

# Site Suitability Analysis – Heber North Campus Launch Tower Zone

Revised for Mag-Rail Pod Launch Architecture – November 2025

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## 1. Introduction

This revised site suitability analysis reflects the updated SDC-COMMS launch architecture for the Heber North Campus Launch Tower Zone. In contrast to the originally assumed vertical rocket launch scenario, the launch system will employ an **electromagnetic mag-rail accelerator** housed within a dedicated launch tower. The vehicle (a **launch pod**) is accelerated to approximately **1,500 m/s** within an enclosed tunnel-like tower, achieving a high initial velocity without any **surface rocket ignition or thrust**. Only after the pod exits the tower and coasts to roughly **10 km altitude** are its **solid rocket motors (SRMs)** ignited to propel the payload to orbit. This fundamental change in launch method eliminates the conventional blast-off at ground level and thus **significantly alters the environmental and operational impacts** at the site. Key differences include the absence of a flame plume and acoustic shock at liftoff, greatly reduced on-site fire/heat hazards, a lower ground-level acoustic signature, and a modified regulatory compliance profile. The analysis below updates each relevant section of the site suitability evaluation to **highlight these differences from a traditional rocket launch**, while preserving the original report's structure and citations.

## 2. Launch System Architecture Overview

The SDC-COMMS launch architecture centers on a **mag-rail launch tower** instead of an open-air launch pad. The tower serves as a **sealed acceleration tunnel** wherein the launch pod is magnetically propelled. This structure replaces many elements of a conventional pad: there are **no flame trenches, no surface exhaust ducts, and no water deluge sound suppression system** required. In a typical rocket launch, engine exhaust exceeding the speed of sound collides with ambient air to produce intense **shockwaves (~200 dB)** and overpressure <sup>1</sup>, necessitating large flame deflectors and water injection systems to protect the vehicle and pad <sup>2</sup>. In the mag-rail system, by contrast, the launch energy is imparted electromagnetically and **enclosed within the tower**, so there is **no open rocket exhaust** at ground level. The launch tower itself contains and guides the vehicle's initial acceleration, and any noise or pressure is largely confined to the structure. The vehicle exits at high velocity through the top of the tower (via a fast-actuating aperture or similar mechanism) without igniting engines. As a result, **SRM ignition and free flight commence only at high altitude (~10 km)**, well above the surface. This architecture effectively moves the most hazardous aspects of launch (combustion, flame, and high-thrust propulsion) away from the ground and into the upper atmosphere. The site infrastructure emphasis thus shifts from flame

handling and sound suppression to **power supply and structural support** for the electromagnetic launcher (e.g. capacitor banks, guide rails, vacuum pumping systems), which are inherently less publicly hazardous at the surface. All other launch support facilities (command and control, payload integration, safety radius, etc.) remain in place, but they benefit from the reduced on-pad risk profile.

### 3. Acoustic and Overpressure Impacts

One of the most significant differences with the mag-rail launch system is the **drastic reduction in acoustic energy and blast overpressure at ground level**. Traditional rocket launches generate extreme noise and pressure waves at ignition: rocket exhaust produces **sound pressure levels approaching 200 dB** near the pad <sup>1</sup>, and the initial overpressure shock can endanger structures and equipment. (For instance, the Space Shuttle's first launch created an overpressure wave that damaged dozens of heat shield tiles <sup>3</sup>.) Consequently, conventional pads employ extensive sound suppression measures – huge volumes of water (hundreds of thousands of gallons) are dumped onto the pad at liftoff to absorb acoustic energy, and flame trenches or sound-damping “acoustic domes” redirect and dissipate shockwaves <sup>2</sup> <sup>4</sup>. Even with these measures, peak noise levels around **140–145 dB** can occur on the pad and in the immediate vicinity during a large rocket launch <sup>1</sup> <sup>4</sup>, and distant rumbles are heard tens of kilometers away.

