Sunlight and Shadow Study Chattanooga TN, Patten Parkway

Shadow Study for Planned Development near the Basilica of Saints Peter and Paul Catholic Church

Chattanooga TN, Patten Parkway

Summary and Engineering Analysis
with assistance from Chat GPT based research and app.shadowmap.org

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Executive Summary

This study is a companion to previously submitted documents: "*Construction Considerations for Planned Development near the Basilica of Saints Peter and Paul Catholic Church*" and "*Shadow Study for Planned Development near the Basilica of Saints Peter and Paul Catholic Church".* The intent is to expand upon and further investigate potential harmful effects if proposed development on Patten Parkway goes forward.

This study differs in nature from the previous two documents, in that this effort seeks to quantify what is truly qualitative and oft times very difficult if not impossible to capture: the loss of beauty

and sacredness due to external factors. The study is primarily focused on the effects of light depravation to the sanctuary.

Significant findings and analysis within the detail of this study:

- **The construction of a 12-story building on Patten Parkway will result in significant occlusion (loss of light) to the priceless Tiffany stained glass windows**. These significant works of art, created by acclaimed artist **Louis Comfort Tiffany**, illustrate key events from the lives of the patron saints. ***The loss of this aesthetic is immeasurable***.
- **Based on the Shadow Study and Seasonal Sun-Path Analysis, the impact on sunlight deprivation is telling. In every season** from sunrise to sunset, significant portions of **the Basilica, the Rectory and St. Dominic Building are shaded**; resulting in **possible health effects and increased energy consumption** to compensate for decreased natural light.
- Even though there is no longer a **"right-to-light" guarantee** in the United States, there are legal provisions in several other areas of the World. Perhaps most notably, is the Doctrine of **Ancient Lights in England and Wales (U.K.),** codified and clarified by the **Prescription Act 1832. This is still present in planning today in** the planning concept of **solar access,** remaining relevant in zoning and design controls to prevent overshadowing of neighbors. (*Wheeldon v Burrows (1879)* LR 12 Ch D 31, English land law). The UK treats **daylight as a *property right*, not merely an amenity**.
- Historic preservation guidelines (such as those used by state historic preservation offices and the National Park Service) specifically encourage **retaining original window openings and daylight access**.
- ***For the clergy that reside in the Basilica Rectory***, light deprivation can result in **lower vitamin D synthesis**, which can affect bone health and immune function, as well as **disruption of circadian rhythms**, leading to **sleep issues, fatigue, depression, and metabolic stress.**

There most certainly would be other deleterious effects such as increased pedestrian traffic, automobile and bus traffic and associated noise pollution, but these are minor compared on the **permanent change to the beauty of the Basilica of Sts. Peter and Paul Catholic Church. Once lost, these treasures cannot be retrieved except in the memories of those privileged few who have loved this church through the 136 years of its existence**. This rezoning would permanently deprive Basilica parishioners (and Rectory residents) of sunlight — a basic health resource — for the benefit of increased density. Zoning exists to protect public health and welfare, not to sacrifice them. For these reasons, **we respectfully urge the Commission to deny this rezoning request**.

Sunlight Shadowing Study for 12 Story Buildings on Patten Parkway

Why Sunlight Matters in Urban Historic Buildings

Daylight Is a Crucial Public Health Resource

Scientific research increasingly highlights that **natural daylight isn't just aesthetic — it's a health necessity**. In dense city environments, limited sun exposure is linked with:

- **Lower vitamin D synthesis**, which can affect bone health and immune function.
- **Disruption of circadian rhythms**, leading to sleep issues, fatigue, depression, and metabolic stress. (*Journal of Urban Management,* Volume 13, Issue 2, June 2024, Pages 175-182)

Urban design that blocks sunlight isn't "just shading," it can **affect daily biological rhythms and long-term well-being**.

