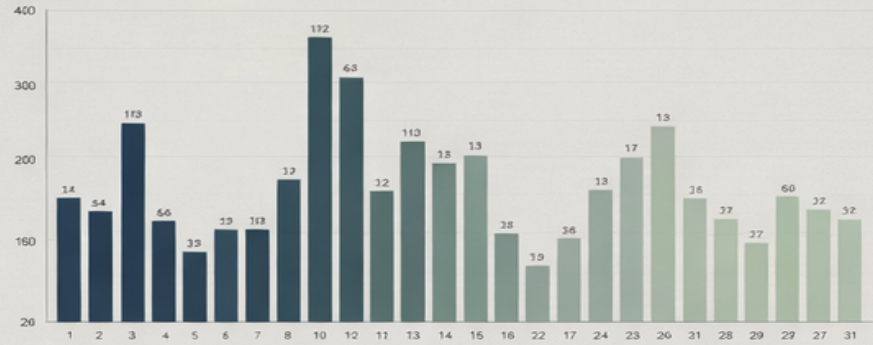


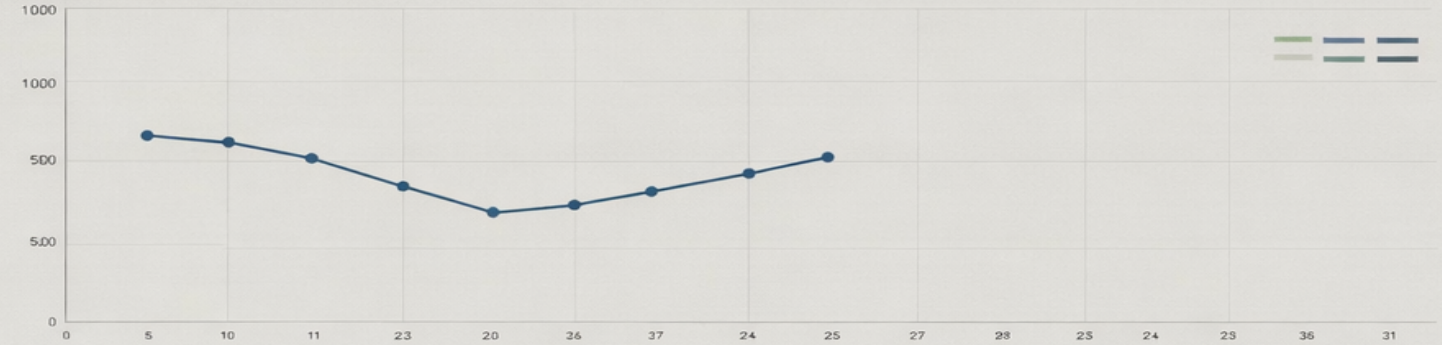
CONTEXTUAL STUDIES

URBAN PLANNING & ENVIRONMENTAL ANALYSIS

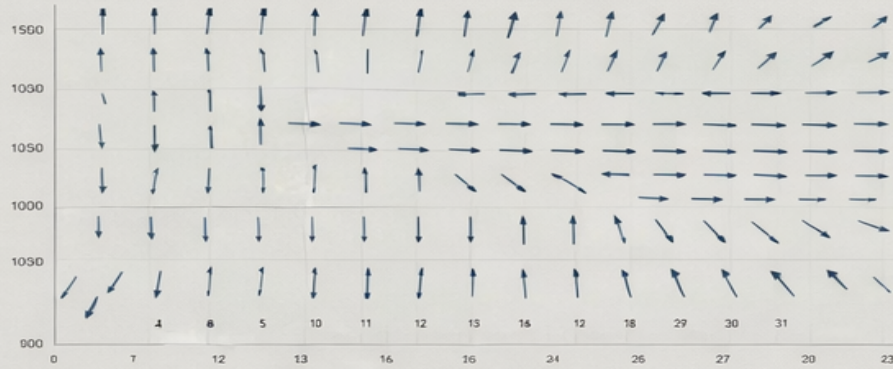
TEMPERATURE



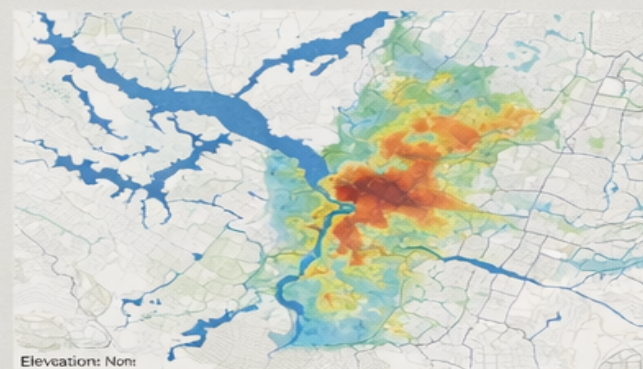
HUMIDITY



VECTOR FIELD DIAGRAM



URBAN HEAT ISLAND



HYDROGRAPHY



Executive Summary

1. Climate & Thermal Comfort

- Max temperature is 41.2°C, which is 11.6°C above the upper comfort limit. Min temperature is 11.7°C, which is 9.7°C below the lower comfort limit.
- The site experiences temperatures outside the comfort range for most of the year. Approximately 16.1% of the year is comfortable.

2. Sun & Shadows

- The West façade receives the highest solar radiation of 1932.4 kWh/m² over 2153 hours. West facade receives the highest radiation.
- The roof receives 1251.3 kWh/m² of solar radiation over 4400 sunlit hours

3. Wind Patterns

- Predominant wind direction is towards East and the annual average wind speed is 3.60 m/s.
- Seasonal winds: summer towards West (5.20 m/s); winter towards Southeast (2.70 m/s); autumn towards Northeast (3.10 m/s); spring towards Southeast (3.40 m/s).

4. Urban Heat Island (UHI)

- The site experiences a negligible UHI effect, raising local temperatures by approximately 0.075°C above the regional average.

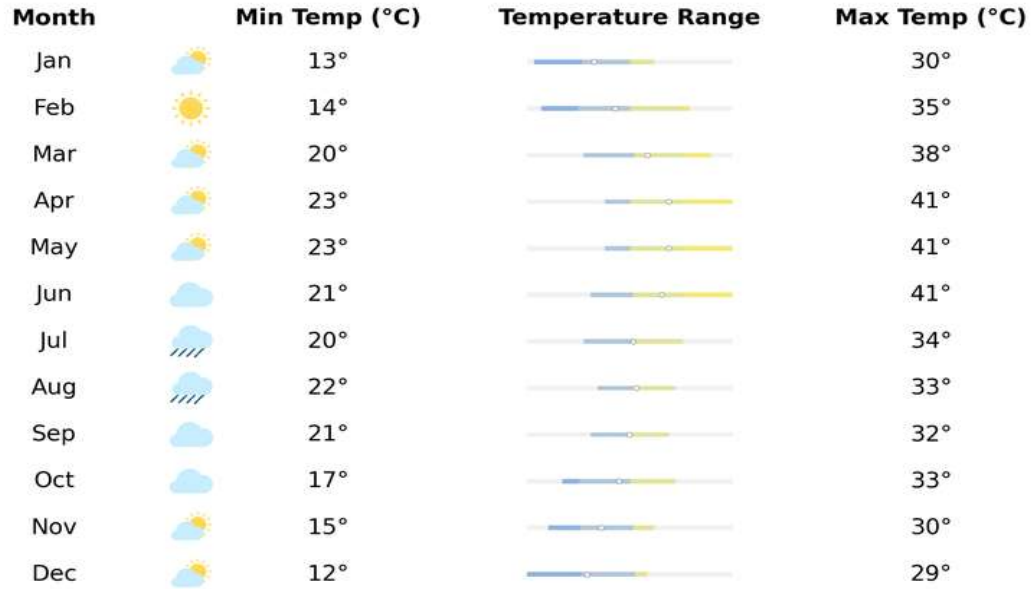
5. Water, Drainage & Harvesting

- Surface runoff flows towards the Northeast
- Considering 10% catchment area, rainwater runoff potential to the site is ~5.46 m³.
- The site can harvest ~3,392.06 m³ including 10% catchment area.

