OECI OPRESNIK ENGINEERING CONSULTANTS INC.

Energy Strategy Report
Zoning By-Law Amendment

Site:

Weston Heights - Block 1-3
15-23 Toryork Drive
Mixed Use & Residential Building
Toronto, Ontario

Report Prepared by:

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Executive Summary

The contents of this Energy Strategy Report will serve to address preliminary conceptual design for high efficiency systems as well as estimated energy use and greenhouse gas intensity. *The Energy Strategy is intended to contribute to achieving the City's objectives* to reduce energy consumption and GHG emissions and become more resilient. Primary objectives include early identification of opportunities to integrate local energy solutions that are efficient, low carbon and resilient. The findings will inform later studies including the Design Development Stage Energy Report required at SPA.

Representative calculations have been generated to simulate the proposed building designs and estimate potential consumption. While the calculations are not an actual representation of the final design, they have been created based on the proposed orientation, location weather file and potential systems and materials that may be used in the actual and final design. The purpose of this report is to illustrate compliance with the TGS and provide the basis of schematic design.

As per the requirements of the TGS v4, the following targets for EUI, TEDI and GHG are set at each tier for minimum energy performance and GHG emissions.

Building Type	Tier	Energy Use Intensity (KWh/m^2)	Thermal Energy Demand Intensity (KWh/m^2)	Greenhouse Gas Intensity (kg/m^2)
Mixed Use Buildings (90% residential, 5% retail, 5% commercial)	1	135	50	15
	2	100	30	10
	3	75	10	5

The preliminary calculations for the Weston Heights Block 1-3 site result in the following EUI, TEDI and GHG estimates for each tier. The results displayed below are based on the design criteria outlined in this report.

Proposed Development	Tier	Energy Use Intensity (KWh/m^2)	Thermal Energy Demand Intensity (KWh/m^2)	Greenhouse Gas Intensity (kg/m^2)
Weston Heights Block 1-3: Site Intensities	1	126.2	46.9	14.5
	2	93.5	28.1	9.6
	3	70.1	9.4	4.8

Background

The City of Toronto has developed the Toronto Green Standard (TGS) in an effort to address climate change. The TGS is and will be the basis in which the City will be shaped in terms of development. The standard continues to evolve and push developments to improve their sustainable design while ultimately reducing energy consumption and carbon footprint. All developments greater than 2,000 square meter or within a City of Toronto Community Energy Plan area must provide an Energy Strategy Report.

Undertaking an Energy Strategy at the application stage for a Plan of Subdivision, Official Plan or Zoning Bylaw Amendment facilitates the following key outcomes:

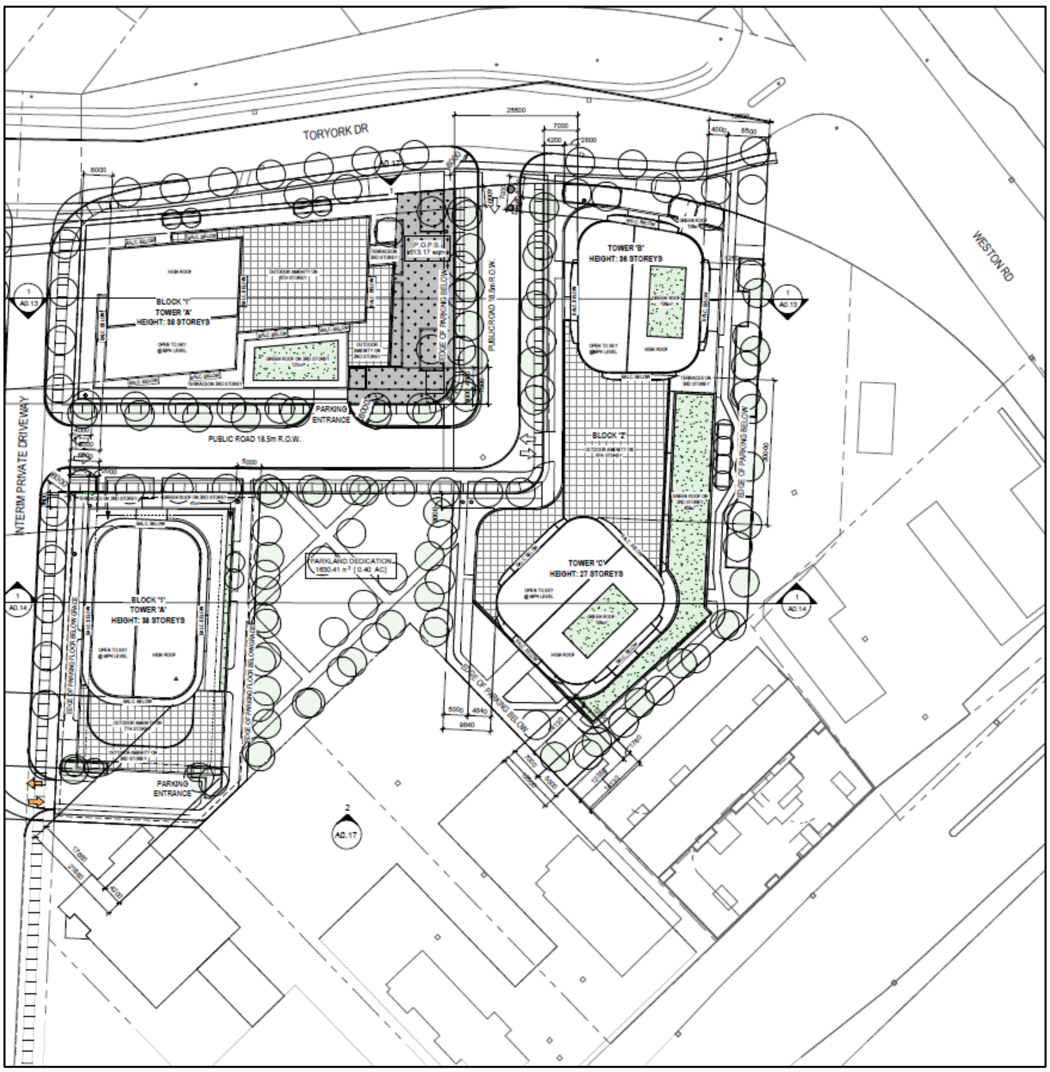
- Opportunity to site buildings to take advantage of existing or proposed energy infrastructure, energy capture and/or solar orientation at the conceptual design stage.
- Consideration of potential energy sharing for multi-building development and/or neighboring existing/proposed developments.
- Consideration of opportunities to increase resiliency such as strategic back-up power capacity (for multi-unit residential buildings).
- Identification of innovative solutions to reduce energy consumption in new construction and retrofit of existing buildings (if part of new development).
- Exploration of potential to attract private investment in energy sharing systems.

The TGS *Zero Emissions Building Framework* has implemented the following three targets:

- Energy Use Intensity – EUI – kwh/m2: Annual building energy use, divided by the conditioned floor area.
- Thermal Energy Demand Intensity – TEDI – kWh/m2: Annual heating load, divided by the conditioned floor area. TEDI excludes the effects of mechanical efficiencies (ex. condensing boilers) but does include passive systems such as in-suite heat recovery, solar gains, and internal gains.
- Greenhouse Gas Intensity – GHGI – kgCO2e/m2: Annual greenhouse gas emissions, divided by the conditioned floor area. The carbon emissions factors currently listed in OBC SB-10 2017 are used for this calculation.

Site Description

The proposed 15-23 Toryork Drive development is three separate blocks connected by multi-level underground parking. The Block 1 podium has Building A which is comprised of 38-storey building; the second podium, Block 2 is comprised of two towers - Tower B, a 36-storey building and Tower C a 27-storey building; and a third podium, Block 3 which is comprised of a 29-storey tower. Each building has residential units with lobby, mezzanine, amenities and retail space(s) on the ground floor. All towers have podium levels below and an MPH level above. Loading areas, bike storage and open space are provided above grade.

