HYPERSCALE DATA CENTERS DO NOT BELONG IN "LIMITED INDUSTRIAL" ZONING DISTRICTS

A Detailed Supporting Assessment & Business Case

January 8, 2026

Table of Contents

EXECUTIVE SUMMARY

Hyperscale Data Centers Do Not Belong in “Limited Industrial” (M-1) Zoning Districts

By requiring 900MW of power to operate, 300 diesel generators, on-site storage for millions of gallons of diesel fuel (and DEF), millions of gallons of trucked in water and chemical treatments, and substantial security perimeters and fencing, modern hyperscale data centers represent a fundamentally different land use than the light industrial, business park, and employment-oriented activities traditionally envisioned under Limited Industrial (M-1) zoning. Their operational scale, infrastructure intensity, environmental footprint, and public safety risk profile more closely resemble heavy industrial facilities. Treating these facilities as “limited industrial” uses exposes counties to significant **land use, infrastructure, fiscal, environmental, and other risks**, particularly when such projects are located near existing residential zoning, schools, and other non-industrial uses.

This document evaluates the proposed Hunting Hawk Technology Park and similar large-scale data center developments within the context of Hanover County’s Comprehensive Plan, zoning framework, and regulatory authority. It concludes that **large-scale data centers are incompatible with the intent of Limited Industrial zoning** and that approving the requested facilities under M-1 classifications—without substantially enhanced regulatory controls—creates long-term exposure for the County and surrounding communities.

A cautious, evidence-based approach grounded in zoning integrity, public safety, and long-term fiscal stewardship is warranted before approving Comprehensive Plan amendments or rezonings that would enable hyperscale data center development to create patchwork zoning that is incompatible with the intent of zoning ordinances, and Hanover’s well thought-out Comprehensive Plan.

Purpose and Scope

This document is intended to provide the **Board of Supervisors and Planning Commission** with a resource to assist in their evaluation as to whether large-scale data center development is consistent with:

- The intent of Limited Industrial (M-1) zoning
- The County’s Comprehensive Plan goals, including preservation of rural character
- The County’s obligation to protect public health, safety, infrastructure, and fiscal stability

The analysis is organized into three areas to address Hunting Hawk Technology Park applications:

1. A business and land use case for no change to the Comprehensive Plan or Zoning
2. A review of risks and impacts to residents, infrastructure, and the environment
3. The necessity of enforceable Conditional Use Permits and Voluntary Proffers should approval be considered

SECTION 1: LAND USE, ECONOMIC, AND GOVERNANCE CONSIDERATIONS

Data Centers Are Not Employment Centers

Amending the Comprehensive Plan land use designation to Employment Center establishes expectations of meaningful employment density. However, modern hyperscale data centers do not function as employment centers once construction is complete.

National guidance indicates that multi-building hyperscale campuses typically employ 125–150 permanent workers, regardless of land area. Applied to the proposed 460-acre Hunting Hawk Technology Park, this equates to approximately 0.27–0.33 employees per acre, far below the 8–15 employees per acre typically associated with employment centers or light industrial uses. This discrepancy raises substantive questions about whether the proposed Comprehensive Plan amendment accurately reflects the land use reality.

In Hanover, Employment Centers are recommended along major arterial roadways and within Emerging Development Zones (EDZs). Ashland Road is minor arterial and designated a Scenic Road in the Comprehensive plan. The Ashland Road corridor has not been designated as an EDZ.

Modern Data Centers Function as Heavy Industrial Uses

Hunting Hawk Technology Park is a major industrial complex characterized by:

- Massive electricity consumption of 900MW
- Three hundred (300) industrial-scale T4 3MW diesel generators
- Over three million (3,000,000) gallons of on-site diesel fuel and DEF chemical storage
- Millions of gallons of chemically treated water for cooling data processing assets
- High-voltage substations and transformers
- High-density lithium-ion Battery Energy Storage Systems (BESS) (Tier 2 CUPs required)
- Reduced air quality due to diesel generator maintenance, testing, and outage operations
- Continuous mechanical cooling infrastructure (closed-loop processor cooling & industrial building HVAC systems)
- Persistent low-frequency and high-frequency noise
- Industrial lighting and 24/7 security operations

Data centers primarily sited in industrially-zoned areas.

- Large-scale or "hyperscale" data centers are increasingly restricted to heavy or general industrial districts.
- Approximately 72% of the Prince William County’s specialized Data Center Overlay District is industrially-zoned land (both M-1 and M-2).
- Henrico County’s recent proposals suggest limiting large-scale data centers to Industrial districts.
- A 2025 James City County, VA proposal aims to reclassify data centers as industrial uses and remove them from "Limited Industrial" (M-1) districts and restricting them to General Industrial (M-2) districts.

- Industrial Traffic - the traffic study shows a significant increase in both industrial and car traffic during construction and operation.

From a land use planning perspective, these characteristics align more closely with **Industrial (M-2)** zoning than with Limited Industrial (M-1), which traditionally anticipates lower-intensity activities with minimal off-site impacts.

