City of Vancouver Sustainable Design Strategy

PREPARED FOR:
Killarney Enterprises (49th) Ltd.
777 West 66th Avenue
Vancouver, BC V6P 2R4

PREPARED BY:
PGL Environmental Consultants
#1500 – 1185 West Georgia Street
Vancouver, BC V6E 4E6

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# List of Acronyms

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<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>COV</td>
<td>City of Vancouver</td>
</tr>
<tr>
<td>GHGI</td>
<td>Greenhouse Gas Intensity</td>
</tr>
<tr>
<td>IRMP</td>
<td>Integrated Risk Management Plan</td>
</tr>
<tr>
<td>TEDI</td>
<td>Thermal Energy Demand Intensity</td>
</tr>
<tr>
<td>TEUI</td>
<td>Total Energy Use Intensity</td>
</tr>
<tr>
<td>ZEBP</td>
<td>Zero Emissions Building Plan</td>
</tr>
</tbody>
</table>
A. OVERVIEW

Pottinger Gaherty Environmental Consultants Ltd. has been engaged by Killarney Enterprises (49th) Ltd. to prepare this report documenting the sustainability strategy for the proposed development at 319-359 West 49th Avenue in Vancouver, BC (the Site). This Sustainable Design Strategy report provides confirmation the project design is on target to meet the requirements as dictated by the City of Vancouver (COV) Green Buildings Policy for Rezonings, Option B. Low Emissions Green Building, as amended on May 2, 2018.

This report documents the preliminary strategies explored by the design team to achieve each of the following requirements of the Low Emissions Green Building pathway:

- Item B.2: Brief summary of strategies and measures to achieve performance limits for energy use, heat loss, and greenhouse gas emissions, including:
  - Preliminary Zero Emissions Building Plan (ZEBP) Energy Checklist, completed by the project energy modeller, showing that the project meets the performance limits for energy use (TEUI), heat loss (TEDI), and greenhouse gas emissions (GHGI), together with key inputs; and
  - A summary of detailed energy model inputs.

- A commitment by the owner to meet the requirements of the Green Buildings Policy for Rezonings with documentation to be submitted at later project phase(s), including:
  - B.3: design, build, and test to meet an airtightness target of 2.0 L/s/m² @ 75 Pa;
  - B.4: complete an enhanced commissioning process;
  - B.5: design and build to include building metering and sub-metering of energy, and to enter into agreement on energy reporting, including assistance for future building owners;
  - B.6: complete refrigerant emissions and embodied emissions calculations;
  - B.7: design and build a direct ventilation system;
  - B.8: design and build with low-emitting materials;
  - B.9: test indoor air quality prior to occupancy; and
  - B.11: design and build a resilient potable water access point.

- Item B.10: The site integrated rainwater management plan (IRMP) describing the chosen strategies and infrastructure measures included in the landscape and building design.
B.1: LEED GOLD – BUILDING DESIGN + CONSTRUCTION

As the project is over 50% residential, LEED registration, design, and certification is not required.

B.2: PERFORMANCE LIMITS

At this stage, the project is still in concept design where the building shape/massing and suite layout are subject to COV approval and other changes. The mechanical, electrical, and envelope design are also in the design stage. The preliminary energy model will serve to guide further design development.

A preliminary energy model has been completed by SRC Engineering Consultants. The model identifies building design parameters that comply with performance limits for Residential Low-Rise buildings not connected to a City-recognized low carbon energy system. Whole-Building Performance Limits modeled for the Site include: TEUI 87.0 kWh/m²; TEDI 14.8 kWh/m²; GHGI 3.8 kgCO₂/m², which meets the applicable COV targets of TEUI 100 kWh/m²; TEDI 15 kWh/m²; GHGI 5.0 kgCO₂/m². The design team and project owner confirm the project will be designed in compliance with these limits.