6. Accessibility & Planning

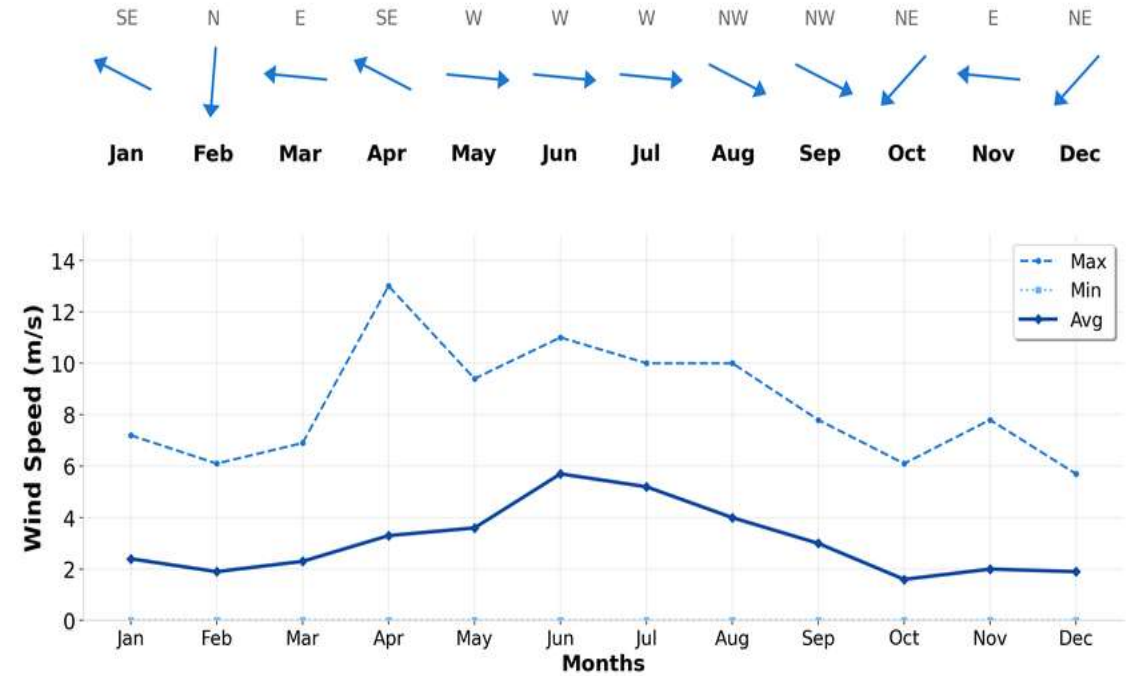
- The site does not qualify for the LEED Diverse Uses credit, as there are no qualifying amenities within an 800-meter radius.

Temperature and Cloud Cover



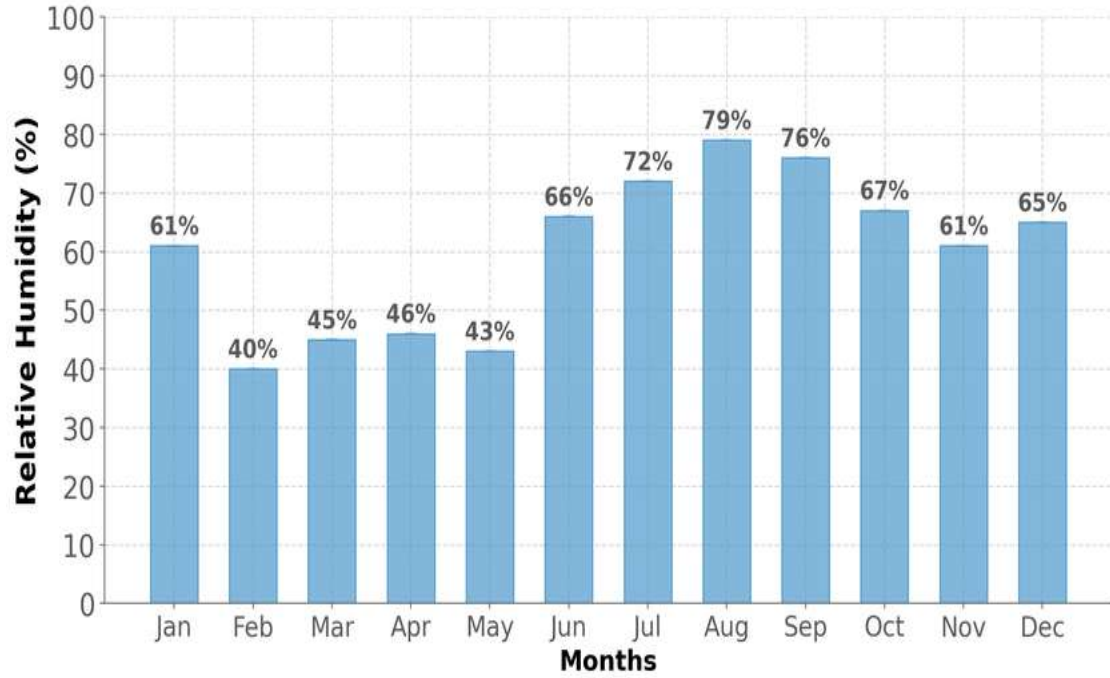
The annual average temperature ranges from 21.74°C to 41.20°C. The hottest month is May (41.20°C) and the coldest is Dec (12.74°C). Cloud cover is highest in Jul and lowest in Feb, indicating good potential for solar access during Feb.

Wind Direction



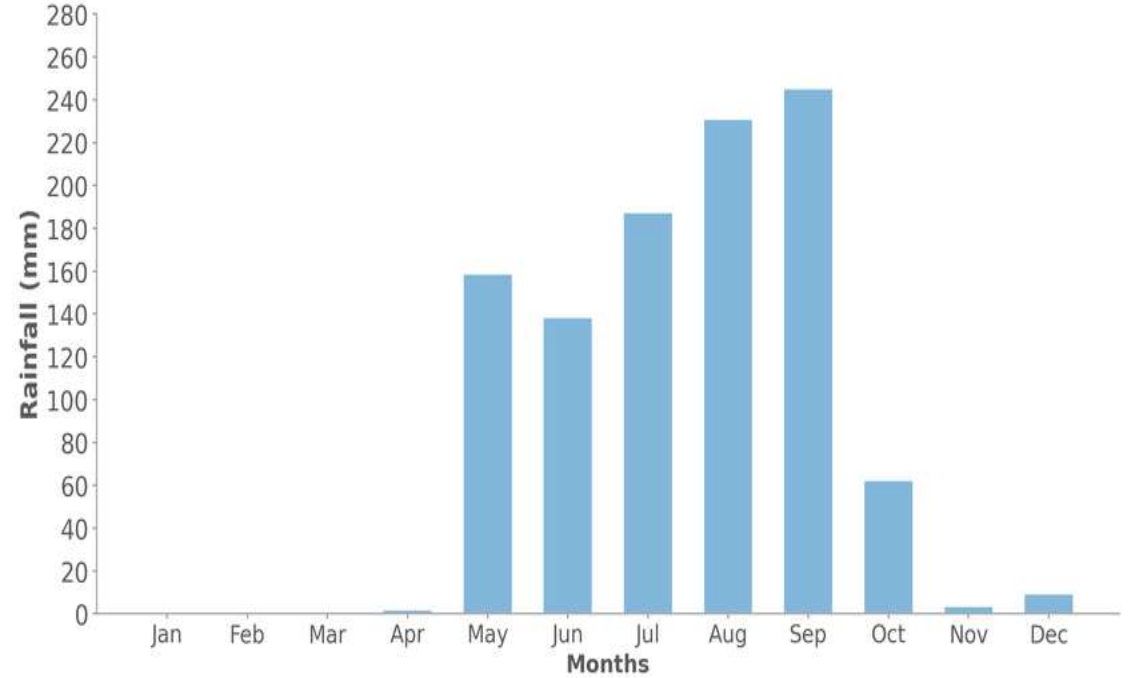
The predominant wind is from the East direction, with seasonal variations—West winds in summer, Southeast winds in winter. Peak wind speeds occur in Apr with maximum speed of 13.00(m/s).

Humidity



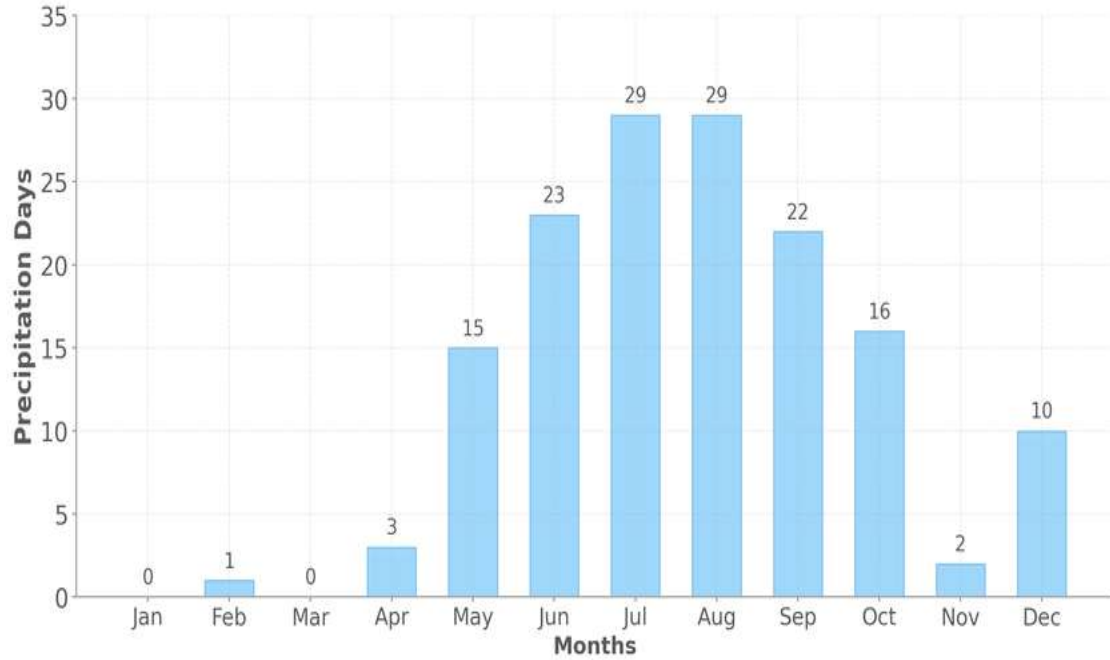
Humidity levels range between 8% and 98%, with discomfort peaks observed during Aug.