HHHunt: Active Member Urban Land Institute (ULI)
HHHunt executives are active members and hold leadership positions. HHHunt leaders voluntarily contribute their industry expertise to further ULI's mission of providing leadership in the responsible use of land and creating thriving communities.

This conclusion is consistent with the **Urban Land Institute (ULI)**, which stated in its 2024 white paper that “because data centers are ultimately an industrial use, we believe that data centers are not appropriate in residential districts.” Many jurisdictions now classify large-scale data centers as heavy industrial uses in recognition of their operational intensity and risk profile.

Zoning Assignment and Regulatory Risk
Hanover County has historically allowed data centers within industrial zoning districts using Conditional Use Permits, Special Exceptions, and Voluntary Proffers. While this approach provides flexibility, it also introduces risk if applied inconsistently or without fully accounting for evolving industry scale and impacts, particularly when the complex will abut residential zoning corridors.

Approving hyperscale data centers under Limited Industrial zoning risks setting a precedent that weakens zoning integrity and limits the County’s ability to impose future controls. Once land is rezoned, opportunities to impose additional restrictions diminish, particularly if state or federal regulations evolve.

If the County were to proceed with M-1 zoning approvals, it would be incumbent upon the County to ensure extremely detailed, enforceable Conditional Use Permits, Special Exceptions, and Proffers that address the full lifecycle impacts of the facility. Recommendations will be provided separately.

Power Grid and Infrastructure Risk
Hanover County’s electric grid is already under strain. Proposed data centers in the area including Tract’s Hanover Technology Park and HHHunt’s Hunting Hawk Technology Park have power requirements of 2.4 gigawatts and 900 megawatts respectively for total of 3.3 gigawatts. This is an amount comparable to the load of a major metropolitan area and just **these two facilities are approaching the total electricity demand of ALL Loudoun County’s data centers combined (5.3 giga watts).**

Utility infrastructure upgrades required to support this demand are typically socialized across ratepayers. The extent to which residential customers are protected from rate increases remains uncertain and is often subject to regulatory and political decisions beyond local control.

Insufficient grid capacity increases the likelihood of power outages, which in turn triggers extended operation of diesel generators—representing a worst-case scenario for air quality and noise impacts.

County Revenue and Fiscal Uncertainty

While data centers are often promoted as major revenue generators, counties across the country have experienced **unexpected infrastructure, emergency services, and administrative costs** associated with rapid, unplanned development.

In Virginia, the proposed extension of state-level sales and use tax exemptions for data centers through 2050 raises questions about the reliability and longevity of projected revenue streams. Nationally, data center operators frequently negotiate long-term tax abatements, depreciation advantages, and exemptions that can significantly reduce realized local revenues.

Absent strong local tax policy alignment and enforceable agreements, counties may face a mismatch between expected revenues and actual fiscal outcomes.

Rezoning Risks

Rezoning decisions of this magnitude carry substantial legal exposure, including claims that approvals were arbitrary or capricious, procedurally defective, or inconsistent with the previously adopted Comprehensive Plan.

Recent cases in Virginia and other states demonstrate that courts are willing to invalidate data center rezonings where notice requirements, plan consistency, or due process standards were not strictly met. Legal consequences may include invalidation of approvals, delays, and increased liability for future land use decisions when the next major industrial complex is applied for in an incompatible area

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SECTION 2: RISKS AND IMPACTS TO RESIDENTS AND THE ENVIRONMENT

Noise and Public Health

Hyperscale data centers generate continuous operational noise and episodic high-intensity noise from generator testing and maintenance. Low-frequency noise (LFN), in particular, can travel long distances, penetrate buildings, and cause sleep disruption and debilitating health impacts even when dBA thresholds are met.

Hanover County’s existing noise ordinance relies primarily on A-weighted measurements, which do not adequately capture low-frequency impacts. Pending state-level consideration of alternative noise metrics underscores this regulatory gap.

Fire, Explosion, and Emergency Response
Large-scale battery energy storage systems (BESS), massive diesel fuel storage, and high-voltage electrical infrastructure introduce unique fire and explosion risks. Transformer and battery fires can burn for days, release toxic smoke, and overwhelm local emergency response capacity—especially when facilities are located near residential areas. It is highly likely that existing Ordinances require that CUPs for the required BESS be required and approved.

Water Demand and Water Quality
Even with closed-loop cooling systems, hyperscale data centers require significant water volumes for initial system loading, ongoing top-offs, and periodic flushing. These systems rely on concentrated chemical additives that pose spill and contamination risks.

Additionally, the storage and handling of well **over three (3) millions of gallons of diesel fuel and Diesel Exhaust Fluid (DEF)** present groundwater and surface water risks within sensitive watersheds, including those feeding the James River and Chesapeake Bay.

The use of non-potable sources of water is of concern because rainwater and runoff usage, storage and return to the ground are undefined.

Air Quality and Emissions
Routine generator testing alone is estimated to produce substantial monthly emissions of carbon dioxide, nitrogen oxides, particulate matter, and other pollutants. Communities near data centers have reported elevated pollution levels, with disproportionate impacts on children and individuals with respiratory conditions. This proposed complex is within 2 miles of several elementary and high schools.

