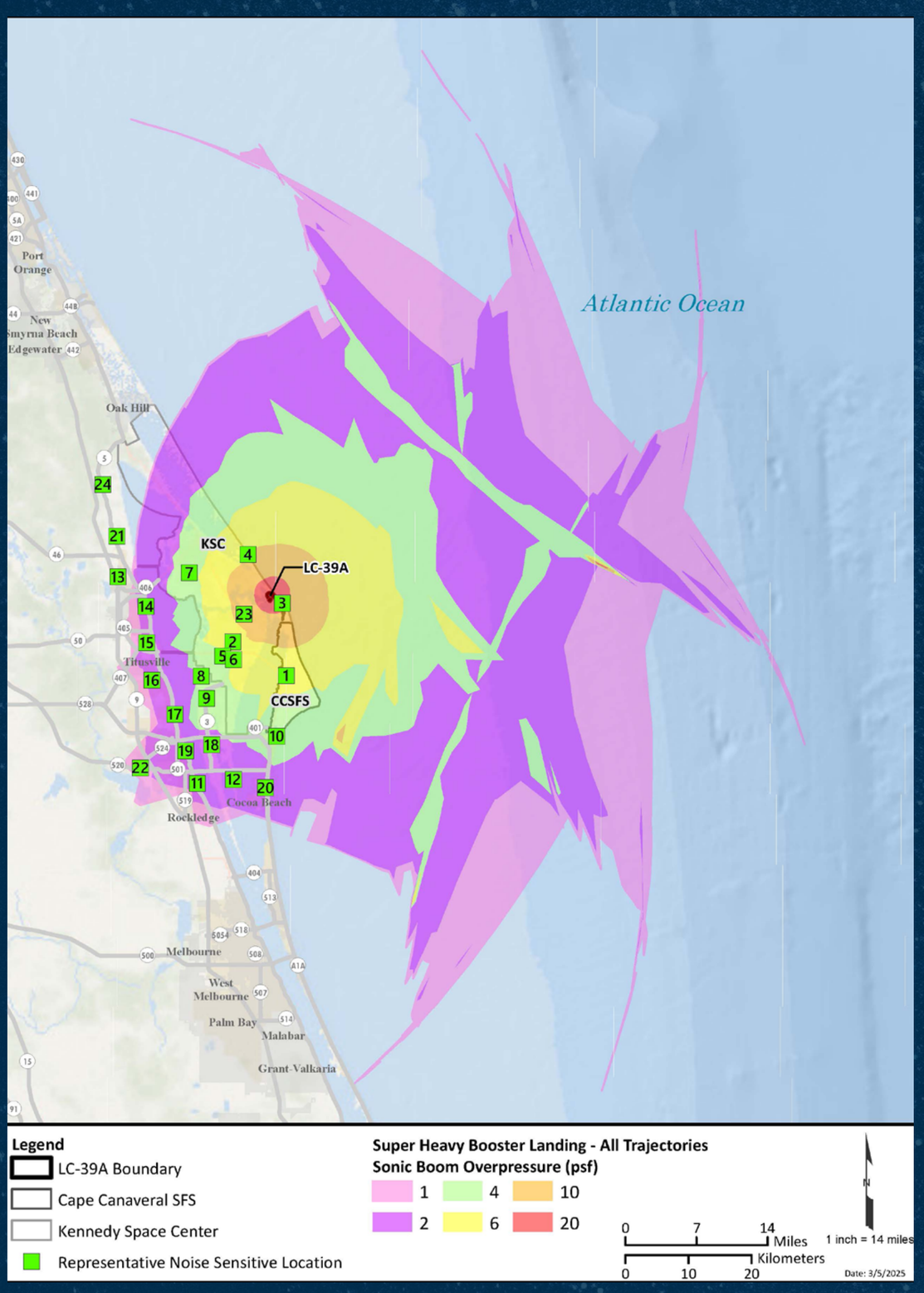
Environmental Impact Statement for SpaceX Starship-Super Heavy Launch Vehicle