This project will meet the above targets by including:

• A high-performance building enclosure that focuses on passive energy savings from reduced thermal transmittance through the building envelope;
• Relatively low glazing ratios and high-performance triple-glazed windows;
• In-suite heat recovery ventilation; and
• Efficient lighting, hot water heating, and low-flow plumbing fixtures.

The Zero Emissions Building Plan Energy Checklist, along with a summary of the preliminary energy model, is included in Appendix 1.

B.3: AIRTIGHTNESS TESTING

Whole-building and suite airtightness testing and reporting is required for this residential building. The project owner has committed to meet this requirement (please see Appendix 2 – Letter of Commitment).

B.4: ENHANCED COMMISSIONING

An enhanced commissioning process is required for all building energy systems. The project owner has committed to meet this requirement (please see Appendix 2 – Letter of Commitment).

B.5: ENERGY SYSTEM SUB-METERING + REPORTING

Separate master metering for each energy utility, along with sub-metering of all major energy end-uses and major space uses is required. The building owner must enter an agreement with the COV to share utility data for minimum three years and provide assistance for future building future owners. The project owner has committed to meet this requirement (please see Appendix 2 – Letter of Commitment).

B.6: REFRIGERANT EMISSIONS + EMBODIED EMISSIONS

Upon Building Permit Application, the project team will provide embodied emissions calculations representing the building permit stage design and a description of what measures, if any, were
taken to reduce embodied emissions. The project owner has committed to meet this requirement (please see Appendix 2 – Letter of Commitment).

B.7: VERIFIED DIRECT VENTILATION
The building’s ventilation system will provide outdoor air directly to all occupiable spaces, in the quantities defined by code. The project owner has committed to meet this requirement (please see Appendix 2 – Letter of Commitment).

B.8: LOW EMITTING MATERIALS
All interior finishes will be selected to minimize volatile organic compounds and urea formaldehyde to improve the indoor environmental air quality. The project owner has committed to meet this requirement (please see Appendix 2 – Letter of Commitment).

B.9: INDOOR AIR QUALITY TESTING
Prior to occupancy, testing for formaldehyde, particulates, ozone, total volatile organic compounds, and carbon monoxide will be conducted. The results will be compared to COV targets and will be reported for occupancy permit. The project owner has committed to meet this requirement (please see Appendix 2 – Letter of Commitment).

B.10: INTEGRATED RAINWATER MANAGEMENT + GREEN INFRASTRUCTURE
In consultation with the COV’s Best Management Practice Toolkit, the project site IRMP includes measures considered appropriate for the building type, design, project location, and surrounding area. The IRMP has been included with this Rezoning Application Package (please see Appendix 3 – Rainwater Management Report).

B.11: RESILIENT DRINKING WATER ACCESS
The building’s design will provide access to potable water which utilizes COV operated system pressure (not electrically aided). The project owner has committed to meet this requirement (please see Appendix 2 – Letter of Commitment).

C. SUMMARY
The above noted strategies support a holistic approach to addressing the requirements of the COV’s Green Buildings Policy for Rezonings. Implementing these strategies through design and construction will produce a sustainable and resilient building capable of delivering optimum building performance, while also improving indoor environmental quality for occupants.

Respectfully submitted,

PGL ENVIRONMENTAL CONSULTANTS
Per:

David Bell, P.Ag., LEED® Green Associate
Environmental Consultant

Susan P. Wilkins, M.Sc., P.Geo., LEEDAP
Principal
Appendix 1

Zero Emissions Building Plan Energy Checklist and Preliminary Energy Model
**Zero Emissions Building Plan Energy Checklist**

Please complete all fields that apply to the project, using information that represents the current stage of design. For fields that do not apply or for which there is no information yet, please enter "N/A".