Light Pollution, Visual, and Security Impacts
Industrial-scale lighting, security infrastructure, and visual massing significantly alter rural landscapes, disrupt ecosystems, and affect residents’ quality of life. Data centers also represent high-value critical infrastructure targets, introducing security-related impacts that extend beyond facility boundaries.

CONCLUSION

The scale, intensity, and risk profile of modern hyperscale data centers distinguish them from traditional Limited Industrial uses. Approving such facilities under M-1 zoning—particularly near residential communities—creates long-term land use, infrastructure, fiscal, environmental, and legal risks for Hanover County.

An evidence-based, risk-managed approach to assessing the Hunting Hawk Technology Park proposed applications supports **maintaining the existing Comprehensive Plan designation and denying the rezoning requests**. Should approvals be considered, they must be accompanied by **robust zoning classifications, enforceable Conditional Use Permits, defensible Special Exception approvals, and**

comprehensive Voluntary Proffers that fully address lifecycle impacts and protect the County’s long-term interests.

INTRODUCTION

This document outlines the environmental, and community impacts associated with enabling the construction and operation of a large-scale data center—such as the proposed Hunting Hawk Technology Park (HHTP)—within a Limited Industrial zoning district, and explains why enhanced regulatory scrutiny, stronger zoning classification, well-negotiated Proffer agreements, and enforceable mitigation measures are essential.

This document is intended to serve as a resource for the Planning Department, Planning Commission, and Board of Supervisors in evaluating whether large-scale data center development is compatible with the intent of Limited Industrial zoning and whether additional safeguards, zoning classifications, or policy measures are necessary to protect public health, safety, and long-term community interests, particularly where a proposed development is immediately adjacent to zoning that is incompatible with major industrial areas.

There are two overall sections to the document plus an attachment of source references:

1. Business Case Against Changing the Comprehensive Plan
2. A Review of Risks and Impacts to Residents & Environment

SECTION 1 - A BUSINESS CASE AGAINST CHANGING THE COMPREHENSIVE PLAN & REZONING

Modern Data Centers Are Employment Deserts Not Employment Centers

The amendment to change the Comprehensive Plan land use designation to Employment Center creates the expectation of a reasonably high number of employees per acre. In fact, after construction, the proposed Hunting Hawk Technology Park would employ 125-150 people (per national guidance for multi-building, hyperscale data centers). With a designated area of 460 acres, this equates to 0.27 to 0.33 people per acre. Nationally and regionally, for “employment centers” and “light/limited industrial”, the range is 8 to 15 employees per acre. As such, the change proposed does not meet the definition of a true Employment Center**.**

Modern Data Centers Are Significant Industrial Complexes, Not “Light Industrial”

Modern hyperscale data centers are no longer simple warehouses housing servers or “data processing centers”. They are energy-intensive, multi-building industrial campuses characterized by:

- Vast amounts of electricity consumption (enough to power a large metropolitan area)

- High number of industrial-scale diesel generators– as many as 300 in this application
- Industrial-scale fuel storage and handling (potentially >3 million gallons of diesel fuel plus 300,000 gallons of diesel fuel treatment chemicals to support 300 generators and potential emergency operations)
- High-voltage substations and transformers
- Millions of gallons of water, chemically treated, for processor cooling systems, whether used in a closed loop or open loop system.
- Massive volumes of lithium batteries (as many as ten (10) 90 MWh Battery Energy Storage Systems requiring CUP approvals - not yet requested)
- Continuous mechanical cooling infrastructure
- Continuous debilitating high frequency and low frequency noise
- Significant air pollution from diesel and DEF during maintenance/testing and emergency use
- Permanent, high-intensity lighting and security systems
- Major fire and security risks

Data centers are primarily sited in industrially-zoned areas due to their high-power requirements and specialized infrastructure.

- Large-scale or "hyperscale" data centers are increasingly restricted to heavy or general industrial districts which allow for the required heavy mechanical equipment, outdoor backup generators, and large cooling systems.
- Approximately 72% of the Prince William County’s specialized Data Center Overlay District is industrially-zoned land (both M-1 and M-2).
- Henrico County’s recent proposals suggest limiting large-scale data centers to Industrial districts.
- A 2025 James City County, VA proposal aims to reclassify data centers as industrial uses and remove them from "Limited Industrial" (M-1) districts, restricting them instead to General Industrial (M-2) districts.

From a land-use planning perspective, the operational intensity, infrastructure demands, and risk profile of modern data centers align more closely with heavy industrial uses than with the traditional intent of Limited Industrial zoning districts, which typically anticipate lower-intensity activities with minimal off-site impacts. The previous approach of allowing data centers in *Limited Industrial* (M-1) rather than *Industrial* (M-2) no longer applies.To further support this position, in their 2024 white paper, the Urban Land Institute (ULI) Americas Data Center Product Council stated that “because data centers are ultimately an industrial use, we believe that data centers are not appropriate in residential districts”. ULI is the oldest and largest network of cross-disciplinary real estate and land use experts in the world. Through its members' dedication to the mission and their shared expertise, the Institute has been able to set standards of excellence in land use development practices.