Historic Urban Buildings Were Designed With Sunlight in Mind

Many historic buildings — including those along Patten Parkway and throughout Chattanooga's core — were constructed with:

- **Large windows**
- **Higher ceilings**
- **Shallow floor plans**

These features weren't just stylistic; they **maximized natural illumination because artificial light was limited historically**. Contemporary research confirms that **historic structures perform well in natural lighting** and occupants rely heavily on daylight for comfort and functionality. ("*Natural Lighting in Historic Houses during Times of Pandemic. The Case of Housing in the Mediterranean Climate*", Int. J. Environ. Res. Public Health 2021)

Urban Morphology Shapes Sunlight Availability

Modern studies of urban form show that **building density and street canyons dramatically reduce solar access** at neighborhood and building scales. Taller or densely sited new developments often create shadows that persist throughout the day and year, especially in winter when the sun angle is lower. ("*The impact of urban morphology on sunlight availability at urban and neighborhood scales: A systematic review*", Sustainable Cities and Society, Volume 121, 1 March 2025, 106194)

Without careful planning, new construction can leave older façades and interiors permanently in shade — **compromising daylight that historic residents depend on**.

Harm to Occupants in Historic Buildings Is Real

Reduced sunlight can result in:

- **Lower occupant comfort and mental health**
- **Increased dependence on artificial lighting** (raising energy costs)
- **Reduced desirability of historic residences**, which can **diminish property values and community stability**

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If a rezoning allows buildings that cast long shadows over existing historic homes, residents may face cumulative harm — **not just aesthetic, but physiological and social**.

Legal Context: "Right to Light" & Solar Access

In many jurisdictions, doctrines like the **"ancient lights" or right-to-light** recognize that long-standing buildings have a de facto interest in preserving access to sunlight. While U.S. common law historically **abandoned formal rights to light**, the planning concept of **solar access** remains relevant in zoning and design controls to prevent overshadowing of neighbors. (*Wheeldon v Burrows (1879)* LR 12 Ch D 31, English land law)

Even where there isn't a direct legal right enforceable in court, planners and judges increasingly consider **solar access and daylight impacts** when reviewing changes in urban form.

Historic Preservation Standards Also Value Daylight

Historic preservation guidelines (such as those used by state historic preservation offices and the National Park Service) specifically encourage **retaining original window openings and daylight access** because it:

- Maintains the **character and integrity** of historic interiors
- Enhances **visual and spatial experience**
- Promotes **occupant comfort**
  Distorting these sunlight conditions through oversized neighboring development can compromise both the **physical fabric of a historic building** and its **intended use**.
  ("*Sustainable Historic Preservation*", Whole Building Design Guide, retrieved 1-8-2026)

Implications for Patten Parkway Rezoning

If development allowed under rezoning would:

- **Significantly shade existing historic buildings**
- Reduce direct sunlight to residential units
- Alter the historic daylight character of the street

Then this issue becomes about **public health, historic character, and quality of life** — not just aesthetics or property economics.

A credible objection could argue that the proposed zoning **fails to protect essential daylight access** necessary for the continued habitability and preservation of these historic homes.

The ability to receive sunlight into the interior spaces of a building are fundamental to good health of occupants. As stated, while historic "right-to-light" is not recognized in U.S. Common Law it is recognized in many areas of Europe.

Right-To-Light Legal Considerations

Here are some of the examples from other parts of the World:

United Kingdom (England & Wales) — Strongest and Most Cited System

Legal Basis

- Rooted in **common law**, primarily through the doctrine of **Ancient Lights**
- Codified and clarified by the **Prescription Act 1832**

How It Works

- If a building has received **uninterrupted natural light through a window for 20 years**, it may acquire a **legal right to that light**
- New development that **substantially interferes** with that light can be:
    - Restrained by **injunction**
    - Required to pay **damages**
    - Forced to modify or remove offending structures

Measurement Standard

- Courts often rely on the **Waldram Method**, which assesses whether at least **50% of a room receives adequate daylight**
- This is a **quantitative, technical standard**, not a subjective one

Practical Impact

- Right-to-light claims are **common in London and historic cities**
- Developers routinely commission **daylight/sunlight studies** before construction
- Rights are strong enough to **halt or significantly redesign projects**

The UK treats daylight as a **property right**, not merely an amenity.

France — *Civil Law Protection of Light and Views*

Legal Basis

- **Code Civil**, particularly:
    - Articles 675–680 (windows, views, light access)
    - Article 544 (property rights)

How It Works

- Property owners may not create openings that **unreasonably infringe on a neighbor's access to light**
- Courts apply the doctrine of **"trouble anormal de voisinage"** (abnormal neighborhood disturbance)

Enforcement

- Case-by-case judicial balancing
- Remedies include:
    - Damages
    - Design changes
    - Height or setback limitations

France protects light as part of **peaceful enjoyment of property**, even without a fixed time threshold like the UK.