Under the **mag-rail pod launch**, these acoustic phenomena are largely eliminated at the source. **No rocket engines fire at the surface**, so there is **no supersonic exhaust stream to produce shockwaves or intense sound**. The launch pod's acceleration is essentially silent externally, aside from minor mechanical noise – any sound from the electromagnetic track (e.g. structural vibrations or the rush of air as the capsule exits) is negligible compared to a rocket blast. There is also **no “ignition overpressure” wave** emanating from the pad, since thrust is not generated until high altitude. The only notable acoustic event may be a **sonic boom or sonic crack** as the pod transitions from the launch tube into open air at supersonic speed. However, this event occurs at the **top of the tower, high above the ground**, and is brief. Its energy dissipation over distance means the heard effect on the ground will be modest – far less intense than the sustained roar of a rocket engine. In summary, the acoustic signature of launches at this site will be **dramatically lower** than originally assumed: nearby facilities and communities should no longer be exposed to extreme launch noise or potentially damaging overpressure. The need for dedicated sound suppression infrastructure is minimal; the tower itself provides isolation, and no water deluge system is required. This represents a major environmental and safety benefit of the mag-rail architecture, **reducing noise-related impacts to people, wildlife, and structures** in the vicinity of Heber North Campus.

### 4. Thermal Plume and Ignition Hazard

Conventional launch vehicles produce a massive **thermal plume** and fire hazard at liftoff, as rocket exhaust gases exceed **3,000 °C** and must be directed away from personnel and infrastructure. At a typical pad, flame ducts and trenches channel this hot exhaust, and water sprayed on the pad not only dampens sound but also cools and **suppresses fires** by quenching embers and dissipating heat <sup>2</sup> <sup>5</sup>. Despite precautions, the blast can ignite nearby materials; **brush fires are an infrequent but not unexpected byproduct** of rocket launches, usually contained to vegetation on site <sup>6</sup>. For example, launch or static-fire operations at Cape Canaveral and other sites have occasionally sparked small wildfires on the pad periphery <sup>6</sup>. In the **Heber North Campus** context (a region with seasonally dry vegetation), the original vertical launch scenario carried a notable **wildfire risk** due to the rocket's exhaust and radiant heat at ground level.

The updated mag-rail launch system essentially **eliminates the ground-level thermal and ignition hazards**. Because there is **no flame at launch**, there is no intense heat plume impinging on the pad or surrounding terrain. The launch tower's interior will experience heating from the electromagnetic acceleration process, but this is a contained engineering concern (managed by cooling systems) rather than an environmental hazard. **No exhaust gases are expelled onto the pad** – meaning **no risk of grass or brush ignition** in the vicinity during a standard launch. The first ignition of propellant (the SRMs) happens at ~10 km altitude, far above any vegetation or structures, and any thermal effects at that point are confined to the upper atmosphere. This drastically **reduces the chance of launch-induced fires** on the ground. In practical terms, features like pad flame deflectors, spark arrestors, or firebreak landscaping – typically critical in a rocket launch complex – are far less significant for this site. Standard fire safety precautions will still be observed (e.g. lightning protection and ensuring no flammable debris near the tower), but the **source of heat and ignition energy is removed** from ground operations. Overall, the wildfire risk and thermal damage potential at the Heber site are **substantially lower** with the mag-rail architecture. This improves safety for the surrounding environment and means the **“Launch Tower Zone” can maintain a smaller hazard footprint** regarding thermal effects compared to a conventional pad.

## 5. Airspace and Flight Corridor Considerations

The shift to a mag-rail launch also impacts **airspace usage and trajectory planning** for the site. Under a conventional launch, a rocket departing vertically (or on a gravity-turn trajectory) creates an expanding volume of restricted airspace due to its rising plume and potential blast radius. Air traffic must be cleared in a broad path downrange, and launch azimuths are chosen to avoid populated areas in case of early aborts or staging events. Additionally, **rocket exhaust plumes can affect air quality and visibility near the site** – for instance, a large launch emits a cloud of combustion byproducts that winds disperse over the ocean or downwind areas <sup>7</sup>. At Heber North Campus, these factors were originally analyzed assuming a standard rocket ascent profile.