HHHunt: Active Member Urban Land Institute (ULI)
HHHunt executives are active members and hold leadership positions such as: **EVP of Real Estate Development** currently serving on **Advisory Council**; **President of HHHunt Communities** previously served on **advisory council**; and the **VP of Real Estate Development and General Manager** a long-time member and active in **ULI Virginia District**. HHHunt leaders voluntarily contribute their industry expertise to further ULI's mission of providing leadership in the responsible use of land and creating thriving communities.

Modern Data Centers Are Incompatible with Rural Character

Hanover County has designated Ashland Road a Scenic Road. The project would replace recreational and agricultural space along that designated road with multi-story industrial buildings, fuel storage tanks, generators, electrical substations and eliminate hundreds of acres of trees, farmland and wetlands. This use is simply incompatible and not harmonious with the existing and surrounding uses contemplated by the County through its Comprehensive Plan.

Zoning District Assignment

In Hanover County, Virginia, data centers are primarily assigned to industrial zoning districts, specifically **M-2 (Industrial)** and **M-1 (Limited Industrial) combined with the use of Conditional Use Permits (CUP) and Special Exceptions (SE), and Voluntary Proffers.** This approach has enabled County officials to apply flexibility in the approval process taking into consideration the unique elements of each project. Further the county's comprehensive plans identify specific corridors as suitable for these facilities.

- **Conditional Use Permit (CUP):** Required for associated utility infrastructure (e.g., electrical substations, wastewater stations, and battery storage systems.
- **Special Exception (SE):** Frequently needed for building height exceptions or specialized fencing requirements.
- **Voluntary Proffers:** Developers often submit legally binding "proffers" during rezoning to address community impacts, such as **perimeter buffers**, closed-loop cooling systems to conserve water, noise abatement systems, and noise studies.

The Ashland Road area is not identified as an Emerging Development Zone (EDZ) by Hanover County. Based on the industrial nature of HHTP, should the County move forward with approving the Employment Center and M-1 zoning for Hunting Hawk Technology Park, it is incumbent on officials to fully detail the Conditional Use Permits (CUPs) and Special Exceptions (SEs) needed to protect both the County as a whole as well as the surrounding community.

Importantly, the County should negotiate a thorough Voluntary Proffer that binds the data center developer/owner to legal requirements. As a reference, the following table summarizes existing and proposed data center projects in Hanover County based on recent planning documents and developer applications:

Economic & Infrastructure Risks

The local grid in Western Hanover County is already under considerable strain; this will only get worse with the addition of more hyperscale data centers. Developers are building or proposing enormous data center campuses including Tract’s Hanover Technology Park (Beaverdam District); and HHHunt’s Hunting Hawk Technology Park. Power requirements are 2.4 GW and 900 MW respectively for a total of 3.3 GW.

The cost to implement the power generation and transmission line capabilities will be pushed primarily to the customers of the utility companies. This is simply a fact of how electric utility companies have been set up and regulated.

There are significant concerns on the part of residents about power rates, reliability for residents, and grid capacity.

PJM Interconnection’s "watchdog", Monitoring Analytics LLC, which oversees local services provided by Dominion Energy and Rappahannock Electric Cooperative states that the grid is already facing significant strain and capacity concerns due to massive load growth, primarily from data centers. Further, Monitoring Analytics, is urging federal regulators (FERC) to mandate a pause or moratorium on connecting massive new data centers to the power grid until PJM confirms it has enough generation and transmission capacity to reliably serve them, citing risks of blackouts, high costs, and grid instability, a stance supported by concerns from grid operators like AEP in Ohio.

Note that an insufficient power grid will result in power outages for both residents and data centers. For data centers, this means that they will resort to the use of diesel fueled generators during those periods. This is a worst-case scenario from an air and noise pollution perspective.

County Revenue Risks

Surprise Costs for Counties

Some counties have been experiencing unexpected new costs and strains on infrastructure and emergency services due to rapid, largely unregulated data center development. These issues arise because data centers require immense resources and often involve tax incentives that can shift financial burdens onto local residents.

Counties that planned for data center growth, like Loudoun County, have successfully leveraged the high tax revenues (generated mostly from personal property taxes on equipment) to fund public services, road repairs during construction phases, and other infrastructure. However, those experiencing a sudden, unplanned "boom" often face challenges in managing the associated costs and community impacts.

Tax Payment Avoidance

Will the promises of major tax revenues coming to the County and reductions to resident taxes be met, or are some of those revenues going to never materialize? **More specifically, how will Virginia’s 2026 Budget Bill that extends the data center industry’s tax exemptions to 2050 impact the revenue stream to Hanover County?**

Data center organizations in Virginia get out of some tax obligations primarily through a massive state sale and use tax exemption on their computer equipment and software. These exemptions are offered in exchange for significant investment (e.g., $150M+) and job creation (50+ jobs paying 1.5x local wage) under agreements with the Virginia Economic Development Partnership (VEDP). While avoiding sales tax on servers, they still pay substantial local business personal property taxes on equipment, generating significant revenue for some counties like Loudoun, which use it for tax relief.