### Project Information (enter all that apply)

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Address</td>
<td>314-359 W 49th</td>
</tr>
<tr>
<td>Secondary Address</td>
<td></td>
</tr>
<tr>
<td>Project Working Title</td>
<td></td>
</tr>
<tr>
<td>POSSE File Name (City use only)</td>
<td></td>
</tr>
<tr>
<td>Gross Floor Area indicated on Arch. Drawings (m²)</td>
<td>-</td>
</tr>
<tr>
<td>Parkade Area (m²)</td>
<td></td>
</tr>
</tbody>
</table>

### Building Information and Performance Limits

For building types with Performance Limits, enter this information in this section:

<table>
<thead>
<tr>
<th>Building Type(s)</th>
<th>Modelled Floor Area (m²)</th>
<th>Rezoning?</th>
<th>City-Recognized Low Carbon Energy System?</th>
<th>TEUI</th>
<th>TEDI</th>
<th>GHGI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential &lt;7 storeys (Group C except Hotel)</td>
<td>4,743</td>
<td>Yes</td>
<td>Yes</td>
<td>100</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td></td>
<td>4,743</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For other building types, create a baseline energy model to establish limits, and enter this information in this section:

<table>
<thead>
<tr>
<th>Building Type Modelled Floor Area (m²)</th>
<th>Rezoning?</th>
<th>TEUI</th>
<th>TEDI</th>
<th>GHGI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td>100</td>
<td>15</td>
<td>5</td>
</tr>
</tbody>
</table>

### Modelled Building Performance

<table>
<thead>
<tr>
<th>End Use</th>
<th>Energy (kWh)</th>
<th>Fuel Type</th>
<th>Em. Factor</th>
<th>Emissions (kgCO2e)</th>
<th>TEUI</th>
<th>TEDI</th>
<th>GHGI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior Lighting</td>
<td>100,842</td>
<td>Electricity</td>
<td>0.011</td>
<td>1,109.26</td>
<td>21.3</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Exterior Lighting</td>
<td>N/A</td>
<td>Electricity</td>
<td>0.011</td>
<td>-</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Heating</td>
<td>70,077</td>
<td>Electricity</td>
<td>0.011</td>
<td>770.85</td>
<td>14.8</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Cooling</td>
<td>26,640</td>
<td>Electricity</td>
<td>0.011</td>
<td>293.04</td>
<td>5.6</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Pumps</td>
<td>21,023</td>
<td>Electricity</td>
<td>0.011</td>
<td>231.25</td>
<td>4.4</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Fans</td>
<td>29,472</td>
<td>Electricity</td>
<td>0.011</td>
<td>324.19</td>
<td>6.2</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Domestic Hot Water</td>
<td>78,074</td>
<td>Natural Gas</td>
<td>0.185</td>
<td>14,443.69</td>
<td>16.5</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>Plug Loads</td>
<td>86,710</td>
<td>Electricity</td>
<td>0.011</td>
<td>953.81</td>
<td>18.3</td>
<td>0.2</td>
<td></td>
</tr>
</tbody>
</table>

**Whole-Building Performance Limits**: N/A N/A N/A

**Modelled Whole-Building Performance**: 87.0 14.8 3.8

### Corridor Pressurization Adjustment

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating Degree Days</td>
<td></td>
</tr>
<tr>
<td>Number of Suite Doors Pressurized</td>
<td></td>
</tr>
<tr>
<td>Airflow for Pressurization per Door (L/s/door)</td>
<td></td>
</tr>
<tr>
<td>Area of Corridors Pressurized (m²)</td>
<td></td>
</tr>
<tr>
<td>Make-Up Air Fuel Type</td>
<td></td>
</tr>
</tbody>
</table>