AT LAUNCH COMPLEX 39A AT THE KENNEDY SPACE CENTER, MERRITT ISLAND, FLORIDA

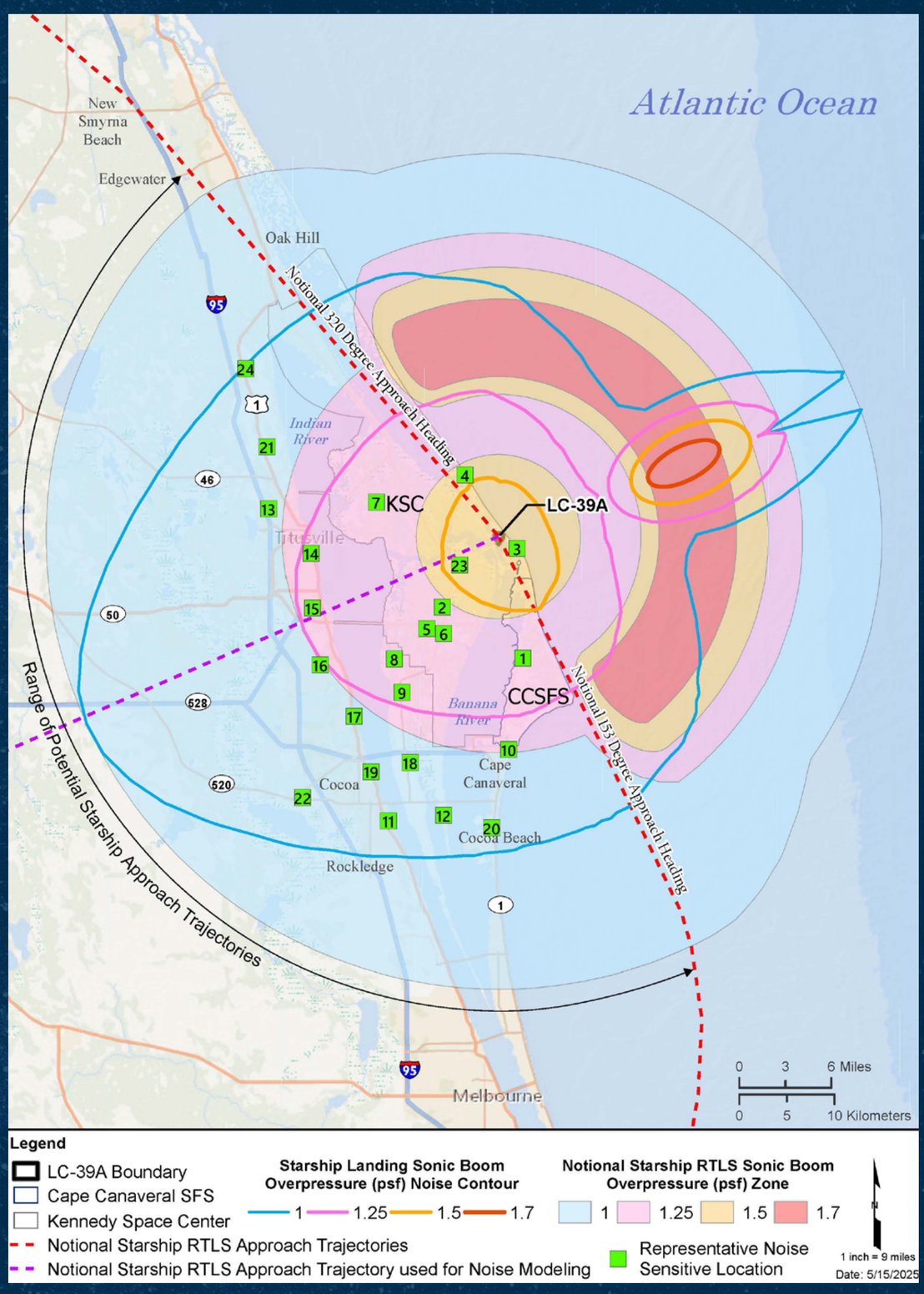
What are the Environmental Impacts?