Precipitation



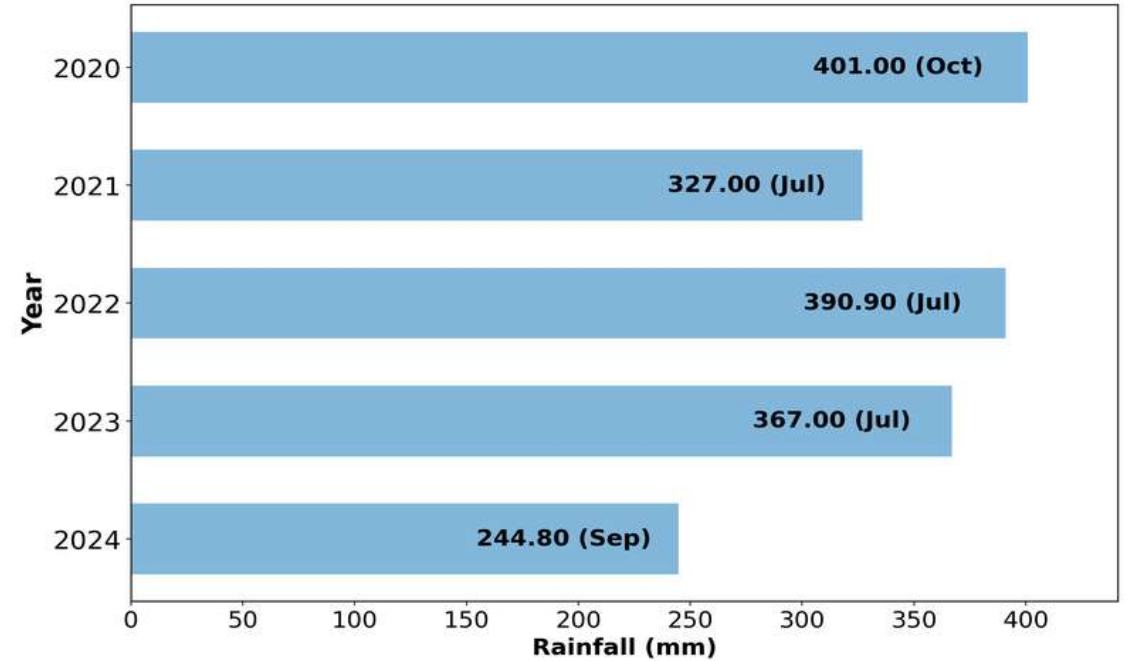
Annual precipitation is 1034.50 mm, with the wettest month being Sep (244.80 mm).

Precipitation Days



The site experiences 150 rainy days annually, peaking in Jul with 29 days.

Annual Maximum Precipitation



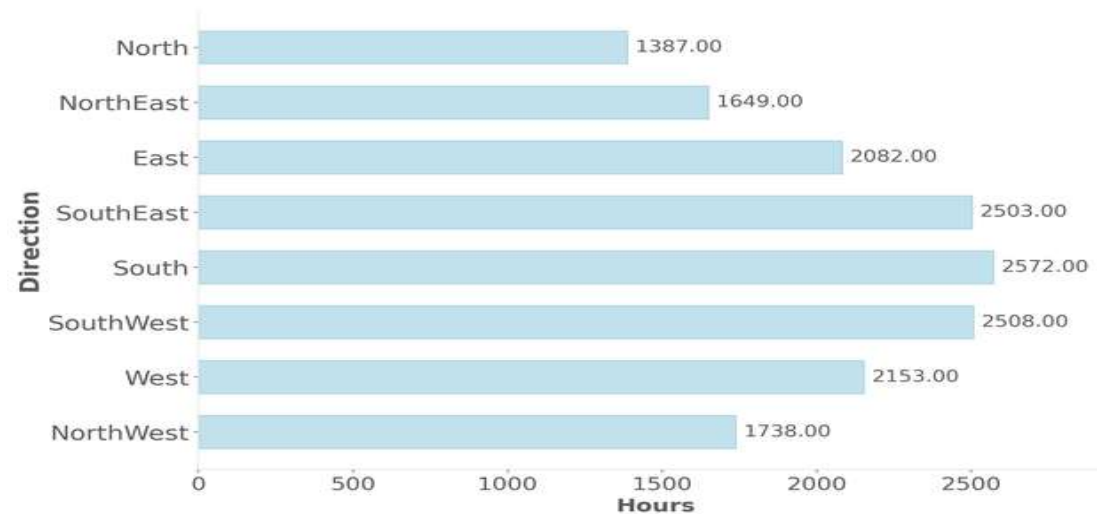
The site receives the highest monthly rainfall of 244.80 mm in Sep 2021. Over the last 5 years, peak rainfall varied annually, indicating the need for seasonal drainage planning.

Radiation on the Walls and Roof



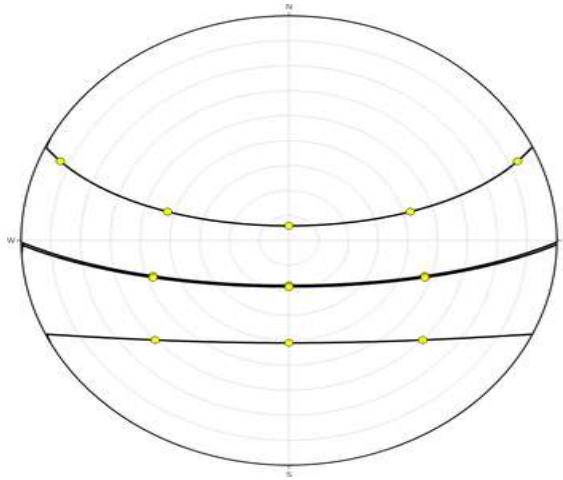
The West facade receives the highest radiation of 1932.42 kWh/m² annually. The roof receives 1251.26 kWh/m², suitable for PV placement.

Sunlit hours on the facade



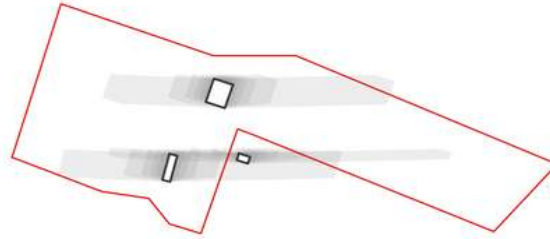
The Roof facade receives the highest annual sunlight exposure at 4400 hours, followed by South with 2572 sunlit hours. Prioritize shading or solar installations on these facades to optimize performance. The North facade receives the least sunlight at 1387 hours, making it suitable for service areas or insulation.

Sun Path Chart

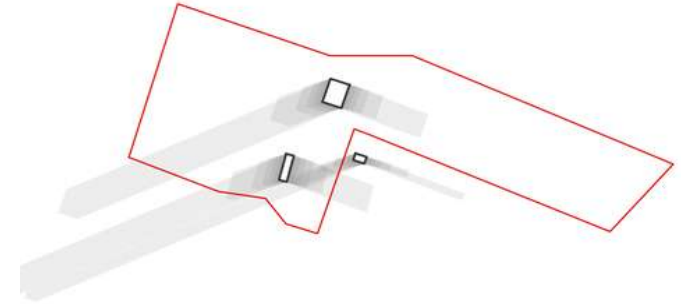


The 2D sun path diagram visualizes seasonal solar angles and sun positions, aiding in orientation, shading, and passive design decisions throughout the year.

