MEMORANDUM

To: Ahmed Zuwawa, P.E., Kimley-Horn and Associates, Inc.
From: Cate Medlock, Kimley-Horn and Associates, Inc.
Date: June 15, 2026
Subject: Townsite 2 Data Center – Heat Study

Purpose

The purpose of this memorandum is to provide a qualitative heat and thermal assessment of the proposed Boulder City Data Center Project (Project), a 167-megawatt (MW) facility located in Boulder City, Nevada. The memorandum is intended as a screening-level evaluation that identifies potential thermal risks and informs site planning and mechanical design considerations. This analysis draws on project-specific information and established scientific literature to evaluate the processes of heat generation, dispersion, and interaction with regional climatic conditions.

Project Location

The Project site is located within the municipal boundaries of the City of Boulder City, Clark County, Nevada, approximately 15 miles southeast of the City of Las Vegas. The developed Boulder City area is located approximately three to five miles northeast of the Project site. Specifically, the site is situated immediately west of U.S. Route 95 and approximately 2,100 feet south of U.S. Route 93/Interstate 11, within the largely undeveloped Eldorado Valley desert area that is characterized by utility-scale solar facilities and open land. The Project site lies north of the Eldorado Solar development area and west of the broader Eldorado Valley solar energy development area. In addition, the Desert Star 500-MW natural gas-fired power plant and associated transmission lines are located in the vicinity of the Project site.

Project Description

The proposed TS2 Data Center is a high-density, utility-scale digital infrastructure facility planned within the Eldorado Valley area of Boulder City, Nevada. The proposed Project includes a total electrical demand of approximately 167 MW and an estimated 133.6 MW of Information Technology (IT) load capacity based on a Power Usage Effectiveness (PUE) of 1.25. Backup generation would be provided by 53 biodiesel[1]-fired generators (52 primary units plus one redundant unit) with a combined standby capacity of approximately 172 MW, ensuring uninterrupted operations during grid outages.

Data center cooling would be achieved using an advanced closed-loop, air-cooled (dry) system that incorporates direct-to-chip liquid cooling and dry cooling towers. The system is designed to reject the full 167 MW of thermal load to the atmosphere through sensible (non-evaporative) heat transfer. As a result, the data center portion of the facility would operate with effectively zero water consumption during normal operations, aside from negligible volumes a purified water/propylene glycol solution required for periodic maintenance. Bathrooms and kitchens associated with the facility are anticipated to require approximately 2,000 gallons of water per day.

Existing Conditions

The Project site is located within the Eldorado Valley, an arid desert basin characterized by high solar radiation, minimal vegetation, and significant temperature variability between daytime and nighttime conditions. Similar to the Las Vegas valley to the northwest, the Eldorado Valley experiences daily high temperatures that often exceed 100 degrees Fahrenheit (°F) which are tempered by relatively low humidity (NOAA, 2005). During winter months, daily temperatures are mild but can drop to below 32°F. Snow accumulation occurs during the winter months in the mountains surrounding the Eldorado Valley.

The Project site is surrounded by several mountain ranges, including the River Mountains to the north, and the Eldorado Mountains to the south and east. These mountain ranges influence surface wind, temperature, precipitation, and runoff patterns (Sonoma Technology, 2020). The region experiences dry conditions year-round due to the presence of mountains which act as barriers to moisture. The regional climate is influenced by seasonal monsoonal patterns. During the summer months, a region of high-pressure forms over the U.S. southwest and the wind becomes more southerly (NOAA, 2026). These southerly winds bring moisture from the Pacific Ocean and the Gulf of California generating thunderstorms and precipitation. Within southern Nevada, the monsoon season occurs from July through September. Monsoon moisture brings high humidity and thunderstorms as the winds come from the southwest.

In southern Nevada, urban temperatures are increasing at a rate faster than surrounding undeveloped land. Urban areas that are warmer than surrounding rural areas are referred to urban heat islands (UHI). The UHI effect in southern Nevada and the Eldorado Valley is driven by