Nationally (and potentially applicable here in Virginia), data center organizations reduce tax obligations in the U.S. through extensive state and local incentives, including sales/use tax exemptions on equipment, property tax abatements, and energy tax credits, alongside federal perks like bonus depreciation, all negotiated to attract large investments, often resulting in decades-long tax relief or even permanent exemptions in some states.

Having an unknown final owner/tenant leaves the county at risk. For instance, financial services companies do not pay taxes on their revenues.

Rezoning Risks for County Government

Approving a rezoning request — particularly for a large land use change such as data centers — carries multiple legal risks for Hanover County. These risks arise from procedural errors, conflicts with comprehensive plans, statutory compliance, and due process concerns. Courts have repeatedly held that zoning decisions may be invalidated if local officials fail to meet legal standards, making proactive legal diligence essential.

The impacts of rezoning lawsuits can be significant including:

- Invalidation of rezoning approvals
- Damages or attorney’s fees if county statutes allow
- Delay or cancellation of major economic development projects
- Mandatory compliance with comprehensive planning requirements
- Adverse court rulings can set precedents that increase county liability in future land use decisions

The tables in Appendix A provide a summary of some of the legal risks for Hanover County’s BoS for consideration in making decisions about the Hunting Hawk Technology Park Comprehensive Plan

changes, Rezoning request as well as Conditional Use Permits (CUPs) and Special Exceptions (SEs) applications.

The Political Reality: Data Centers are a Bipartisan Issue

There is a popular quote that goes “potholes are not partisan”.

Political affiliation does not neatly determine a community's stance on new data centers; instead, opposition has become a rare area of bipartisan alignment, though the specific arguments often vary along party lines. Concerns are primarily local and cross the political spectrum. A review of public statements found that 55% of officials opposing data center projects were Republicans and 45% were Democrats, highlighting the non-partisan nature of the resistance.

Generally speaking, the left side of the spectrum often emphasize direct impacts on individuals, environmental impacts, focusing on resource consumption, such as the massive water use for cooling, carbon emissions, and renewable energy. On the right side of the spectrum, particularly those in rural areas like Hanover County, concerns tend in the direction of tax abatements granted to big tech developers, the industrialization of rural landscapes, energy demands, and the potential erosion of local authority in planning and zoning decisions. Both sides are concerned about water issues and the likely increase in electricity costs, as well as the optics of a “corporate takeover” of rural lands.

So, “potholes are not partisan” applies directly, maybe more so, to data center development. Regardless where the Hanover County constituency is on the political spectrum, they will have a very strong preference to what happens and how it affects them directly. This has borne out thus far in this process, whereby there has been a strong, bi-partisan, groundswell of opposition across Hanover County.

Ability to Predict the Future, Time to Take a Breath?

What are the economic and infrastructure risks for enabling the proposed Hunting Hawk Technology Park data centers? Is Hanover moving too quickly to bring in data centers?

Given the high requirements for power in these data centers and the industry’s watchdog organization calling for a moratorium on new data center projects, wouldn’t a delay on changing the Comprehensive Plan, Rezoning, and other data center approvals make sense? Wouldn’t this give the County the time necessary to fully understand the impacts and implications of data centers and answer the following questions?

- Given the goal of the Comprehensive Plan to remain primarily a rural County, how will the rural communities be impacted?
- Is the AI bubble bursting? What will be done with partially completed data center facilities if the owners “walk away”? Who pays for the remediation? What happens to rezoned lands if the data center business model collapses and the rezoned properties need to be used for something else that wasn’t fully planned?

- Will the County benefit from the tax revenue as expected? Has the County locked in the tax revenues, or will the operators be able to find ways to avoid paying the taxes? Will unexpected costs eat away at what was supposed to be tax revenue surplus? Is an AI bubble burst imminent that will put the County finances at risk?
- Will water demands really be curbed by “Closed Loop” cooling technology or have water requirements exceeded estimates? Has the County required data center operators to report water consumption measures on a monthly basis? Does the County have the ability to curb data center water consumption in times of drought?
- What has happened to County and State roads during the construction? Were the traffic studies correct? Have residents been overly burdened by traffic congestion caused by the construction? Can Ashland Road withstand the substantial construction and operational traffic to support this major industrial development?

Will significantly more efficient, safer and less costly technologies exist in the short and long term? Like the computer industry, the AI data center industry will be driven by rapid change. This project could be out of date before ground is broken.

SECTION 2 - A REVIEW OF RISKS AND IMPACTS TO RESIDENTS & ENVIRONMENT

Noise Generation & Related Risks

The proposed 900-megawatt data center will produce significant noise, including:

- Industrial HVAC systems for 10 buildings
- Closed-loop cooling systems for the digital assets (e.g., servers)
- Power distribution equipment
- Three hundred (300) T4 3MW generators [Note: the proposed generators are the size of a railcar and emit high level and low-level frequency noise]
- Construction noise that will exist for the lengthy period of data center construction and implementation

Ongoing operational noises produced are characterized by a constant, low-frequency hum which can travel long distances and penetrate buildings. While this noise might not register a high dBA level, it can still be highly annoying, disrupt sleep, and cause health issues for nearby residents. Studies have shown that Low Frequency Noise (LFN) can be more debilitating to individuals who are submitted to LFN on a continuous basis leading to physical and mental disabilities.