Germany — *Strong Planning-Based Solar Protection*

Legal Basis

- Federal Building Code (**Baugesetzbuch**)
- State building regulations (**Landesbauordnungen**)

How It Works

- Buildings must meet **minimum daylight and sunlight exposure requirements**
- Overshadowing of neighboring buildings is **explicitly regulated**
- Historic buildings receive **additional consideration**

Enforcement

- Mostly through **planning approval and permitting**
- Courts can invalidate approvals that fail to protect daylight

Germany treats sunlight access as a **public-law planning obligation**, not a private easement.

Italy — *Codified Minimum Distances and Light Protection*

Legal Basis

- **Italian Civil Code**
- Local planning regulations

How It Works

- Mandatory **minimum distances between buildings**
- Height and massing controls designed to preserve:
  - Light
  - Air
  - Health

Enforcement

- Strong municipal control
- Courts frequently side with existing residents when daylight is materially reduced

Italy embeds light protection directly into **urban form regulations**.

Spain — *Right to Healthy Housing*

Legal Basis

- National and regional planning laws
- Constitutional right to **adequate housing**

How It Works

- Daylight and solar access are considered **health and habitability requirements**
- New development must demonstrate compliance

Sunlight is framed as a **habitability and health issue**, not merely property aesthetics.

Netherlands — *Quantitative Daylight Standards*

Legal Basis

- Dutch Building Decree (**Bouwbesluit**)

How It Works

- Strict numerical requirements for:

    - Window size
    - Daylight penetration
- Overshadowing that reduces compliance is prohibited

Daylight is treated as a **measurable building performance standard**.

Japan's Right to Light (日照権 / Nisshōken)

Legal Foundation

Japan's right to light is enforced primarily through:

- Building Standards Act of Japan
- City Planning Act
- Related ministerial ordinances and local regulations

Rather than relying on lawsuits after harm occurs, Japan prevents sunlight loss before construction is approved.

How Japan's System Works

- Mandatory Sunlight (Shadow) Regulations
- Japan imposes strict shadow-casting limits on buildings, especially in residential zones.
- Developers must prove that a proposed building will not exceed:
- Maximum allowable shadow duration
- On neighboring properties
- During specific times of day and seasons (often winter solstice, when shadows are longest)
- If the building fails these tests, it cannot be built as designed.

("*The Fight for Sunlight: How Japan's Laws Protect Your Right to Natural Light*", E-Housing Blog, Feb. 9, 2025)

European and Japanese Pattern (Big Picture)

Across Europe and in Japan:

- Sunlight is widely recognized as:
    - A **health necessity**
    - A **component of housing quality**
    - A **protected planning interest**
- Historic buildings often receive **heightened protection**
- Overshadowing impacts are routinely evaluated **before rezoning or permitting**

Contrast With the United States

- The U.S. largely **abandoned common-law right-to-light doctrines**
- Protection is typically limited to:
    - Zoning height limits
    - Setbacks
    - Solar easements (voluntary and rare)
- **No automatic, long-term right to daylight** exists in most jurisdictions

However, case law in other eras of the World inform prudent approach locally.

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Why This Matters for Chattanooga / Patten Parkway

While European, Japanese, and UK laws are **not binding** in Tennessee, they are often used:

- In **planning best-practice arguments**
- To demonstrate **international norms**
- To support claims that sunlight access is a **legitimate public interest**, not a private preference

This can be especially persuasive when:

- Historic buildings are involved
- Residents face permanent sunlight loss
- Rezoning would enable out-of-scale development

Sunlight Effects at the Basilica

Shadow Study / Sunlight Tracking Maps

The Shadow Study was performed using the website application https://app.shadowmap.org . The focus of the study was to identify the profile that the proposed 12-story building would project onto the Basilica of Sts. Peter and Paul Catholic Church, and by extension associated buildings on the same property. Using a basis of the material provided by the Developer for the Zoning Request, the dimensions of the building can be determined to 80 ft (24.4m) wide by 300ft (91.4m) long by 125ft (38.1m) high. Figure 1 shows the situational relationship of the proposed building to the Basilica and associated property.