With the mag-rail system, the **initial phase of flight is entirely contained and vertical**, simplifying some aspects of airspace management. The vehicle does not begin free flight until it exits the tower at altitude, so **below 10 km it follows a fixed, controlled path** (the direction of the tower). There is no drifting launch plume or multiple trajectory events (like booster jettison) in the lower atmosphere. As a result, the immediate airspace exclusion zone can be more tightly confined to the column directly above the launch tower, at least for the boost phase. Of course, once the pod exits and the SRMs ignite, it effectively becomes a small rocket in mid-air – from that point onward standard range safety practices apply. A **Notice to Air Missions (NOTAM)** and restricted airspace will still be required for the launch window, but largely to protect aircraft from the fast-moving vehicle *post-launch* rather than from any blast plume or shockwave at ground level. The **acoustic impact to aircraft and communities** is minimal at liftoff (no loud shock or engine noise propagating outward). A brief sonic boom from the pod's supersonic exit may occur, but at 10 km altitude this would attenuate significantly before reaching the surface, if it is heard at all. There will be **no immediate smoke column or debris** rising from the pad, which improves visibility and potentially allows quicker resumption of nearby air operations after launch (since there's no lingering cloud of exhaust to avoid).

In terms of **flight corridor**, the launch tower's fixed orientation will determine the initial trajectory. It is expected that the tower can be aligned to accommodate the desired launch azimuth for orbital insertion. The benefit is that the initial acceleration is *vertical/upward* with no downrange travel near the ground, meaning the vehicle gains altitude rapidly before any significant horizontal movement. This reduces the

area of concern for any early-flight mishap (e.g. if the vehicle fails to accelerate properly or breaks up on exit, debris would largely fall close to the pad, within a pre-defined safety radius). Traditional rockets, by contrast, begin moving downrange almost immediately, potentially spreading debris over a larger footprint in a failure scenario. The mag-rail approach localizes early-flight risk overhead. Overall, while the **need for coordination with the FAA and airspace closure remains**, the nature of those closures is different: they can be more **localized and shorter in duration**, and they primarily guard against the launched object itself (and any high-altitude ignition events) rather than massive blast effects. This refinement in airspace usage is a positive aspect for the site, as it could lessen disruption to civilian flights and simplify range safety calculations, provided the unique launch profile is clearly communicated to air traffic authorities.

## 6. Regulatory and Environmental Compliance

The Heber North Campus Launch Tower project will continue to undergo rigorous regulatory review, but the **mag-rail pod launch architecture offers distinct advantages that should be highlighted in compliance documentation**. Under the purview of the Federal Aviation Administration (FAA) Office of Commercial Space Transportation, a launch operator license must be obtained for this facility. The licensing process (14 CFR Part 450) requires demonstrating that the launch will not pose undue risk to public safety or property. In this regard, the updated design inherently **reduces several risk factors**: there is no on-pad explosive ignition, meaning a much lower probability of catastrophic pad accidents (no hypergolic fuels or cryogenic rocket stages at ground level during launch). The absence of a huge initial blast and shockwave means that the **public hazard zones for overpressure and sound** can be drawn smaller than those for a conventional rocket of similar payload class. For example, the need to evacuate areas for fear of window shattering or other overpressure effects is essentially negated – a concern that typically exists for large rocket launches (e.g., Saturn V class launches had to account for glass breakage radius due to acoustic energy). The **flight safety analysis** will of course still consider the launched vehicle's trajectory and any potential failure modes (e.g. an abortive fall-back or late ignition of SRMs), but these are more akin to mid-air failures than pad explosions. The safety footprints and probabilistic risk assessments provided to the FAA should be recalculated to reflect the **significantly lower initial blast risk**, and this distinction should be made clear to regulators.