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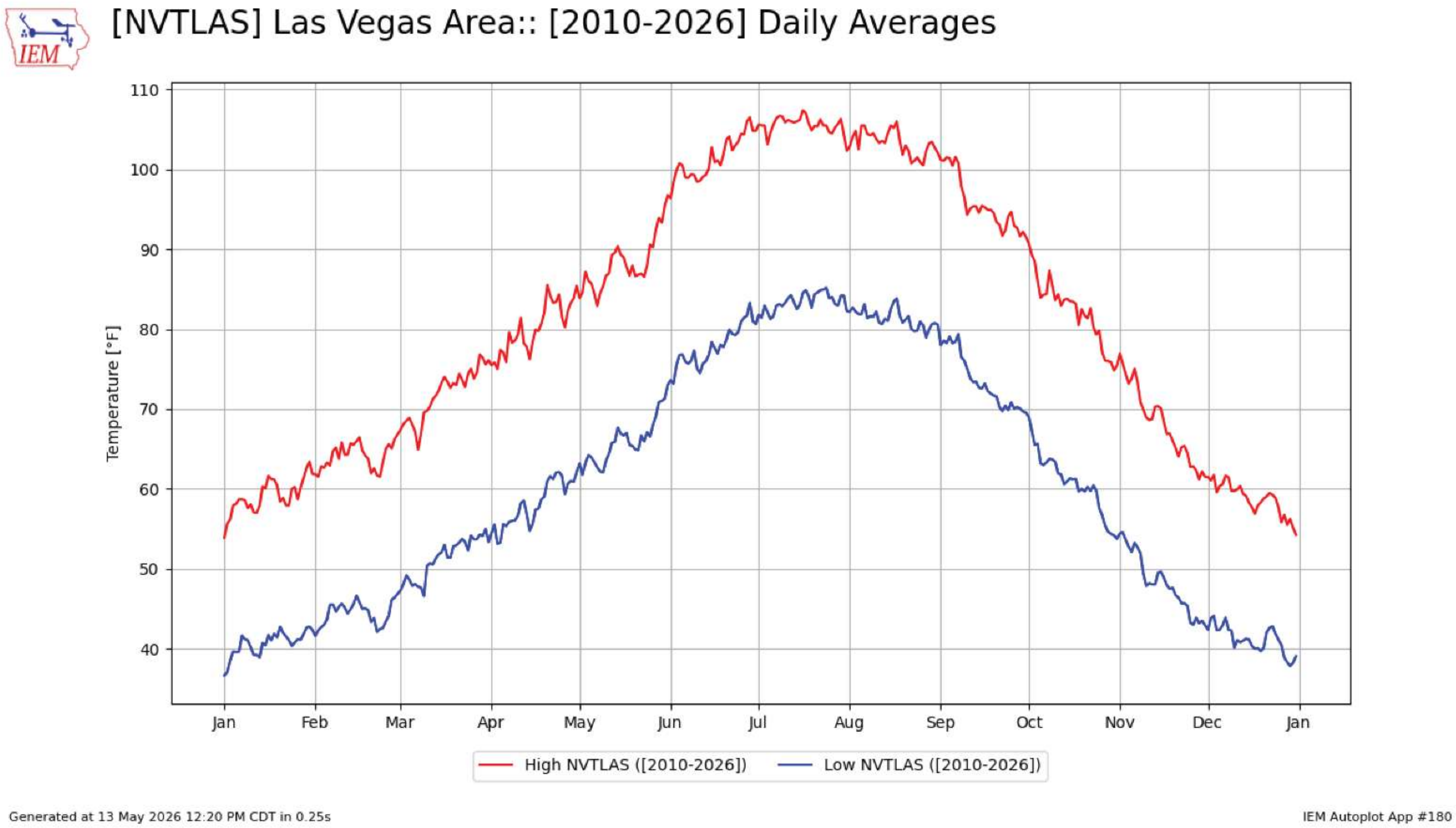
[1] Biodiesel is a renewable, biodegradable alternative to petroleum-based diesel fuel, manufactured from organic resources such as vegetable oils, animal fats, or recycled restaurant grease. Biodiesel can be used in most unmodified diesel engines.

a lack of tree canopy coverage and industrial and commercial land uses (Black, Ahmad, & Stephen, 2019; Southern Nevada Heat Resilience Lab, n.d.). UHI exists year around, but the intensity may vary depending on the season (Black, Ahmad, & Stephen, 2019). Other factors influencing UHI include impervious surface area, surface heat transfer properties, changes in surface geometry, and anthropogenic activities. Boulder City experiences less UHI than the City of Las Vegas, likely due to more tree canopy cover and fewer industrial land uses (CAPA Strategies, LLC, 2022).

Temperature Profiles

Southern Nevada experiences extreme summer temperature conditions, with sustained high daytime temperatures and elevated nighttime temperatures, as shown in Figure 1. During winter, average daytime high temperatures are relatively mild, generally ranging from approximately 55°F to 60°F, while overnight low temperatures frequently fall into the upper 30s to low 40s°F range. The relatively large separation between daytime highs and nighttime lows indicates strong radiative cooling at night, which is typical of arid environments with low humidity and clear skies. Through the spring months, temperatures increase steadily. By late spring, average daytime highs reach the mid-80s°F, while nighttime lows rise into the low to mid-60s°F range. The summer period exhibits the most extreme temperatures. Average daily high temperatures peak between 103°F and 107°F, with the highest values occurring in July and early August. Nighttime temperatures remain elevated, typically ranging between 80°F and 85°F, indicating very limited nighttime cooling compared to other seasons.