Noise and Noise-Compatible Land Use Effects

SUPER HEAVY BOOSTER LANDING SONIC BOOM OVERPRESSURE (PSF)*



NOTIONAL STARSHIP RETURN TO LAUNCH SITE (RTLS) SONIC BOOM OVERPRESSURE (PSF)



*Maximum overpressure for sonic boom events is reported in psf (pound per square foot)

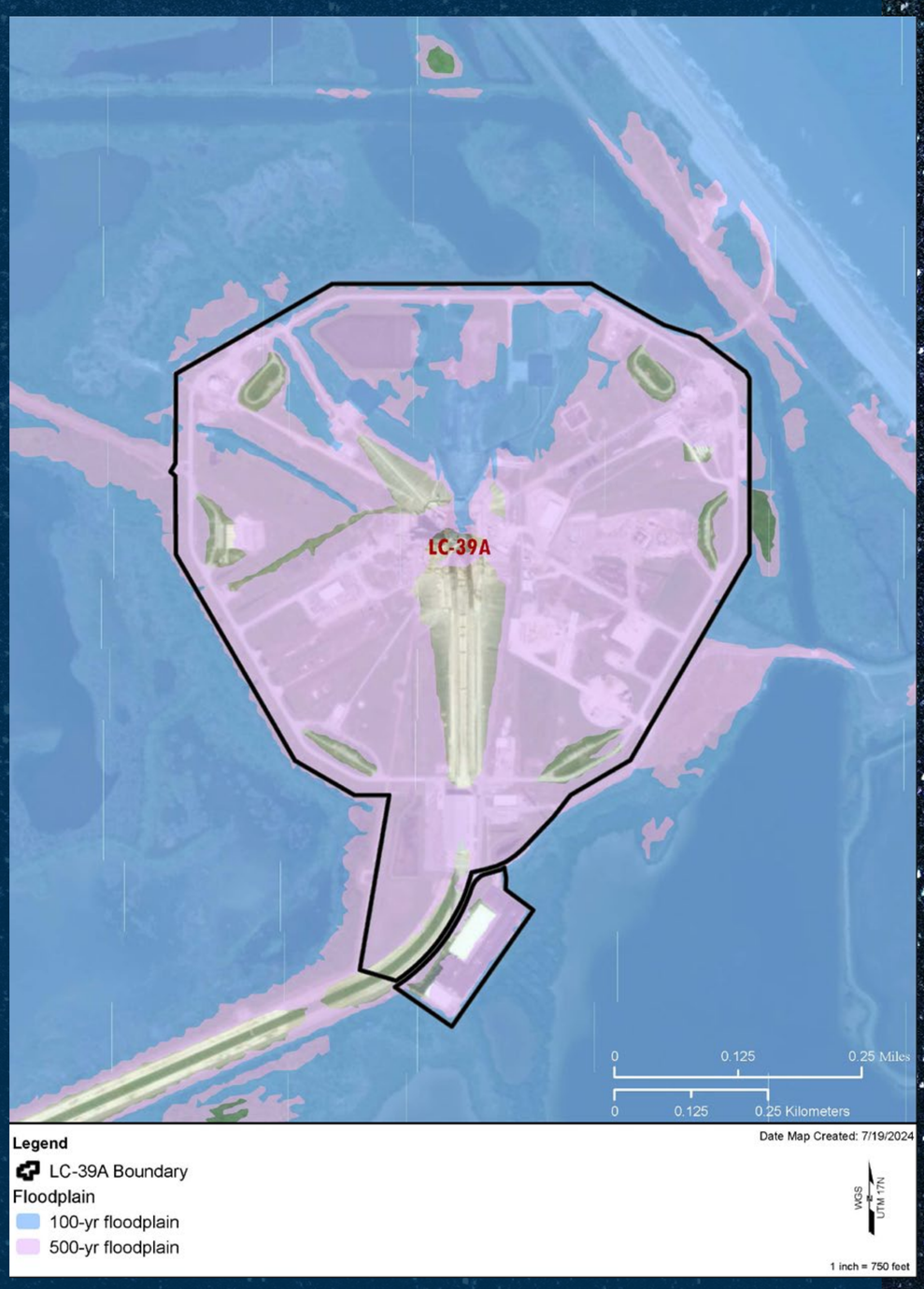
Environmental Impact Statement for SpaceX Starship-Super Heavy Launch Vehicle