Adjustments for Corridor Pressurization: N/A N/A N/A

### Suite-level Metering for Space Heating

Note: select yes if the energy used for heating is metered at the suite level

Adjusted TEDI Performance of Portions with Limits: N/A

Adjusted Whole-Building Performance for Compliance: N/A
<table>
<thead>
<tr>
<th>Modelled Inputs</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Modelled Above-Ground Wall Area (m²)</td>
<td>4,743</td>
<td></td>
</tr>
<tr>
<td>Window-to-Wall Area Ratio (WWR)</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>Infiltration Rate (L/s/m²)</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td>Wall Effective R-Value - incl. thermal bridging (m²K/W)</td>
<td>3.8</td>
<td>21.34 (ft²hr°F/Btu)</td>
</tr>
<tr>
<td>Roof Effective R-Value - incl. thermal bridging (m²K/W)</td>
<td>9.7</td>
<td>54.93 (ft²hr°F/Btu)</td>
</tr>
<tr>
<td>Average Window Effective U-Value (W/m²K)</td>
<td>1.24</td>
<td>0.22 (Btu/ft²hr°F)</td>
</tr>
<tr>
<td>Average Suite Occupant Density (m²/pers)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Suite Ventilation Rate (L/s/m²)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average HRV Effectiveness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating System Type (fuel, plant, distribution, etc.)</td>
<td>Electric Baseboard</td>
<td></td>
</tr>
<tr>
<td>Cooling System Type (fuel, plant, distribution, etc.)</td>
<td>Split systems (CRUs)</td>
<td></td>
</tr>
<tr>
<td>DHW System Type (fuel, plant, distribution, etc.)</td>
<td>Central Condensing Natural Gas</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modeller Information</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Modeller Name</td>
<td></td>
</tr>
<tr>
<td>Company</td>
<td></td>
</tr>
<tr>
<td>Phone Number</td>
<td></td>
</tr>
<tr>
<td>Email</td>
<td></td>
</tr>
</tbody>
</table>

These results have been created using the COV Energy Modelling Guidelines version: 2
The proposed development at 314-359 W 49th Avenue is a 5 storey mixed use building, with 51 residential suites, amenity spaces, 5 commercial rental units, and underground parking.

The purpose of this analysis was to develop a preliminary design strategy for achieving compliance with the City of Vancouver Green Buildings Policy for Rezoning. The building envelope, mechanical, and electrical design are not fully defined at this stage, but results from this analysis will serve to guide further design development.

A variety of energy conservation measures have been included, with a focus on passive energy savings from reduced thermal transmittance through the building envelope, improved airtightness, and heat recovery ventilation. Additional energy savings are pursued through efficient lighting, hot water heating, and low flow plumbing fixtures.

Double stud wood frame walls are proposed for the residential portion of the building, along with high performance triple glazed windows, and a hybrid roof assembly for the main roof areas.

Ventilation is provided by in-suite cross counterflow heat exchangers with a high sensible recovery effectiveness. Space heating is to be provided by electric baseboard heaters. The parkade will be unheated, and have exhaust fans controlled by carbon monoxide and combustible gas sensors.

As part of the rezoning application for this project, this report has been prepared to confirm the project is on target to comply with the requirements for Low Emissions Green Buildings, identified in the Green Buildings Policy for Rezoning, as amended May 2, 2018. Since more than 50% of the building gross floor area is residential space, the performance limits for a residential low-rise building less than seven storeys apply as follows:

<p>| Performance Limits for Buildings Not Connected to a City-recognized Low Carbon Energy System |</p>
<table>
<thead>
<tr>
<th>Type</th>
<th>TEUI (kWh/m²)</th>
<th>TEDI (kWh/m²)</th>
<th>GHGI (kgCO₂/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Low-Rise (&lt; 7 storeys)</td>
<td>100</td>
<td>15</td>
<td>5</td>
</tr>
</tbody>
</table>

Building Geometry Statistics:

Conditioned Floor Area:

Residential Low-Rise: 4278 m²
Retail: 465 m²
Total: 4743 m²

<table>
<thead>
<tr>
<th>Orientation</th>
<th>Vertical Glazing Area (m²)</th>
<th>Above Grade Wall Area (m²)</th>
<th>Glazing Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>313.7</td>
<td>810.3</td>
<td>38.7%</td>
</tr>
<tr>
<td>East</td>
<td>142.6</td>
<td>542.9</td>
<td>26.3%</td>
</tr>
<tr>
<td>South</td>
<td>412.4</td>
<td>832.3</td>
<td>49.5%</td>
</tr>
<tr>
<td>West</td>
<td>18.1</td>
<td>534.1</td>
<td>3.4%</td>
</tr>
<tr>
<td>Total</td>
<td>886.8</td>
<td>2719.7</td>
<td>32.6%</td>
</tr>
</tbody>
</table>

VFAR = 0.57
Building Envelope Details

The wood frame exterior wall detail below is proposed for combustible portions of the building:

<table>
<thead>
<tr>
<th>W1</th>
<th>EXTERIOR WALL - FIBRE CEMENT BOARD / SIDING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FIBRE CEMENT BOARD / SIDING</td>
</tr>
<tr>
<td></td>
<td>3/4&quot; P.T. STRAPPING</td>
</tr>
<tr>
<td></td>
<td>SELF-ADHERED MEMBRANE SOPREMA</td>
</tr>
<tr>
<td></td>
<td>SOPRASEAL STICK VP OR EQUIVALENT TYP,</td>
</tr>
<tr>
<td></td>
<td>1/2&quot; EXTERIOR SHEATHING (PLYWOOD)</td>
</tr>
<tr>
<td></td>
<td>2 X 6 WOOD STUD &amp; R-24</td>
</tr>
<tr>
<td></td>
<td>2X4 WOOD STUD &amp; R-14</td>
</tr>
<tr>
<td></td>
<td>(2X4 &amp; 2X6 STUDS STAGGERED ON 2X10 PLATES)</td>
</tr>
<tr>
<td></td>
<td>6 MIL POLY VAPOUR BARRIER</td>
</tr>
<tr>
<td></td>
<td>1 LAYER OF 5/8&quot; TYPE &quot;X&quot; GWB</td>
</tr>
</tbody>
</table>

The equivalent clear field R-value for this assembly is R-31.9, as calculated using the parallel path method, including interior and exterior air films.
Glazing:

Storefront glazing:
U-Value = 0.23
SHGC = 0.45
Based on triple glazed IGU in thermally broken aluminum framing

Residential:
U-Value = 0.20
SHGC = 0.45
Based on triple glazed IGU in vinyl framed windows

Main roof
R-55 hybrid roof assembly

Terrace roofs:
R-35

Exposed floor slab:
R-20

Infiltration:
0.12 l/s·m² (constant rate)
Appendix 2

Letter of Commitment
February 8, 2019

Via E-mail: planning@vancouver.ca

Planning, Urban Design and Sustainability Department
City of Vancouver
436 West 12th Avenue
Vancouver, BC
V5Y 1V4

RE: OWNER COMMITMENT LETTER

As a part of the Rezoning Application package for 319-359 W 49th Avenue (the Site), Killarney Enterprises (49th) Ltd. hereby commits to meet the requirements of the Green Buildings Policy for Rezonings. At this concept stage of design, in addition to the measures identified in the Sustainable Design Strategy report, Killarney Enterprises (49th) Ltd commits to the following requirements:

- B.3: Airtightness Testing: design, build, and test to meet an airtightness target of 2.0L/s/m² @ 75 Pa;
- B.4: Enhanced Commissioning: engage a third-party commissioning agent to complete an enhanced commissioning process;
- B.5: Energy System Sub-Metering and Reporting: design and build to include building metering and sub-metering of energy, and to enter into agreement on energy reporting;
- B.6: Refrigerant Emissions and Embodied Emissions: complete refrigerant emissions and embodied emissions calculations;
- B.7: Verified Direct Ventilation: design and build a direct ventilation system;
- B.8: Low-Emitting Materials: design and build with low-emitting materials;
- B.9: Indoor Air Quality Testing: test indoor air quality prior to occupancy; and
- B.11: Resilient Drinking Water Access: design and build a resilient potable water access point.