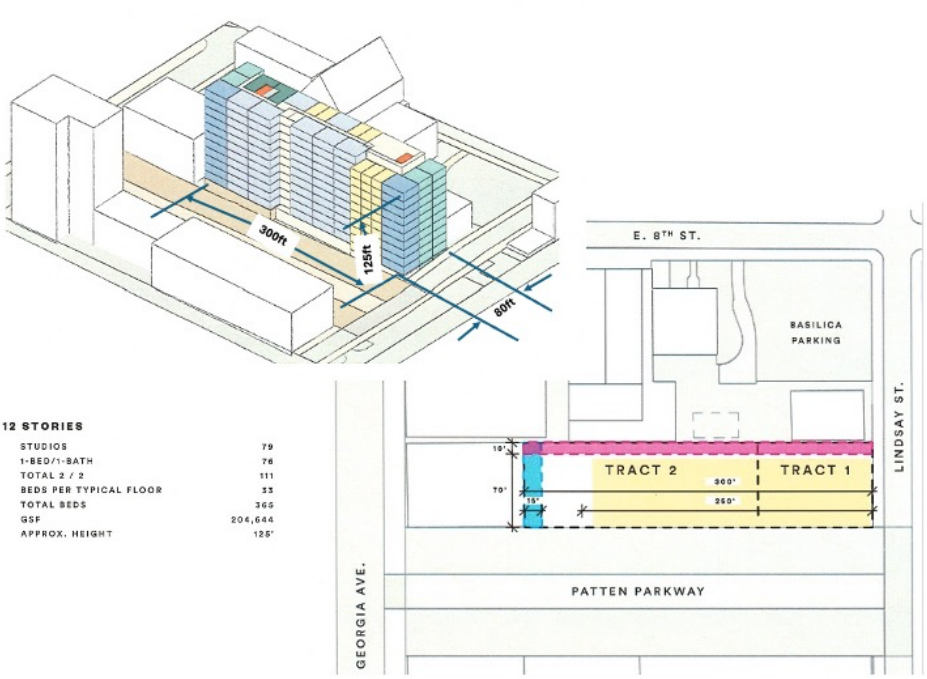

Figure 1 Proposed 12-Story Building Dimensions

Utilizing the Shadow Map website application, 4 different dates and multiple times at each date were analyzed for sunlight tracking and shadow placed on the Basilica, the Rectory, the St.

Dominic Building and surrounds. The Rectory is the building which serves as home to the clergy who minister to the parish and community. The St. Dominic Building is a former Convent, re-purposed and renovated as a meeting space for ministry and parish staff and parishioners. It should be noted that in addition to the Basilica and surrounds, there are accompanying neighbors negatively impacted by the light occlusion and quite likely foundation effects as well, including the residential Tomorrow Building (a repurposed historic building) and the historic Carnegie Library (now Cumberland Title & Guaranty) Figure 2 through 22 cover times at differing impacts from Sunrise to Sunset for the following dates: March 20, 2026; June 22, 2026; September 22, 2026, and December 25, 2026.

During this period, the sun's trajectory results in varied patterns of light exposure throughout the day. The shifting solar angle not only influences the intensity of illumination but also dictates which windows and areas are affected by shadowing. This interplay between sunlight and architectural features is especially apparent on dates near the solstices, when the extremes of solar declination are reached.

March 20, 2026

This time frame is near the Vernal Equinox and close to Easter (April 5th in 2026), and also represents a zero declination for the Sun. From sunrise to sunset at various times, sunlight is blocked from the Basilica's east windows, all south-end windows, and most east-side windows of the Rectory and St. Dominic Building. The highest levels of light occlusion are observed at sunrise, 11:00 a.m., noon (partial obstruction), and from 3:00 p.m. until sunset. Detailed indications of building structures and the sunlight path, as well as compass orientations, are provided in Figure 3.

On March 20, 2026, the shadow study revealed a significant decrease in sunlight reaching the Basilica, Rectory, and St. Dominic Building throughout the day. Early morning hours saw elongated shadows cast across the east-facing windows, severely limiting natural light to those spaces. As the day progressed, shadows shifted but continued to obstruct various portions of the buildings, particularly during midday and late afternoon.

It is important to note that at the times of maximum light occlusion, particularly around Sunrise and 11:00am there are regularly scheduled religious services. And, there are specific prayer times that include use of the worship space in late afternoon as well, another time of maximum light occlusion. ***The result of the late afternoon occlusion is effectively "early sunset" with the lack of sunlight, counter to the intent of the original construction design***.