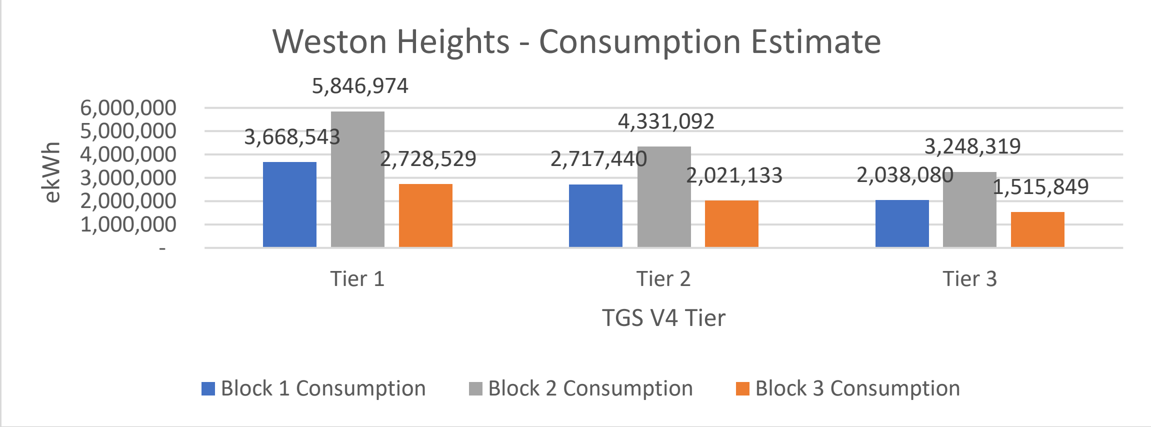


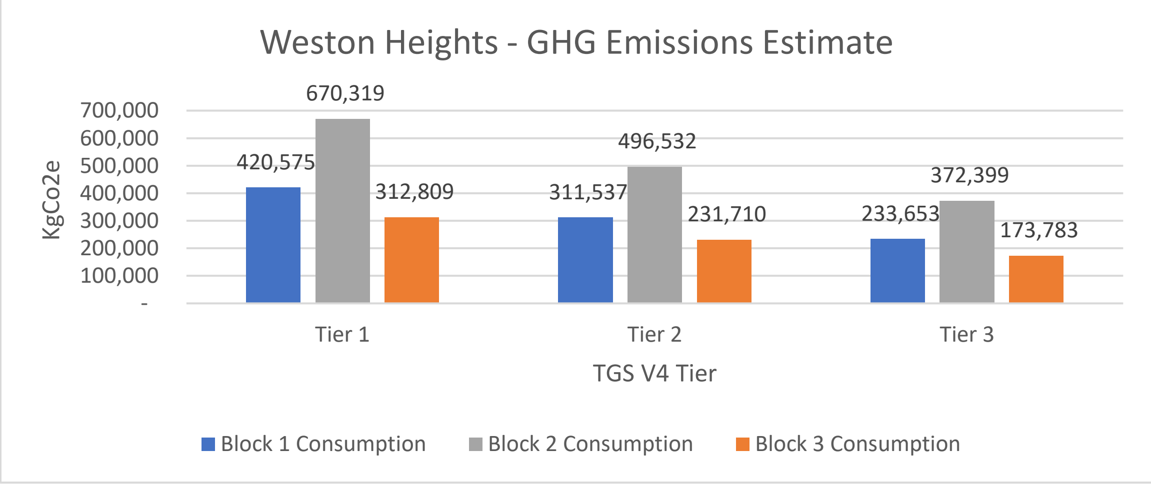
Weston Heights – Proposed Site

Energy Performance Estimate

The baseline energy models will be created to ensure compliance with NECB 2015 as required by the Ontario Building Code SB-10. The proposed buildings will comply with TGS requirements for Absolute Performance Targets Pathway and proposed and reference models, complete with supporting documentation, will be submitted at the SPA stage to illustrate compliance with TGS. The energy model considers all aspects of sustainable building design with consideration given to minimizing maintenance and the need for replacement in the future. The design will assist in the city *achieving it's 2050* target of GHG reductions.

As per the TGS - Zoning By-Law Amendment - Energy Strategy Requirements, developments must provide preliminary estimates for consumption that will be confirmed by modelling at the SPA stage. The following graph displays the estimated energy consumption and GHG emissions for Weston Heights Blocks 1-3 based on high efficiency design criteria that complies with the TGS Tier 1-3 building energy performance requirements.