Source: IEM, 2026

Figure 1: Las Vegas Area Temperature Profile

Boulder City Data Center Project

Not to scale

Wind Patterns

The wind regime in Boulder City is characterized by a strong seasonal directional shift, combined with generally moderate wind speeds and a relatively high frequency of calm conditions. During the winter months (December through February, including January and November as transitional conditions), winds are predominantly from the north to the northeast. As shown in Figure 2, the highest frequency of winds originates from the north, north-northeast, and northeast sectors. These winter winds tend to occur at modest speeds, typically in the 5 to 15 mile per hour (mph) range, although occasional higher-speed events exceeding 15 mph are present. Calm conditions are relatively frequent during winter, generally ranging from approximately 27 to 37 percent, indicating that stagnant or low-wind conditions are common during colder months.

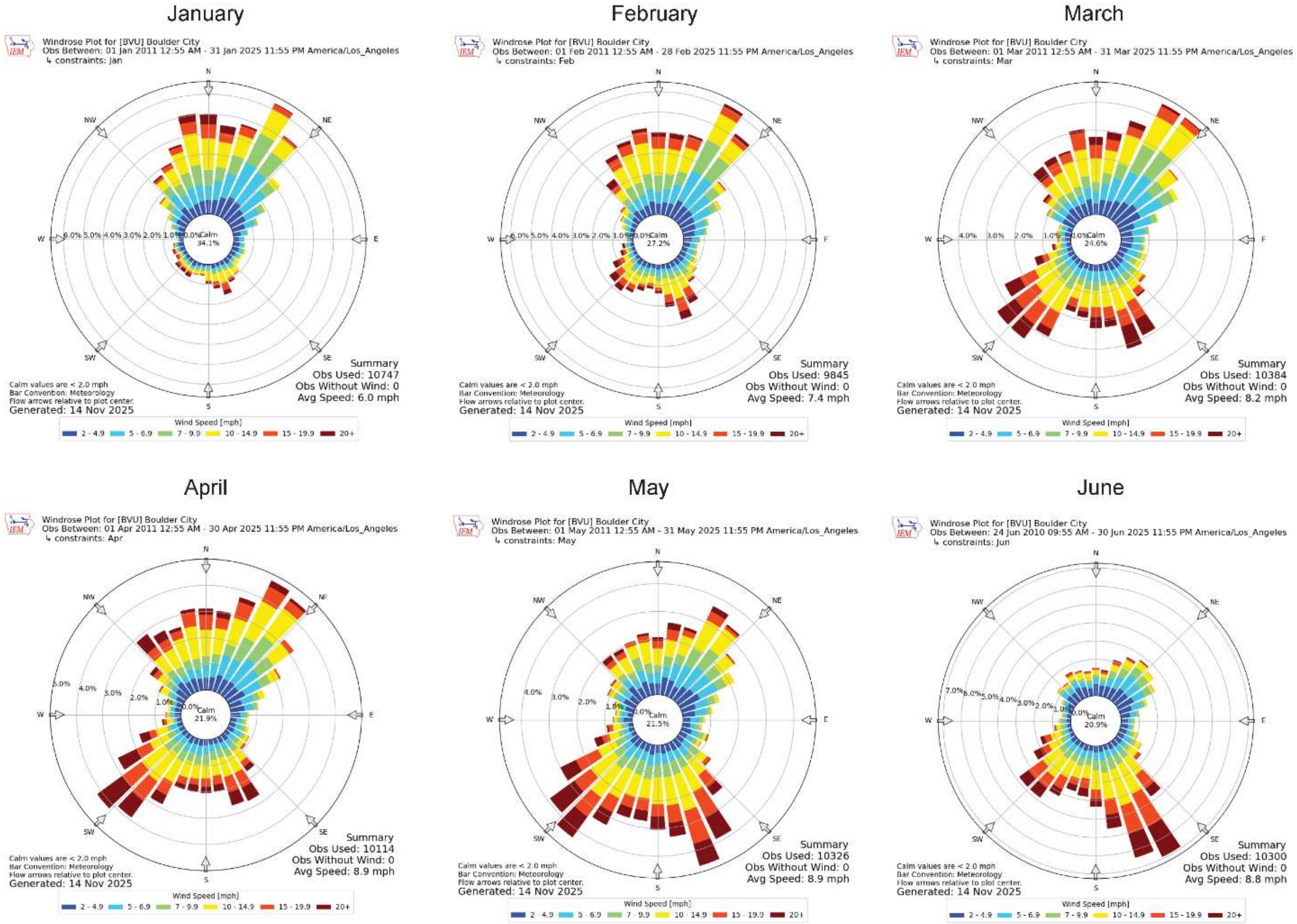
As the region transitions into spring (March and April), wind direction becomes more variable. As shown in Figure 2, March and April show a bimodal pattern, with continued northerly to northeasterly flow persisting, while southwesterly winds begin to emerge. Spring also shows an increase in wind intensity relative to winter, with more frequent occurrences of winds in the 10 to 20 mph range and above, particularly from the southwest. Calm conditions decrease during this period, generally falling near 21 to 25 percent, indicating more consistent airflow. By late spring and early summer (May and June), the wind regime undergoes a distinct reversal. Winds become predominantly southerly to southeasterly and south-southwesterly, with the strongest and most frequent winds occurring from the south and southeast quadrants.