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Figure 2 March 20, 2026 Sunrise

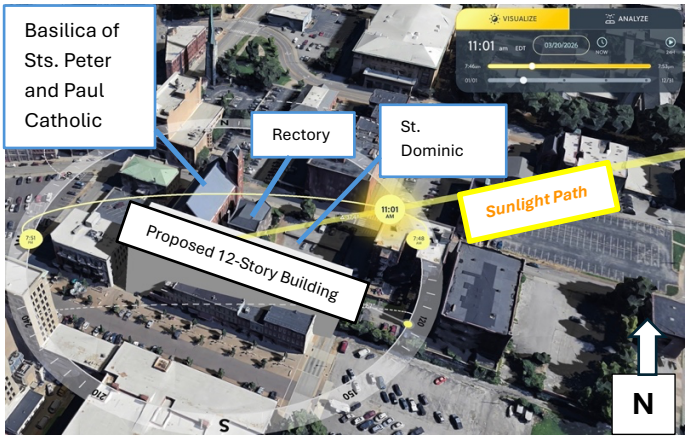

Figure 3 March 20, 2026 11:00am

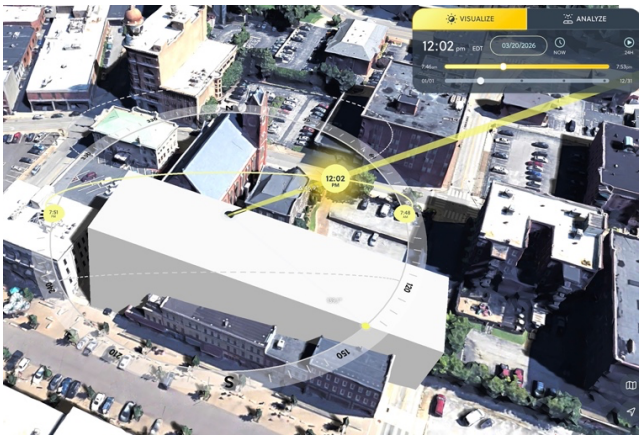

Figure 4 March 20, 2026 Noon

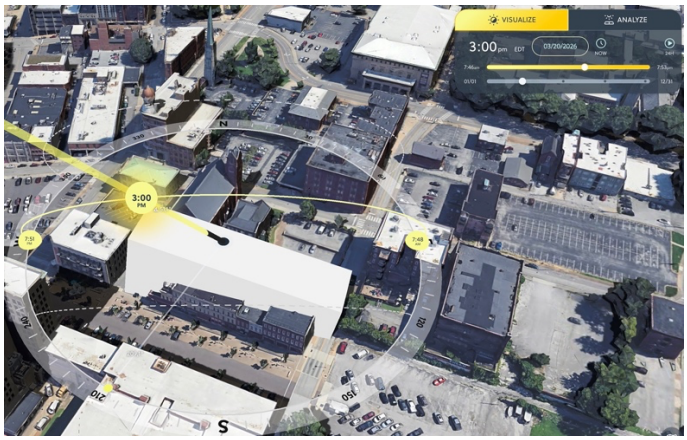

Figure 5 March 20, 2026 3:00pm

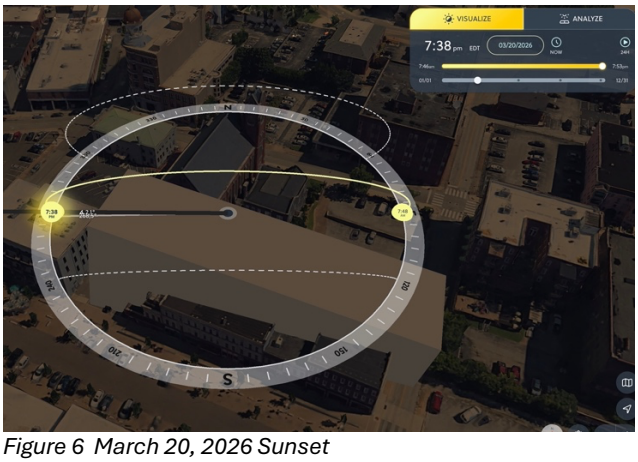

Figure 6 March 20, 2026 Sunset

June 21, 2026

This date coincides with the Summer Solstice and represents the approximate solar declination of 23.45° North, which is the maximum value reached for the year. This is the date that could reasonably expected to have the least shadowing on the Basilica and surrounds. ***Yet again, from sunrise to sunset, sunlight is blocked at many times from the Basilica's east windows, all south-***

end windows, and most east-side windows of the Rectory and St. Dominic Building. The highest levels of light occlusion are observed at sunrise, noon (partial obstruction), 2:00pm, and from 3:00 p.m. until sunset.