Energy Conservation & Demand Reduction

The development and therefore all its buildings, are in the concept stage and the following mechanical systems are being considered, however, these are only preliminary considerations. Design development, including mechanical and electrical schematic design briefs will be submitted as required during the SPA stage. At this time, any and all options are concept design only and are not to be considered as a design brief or construction design. It should be noted, that regardless of design, the design team will implement maximum resource conservation wherever it is commercially viable. In other words, the design will incorporate energy efficient measures in balance with the total associated costs to install and maintain the equipment and/or systems.

Mechanical Systems

The building could be conditioned primarily by a high efficiency plant consisting of an Air Source Heat Pump (ASHP) system for heating/cooling with boiler plant as a back-up only (for low ambient temperatures). In-suite 4-pipe fan coils would be connected to the loops. The system can utilize variable refrigerant flow (VRF). A central corridor spanning each floor could be conditioned by a make-up air unit located on the rooftop, providing ventilation and pressurization to the central corridors.

The heating/cooling plant ASHP system would be energy efficient with a COP greater than 3.0 and the boiler back-up with a greater than 92% efficiency. All associated pumps would be variable speed. Using a water loop is the most effective means of provided in-suite and perimeter heating. Any primary and secondary circulation pumps would consider variable speed options and all fan blower motors could be variable speed. This allows for energy savings when demands are decreased to partial levels.

Retail and amenity spaces could be conditioned by high efficiency heat pumps and/or single zone packaged units complete with dedicated energy recovery ventilation units to maximized indoor air quality and outdoor air preheat efficiencies. The ground floor perimeter heating may be supplemented by radiant panels and baseboards connected to the plant.

Each suite may be equipped with independent energy recovery ventilators (ERVs), the ERVs will have a minimum efficiency rating of 60%, which would exceed the ASHRAE 90.1-2007 minimum requirement of 50% efficiency. The units would also consider an ERV bypass – this would allow free cooling to occur through damper/economizer modulation and provide additional savings by disengaging the ERV*'s fan during free cooling. Free* cooling is considered a passive solution, as the mechanical cooling is also disengaged.

The ERVs will recover the heating or cooling within the exhaust air and preheat or precool the outdoor air being provided to the space. Dedicated and operation specific exhaust areas such as kitchen hoods would not be connected to the ERVs.

Building Envelope

All fenestration will be at least Solarban 60 double glazed low-e and argon filled. This provides substantial energy saving by reducing the solar heat gains during the summer months and provides significant savings in the winter months by reducing the heat loss through the windows. Fenestration selection will be based on both insulating properties of the glass and solar heat gain values. Thermally broken insulated aluminum frames would also be considered for all fenestration.

The building insulation for the roof will be two layers of polyisocyanurate, which provides an overall average insulation R-value of R-35. The energy modeling ran multiple iterations on the amount of insulation best suited for this application and the results supported this level of insulation. Increases in the roof insulation beyond the R-35 resulted in diminishing returns as the associated installation costs increased to the point that it was no longer pragmatic to increase the insulation. The top layer of the roof is a white TPO membrane or green roof as required by the TGS.

The City of Toronto requires that thermal bridging calculations be submitted during the SPA application. This includes all linear interfaces such as window/wall transitions, balcony/slab edges, parapet/ceiling connections, service penetrations and exterior cladding attachments.

Lighting Solutions

LED lighting provides quality lighting and color rendition comparable to fluorescent lighting, however, at less than half the light power density. LED lighting will be considered with occupancy sensing wherever practical. The energy models will capture the savings from the lighting and occupancy measures in accordance with best practice energy modeling procedures from ASHRAE Appendix G and NECB 2015 Division B Part 8, Advanced Energy Modeling.

Low-Carbon Solutions

While energy sharing, photovoltaics and strategic back-up power are being discussed and considered during the conceptual stages, as the buildings are primarily residential, feasible applications are limited. Every opportunity will be considered in maximizing the design(s) to reduce energy consumption and GHG emissions and ensure the design becomes more resilient.