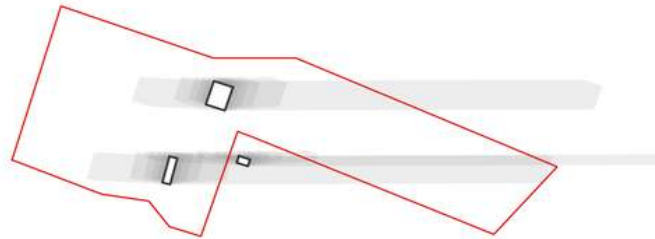
Spring Equinox - March 21



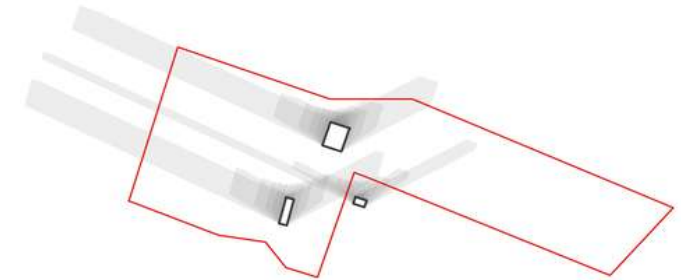
Summer Solstice - June 21



Autumn Equinox - September 21



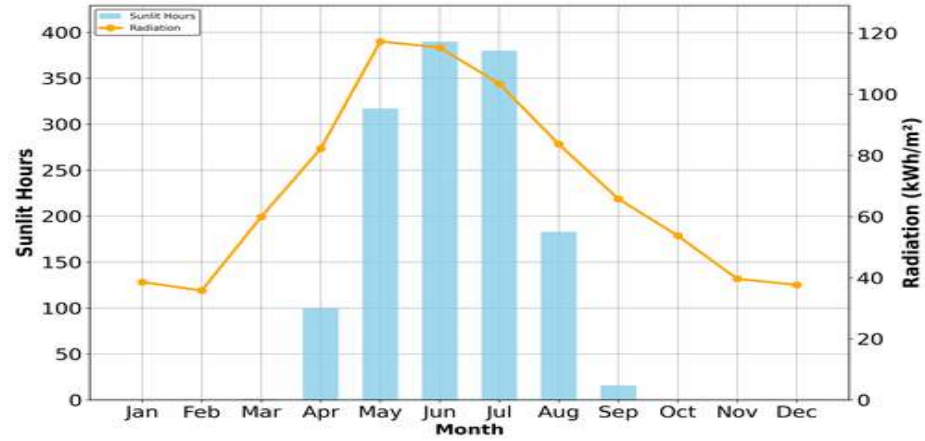
Winter Solstice - December 21



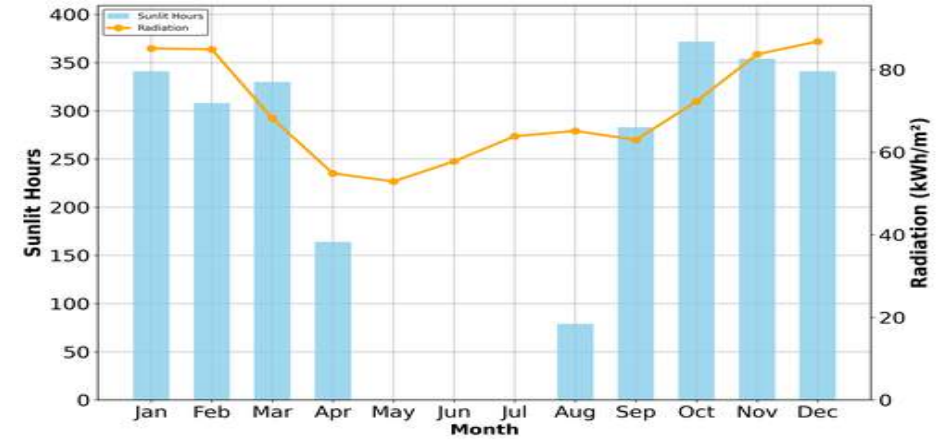
The analysis illustrates the sun-shadow patterns for the site. The shadows are shown across different seasons, capturing critical solar conditions throughout the year for optimal passive design planning.

Solar Orientations

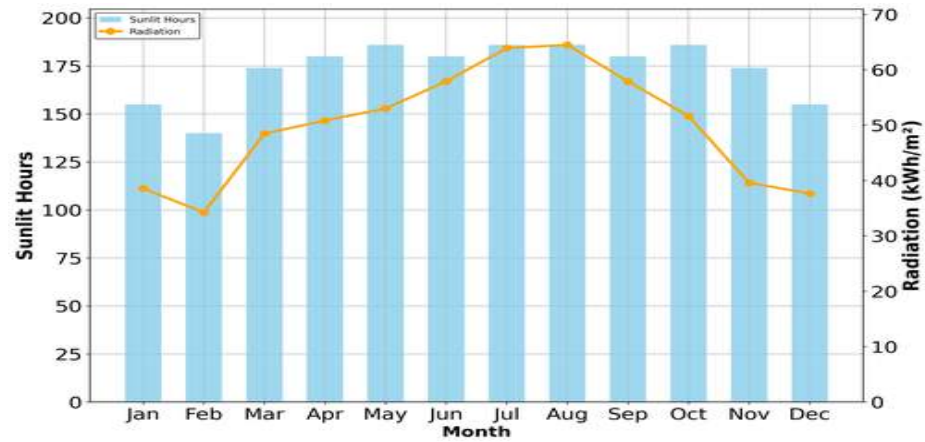
North



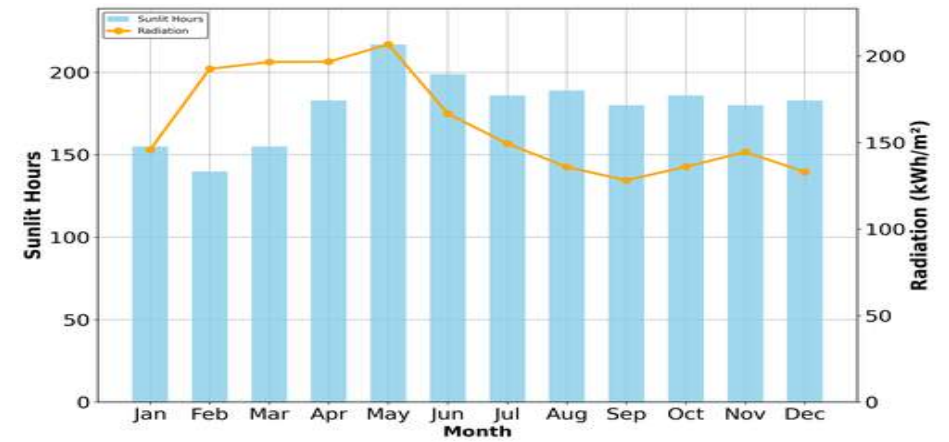
South

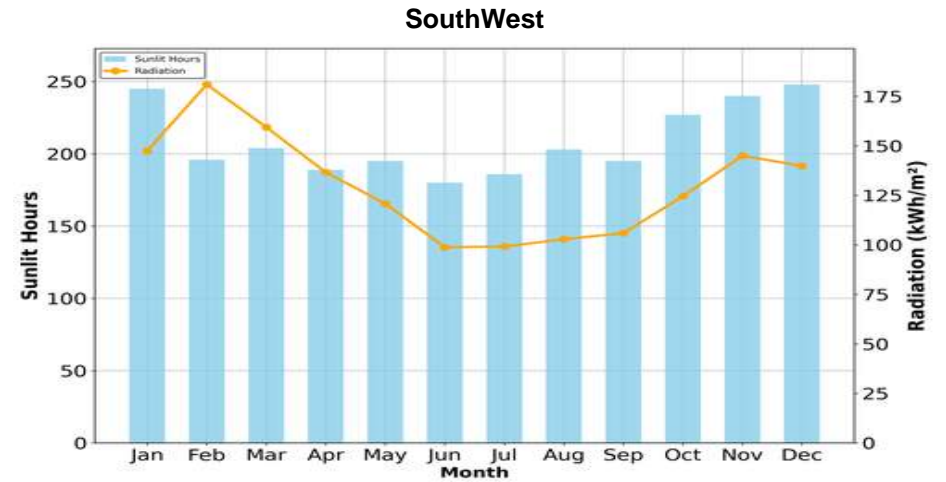
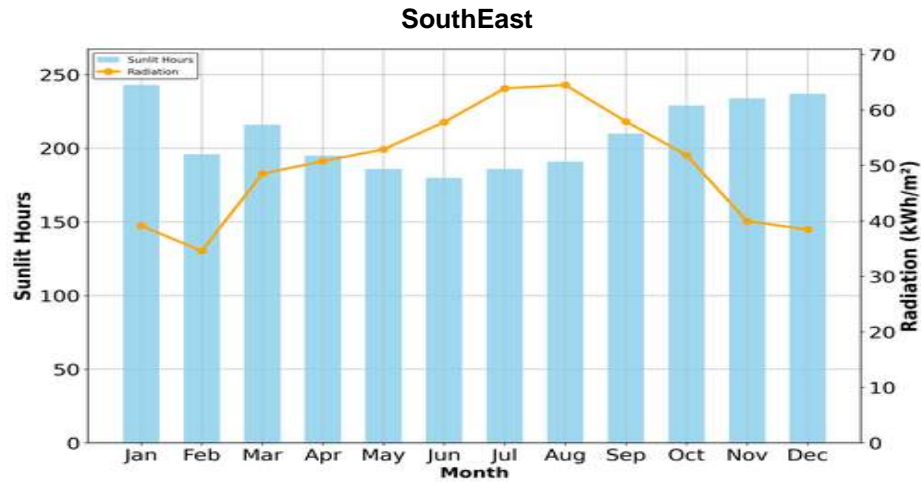
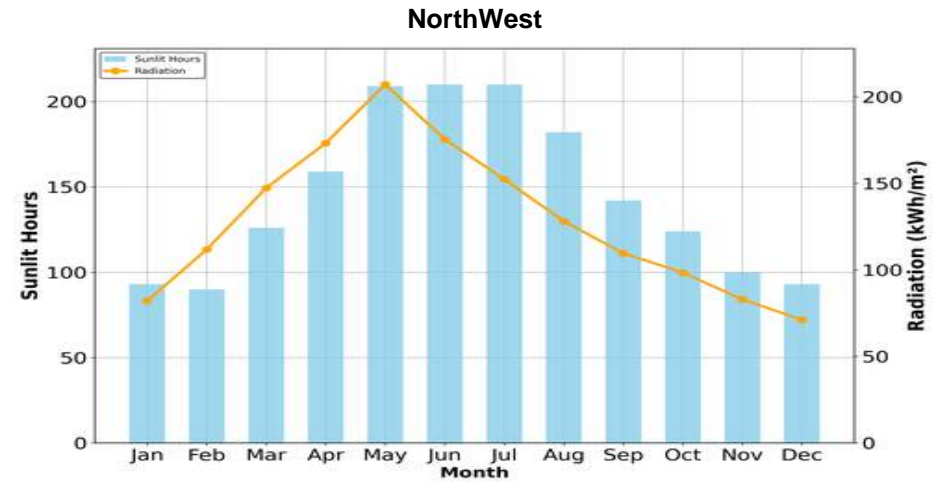
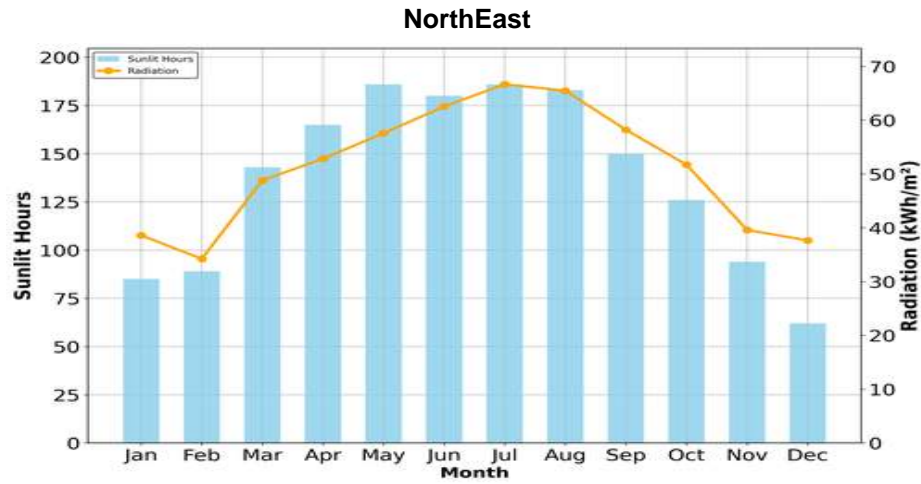