Layering on top of operational noises are generator maintenance and testing noise. These are often described as extremely loud (like a lawnmower or motorcycle at close range) and is typically the loudest noise the data center produces.

Hanover County's current noise ordinance, which primarily uses A-weighted decibel (dBA) limits, is considered insufficient by experts for effectively managing all frequencies of sound—particularly **low-frequency noise**—generated by large-scale data centers. The Hanover County ordinance, like many traditional noise codes, measures sound using dBA metrics. This weighting effectively measures the range of sound most easily heard by the human ear, **but it de-emphasizes lower frequencies**. For residential zones, the limits are 57 dBA during the day (7 a.m. – 10 p.m.) and 52 dBA at night (10 p.m. – 7 a.m.) which are insufficient for industrial hyperscale data centers.

The Virginia state legislature has considered bills, such as SB1046 in the 2025 session, that would require localities to adopt noise ordinances for data centers using "alternative low frequency noise metrics" (like C-weighting or dBC) in addition to dBA, acknowledging the current measurement gap. Unfortunately, this legislation has not yet passed.

To address this gap in the Hanover County Noise Ordinance, County officials should consider changes that address low frequency noises. In regard to the Hunting Hawk Technology Park, this is additional evidence that such a facility is incompatible with “Light Industrial”.

Further, because the proposed Hunting Hawk Technology Park construction is described as a multi-year effort (could be as long as 10 years), the current County Ordinance that restricts construction noise between the hours of 9pm and 7am the next day will not be sufficient. As currently written, this would allow construction seven days a week running from 7:00am to 8:59pm each day. A more reasonable requirement to be included in the Hunting Hawk Proffer would state: **“Exterior *Construction is permitted Monday through Friday from 7:30am to 6:00pm and Exterior Construction is not permitted on Saturdays, Sundays, Commonwealth holidays, nor federal holidays.*”**

Fire, Explosion, and Emergency Response Risk

Modern hyperscale data centers pose unique fire risks due to:

- High-density lithium-ion Battery Energy Storage Systems (BESS)
- Large volumes of diesel fuel and chemical additives (>3,300,000 gallons)
- High-voltage electrical equipment
- Liquid cooling systems using chemically treated water
- Numerous diesel generators (300)

The Hunting Hawk Technology Park will require Battery Energy Storage Systems (BESSs) for each building with each providing 90 megawatts-hours (MWh) capacity to deliver 1 hour of backup time. While data centers will use Li-ion for UPS for the initial moments of an outage, the BESSs will be the longer-term power supply while generators are started and brought up to full capacity.

Data Center Fire Incidents Impacting Residents

- Hillsboro, Oregon (May 2025): A fire at a Digital Realty data center that burned for five hours, producing dense, toxic smoke. Located just one mile from schools and residential neighborhoods, placed them in dangerous exposure to lithium-ion battery emissions like hydrogen fluoride.
- Chesterfield, Virginia (August & September 2025): The Chirisa Technology Park experienced four separate fire incidents within a single year. Fires were caused by manufacturing defects in batteries. The frequency caused ongoing alarm with local emergency responders regarding the facility's long-term safety.
- Moss Landing, California (September 2021 & February 2022): Battery storage site serves as a key case study for data center safety due to its massive impact when fire suppression failed. A toxic plume led to the closure of local schools and major roads, and soil sampling later revealed heavy metal contamination up to a mile away.
- El Segundo, California (May 2023): A fire at data center involved a burning stack of servers. The incident reflects a growing pattern of electrical and equipment failures in high-density data centers located near populated areas.

Hanover County ordinance provides the following definition:

- *“Tier 2 battery energy storage systems have an aggregate energy capacity greater than six hundred (600) kWh or are composed of more than one (1) storage battery technology in a room or enclosed area.”* [NOTE: Each data center BESS will deliver 150 times the level defined by Tier 2 battery storage]
- ***“Tier 2 battery energy storage systems. Tier 2 battery energy storage systems are permitted through the issuance of a <u>Conditional Use Permit</u> by the Board of Supervisors within the A-1, M-1, M-2, and M-3 zoning districts.“***

BESSs of this size are industrial in nature due to severe fire, explosion, and toxic gas hazards, requiring highly specialized, robust fire suppression (beyond standard systems), strict climate control, dedicated non-combustible enclosures (like UL-listed cabinets), strict spacing, and compliance with stringent codes to prevent catastrophic thermal runaway, which can spread rapidly, damage critical infrastructure, and endanger lives. Major risks include: Thermal Runaway, Hard-to-Extinguish Fires, and Toxic & Flammable Gases.

Industrial level mitigation requirements are not optional including Specialized fire suppression; Strict temperature and humidity climate control to prevent overheating; Non-combustible enclosures; and Strict adherence to engineering guidelines

In summary, BESS requirements for Hunting Hawk Technology Park are massive and, per Hanover County ordinance, require Conditional Use Permits. As a side note, it is estimated that each BESS will be the equivalent size of a water tank that is 27 feet in diameter and 20 feet in height.