During the summer months (July and August), winds are strongly focused in the south to southeast sector, as shown in Figure 3. These months also exhibit some of the highest wind speeds, with frequent occurrences in the 10 to 20 mph range and notable contributions above 20 mph. This reflects strong thermal gradients and convective mixing typical of desert summer conditions, often associated with monsoon season influences.

In the late summer and early fall transition (September and October), wind patterns begin to shift back toward northerly dominance. September still retains a strong southerly and southeasterly component, but with increasing contributions from northeast winds, suggesting a transitional regime. By October, the wind roses clearly show a return to north- northeast dominance.

Sensitive Receptors

Noise exposure standards and guidelines for various types of land uses reflect the varying noise sensitivities associated with each of these uses. Places of worship, libraries, educational facilities, hospitals, residences or uses containing sleeping quarters are treated as the most sensitive to noise intrusion and therefore have more stringent noise exposure targets than do other uses, such as manufacturing or agricultural uses that are not subject to impacts such as sleep disturbance. Sensitive receptors nearest to the Project site are shown in Table 1.



Source: IEM, 2025

Figure 2: Boulder City Wind Patterns - January to June

Boulder City Data Center Project

Not to scale

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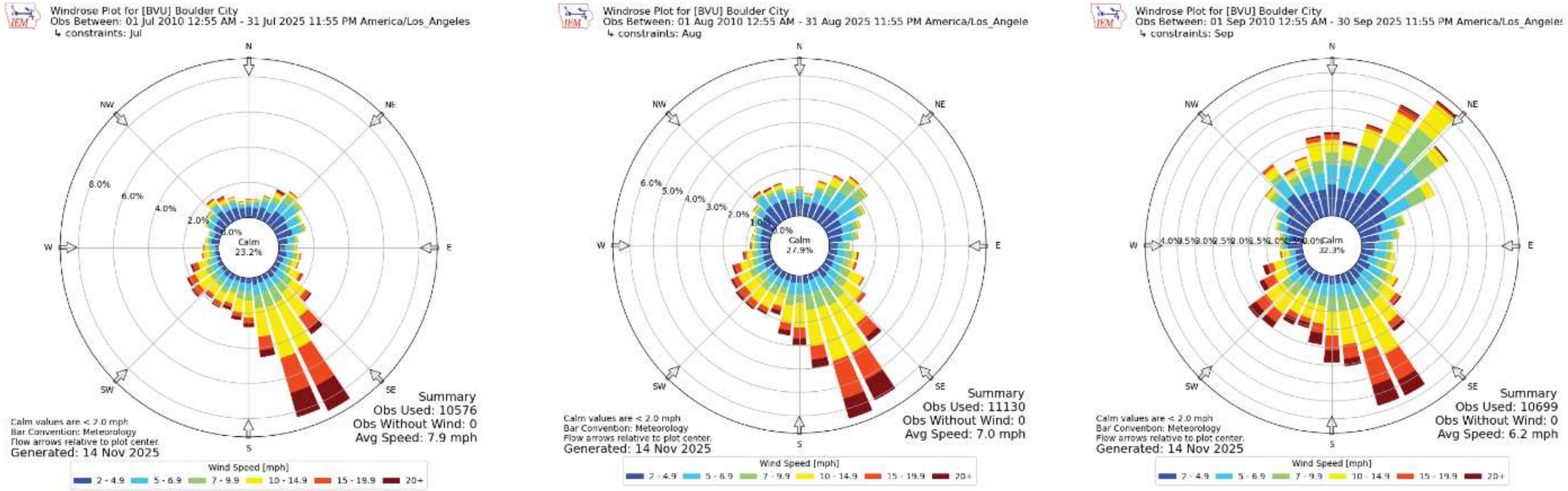
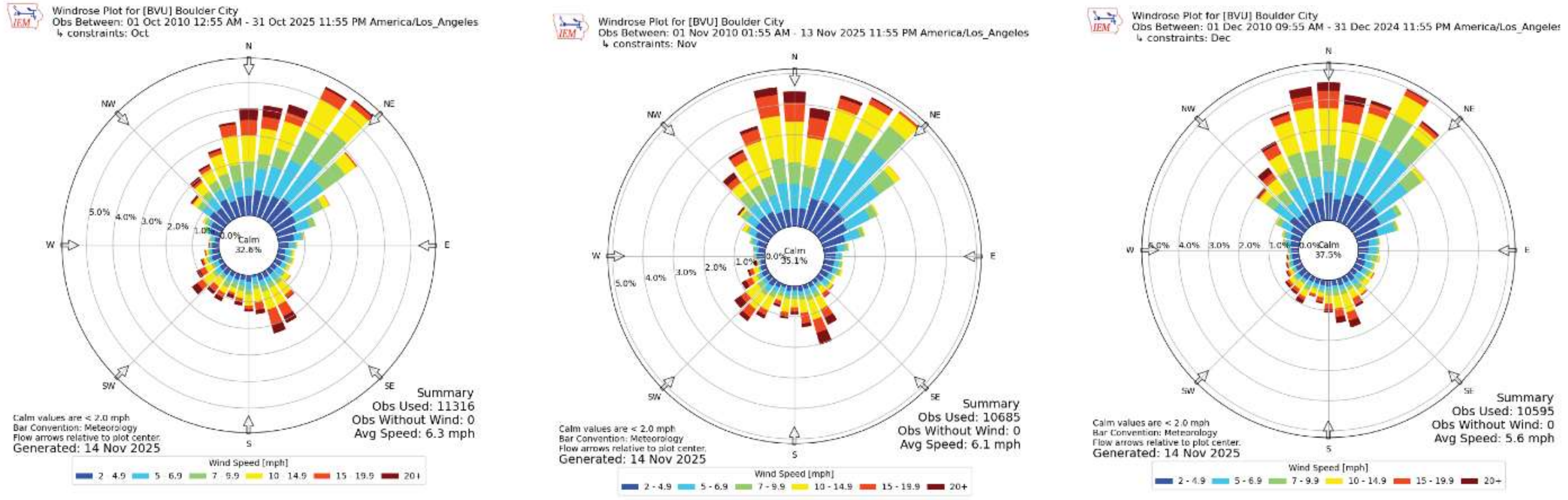
July August September