Low-carbon energy solutions will be considered on-site and off-site through connection to nearby existing or planned buildings and infrastructure. This could include:

- Solar ready infrastructure for solar photovoltaic (PV) or solar thermal systems
- Heat recovery from sewer lines
- Geoexchange – Use of electric ground source heat pumps coupled with horizontal or vertical ground loop piping systems to provide heating and cooling energy; or use of direct ground contact systems
- Connection to an existing thermal network

Given the size of the proposed development, the following campus-type opportunities for shared energy solutions will be considered as the design develops:

- Thermal energy distribution networks to connect all buildings within the development
- Common mechanical rooms for heating and cooling equipment
- Large scale renewables such as lake water cooling, biomass, and waste heat recovery
- Thermal energy storage
- Shared back up power systems and micro-grids with the ability to separate from the electrical grid

Feasible low carbon solutions have been examined in this report given the current site conditions. Future considerations will be given to other solutions as the Toronto region continues to develop.

Low-Carbon Solutions – Energy Savings

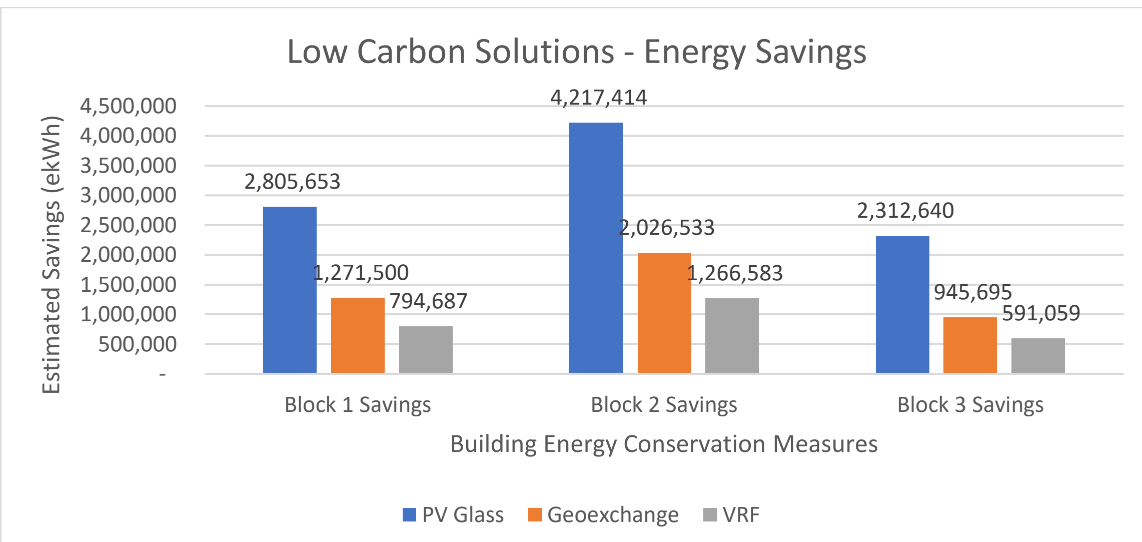
The following low carbon solutions have been investigated as they present the best case for energy savings at the Weston Heights Blocks 1-3 site.

Solar Photovoltaic Glazing Panels
New technology for solar PV has enabled high-rise buildings with large amounts of glazing to convert a percentage of the glass into photovoltaic glass. The glass incorporates transparent semiconductor-based photovoltaic cells, which are also known as solar cells. The cells are sandwiched between two sheets of glass.

A sample calculation for this site has been generated with a product by Onyx Solar. The product selected is a high transparency glazing with a U-value of 0.28 (similar to the glazing used in the energy model). If 50% of the buildings glazing were to be replaced with PV glass, the estimate results show that the buildings electricity consumption in the energy model could be offset. The table below shows the results for the potential energy output of installing PV glass on the buildings.

Variable Refrigerant Flow
As per current research VRF technology allows 40 to 50 percent efficiency improvement over standard ASHRAE 90.1 standard RTU units. The table below shows the potential savings of a VRF system.

Geoexchange
Geoexchange systems (ground source heat pumps), also known as low-temperature or shallow geothermal systems, utilize the constant temperature just below the earth's surface to heat and cool buildings. According to current research Geoexchange systems can produce energy savings of 30-70% and 20-95% for space heating and cooling. The table below displays the potential savings of a Geoexchange system on this site.