Figure 7 June 21, 2026 Sunrise

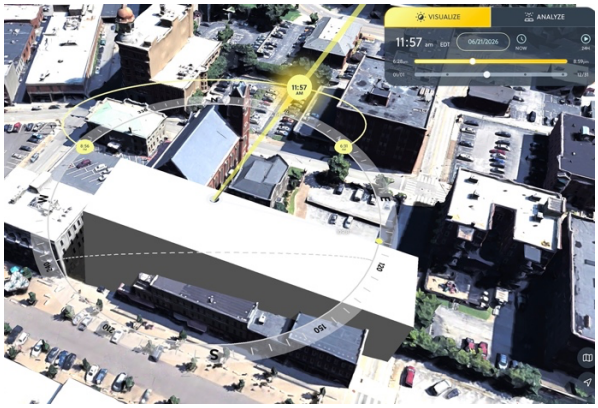

Figure 8 June 21, 2026 Noon

Figure 9 June 21, 2026 2:00pm

Figure 10 June 21, 2026 3:00pm

Figure 11 June 21, 2026 Sunset

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September 22, 2026

This date represents the Autumnal Equinox, and as in March the Solar Declination is approximately 0 degrees. ***Like in March, sunlight is blocked all day from the Basilica's east windows, all south-end windows, and most east-side windows of the Rectory and St. Dominic Building***.

The highest levels of light occlusion are observed at sunrise, 10:00am, noon (partial obstruction), and from 2:00pm until sunset.