East



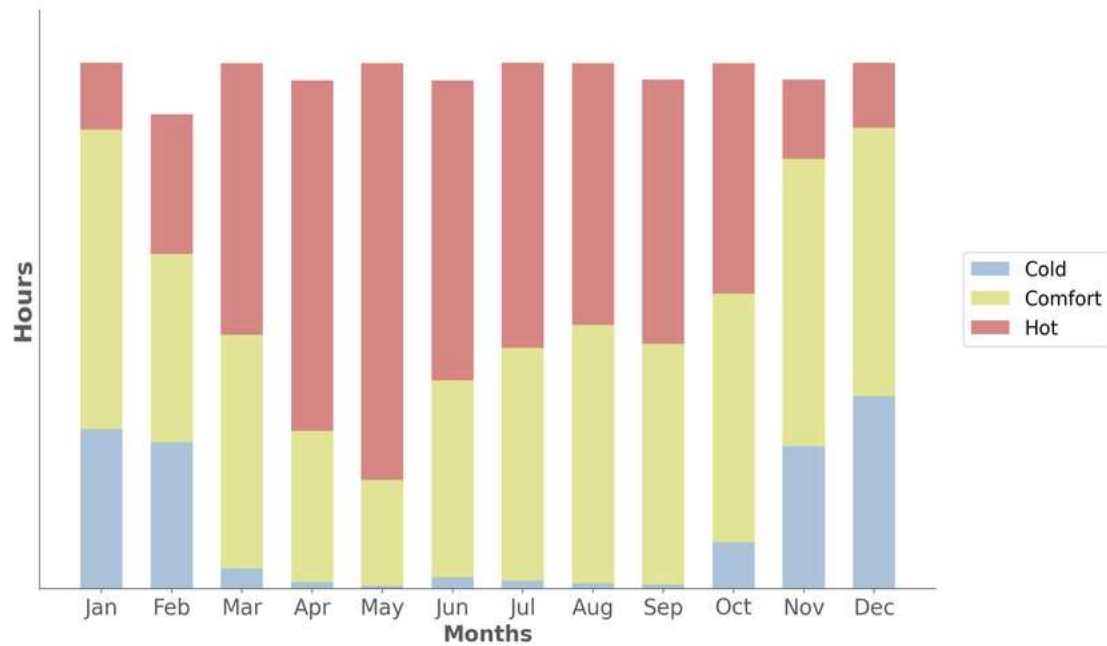
West





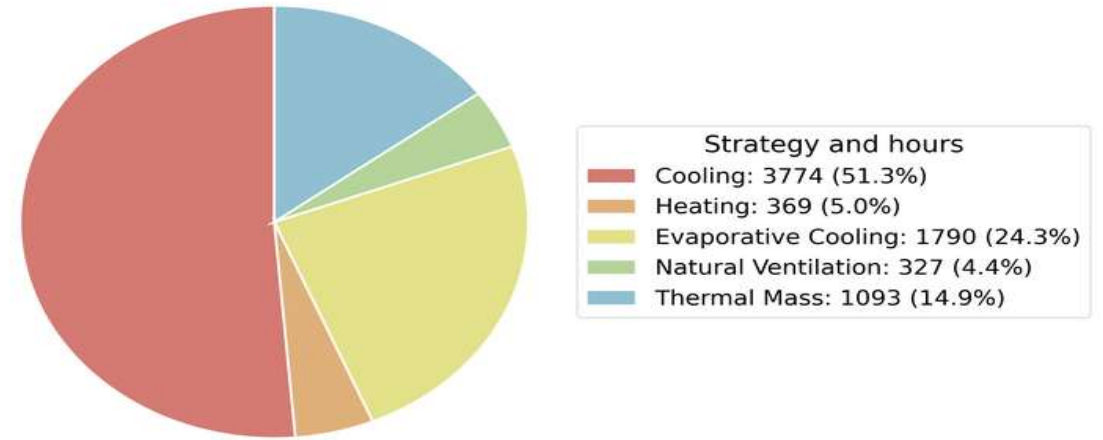
This graph is useful for evaluating solar potential and passive design strategies at the site. The correlation between higher radiation and longer sunlit hours also helps in optimizing shading devices, thermal mass usage, cooling load planning, active lighting and heating interventions.

Monthly Comfort Hours



The distribution of thermal comfort varies significantly across the year. During certain months like winter months, cold conditions dominate, limiting passive comfort. Months such as summer months show extended periods of heat stress, highlighting the need for cooling strategies. The most favorable conditions occur in spring and fall, where a substantial portion of hours fall within the comfort range.

Contribution of Strategies



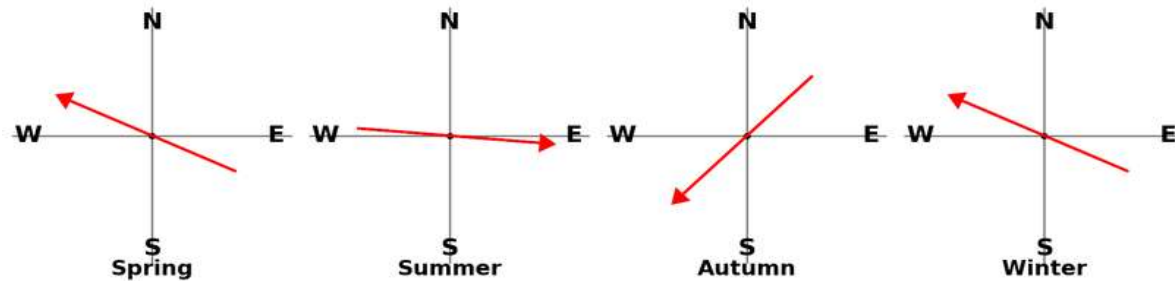
The analysis shows that passive strategies contribute significantly to overall comfort, with Natural Ventilation (4.45%), Thermal Mass (14.86%), and Solar Heat Gain (0.00%). Among active systems, Cooling (51.33%), Heating (5.02%), and Evaporative Cooling > Two Stage (2.92%) coverage.

NASH Comfort Hours



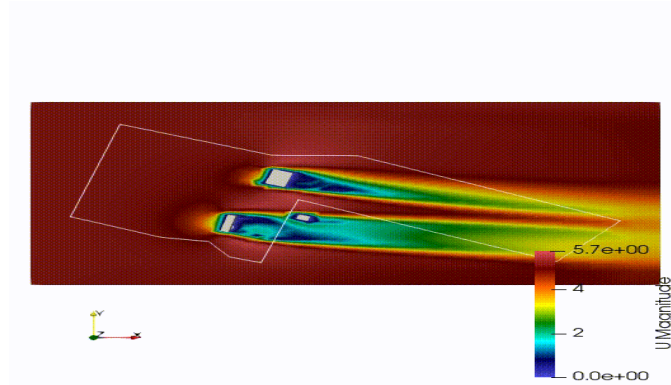
Out of the total 8,760 hours in a year, the site experiences approximately 1271.00 hot hours, 347.00 warm hours, 1407.00 comfort hours, and 613.00 cold hours. This distribution indicates that passive design strategies can effectively provide thermal comfort for 16.06% of the year.