October November December



Source: IEM, 2025

Figure 3: Boulder City Wind Patterns - July to December

Boulder City Data Center Project

Not to scale

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Table 1: Sensitive Receptors

Receptor Description	Distance and Direction from the Project
Townsite Solar 1 Solar Plant	130 feet to the south and east
Boulder Creek Golf Club	13,000 feet to the northeast
Mobile homes	14,000 feet to the northeast
Student Housing	14,125 feet to the northwest
Single-family residential	14,260 feet to the northwest
School	14,455 feet to the northwest
School	16,728 feet to the northwest
Single-family residential	17,933 feet to the east

Source: Google Earth, 2026.

Relevant Studies

During the last two decades, the increase in demand for data processing, artificial intelligence (AI), and data storage has resulted in rapid growth of data center development. Recent energy statistics indicate that energy consumption from data centers account for approximately 3 percent of the global energy consumption (Pei Huang, 2020). Waste heat from the data center industry reached 56 terawatt-hour (TW h) in 2016 (Yuan, et al., 2023). Waste heat from data centers are considered low-grade heat sources as it is produced at relatively low temperatures. Many data centers have power densities in excess of 10,000 W/m^2 and up to 20,000 W/m^2 with individual server racks commonly rejecting 30 kW of heat (Ebrahimi, Jones, & Fleischer, 2013).

A study conducted by Ebrahimi, Jones, and Fletcher (2013) evaluated three cooling systems: air-cooled, liquid-cooled, and two-phase cooled systems. Of these, liquid-cooled and two-loop architectures are identified as the most effective for managing high heat densities and for producing controlled, predictable heat rejection streams. The study documents an IBM demonstration facility using a two-loop, chiller-less design in which cooling energy demand was reduced from approximately 45 percent of total facility power to approximately 3.5 percent with all heat ultimately rejected to ambient air through dry coolers. The study further notes that two-loop liquid systems generate low-grade but high-volume waste heat, typically in the 35 to 60 degrees Celsius (°C) range, which is well suited for waste heat recovery.