From a **NEPA (National Environmental Policy Act)** standpoint, the change in launch architecture is also beneficial. An Environmental Assessment (EA) or Environmental Impact Statement (EIS) for the launch site will need to evaluate factors such as noise, air quality, ecological impacts, and safety. In the original rocket-based scenario, the EA/EIS would consider the loud noise impacting nearby communities and wildlife, the potential for chemical exhaust fallout (e.g. **HCl deposition** from solid rocket motors on vegetation <sup>6</sup>), emission of **greenhouse gases and particulates** at ground level, and the risk of brush fires or habitat damage from launch operations <sup>8</sup>. With the mag-rail system, **many of these impacts are avoided or greatly reduced**. There are **no significant exhaust emissions at ground level** during a normal launch – the only combustion emissions occur high in the atmosphere, where they will not cause measurable air quality effects locally <sup>7</sup>. The **noise impact** on surroundings is far less, likely obviating any need for special sound abatement for wildlife or historic properties. The **potential for launch-startled wildlife or human disturbance is minimal**, as the event on the ground will be comparatively quiet. Additionally, since water deluge systems are not used, there is no large consumption of water or drainage of deluge runoff that could carry contaminants. The **environmental documentation should clearly note these differences**, as they may support a Finding of No Significant Impact (FONSI) or reduce the scope of mitigation required. For instance, while a conventional launch site EIS might mandate monitoring of acidic fallout or large exclusion

zones for noise-sensitive species, the Heber site with an electromagnetic launch might not trigger those concerns to the same degree.

It is important to communicate to regulators and stakeholders that although the **launch method is novel, its environmental footprint is more benign** than that of a traditional rocket launch. Any **public outreach or interagency consultations** (with agencies like the U.S. Fish and Wildlife Service, state environmental quality departments, etc.) should emphasize the lack of ground-level rocket exhaust and the reduced noise. Early coordination with the FAA's environmental review team and local authorities will help ensure they understand that many typical launch impacts (sound, blast, fumes) **will not occur at Heber** under the mag-rail architecture. Nonetheless, compliance efforts will focus on **new areas** such as electromagnetic safety (ensuring the launch system's strong magnetic fields or electrical systems pose no hazard beyond the site boundary), and the structural/environmental soundness of building a tall launch tower in the area. Standard construction permits, local site approvals, and any necessary environmental mitigation for the tower structure (e.g. visual impact or ensuring no avian impacts with a tall structure) will be addressed through normal processes. In summary, the regulatory path is expected to be smoother in certain respects due to the **intrinsically lower environmental impact** of the mag-rail launch, but it remains essential to document these differences thoroughly in all FAA and NEPA filings to secure the required approvals.

## 7. Conclusion

The adoption of an electromagnetic mag-rail launch system for the SDC-COMMS program at Heber North Campus represents a **transformative improvement** in site safety and environmental compatibility. By removing the rocket ignition from the pad and relocating it to high altitude, the design achieves **orders-of-magnitude reductions in acoustic energy, overpressure, and thermal hazards at the launch site**. Many traditional concerns – deafening noise, pad ablative scorch, chemical plume fallout, and brush fire ignition – are **mitigated or eliminated**. This revised site suitability analysis has updated all relevant sections to reflect these changes, and the findings reinforce that the Heber North Campus Launch Tower Zone remains an excellent and even more **advantageous location** under the new architecture. The surrounding community and environment will experience far less impact during operations than originally anticipated for a rocket launch. Moving forward, project stakeholders should leverage this fact in risk communications and regulatory negotiations, underscoring that the **mag-rail pod launch is a cleaner, quieter, and safer approach** to achieving orbit. All original site selection criteria – such as geography, accessibility, and logistics – continue to be satisfied, and indeed the case for suitability is strengthened by the reduced risk profile. In conclusion, the Heber North Campus launch site is well-aligned with the innovative launch tower concept, and with proper implementation, it will set a precedent for **low-environmental-impact space launch operations** consistent with NASA's safety and stewardship goals.

### Sources:

1. NASA KSC Sound Suppression System description – acoustic energy and water deluge usage <sup>1</sup> <sup>4</sup> .
2. NASA (Mars 2020 Final EIS) – notes on launch noise, pad overpressure, and exhaust impacts (acid deposition, brush fires) <sup>8</sup> <sup>7</sup> .
3. U.S. Fish & Wildlife Service / NASA – observation that minor brush fires from launches are contained on-site <sup>6</sup> .

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6 7 8 Final Environmental Impact Statement for the Mars 2020 Mission

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