Separately, but equally important, on-site high-voltage transformers are often cooled with flammable mineral oil. If these overheat or leak, they can cause long-duration fires that emergency teams may have to let "burn out" for days.

Seismic and Structural Risks

Hanover County lies within the Central Virginia Seismic Zone, an area with documented moderate seismic activity.

Even moderate seismic events can:

- Damage cooling systems and fuel storage
- Trigger hazardous material releases
- Compromise structural integrity of high-density electrical infrastructure

Emergency response capacity must be evaluated against worst-case cascading failures.

Should earthquakes occur, the potential impacts to the surrounding residential and business communities are comparable to those incurred as a result of data center fire. Southern Hanover County is considered a moderate risk area for seismic activity because it is located within the Central Virginia Seismic Zone (CVSZ). Hanover County sits in this active zone. Seismic events here often occur at depths of 3 to 15 miles and are typically not linked to faults visible on the surface. The county has an average earthquake risk score of roughly 38%, which is classified as moderate.

Water Demand and Water Quality Risks

Water Demand Risks

Hyperscale data centers such as the one proposed at Hunting Hawk will consume large amounts of water, regardless of the source. The impact will be felt somewhere. Initial loading of the system requires large volumes of water which may cause shortages at the water source location. Ongoing “top off” water needs may be large to address evaporation during the ongoing operation of the data center. In addition, the maintenance of closed-loop systems includes the periodic flushing and replacement of the cooling system which requires significant additional water consumption.

As such, it is incumbent on the County to implement mandatory mechanisms to monitor water consumption on a monthly basis. The surrounding residential community has experienced water shortages in their daily consumption in periods of drought. By effectively monitoring and limiting data center usage of water, the County is able to protect residents.

A 2016 Uptime Institute survey found that fewer than one-third of data center operators track the Water Usage Effectiveness (WUE) metric for water consumption.

Further, there are unanswered questions as to the source of the water to be trucked in for the initial priming of the cooling systems, ongoing topping off, and replacement following system flushing.

There are questions about the use of non-potable water and the undefined source, quantity, storage method and purpose.

Water Pollution Risks

Water pollution is a major risk when introducing a hyperscale data center to a community. There are, minimally, two areas of water pollution impact to be understood and mitigated as summarized in the following table.

Component	**Water Pollution Risk Areas**	**Impact Level**
Digital Asset Cooling via Closed-Loop Systems	Highly concentrated chemicals including biocides, glycol, and corrosion inhibitors. Periodic purging of system during maintenance creates spill risks	High (if leak, drain, spill occurs)
Three hundred (300) 3 MW T4 Generators with ~3.3M gallons of fuel and chemical storage	Diesel fuel leaks, oil runoff, and spills as well as spills of Diesel Exhaust Fluid (DEF).	High (proximity to watersheds of James River and Chesapeake Bay)

Closed-Loop Cooling System Chemical Risks

A closed-loop water cooling system could meet the 900MW data center needs at Hunting Hawk Technology Park, by recirculating a fixed amount of chemically treated water, drastically cutting daily water consumption (only needing top-ups), handling high heat loads efficiently, and satisfying regulatory demands for water conservation while supporting intensive computing with technologies like direct-to-rack liquid cooling for maximum efficiency and density.

While closed-loop systems use far less water, they rely on a concentrated cocktail of chemicals that can be released during maintenance or equipment failure. Note that maintenance includes period purging and refilling of the entire system which introduces risks of major spills.

- **Chemical Additives**: Water is often treated with biocides (to prevent bacterial growth), corrosion inhibitors (such as phosphates), and anti-freeze agents like glycol.
- **Accidental Discharges**: A single unplanned drain-down of a large loop for repair can release several tons of nitrogen-based chemicals into the local water shed.
- **Storm Drain Contamination**: Leaks into watersheds are particularly hazardous; glycol concentrations above 10% can suffocate aquatic life faster than raw sewage.
- **Heavy Metals**: Over time, cooling system components may degrade, leaching trace amounts of copper, zinc, or lead into the water.

Separately, zero-water alternatives are being introduced to the data center industry. These newer "zero-water" cooling systems exist that use direct-to-chip liquid cooling and dry chillers or adiabatic systems, which can significantly reduce or eliminate onsite water consumption by rejecting heat to the air without evaporation. These systems typically use a different coolant, such as a glycol mixture or specialized fluid, and the only water use is for minor needs like humidification or domestic use.

Generator Diesel Fuel & Diesel Exhaust Fluid (DEF) Risks

With 300 units of 3-MW T4 generators, the primary water concern is both diesel fuel and lubricant runoff and spills rather than direct usage.

- It has been estimated that **over 3 million gallons and as much as 5 million gallons of diesel fuel** will be stored on site to operate the 300 generators for required outages backup. This presents a major risk of ground and surface water contamination from leaks or spills during refueling and disaster events.
- The proposed T4 generators use Diesel Exhaust Fluid (DEF) to reduce emissions. The estimate for **DEF fluid is over 300,000 gallons**. Spills of this urea-based fluid can cause localized nitrogen spikes in nearby water bodies.