The potential impacts of data center heat generation on nearby communities are relatively unstudied. One recent study has identified that large-scale data centers can produce measurable localized warming effects under certain conditions. The study was a preprint and has not been peer-reviewed. A global analysis of AI hyperscale facilities found that land surface temperatures increased by approximately 3.6°C on average following the start of operations, a phenomenon referred to as the "data heat island effect" (Marinoni, et al., 2026). The study conducted by Marinoni et al. (2026), relied on land surface temperature measurements for 8,472 data centers located outside of highly dense urban areas. The average land surface temperature ranged from 0.5 °F and 16.4 °F. These effects were observed to extend up to 10 kilometers from facilities, and the data heat island effect reduced its intensity to 30 percent within 7 kilometers around the data centers. The study found that the land surface temperature increase recorded in the area surrounding the data centers was consistent across different regions in the world. However, the study acknowledges that advances in technology can be used to mitigate the data heat island effect of data centers. It is noted that the study does not include specifics on the cooling systems. It does not discuss whether data centers use cooling loop configurations (e.g., closed-loop vs. open-loop systems), there is no evaluation of water consumption, blowdown, or cooling tower impacts, and there is no comparison of closed-loop efficiency or emissions implications. Therefore, the results of this study may not be directly relevant or applicable to the proposed Project.

A study published in May 2026 evaluates the thermal impacts of four data center facilities in the Phoenix, Arizona metropolitan area ranging from a 36 MW single-building data center to a 169 MW colocation campus (Sailor, Abolhassani, & Martin, 2026). Vehicle-based traverse measurements were conducted at the data center sites, which captured thermal gradients at each site associated with data center waste heat rejection. The downwind warming effect from the operational data centers was as large as 4.0 °F and average downwind air temperatures 1.3-1.6 °F warmer than corresponding upwind areas. Thermal signatures were detectable within 1,640 feet of the data centers. One site showed apparent cooling relative to the areas upwind of the site, likely due to the presence of an adjacent water detention basin in a park that was situated downwind of the data center. The study indicated that this could be a potential mitigation strategy for thermal impacts from data centers. As noted above, the closest residences would be 14,000 feet from the proposed Project and well outside of the 1,640-foot distance that this study found thermal signatures could be detected.

These studies collectively demonstrate that while data centers represent significant thermal sources, the magnitude and extent of their impact depend strongly on cooling technology, siting, and atmospheric conditions.

Regulatory Framework

Regulations at the local, state, and federal levels do not typically establish explicit thresholds for thermal emissions from data centers. Instead, heat is generally considered indirectly through related environmental topics such as air quality, energy efficiency, and land use compatibility. While regulations governing data centers in southern Nevada are currently limited, several new policy developments are emerging in 2026. Notably, Boulder City voters will consider whether data centers should be permitted as a land use within the Eldorado Valley Transfer Area (Las Vegas Review-Journal, 2026). Although this area is not the location of the proposed Project, the initiative reflects a broader shift in local regulatory attitudes and signals the potential for future changes to the permitting and land use environment affecting data center development in the region. The following regulations are applicable to the Project:

Southern Nevada Water Authority

In February 2024, the Southern Nevada Water Authority passed a resolution supporting a moratorium on the installation and use of evaporative cooling mechanisms in new commercial and industrial buildings in the Las Vegas valley, including data centers (Southern Nevada Water Authority, 2026). Boulder City is a member agency of the Southern Nevada Water Authority.

Nevada Assembly Bill 96

Assembly Bill 96, taking effect July 1, 2026, requires Clark County to incorporate heat mitigation strategies into their local master plans to address rising extreme heat conditions. These plans must include measures such as expanding access to cooling spaces, improving drinking water availability, and promoting “cool building” practices like reflective materials, shaded surfaces, and drought-tolerant tree cover. While the law is not specific to data centers, it establishes a policy framework that can influence how high heat-generating uses are planned and approved, potentially leading to stricter expectations for site design, cooling methods, and overall contribution to urban heat conditions in Southern Nevada.

Southern Nevada Building Official’s International Energy Conservation Code

Nevada regulates heat generation from data centers through its adopted building energy codes rather than explicit thermal limits. The state has implemented the 2024 International Energy Conservation Code (IECC) and American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) 90.1-2022 as its baseline standards, with Clark County adopting the amendments to the code on July 15, 2025. In accordance with the code, data centers must comply with Section C403.1.1, Section C403.1.2 and Sections C403.6 through C403.17. These codes do not directly cap heat output, but they indirectly constrain it by requiring high-efficiency cooling systems, establishing minimum performance standards for building envelopes and mechanical equipment, and promoting energy-efficient design. The Project includes advanced closed loop air (dry) cooled cooling system with direct to chip liquid cooling and dry cooling towers that would comply with these requirements.

Industry Standards and Guidelines

While not enforced through local, state, or federal regulations, several industry standards provide guidelines and best management practices for data center development. The following standards and guidelines may be relevant to the Project:

- **ASHRAE 90.4 – Energy Standard for Data Centers**: The ASHRAE developed Standard 90.4 to provide a framework for the energy efficient design of data centers. The standard applies to data centers with a conditioned floor space that has a power density greater than 20 W/ft^2 and IT equipment loads greater than 10 kW. The standard also contains specific requirements for mechanical and electrical systems.