Wind Direction Compass

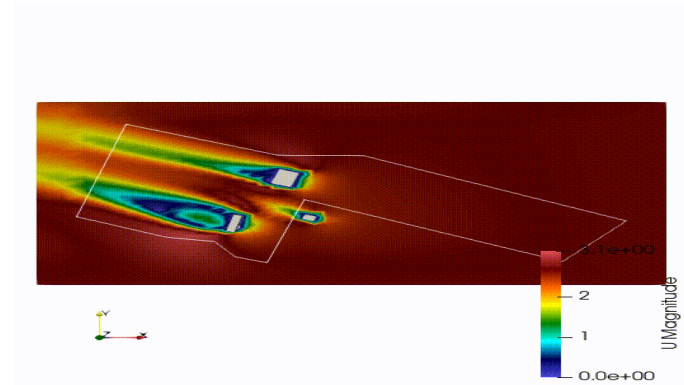


Wind Flow

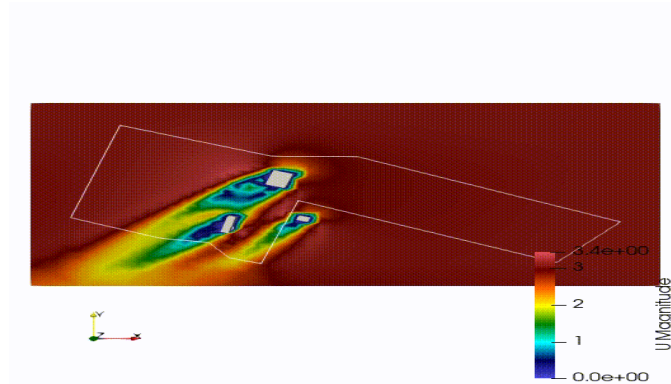
Summer Winds



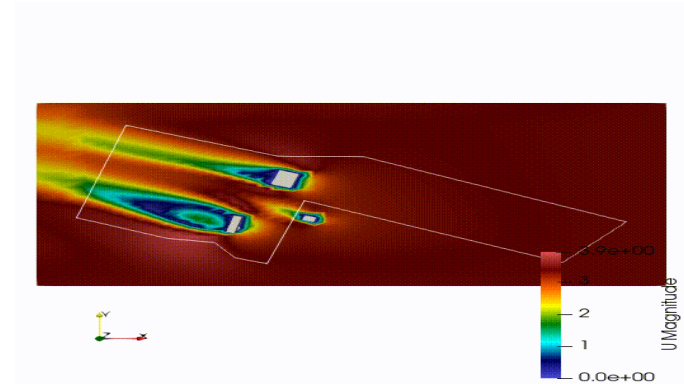
Winter Winds



Autumn Winds

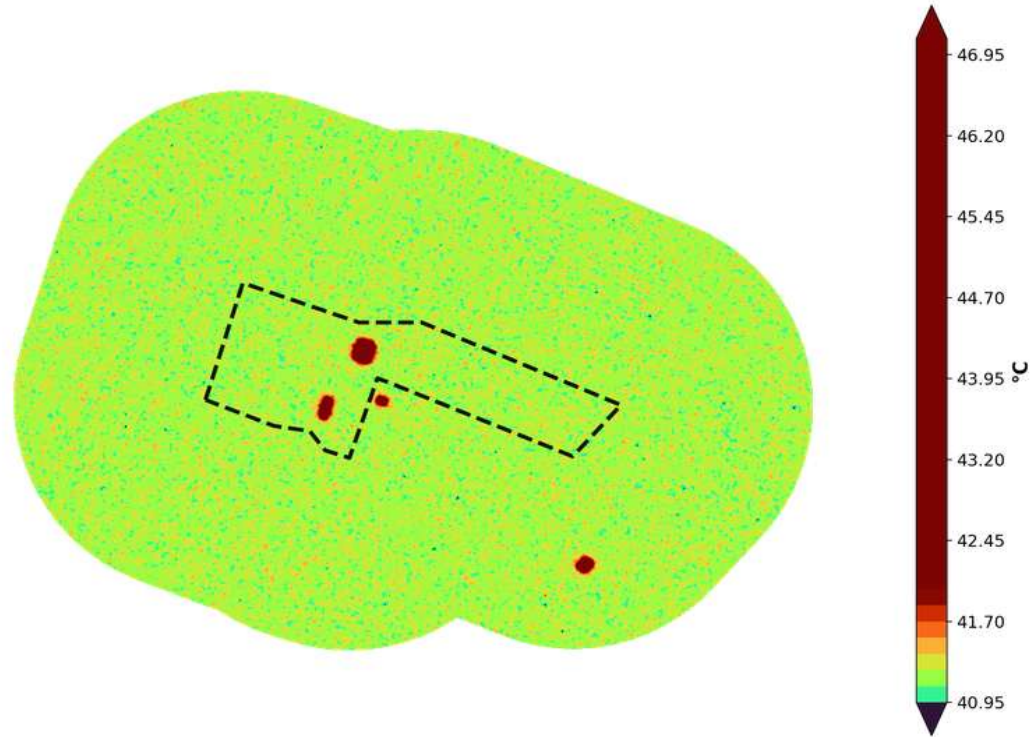


Spring Winds



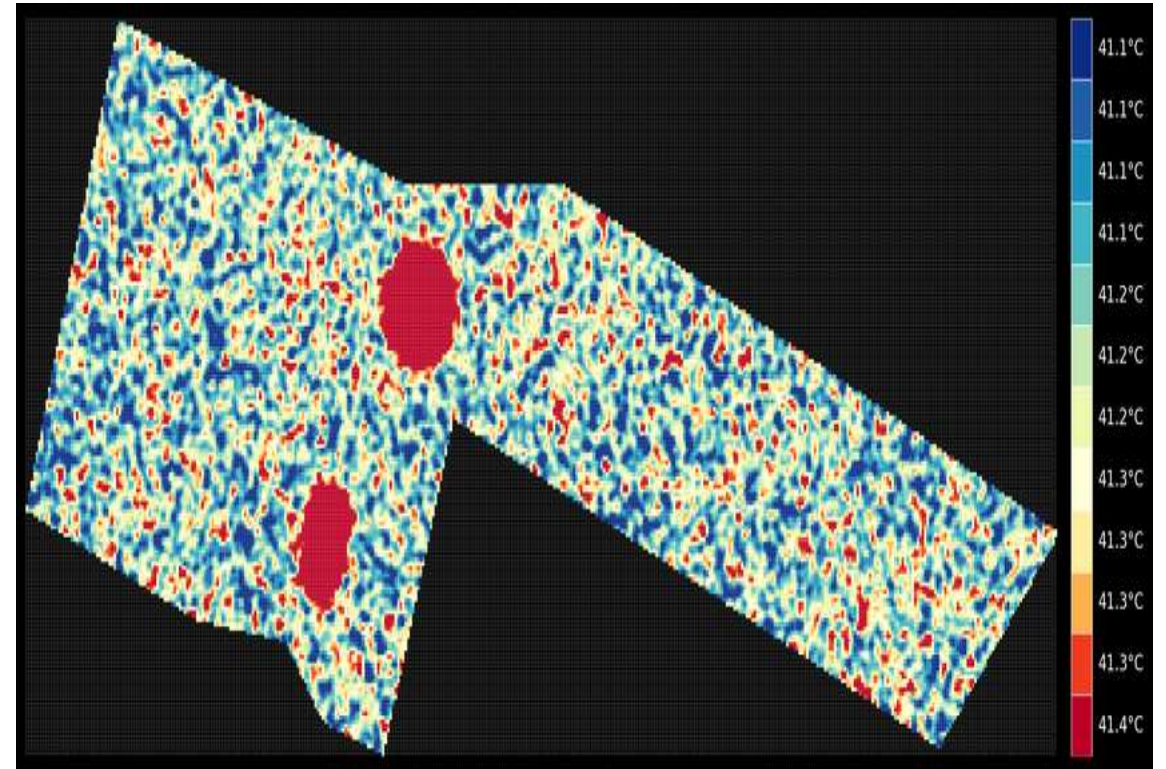
- Predominant wind direction is towards East and the annual average wind speed is 3.07 m/s.
- Seasonal winds: summer towards West (5.20 m/s); winter towards Southeast (2.70 m/s); autumn towards Northeast (3.10 m/s); spring towards Southeast (3.40 m/s).