The storage of this volume of fuel and DEF is simply not compatible with the definition of Light Industrial. However, should this zoning application move forward, risk mitigation requirements should be incorporated in the Proffer to account for the risks to the James River and Chesapeake Bay watersheds.

Air Quality and Public Health Risks

The proposed 900-megawatt data center will primarily impact air quality through emissions from its diesel backup generators. These emissions include harmful pollutants like nitrogen oxides, carbon monoxide, particulate matter, and volatile organic compounds (VOCs), which raise significant local health and environmental concerns, particularly for nearby communities. Studies indicate that communities within a one-mile radius of EPA-regulated data centers experience higher air pollution levels compared to national averages.

When running, the proposed three hundred (300) T4 3-megawatt generators for the Hunting Hawk Technology Park will release a set of pollutants known to cause or exacerbate chronic respiratory illnesses like asthma and other serious conditions.

It is estimated that these 300 generators will each operate 30 minutes each month for maintenance as well as operating during times when the grid is not able to keep up with electricity demand (a likely scenario given the current gap in current infrastructure).

Just the maintenance of these generators will generate at least 1,200 metric tons of CO2 per month. Operating these 300 generators for 30 minutes per month for maintenance and testing generates a significant amount of air pollution including:

- Nitrogen Oxides (NOx): 180 kg per month
- Carbon Monoxide (CO): 9,000 kg per month
- Carbon Dioxide (CO2): 1,200 metric tons per month
- Particulate Matter (PM): 13,500 grams per month
- Volatile Organic Compounds (VOCs), such as benzene
- Sulfur Dioxide (SO2): 540 grams per month

Looking at a Particulate Matter (PM) as an example. Particulate matter poses serious health risks because it can be inhaled deep into the lungs and enter the bloodstream. Children are particularly vulnerable because they breathe more rapidly than adults, absorbing more pollutants, and their bodies and brains are still developing. Exposure can lead to impaired lung growth, asthma, respiratory infections, and potentially affect neurodevelopment and cognitive performance, including lower test scores and increased absenteeism.

The Virginia Department of Environmental Quality (DEQ) regulates these emissions through air permits which limit run times and maximum annual emissions. However, the cumulative impact of numerous data centers and their associated generators across the state remains a major point of contention for local residents and environmental advocates.

Further scrutiny must be given in this regarding in light of the fact that the subject complex is within 2 miles of multiple elementary schools. Again, the proposed change to the Comprehensive Plan is not harmonious with the surrounding land uses.

Light Pollution and Visual Degradation Risks

A 900 MW data center located in Hunting Hawk Technology Park will significantly increase light pollution, disrupting nocturnal ecosystems, affecting human sleep patterns (circadian rhythms), and altering the night sky's visibility, particularly in a growing, but still somewhat rural, area like Western Hanover, with potential for spillover light impacting nearby communities and natural areas, though specific regulations and design choices can mitigate these effects.

Western Hanover is near developed and developing areas but retains rural character, meaning new light sources will have a more noticeable impact on residents and dark skies than in already developed "Data Center Alley" in Northern Virginia, says Cardinal News.

In essence, a 900 MW facility is huge, and while emergency generators and cooling systems are big topics, the constant, massive footprint of lights presents a major challenge to local light environments.

Specific light pollution impacts:

- Sky Glow: The sheer scale of illumination from large, windowless buildings, security lighting, and extensive parking lots creates significant upward-directed light, contributing to regional skyglow that washes out stars and affects astronomy.
- Ecological Disruption: Artificial light disrupts the behavior of nocturnal animals (insects, birds, mammals) by altering foraging, mating, and migration patterns, impacting local biodiversity.
- Human Health & Well-being: Light intrusion into nearby homes can disrupt sleep, increase stress, and affect circadian rhythms for residents, as noted by communities near other data centers.
- Visual Blight: The large, industrial nature of these facilities, even with lighting controls, changes the rural landscape, a major concern for residents in areas like Hanover.

Terrorism Risks to Modern Data Centers

Modern data centers are high-value targets for terrorist groups seeking to disrupt national critical infrastructure, steal sensitive government or financial data, or cause widespread operational paralysis. Unlike traditional targets, these facilities face a convergence of digital and physical vulnerabilities that can be weaponized to cause cascading impacts on society.

For local communities, the direct impact includes the visibility of heavy security fencing, vehicle blockades, and 24/7 lighting that cause "light trespass" and a loss of scenic views for adjacent property owners. The “light trespass” is especially impactful to the rural community residents as well as domestic animals and wildlife.

For local communities, the impact of terrorist risks extends beyond the immediate facility to affect public health, utility costs, and economic stability. Some examples are as follows:

Terrorist Risk Example	Potential Community Impacts
Elimination of power substations or other power supply disruptions	Long-term operation of backup generators will cause significant air and sound pollution impacts Blackout conditions throughout the community
Remote cooling system shutdown	GPU failure/meltdown and fire; An industrial fire of electronic components and batteries will generate highly toxic conditions throughout the community
Attacks on data transmission services	Long-term disruption of internet services at homes and businesses in the area

Please note reference documents used as source information for the development of this document are available upon request.