Energy Resilience

Improving the ability of the buildings to withstand the impacts of climate change and extreme weather is an important step towards creating a more resilient residential development and to protecting the health, safety and economic wellbeing of the residents and property.

Backup power systems will be considered to improve the resiliency of the development to area-wide power outages. This includes satisfying all emergency power (life safety) requirements in addition to providing a 72-hour minimum back-up power system ensuring power is provided to enable access and egress and essential building functions during a prolonged power outage.

A refuge area will be considered (0.5m2/occupant) which could act as building amenity space during normal operations. Common refuge areas to be considered would be temporarily shared, lit spaces where vulnerable residents can gather to remain onsite, charge cell phones and access the internet, safely store medicine, refrigerate basic food necessities, access potable water, toilets and perhaps prepare food. *The "common refuge area" will take into account the potential for prolonged backup power requirements for* space heating and cooling to ensure occupant comfort and safety during a prolonged power outage.

The development will consider at least one elevator per building, in addition to the firefighter's designated elevator, to be backed up for resident use during a power outage. Back-up power for lighting will be considered in all common areas and corridors for the 72-hour period.

The design will take into consideration the option to have the sump pumps in basements backed up to ensure that any water entering below grade, such as during a rainstorm, can be pumped out during a power outage. Backing up booster pumps will also be considered to provide adequate water supply to units as water for drinking, washing, and flushing toilets is essential during extended power outages. Ensuring hot water circulation is an important aspect of asset management as it would help preserve the integrity of pipes during potential power outages in the winter.

Implementation Strategy

By executing sustainable design practices with the aforementioned measures, an expected outcome of less maintenance and decreased operational costs can be realized. This approach is the basis of the sustainable design process for the project and combines the knowledge of well tested materials with established industry standards as well as feedback from end users and commissioning agents. Such methods and measures will reduce the overall stress on building components and systems and as a result increase the life span of the buildings.

Short-term investment strategies and solutions are typically the downfall of sustainability as they cause underinvestment and economic inefficiencies. Fixed income return on investment focuses on risk or minimizing downsides; long-term investment focuses on upside opportunities and minimizing potential risks. Key components to long term investment that were implemented and considered in the design are:

- Successful implementation of life cycle costing based on performance and risk. The durable building requirements outline life expectancy; however, these are only achievable by continued maintenance with quality parts and materials that reflect the initial installation.

- Benchmarks – potential risks can be mitigated by utilization of the measurement and verification means that have been incorporated into the design to assist in maintaining the initial design and building performance as defined by the energy model baseline.

- Tracking errors – operational changes and seasonal anomalies can be updated on an ongoing basis by adjusting the energy model reference baseline. This provides the ability to track actual performance versus projected annual consumptions

- Performance Monitoring – The energy model baseline is critical to establishing baseline performance and providing the means and methods for recommissioning of systems to restore original performance upon the completion of standard operational and maintenance procedures.

Conclusion and Recommendations

Moving forward with execution of the recommended actions and energy efficiency measures outlined in this report will depend on ongoing engagement with developers and consultants. Sustainability and energy experts should be engaged throughout the design process to continually manage the projects compliance for TGS, building code and project energy goal requirements. The energy and emissions estimates in this report are preliminary; a detailed energy model should be performed once building and system *designs are finalized to assess the development's performance.* Furthermore, achieving Tier 1 of TGS v4 will need to be further investigated in the Design Development Stage Energy Report filed as part of a Site Plan Control Application.

Consideration for achieving higher levels of sustainable design beyond Tier 1 will be included throughout the design process. Incentives for this include the Toronto Green Standard Version 4 Development Charge Refund program which offers a partial development charge refund for projects achieving Tier 2 or higher.

The preliminary estimates outlined in this report for Energy Use Intensity, Thermal Energy Demand Intensity, and Greenhouse Gas Intensity are representative of the high efficiency design strategies that will be considered in the design. Modelling has shown that these design strategies will meet or exceed the intensity targets established for mixed use buildings.

Therefore, it is the opinion of Opresnik Engineering Consultants Inc., that by continuing to explore energy efficiency measures/designs, the proposed development Weston Heights at 15-23 Toryork Drive will meet and/or exceed the requirements outlined in the TGS v4 standard.