The design team and future operations team will coordinate to incorporate the measures required to meet all requirements of the Green Building Policy for Rezonings.

KILLARNEY ENTERPRISES (49th) LTD.

Per:

Authorized Signatory
Appendix 3

Rainwater Management Report
319, 339 & 359 W49th Avenue
City of Vancouver

Rainwater Management Report
December 3, 2018
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INTRODUCTION

As new developments are occurring in the City of Vancouver, more and more impervious surfaces are being created. This results in an increased amount of runoff, which was previously infiltrated, being discharged into the city storm sewer network. Since the City of Vancouver’s current storm water infrastructure ties into sensitive watercourses (For example: False Creek, Coal Harbour, Jericho and Spanish Banks, etc.), the City of Vancouver desires to reduce drainage flows to pre-development levels and reduce the amount of pollutants being released into the environment by incorporating green infrastructure into each development.

The reduction in the overall flow from each development assists in stabilizing drainage flows into the natural receiving watercourses and helps reduce result in erosion of the existing channels and waterways. Furthermore, by treating the storm water runoff before discharging into the sensitive watercourses, wildlife is sustained and fish habitats are maintained. Incorporating green infrastructure also results in cleaner beaches and maintains water quality for recreational purposes.

The subject property is located in the Fraser Area – South Hill region of the Integrated Rainwater Management Plan (IRMP), which is in the South-East Rainwater Management area. (Refer to Figure 1 below for the Rainwater Management Areas in Vancouver)

![Figure 1: Rainwater Management Areas (Figure I-13 from IRMP)](image-url)
SITE BACKGROUND

This 0.20 hectare site is located on the north side of West 49th Avenue just east of Cambie Street in Vancouver as shown in Figure 2. Presently, the property is zoned RS-1 and encompasses 3 single family residential properties. The site generally slopes downward from the rear of the parcel towards the front, with an approximate elevations ranging from 73.4 meters to 71.1 meters.

![Figure 2: Existing Site](image)

Figure 3 shows a map from City of Vancouver’s IRMP which differentiates the levels of infiltration in Vancouver.

![Figure 3: Map of Infiltration in Vancouver (Figure I-6 from IRMP)](image)

The infiltration map uses colors to represent the levels of soil infiltration, purple areas having low infiltration potential and yellow areas having moderate infiltration potential. The proposed development is situated in the
yellow area and is identified as having predominately moderate infiltration potential.

No geotechnical report has been prepared to specifically address the infiltration capabilities of the existing soils on the site, but given that the building and 2-level parking structure and unit patios/sidewalks covers 95% of the site with most of the remaining 5% within 5 meters of the impervious area, it will not be viable to achieve Tier 1 infiltration into in-situ soils.

**PROPOSED DEVELOPMENT**

The development will consist of a four-story commercial and residential mixed-use structure with ground level concrete structure and the upper 3 floors of wood frame building. A shared two level underground parking garage is to be accessed from the rear lane.

As noted earlier, the impervious area covers approximately 95% of the site. Of the remaining 5% of the site, most of this area is related to the preservation of several mature trees at the west and south end of the site. This area will remain largely undisturbed with any works performed within to be done under the supervision of the project Arborist.

A plan of the proposed development is shown in Figure 4.
RAINWATER MANAGEMENT OBJECTIVES

The general objectives of IRMP are outlined in the City of Vancouver Rainwater Management Bulletin dated July 11, 2018. The IRMP outlines a three tier approach to Rainwater Management with Tier 1 practices being the preferred approach.