AT LAUNCH COMPLEX 39A AT THE KENNEDY SPACE CENTER, MERRITT ISLAND, FLORIDA

What are the Environmental Impacts?

Water Resources

- Wetlands
  - No wetlands within LC-39A
  - Operations would not significantly affect adjacent wetlands due to stormwater controls
- Floodplains
  - Both the 100-year and 500-year floodplains have been designated within LC-39A
  - Construction and operation would not result in significant effects to floodplains due to facility design considerations



- Surface Waters
  - KSC is located within the Banana River sub-watershed of the Indian River Lagoon watershed
  - KSC is bounded to the east by the Atlantic Ocean and to the west by the Banana River
  - Construction and operation would not result in significant effects to surface waters due to permit-related construction stormwater controls, and operations controls such as retention/evaporation ponds. No wastewater would be released into adjacent surface waters
- Groundwater
  - Groundwater at KSC is not used for drinking water
  - SpaceX currently operates under a Florida Department of Environmental Protection industrial wastewater permit at LC-39A
  - Construction and operation would not result in significant effects to groundwater
- Wild and Scenic Rivers
  - No Wild and Scenic rivers are within the study area

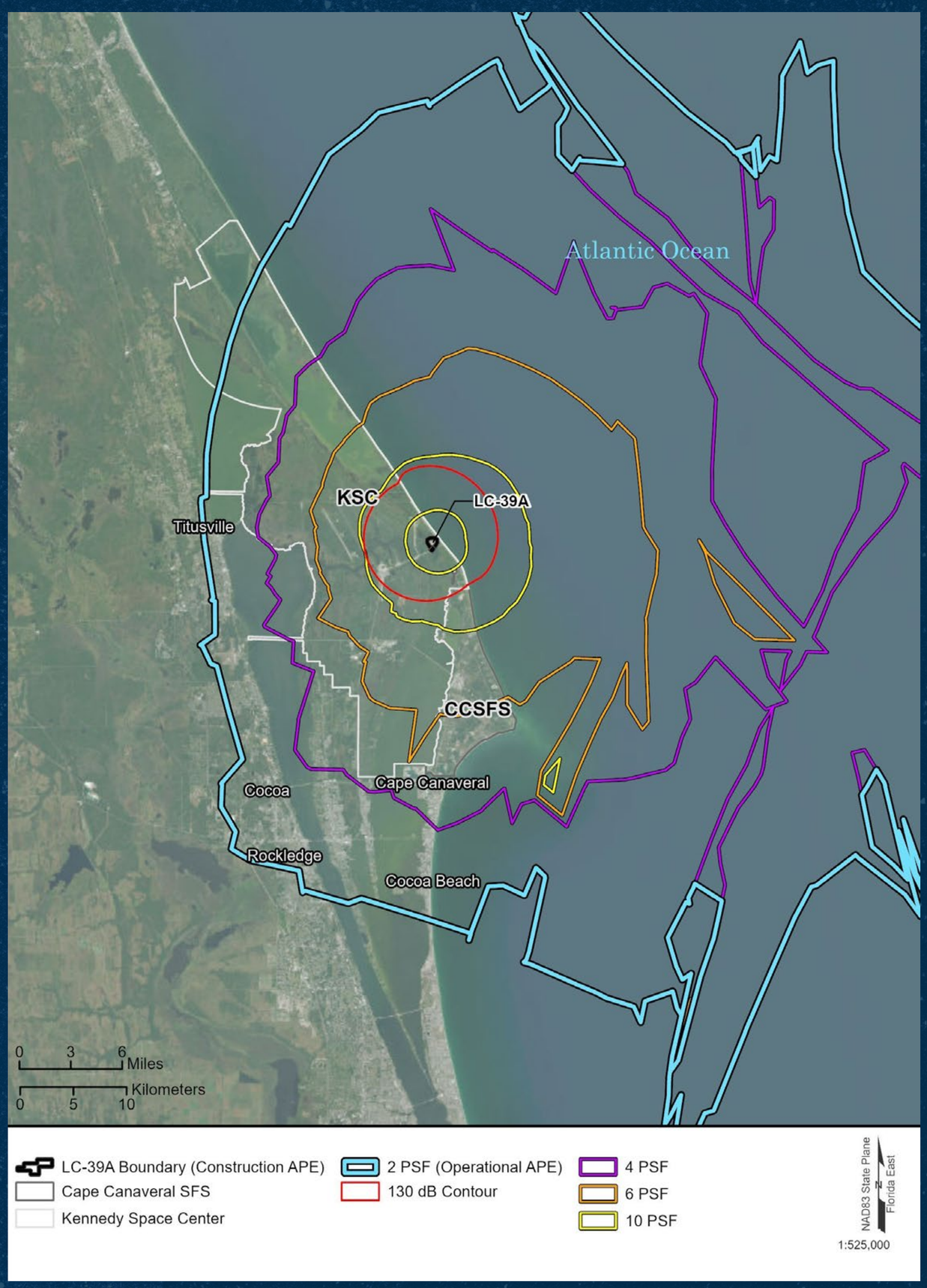
Environmental Impact Statement for SpaceX Starship-Super Heavy Launch Vehicle