Figure 12 September 22, 2026 Sunrise

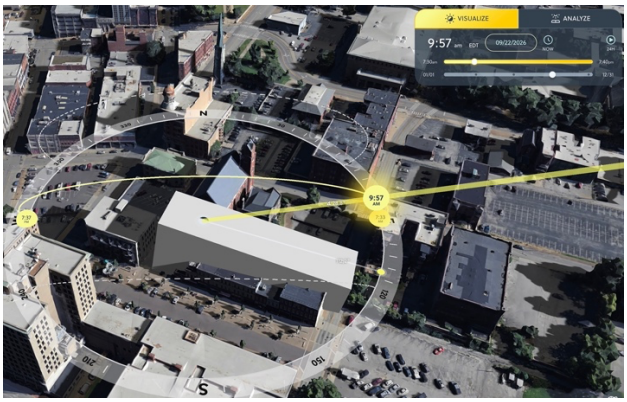

Figure 13 September 22, 2026 10:00am

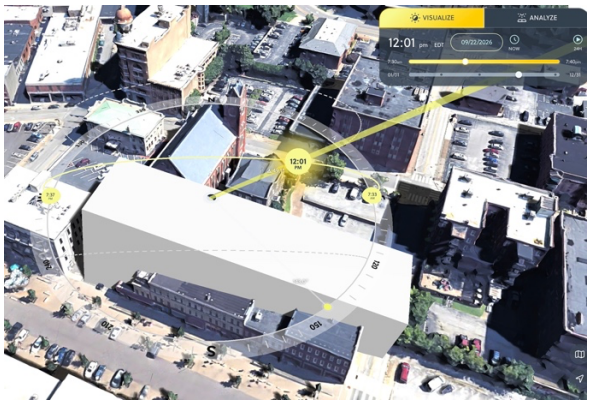

Figure 14 September 22, 2026 Noon

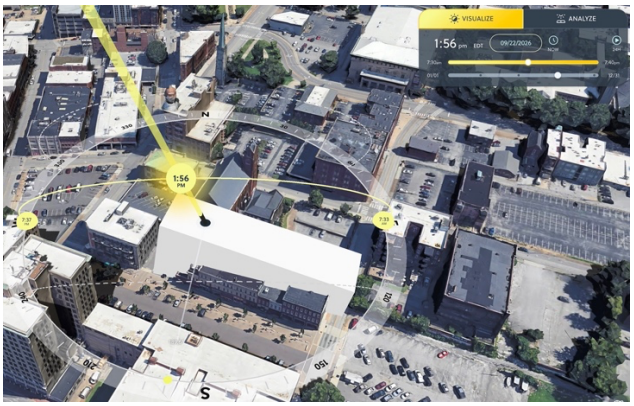

Figure 15 September 22, 2026 2:00pm

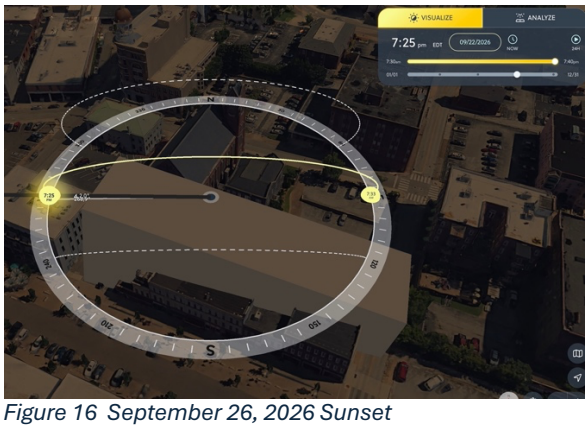

Figure 16 September 26, 2026 Sunset

December 25, 2026

Christmas falls near the Winter or December Solstice, which occurs on December 21st when the Sun reaches its lowest position of -23.44° (or 23.44° South). On Christmas Day the declination is very close at -23.35 degrees (or 23.35° South). ***With this being the lowest declination, one could expect the most occlusion. Indeed, this date does have the highest amount of light occlusion***, especially at Sunrise, 9:00am, noon (partial occlusion), 2:00pm, and 3:00pm to Sunset. Sunlight is blocked from the Basilica's east windows, all south-end windows, and most east-side windows of the Rectory and St. Dominic Building. Christmas Day religious services are one of the high points of Christian worship, and lack of sunlight to enhance and enliven the Tiffany-stained glass windows is antithetical to the intent of the atmosphere and focus of the worship. ***This day is certainly one of those days where the results of lack of proper sunlight illumination to the worship space would be tragic***.

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Figure 17 December 25, 2026 Sunrise