UHI Analysis



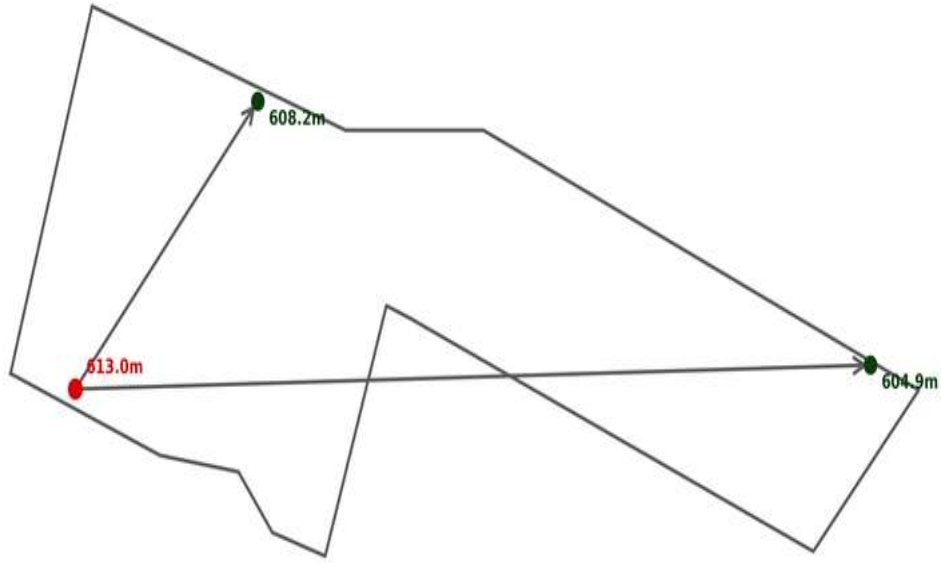
The site experiences a negligible UHI effect, raising local temperatures by approximately 0.07°C above the regional average. This analysis helps identify optimal cooling strategies.

Site Level Air Temperature



Site-specific temperature mapping reveals microclimatic variations within the project boundary. The ambient temperature is 41.20°C while the site temperature reaches 41.28°C.

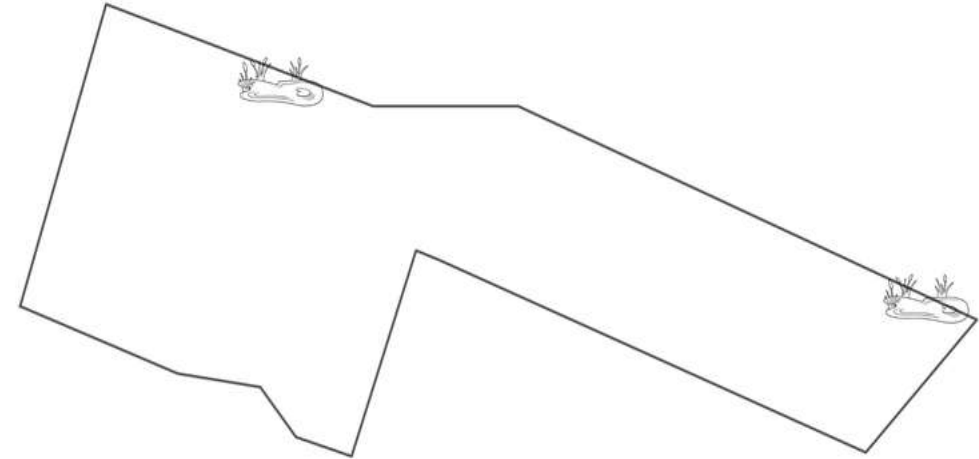
Terrain Slopes



— Site Boundary ● Highest Point (613.0m) ● Lowest Point (604.9m)

The site slopes towards the Northeast, with site elevation ranges from 604.9m to 613.0m, with a moderate total elevation change of 8.1m.

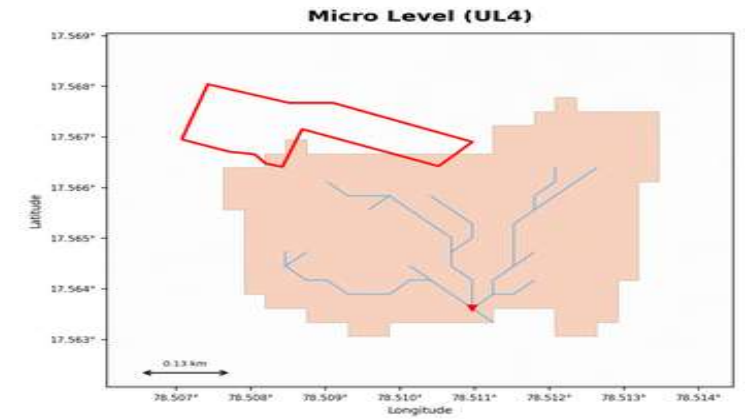
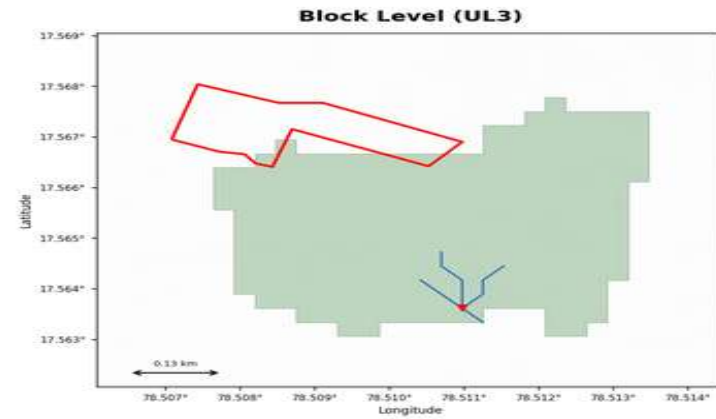
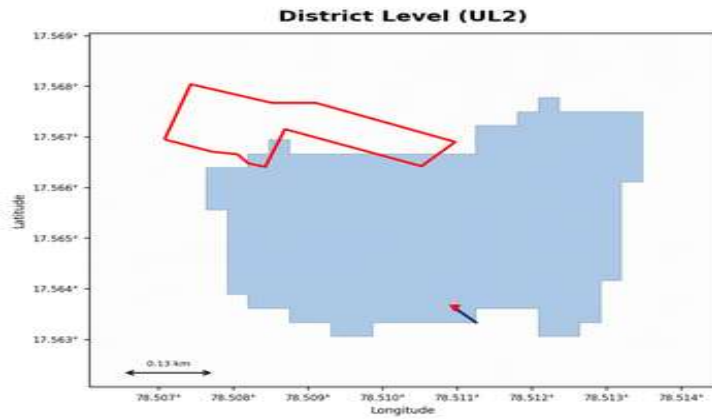
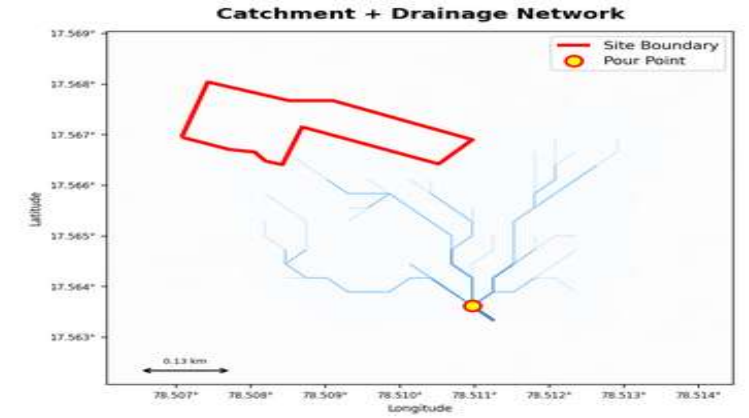
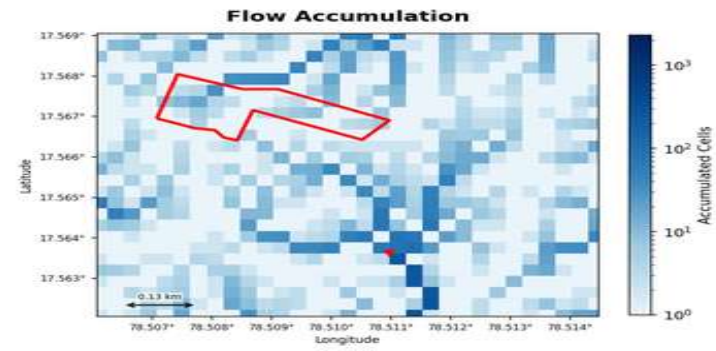
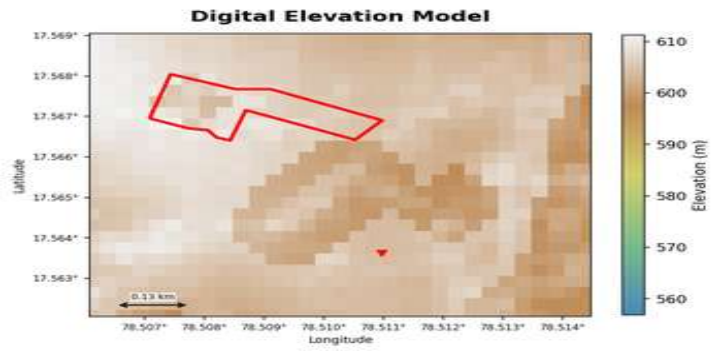
Pond Area