AT LAUNCH COMPLEX 39A AT THE KENNEDY SPACE CENTER, MERRITT ISLAND, FLORIDA

What are the Environmental Impacts?

Historical, Architectural, Archaeological, and Cultural Resources

- Construction Area of Potential Effects (APE)
  - Construction APE is limited to the existing boundaries of LC-39A
  - Proposed new construction would not pose viewshed effects to historic properties
- Operational APE
  - Operational APE considers the proposed auditory effects as well as the over-pressure effects of the sonic boom generated during atmospheric reentry
  - Significant impacts to historical, architectural, and cultural resources would be unlikely due to the infrequency of damage to these kinds of resources when exposed to sonic boom overpressure events and vibratory effects
  - NASA is continuing Section 106 consultation with the Florida State Historic Preservation Office, federally recognized Indian tribes, and other consulting parties
  - NASA intends to execute a Programmatic Agreement to guide future identification, evaluation, monitoring, and mitigation that may be determined necessary



Environmental Impact Statement for SpaceX Starship-Super Heavy Launch Vehicle

AT LAUNCH COMPLEX 39A AT THE KENNEDY SPACE CENTER, MERRITT ISLAND, FLORIDA

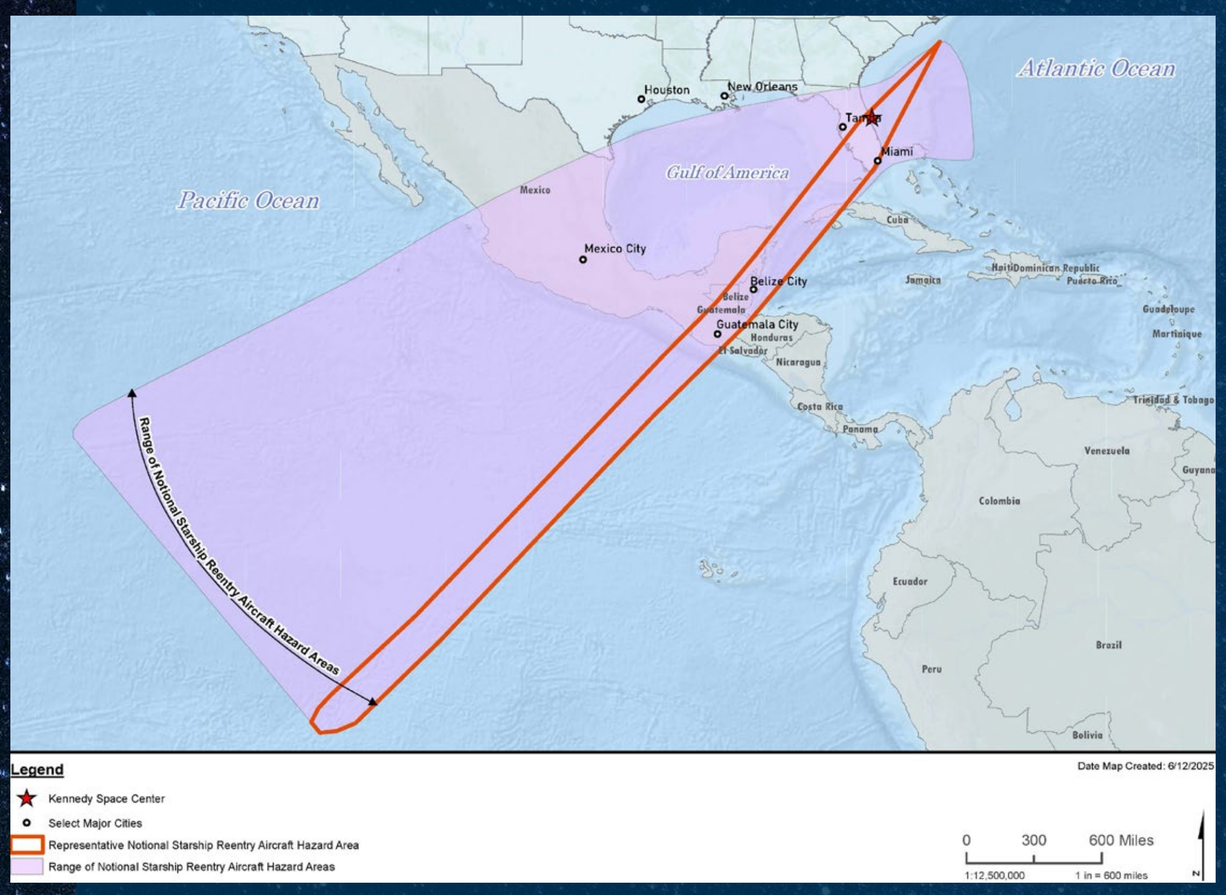
What are the Environmental Impacts?

Airspace

The FAA approves airspace closures for launch and landing operations to ensure public safety.

- Operations associated with the Proposed Action could result in the following effects:
  - Launch and Super Heavy booster returns may necessitate the temporary closure of airways over the Atlantic Ocean and affect the airspace of the Bahamas[1]
  - Starship reentry may necessitate the temporary closure of airways over portions of the Pacific Ocean, Gulf of America, Caribbean Sea, and Atlantic Ocean and affect the airspace of several Central American countries[1]

- The Proposed Action may result in significant aircraft rerouting to avoid the Aircraft Hazard Areas (AHAs). Multiple airports may require ground stops due to the overlying AHAs. The average expected flight delay could be:
  - Launches/booster landings – approximately 40 minutes and could last up to two hours
  - Starship reentries – approximately 40 minutes and could be up to one hour



- All launch and reentry operations would comply with necessary notification requirements, including issuance of Notices to Airmen (NOTAMs) and identification of AHAs that assist pilots in scheduling around temporary disruption of flight activities:
  - The FAA would conduct collaboration between space operators, commercial airlines, general aviation, and defense stakeholders

[1]Specific airspace routes affected would be dependent on the actual trajectory of the launch, return, and reentry.