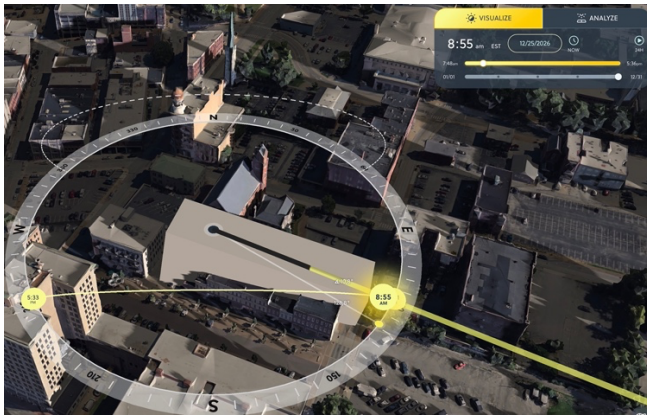

Figure 18 December 25, 2026 9:00am

Figure 19 December 25, 2026 Noon

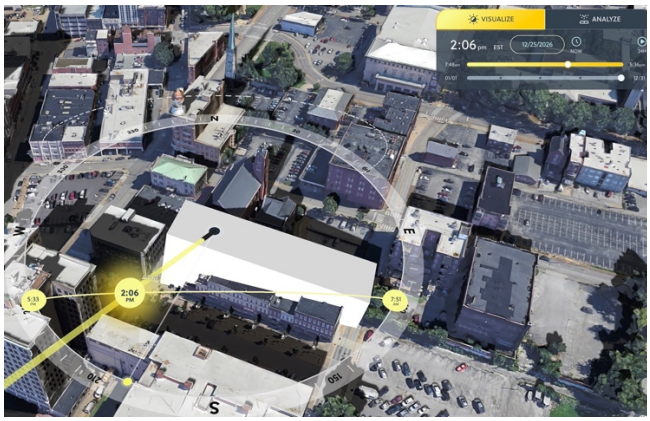

Figure 20 December 25, 2026 2:00pm

Figure 21 December 25, 2026 3:00pm

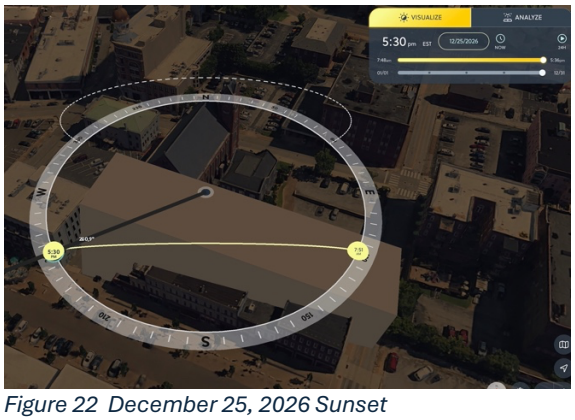

Figure 22 December 25, 2026 Sunset

Analysis and Conclusions

At the outset of this analysis, it was anticipated that light occlusion would occur only during limited periods throughout the year, with the majority of days reflecting conditions similar to the Basilica's original design for light transmission. However, the study's findings indicate a different reality: significant light occlusion is present on nearly every day of the year. **All the windows on the east side will be occluded, save perhaps for mid-May to mid-July when the sun is at its highest declination. This not only affects the aesthetics and ambiance of the worship space**

but also diminishes the atmosphere that parishioners have experienced and valued over 136 years of service.

Additionally, it is important to note that the Rectory serves as the residence for the clergy who minister at the Basilica and in the surrounding community. **Light occlusion in this area extends beyond aesthetic concerns; as outlined previously, inadequate natural light can have detrimental effects on health.** Ensuring a healthy environment for the clergy is critical, given their central role in providing service and support.

Lastly, the St. Dominic Building, which hosts religious ministry and community social services, is also affected. Even though this space is not residential, extended operational hours mean that insufficient lighting can have a clear negative impact on those who use it.

Summary and Conclusion: A Reasonable and Lawful Basis for Zoning Denial

The lack of light will most certainly negatively impact both parishioners and clergy at the Basilica, and rezoning for a 12-story building on Patten Parkway creates this issue.

Points to consider from a legal aspect from the research:

- **The reduction of natural light caused by the proposed 12-story building will adversely affect the visibility of the Tiffany stained glass windows in the worship area of the Basilica of Sts. Peter and Paul Catholic Church**. These significant works of art, created by acclaimed artist **Louis Comfort Tiffany**, illustrate key events from the lives of the patron saints. ***The loss of this aesthetic is immeasurable***.
- Even though there is no longer a **"right-to-light"** guarantee in the United States, there are legal provisions in several other areas of the World. Perhaps most notably, is the Doctrine of **Ancient Lights in England and Wales (U.K.),** codified and clarified by the **Prescription Act 1832. This is still present in planning today in** the planning concept of **solar access,** remaining relevant in zoning and design controls to prevent overshadowing of neighbors. (*Wheeldon v Burrows (1879)* LR 12 Ch D 31, English land law). The UK treats daylight as a **property right**, not merely an amenity.
- **Historic preservation guidelines** (such as those used by state historic preservation offices and the National Park Service) specifically encourage **retaining original window openings and daylight access**.
- ***For the clergy that reside in the Basilica Rectory***, **light deprivation** can result in **lower vitamin D synthesis**, which can affect bone health and immune function, as well as **disruption of circadian rhythms**, leading to **sleep issues, fatigue, depression, and metabolic stress.**

Based on the Shadow Study and Seasonal Sun-Path Analysis, the **impact on sunlight deprivation is telling**. **In every season** from sunrise to sunset, **significant portions** of both the Basilica, Rectory, and the St. Dominic Building **are shaded**, **resulting in possible health effects and increased energy consumption to compensate for decreased natural light**.

Given these findings, it is evident that the proposed development would fundamentally alter the character and functionality of the Basilica and its associated buildings. The persistent lack of natural light not only compromises the visual and spiritual experience of the space but also poses tangible risks to the well-being of those who live, work, and gather within its walls. **Such impacts warrant careful consideration to deny rezoning, especially in light of the Basilica's long-standing role as a cornerstone of community and heritage.**

This rezoning can credibly be considered to have the potential to:

- Endanger public health
- Degrade habitability
- Undermine historic neighborhoods (the Chattanooga Catholic community)
- Create inequitable environmental burdens

Denying this rezoning thus should not be viewed as anti-development. Denial of rezoning is **pro-health, pro-community, and consistent with historical constitutional zoning principles**.

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