The Tier 1 practices utilize volume reducing green infrastructure practices for the first 24mm per day of rainfall onsite. The Tier 2 practices utilize non-infiltrating landscapes such as absorbent landscaping and planter boxes to reduce the volume of rainwater being discharged from the site. Beyond this, the Tier 3 practices are to treat the excess rainwater to improve the quality of the discharge and then safely convey this additional rainwater away from the site using traditional practices such as overland flood routing or gravity discharge to the City drainage piping network.

RAINWATER MANAGEMENT DESIGN

Our recommendation for the Rainwater Management Design is to implement Tier 2 absorbent landscaping combined with Tier 3 detention and water quality treatment. We recognize that the City of Vancouver would prefer Tier 1 solutions but the site constraints (parking garage, patios, sidewalks, and tree retention) make this impractical.

We are requesting an exemption from the Tier 1 practices in favor of the above recommendation.

The following summarizes our review of the Rainwater Management Practices considered for this project.

TIER 1: VOLUME REDUCING GREEN INFRASTRUCTURE PRACTICES

Infiltration into In-Situ Soils - The building and 2-level parking structure and unit patios/sidewalks covers 95% of the site and most of the remaining 5% are within 5 meters of the impervious area. Existing trees - that are to be preserved - occupy what remains of those areas located at least 5m from the impervious area. As a result it is not viable to achieve Tier 1 infiltration into in-situ soils for this site.

Green Roofs - This option is undesirable for wood frame structures due to additional structural loading and long term maintenance concerns.
Rainwater Harvesting for Reuse – The proposed development will incorporate a rainwater cistern that will hold approximately 43m$^3$ of rainwater for reuse.

For the purpose mitigating downstream drainage impact in a major event, we have decided against taking into consideration any rainwater volumes attributable to rainwater harvesting. While the practice of rainwater harvesting is sound and can assist land owners and the City in lowering the amount of potable water that would otherwise be utilized for watering planter boxes and gardens; rainwater harvesting is not particularly effective in managing the volume of rainwater leaving a site. Consider:

- 6 months of the year most irrigation systems are shut down to prevent winter damage (typically the rainy months). With no irrigation drawdown the tanks are typically full.
- Approximately 3 months of the year we have limited rainfall which limits the recharge of the harvesting tanks (often requiring supplementing from the potable water system).
- In a public strata development the non-potable harvested rainwater should be treated for bacteria, larvae, and algae before reuse.

For rainwater harvesting to be effective for managing the volume of rainwater leaving a site, it must have a substantial volume of unused space in the tanks (if the tanks are already full when a storm arrives then the excess overtops the overflow and gets discharged from the site – effectively un-detained). However if the tanks are empty or near empty then you lack the volume of harvested water required for irrigation. After considering the above, it is fairly evident that rainwater harvesting from the perspective of managing rainwater volumes operates in a similar manner to a standard storm water detention tank.

Rainwater harvesting could be considered for achieving potable water reduction purposes but we do not consider rainwater harvesting effective in providing appreciable assistance in managing rainwater volumes.

TIER 2: NON-INFIltrATING LANDSCAPES

Retention within Non-Infiltrating Landscapes - While the areas located outside of the parking structure and patios/sidewalks may not be suitable for in-situ infiltration into the native soils. The ground level landscaping and rooftop planter areas are suitable for Tier 2 retention of rainwater and evapotranspiration. Where viable, all landscaped areas and closed bottom planter boxes will comprise 450mm of absorbent landscaping. There is no expectation that hard surfaces will be directed into the landscaping and
planter boxes, so our estimate of the 24hr rainwater volume entrained in these soils will be:

Rooftop Planters: 352m² * 24mm/day = 8.4m³  
Ground Level Landscape: 65m² * 24mm/day =1.6m³  
Total Rainwater Stored: 8.4 + 1.6 = 10.0 m³ (10 m³)

450mm of absorbent landscaping can accommodate between 45 and 90mm/day of rain water so saturation of this landscaping is unlikely except in the most extreme storms or long term rainfall events.