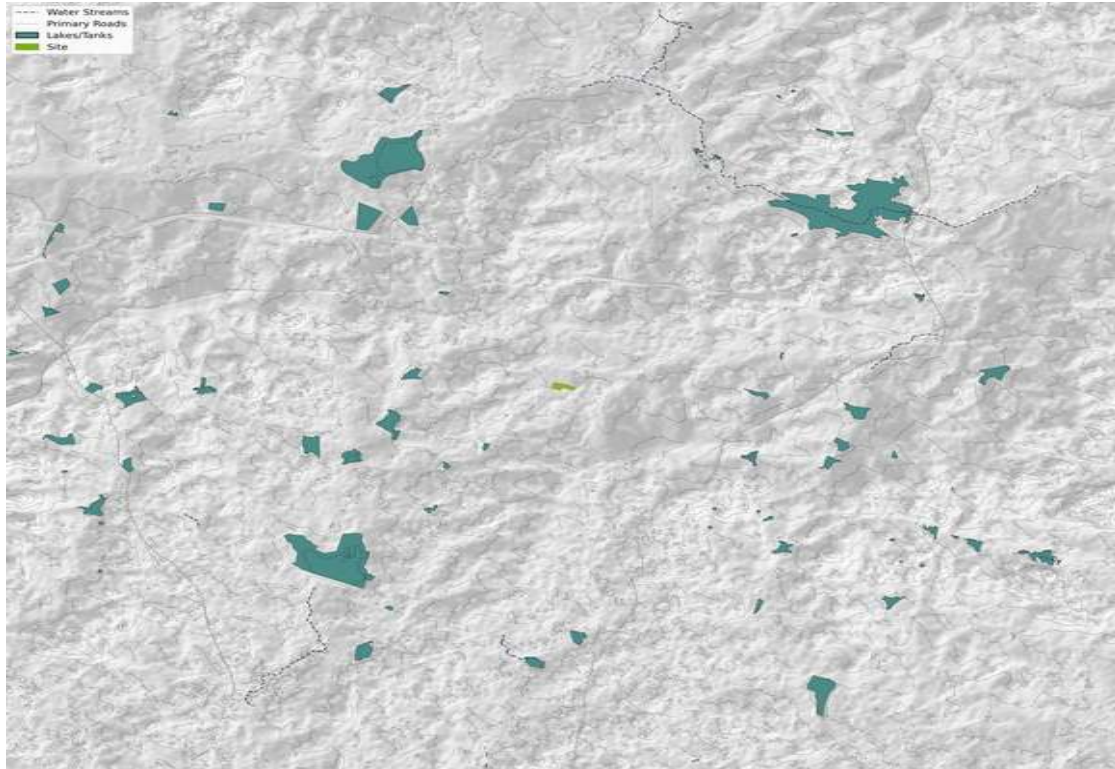
Pond Volume: 3392.06 m³

Based on the site's runoff potential and terrain slope, a pond area of approximately 1,696.03 m² is recommended for effective water retention. This sizing supports stormwater management, including functioning as a passive landscape for recharge zone near the site's lowest elevation.

Watershed Visualization



Watershed



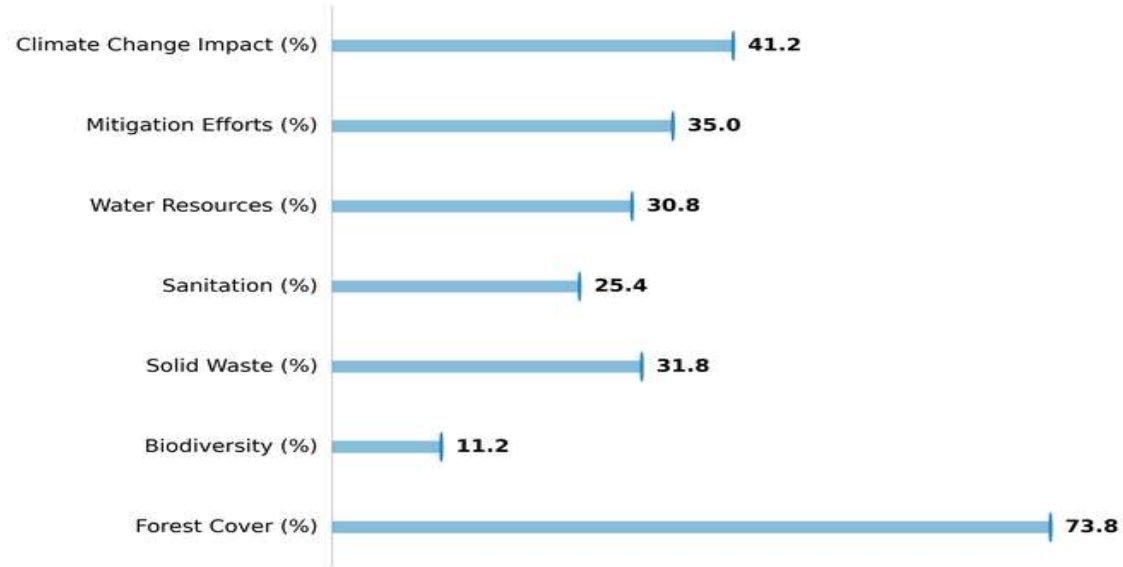
This map shows nearby water streams and drainage patterns around the site. It helps identify upstream catchment areas that contribute runoff, useful for calculating inflow volume and sizing ponds or water retention systems.

Amenities



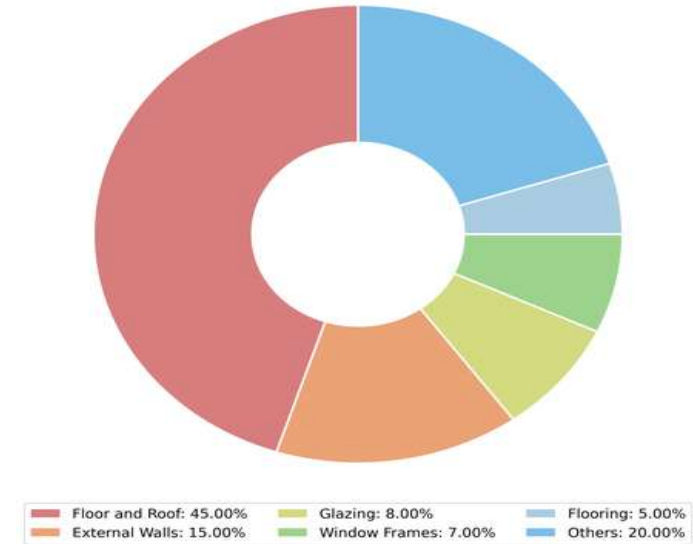
The site does not qualify for the LEED Diverse Uses credit, as there are no qualifying amenities within an 800-meter radius.

Environmental Metrics



This chart represents key country-level environmental metrics including climate change impact, mitigation efforts, water resources, sanitation, solid waste, biodiversity, and forest cover, used to assess ecological sustainability.

Carbon Contribution by Building Element



This section shows the embodied carbon performance of construction materials based on different categories such as Floor and Roof, Window Frames, Glazing, and Walling. The values reflect $\text{kgCO}_2\text{e}/\text{m}^2$ emissions and help prioritize low-carbon alternatives for sustainable construction.

Low Carbon Materials

Floor and Roof



In-situ Reinforced
Conventional Slab
kgCO₂e/m²: 174.00
kg/m²: 174.00



Concrete Precast | Hollow
Core Slab
kgCO₂e/m²: 124.00
kg/m²: 124.00



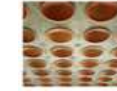
RCC with >30% PFA
kgCO₂e/m²: 97.00
kg/m²: 97.00



Concrete Precast | Double
Tee Units
kgCO₂e/m²: 95.00
kg/m²: 95.00



RCC with >25% GGBS
kgCO₂e/m²: 96.00
kg/m²: 96.00



Concrete Slab | Filler Slab
kgCO₂e/m²: 89.00
kg/m²: 89.00

External Walling



Brick
kgCO₂e/m²: 152.00
kg/m²: 152.00



Hollow Block
kgCO₂e/m²: 81.00
kg/m²: 81.00



Solid Concrete Block
kgCO₂e/m²: 58.00
kg/m²: 58.00



ACC
kgCO₂e/m²: 48.00
kg/m²: 48.00



CSEB
kgCO₂e/m²: 33.00
kg/m²: 33.00



GGBS
kgCO₂e/m²: 4.00
kg/m²: 4.00



Rammed Earth
kgCO₂e/m²: 3.00
kg/m²: 3.00

Flooring



Tiled | Ceramic Tiles

kgCO₂e/m²: 14.00
kg/m²: 14.00



Concrete | Finished Floor

kgCO₂e/m²: 9.00
kg/m²: 9.00



Tiles | Terrazzo Tiles

kgCO₂e/m²: 17.00
kg/m²: 17.00



Wood | Laminated Wood

kgCO₂e/m²: 3.00
kg/m²: 3.00



Tiled | Terracotta Tiles

kgCO₂e/m²: 17.00
kg/m²: 17.00

Window frames



Aluminium

kgCO₂e/m²: 169.00
kg/m²: 169.00



Steel

kgCO₂e/m²: 43.00
kg/m²: 43.00



Timber

kgCO₂e/m²: 42.00
kg/m²: 42.00



UPVC

kgCO₂e/m²: 56.00
kg/m²: 56.00



Aluminum-clad Timber

kgCO₂e/m²: 67.00
kg/m²: 67.00

Glazing



Single Glazing

kgCO₂e/m²: 27.00
kg/m²: 27.00



Double Glazing

kgCO₂e/m²: 54.00
kg/m²: 54.00



Triple Glazing

kgCO₂e/m²: 81.00
kg/m²: 81.00