- **ASHRAE Technical Committee (TC) 9.9 – Thermal Guidelines and Cooling Best Practices**: The TC 9.9 provides technical guidance for cooling, airflow management, and environmental conditions for data centers (ASHRAE Technical Committee, 2016).
- **Department of Energy (DOE) Federal Energy Management Program (FEMP) Best Practices Guide for Energy-Efficient Data Center Design**: Published in July 2024 by the DOE FEMP, the guide provides an overview of best practices for data center design including IT systems, cooling, electrical systems, and heat recovery (Federal Energy Management Program, 2024).

Heat Generation

The Project would use a close two-loop, air-cooled system. The system begins at the source of heat generation, which is the IT equipment itself. High-performance computing components such as Graphics Processing Units (GPUs) and Central Processing Units (CPUs) generate substantial thermal loads during operation, with individual chips producing on the order of hundreds of watts of heat. The facility's total load of approximately 167 MW corresponds directly to its thermal output.

Immediately at the point of generation, heat is captured using direct liquid cooling technologies, which form the first stage of the closed loop system. The design utilizes copper micro-channel cold plates attached directly to chips, allowing heat to be removed at the source before it diffuses into the surrounding air. These cold plates capture the majority of the thermal load, approximately eighty percent, while the remaining heat from lower-power components is captured at the rack level by rear-door heat exchangers.

Once heat is extracted from the IT equipment, it is transferred into the primary cooling loop, also referred to as the Technology Cooling System. This loop consists of a closed liquid circuit containing a glycol-water mixture. The fluid circulates continuously, absorbing heat from the cold plates and transporting it away from the servers. Because the loop is fully sealed and never exposed to the external environment, it maintains stable thermal and chemical conditions while preventing any direct heat release at this stage.

The heated fluid in the primary loop is then routed through Coolant Distribution Units[2], which act as the interface between the internal system and the facility-level cooling infrastructure. Within these units, heat is transferred across a plate heat exchanger to a second, separate loop. Importantly, the two loops remain physically isolated, which allows for controlled heat exchange while protecting sensitive IT equipment from variations in the external cooling system.

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[2] A coolant distribution unit (CDU) is a localized system that circulates and controls coolant delivered to liquid-cooled IT equipment, typically via a secondary loop, whereas a chiller is central plant equipment that generates chilled water by removing heat through a refrigeration cycle. The chiller provides the cooling capacity, and the CDU manages how that cooling is distributed and applied at the rack or equipment level.

The secondary loop, sometimes referred to as the facility water system, receives the thermal load from the primary loop and transports it toward the final stage of heat rejection. Like the primary loop, this system is also closed, meaning that heat continues to be contained and managed internally rather than being released incrementally throughout the facility. This design centralizes heat rejection and allows for more efficient control of plume location and behavior.

The final stage occurs at the dry cooling towers, where heat is transferred from the circulating fluid to the ambient air. These systems use finned-tube heat exchangers and high-capacity fans to move air across heated surfaces, allowing heat to dissipate into the atmosphere. The heat transfer at this stage is entirely sensible, meaning it raises the temperature of the air without producing moisture or evaporation. As a result, the system does not generate visible plumes or water vapor, and all heat is released as warm air discharged upward from the cooling equipment.

Under certain conditions, particularly during periods of high ambient temperature, mechanical chillers may operate to assist in cooling. However, when outdoor conditions permit, the system can bypass these chillers and rely entirely on direct air cooling, often referred to as free cooling. This capability allows the facility to adapt to seasonal variations in temperature while maintaining consistent heat rejection performance.

Heat Impact Screening

Thermal Conditions

The Project would use dry cooling towers to reject heat vertically into the air. The facility's reliance on dry cooling results in the release of warm air without added humidity, meaning that thermal effects are governed primarily by temperature and airflow. The heat plume rejected from the dry cooling towers would be warmer than the surrounding ambient air and would rise away from the surface. During this upward movement, the warm air expands and mixes with surrounding air, which would decrease the temperature of the rejected heat. During summer in desert environments, strong surface heating promotes enhanced vertical mixing in the lower atmosphere. This increased atmospheric mixing improves the dispersion of heat by transporting it upward and diluting it more effectively near the ground level. As such, heat rejected from the Project would not remain concentrated at ground level and would reduce the surface-level temperature effects.

Wind Dispersion

Prevailing wind conditions are expected to play a dominant role in dispersing thermal plumes. Horizontal wind transport reduces the persistence of localized warming. As discussed above, winds during the winter months originate from the north to northeast. The thermal plume from the cooling towers would be transported to the southwest of the Project site. The area southwest of the Project site consists of primarily undeveloped desert that is characterized by utility-scale solar facilities, undeveloped land, and mountain ranges. During the winter months, the thermal plumes from the Project would be directed away from communities and sensitive receptors. It is noted that the existing Desert Star 500-MW natural gas-fired power plant is also in the vicinity of the Project site.