**TIER 3: DETENTION AND WATER QUALITY TREATMENT**

An underground storm water detention system will be constructed to capture the first 24mm of rainfall from the impervious surfaces and to slowly release it at a 6 month pre-development rate. All rainwater from site will be routed to an underground concrete tank for detention. Any amount over the first 24mm will be discharged from the site via an overflow assembly. The detention volume and maximum allowable release rate are determined to be 40m³ and 11.0/s, respectively, as per calculation below.

**Detention Volume:**

<table>
<thead>
<tr>
<th>Site Area</th>
<th>2012 m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall</td>
<td>24 mm (24 hour period)</td>
</tr>
<tr>
<td>Total Rainfall Volume</td>
<td>48 m³ (24 hour period)</td>
</tr>
<tr>
<td>Minus Tier 2 Soils Entrainment:</td>
<td>10 m³ (24 hour period)</td>
</tr>
<tr>
<td>Total Detention Volume=</td>
<td>38 m³ (24 hour period)</td>
</tr>
</tbody>
</table>

**Design Rainfall Parameters:**

<table>
<thead>
<tr>
<th>R Pre-development</th>
<th>0.60</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (ha)</td>
<td>0.20 ha</td>
</tr>
<tr>
<td>N</td>
<td>0.00278</td>
</tr>
</tbody>
</table>

\[ I = aT^b, \] where I (mm/hr), T (hr), a & b are constants.

\[ a_{2-yr} = 15.13 \]
\[ b_{2-yr} = -0.51 \]

\[ T_{min} = 10 \text{ mins} \]

\[ I = 38.00 \text{ mm/hr} \]

\[ Q_{2 \text{ year \ Pre-development}} = 0.013 \text{ m³/s} \]

\[ Q_{6 \text{ months \ Pre-development}} = 0.010 \text{ m³/s} \quad [75\% \text{ of } Q_{2 \text{ year}}] \]

A 9.0m L x 5.5m W x 0.8m (avg.) H detention tank is proposed to be located within the building access ramp at the rear of the parcel as outlined in red in Figures 5 and 6. The storm service connection and treatment system (Jellyfish, First Defense, or equal) will also be located in the general vicinity (but not
within the access ramp). Further details and refinement of the system will be prepared if this report is accepted by the City.

Figure 5: Proposed Location for Detention Tank on Plan View

Figure 6: Proposed Location for Detention Tank in Cross-Section

EMERGENCY CONVEYANCE

An overflow system will be provided with the detention system and this overflow will be directed to the existing 250mm diameter combined sanitary and storm sewer along W49th Avenue.
MAINTENANCE

Maintenance of the systems must be done regularly to ensure that the effectiveness of the system is maintained throughout its lifespan. We recommend the following maintenance cycle for the following components:

<table>
<thead>
<tr>
<th>Item</th>
<th>Maintenance Cycle</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landscaping and Planter Boxes</td>
<td>Annually</td>
<td>Soils in Landscaped Areas and Planter Boxes are to be topped up with soil mixes as specified by the Landscape Consultant.</td>
</tr>
<tr>
<td>Storm Flow Control Apparatus</td>
<td>Annually</td>
<td>Visual inspection of control orifice and overflow, clean wire baskets</td>
</tr>
<tr>
<td>Water Quality Manhole</td>
<td>Annually</td>
<td>Remove floatables, extract oils and sediments and legally dispose</td>
</tr>
<tr>
<td>Detention Tank</td>
<td>5 years</td>
<td>Flush and clean tanks. Inspect for cracking and repair and seal if required (reduce the frequency of future maintenance cycles if cracking is observed)</td>
</tr>
</tbody>
</table>

CONCLUSION

By implementing the integration of the detention, infiltration, and water treatment systems design, we are confident that this development will meet the required Water Quality Target and Water Volume Reduction Target as specified in the Integrated Rainwater Management Plan.

Yours Truly,
Core Concept Consulting Ltd.

David R. Kozak
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Senior Engineer