

STARSHIP

OVERVIEW OF BIOLOGICAL ASSESSMENT ADDENDUM

August 2023



SpaceX Proprietary Information

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Launch Pad

Starship-Super Heavy
integrated on launch
mount

Deluge water tanks

Flame Divertor
underneath launch
mount



Suppression System

Purpose: The water-cooled flame diverter system is designed to protect ground systems, payloads, and launch vehicles by suppressing noise, vibration, heat, fire, and dust.



Plume of rocket with no deluge



Plume of rocket with deluge



DELUGE SYSTEM

- The deluge system would be activated during each ignition event on the orbital launch pad including engine ignition tests and vehicle launches.
- The October 2021 BA and May 2022 BCO contemplated 10 annual licensed operations per year (Starship hops and launches combined).
 - Each launch includes two static fire engine tests, so the BA amendment assumes 30 activations of the system per year.
- The amount of water applied during activation of the deluge system will differ depending on the type of ignition event. It is estimated that approximately 72,000 gallons of water would be used for each static fire, and approximately 132,000 gallons of water for each launch event.
- The maximum volume of water available in the tanks is 358, 000 gallons



DELUGE SYSTEM COMPONENTS

- **Water Storage:**

- The deluge system water will be stored in water storage tanks located within one or more of the tank farm areas of the Vertical Launch Area (VLA).

- **Press Tank:**

- The press tank is a storage tank pressurized with nitrogen gas at 3,000 pounds per square inch (psi) which provides the driving force to expel the water when the deluge system is activated.

- **Pumping System and Piping Network:**

- A system of pumps will move water from the water storage tanks to the piping network of the deluge system.

- **Control System and Valves:**

- The control system is used to activate and deactivate the deluge system and includes sensors, actuators, and a central control unit to monitor water levels, pressures, and system status.

- **Water Containment:**

- Most of the water applied during deluge operations will be captured by containment structures within the VLA. These containment structures include gutters, a retention basin below the launch pad, one or more retention ponds, and berms.
- SpaceX has constructed retention ponds within the VLA with a capacity of 276, 000 gallons of containment, with plans to add an additional 30, 000 gallons of storage.



DELUGE WATER DISPERSAL

- **Vaporization – 92% of water volume when engines running**
 - The heat and the thrust from the rocket fire quickly vaporize most of the water applied by the deluge system and would generate a condensate cloud of steam and aerosolized mist.
 - With the addition of the water, the distance the heat travels is expected to be within 0.2 miles of the pad.
- **Push Out – Portion of the total 20% water volume**
 - Prior to engine ignition, the deluge water is activated and the water collects on the pad
 - When the engine ignites, some of the water applied by the deluge system could be pushed by the rocket thrust past the containment structures beyond the boundary of the existing developed area of the VLA.
 - Similar to the possible extent of overland sheet flow, it is expected that pushed water would infiltrate the areas immediately adjacent to the site, or flow into adjacent water bodies.
- **Overland Sheet Flow – Portion of the total 20% water volume, expected to be minimal, if any**
 - Some of the deluge water would disperse over land as sheet flow. Most of the sheet flow will be contained within the VLA by the water containment structures and confined to the existing developed area of the VLA.
 - It is possible that some sheet flow would either evade or overwhelm the containment structures and enter into the areas immediately adjacent to the developed area of the VLA.



ENVIRONMENTAL ANALYSIS

(b) (4)



ENVIRONMENTAL ANALYSIS

- **Water Quality**

- A vapor cloud would form as a result of the rocket engine fire vaporizing water from deluge system operation. The rocket engine fire includes exhaust from the combustion of the propellant fuels. The launch vehicles use only liquid oxygen (LOX) and cryogenic liquid methane (LCH₄).
- The exhaust produced from the combustion of LCH₄ and LOX in the rocket engine primarily consists of carbon dioxide (CO₂) and water vapor (H₂O); thus, the exhaust cloud would consist mainly of CO₂ and steam and would contain only trace amounts of other combustion byproducts such as carbon monoxide (CO) and nitrogen oxides (NO_x).
- None of the combustion byproducts are expected to degrade the quality of water that may leave the VLA.

- **Truck Traffic**

- The initial filling of the water storage tanks will require deliveries by tanker trucks from either the nearby town of Brownsville or from Starbase. An average large-capacity tanker truck will hold approximately 5,000 gallons. Filling the water storage tanks to the 361,000-gallon capacity would require 73 truck trips.
- The original BA stated it was anticipated that the combined construction activity and SpaceX staff vehicles would add up to 505 vehicles per day along State Highway 4.
- Assuming the entire capacity of the water tanks is depleted between each ignition event and needs to be fully refilled, which is unlikely, the maximum additional traffic from water truck deliveries would add less than 1% to this estimated daily traffic load of trucks.



ENVIRONMENTAL ANALYSIS

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MEASURES TO MINIMIZE ADVERSE EFFECTS

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Overhead View – Deluge System

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NEXT STEPS?



BACK UP ON SPECIES



ADDITIONAL SPECIES INFORMATION

- Northern Aplomado Falcon

- The October 2021 BA and May 2022 BCO determined the species was likely to be adversely affected due to the construction of the new infrastructure that could attract falcons to the launch site for nesting and perching. Perching and potential foraging habitat exist within the deluge impact area.

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- Piping Plover and Critical Habitat

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ADDITIONAL SPECIES INFORMATION

- Red Knot and Critical Habitat

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- Gulf Coast Jaguarundi and Ocelot

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- Sea Turtles

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