During the summer months, wind originates from the south and southeast, and the thermal plume would be transported to the northwest. Land uses to the northwest of the Project site include undeveloped lands and mountain ranges, the City of Henderson, and the greater Las Vegas Metropolitan Area. However, winds are highly variable due to topography. Winds could be funneled through narrow valleys in nearby mountain ranges, such as the River Mountains to the north. Boulder City would not be expected to be impacted by the thermal plumes from wind transport. The Project site is located in the open desert, and the nearest structure is the Desert Hills Shooting Club located approximately 0.6 miles (3,168 feet) to the north. There are limited buildings and structures within the vicinity of the Project site, such that the heat plumes would not be trapped by surrounding development, and heat dispersion would not be impeded. The nearest sensitive receptor to the Project site is the Boulder Creek Golf Club located approximately 2.5 miles (13,000 feet) to the northeast and the nearest residents are located approximately 2.7 miles (14,000 feet) to the northeast. While wind dispersion would transport the heat plume away from communities during the winter, the heat plume could impact sensitive receptors during the summer. Seasonal variability in wind direction means that any potential exposure is intermittent rather than continuous.

Surface Materials and Heat Retention

Surface materials at the site influence localized heat retention. These effects are secondary to direct heat discharge from cooling systems and are generally consistent with existing land use conditions in the region. Impervious surfaces such as concrete, asphalt, and roofing absorb and store heat, contributing to localized warming consistent with typical industrial development patterns in desert environments. This phenomenon is particularly prevalent in the summer and is a major contributor to the UHI effect. These materials typically have low albedo and high thermal capacity that absorb more solar radiation than surrounding vegetated areas (NASA, 2015). The removal of vegetation also contributes to the thermal footprint of a data center. Furthermore, the position and layout of thermal rejection systems contribute to how heat is dispersed into the environment. Therefore, vegetation removal and impervious materials used in the construction and operation of the data center can increase the ambient air temperature around the site.

Design Drivers and Best Practices

Effective site design is a primary mechanism for minimizing thermal effects. Minimizing unnecessary impervious surface areas and preserving vegetation, where feasible, can limit surface heating at the site. The open desert setting facilitates airflow, and appropriate spacing of structures and cooling equipment allows for efficient dispersion. Locating heat rejection systems to align with prevailing wind directions and maintaining unobstructed airflow paths are critical considerations. Compliance with industry standards and environmental regulations would ensure that data center design and development is energy-efficient and compatible with existing land uses. Industry standards and environmental regulations would also minimize heat effects to surrounding areas.

Conclusion

Project design, atmospheric conditions, and heat rejection characteristics would limit the potential for adverse localized heat effects. The Project's closed-loop cooling system would centralize the thermal load and release it as sensible heat through elevated discharge points, producing a buoyant plume that rises and disperses rather than accumulating near the ground.

Because the discharged air would be warmer and less dense than ambient air, it would rise and disperse quickly. Strong desert mixing, moderate winds, open terrain, and the lack of nearby structural barriers would further disperse the plume and limit ground-level temperature increases. Seasonal wind shifts would generally carry the plume over largely undeveloped desert, and the distance to the nearest sensitive receptors (more than 2.5 miles) would further reduce the potential for sustained heat exposure. Additionally, as described above, industry standards and environmental regulations would also minimize heat effects to surrounding areas. Although surface materials and impervious areas may slightly increase localized heat retention, those effects would be typical of industrial development in arid environments and would not materially affect regional thermal conditions. Overall, the Project's thermal emissions would be transient, diffuse, and readily dispersed.

Recent studies (e.g., Sailor, Abolhassani, & Martin, 2026) indicate that large data centers can cause measurable but localized air temperature increases within several hundred meters downwind of cooling equipment. Those effects are transient, plume-driven, and controlled by dispersion conditions. They do not change the Project's impact determination because the Project site is in an open desert setting with strong convective mixing, limited structural obstruction, moderate winds, and sensitive receptors located more than 2.5 miles away. Additionally, environmental regulations and project design with advanced closed loop air dry cooled cooling system with direct to chip liquid cooling and dry cooling towers would minimize heat impacts to surrounding areas. Given that reported temperature effects decline rapidly with distance and were not observed beyond several hundred meters, any Project-related plume would be substantially diluted before reaching off-site receptors 2.5 miles (4,023 meters away).

Accordingly, while short-duration temperature increases may occur immediately around the heat rejection equipment, the Project would not cause a measurable or sustained increase in ambient temperature at nearby communities and would not create a localized or regional heat island effect.

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