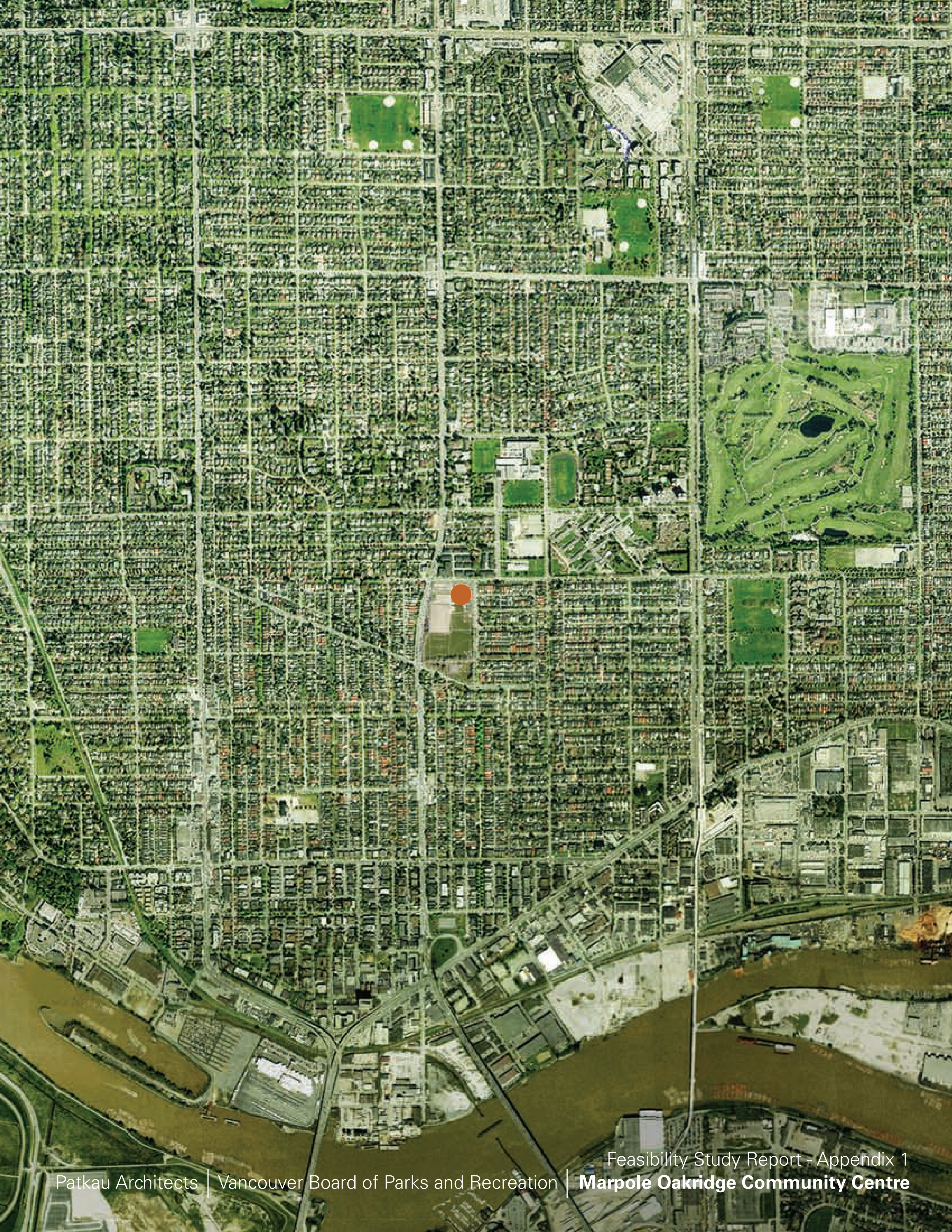

Feasibility Study Report - Appendix 1

Patkau Architects | Vancouver Board of Parks and Recreation | **Marpole Oakridge Community Centre**

Structural Engineering Design

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Marpole-Oakridge Community Centre

Feasibility Structural Design Report

1. Design Criteria

Vancouver Building Bylaw 2007

Ground Snow:	Ss = 1.9 kPa Sr = 0.3 kPa
Live Loads:	4.8 kPa
Seismic Loads:	Sa(0.2) = 0.95, Sa(0.5) = 0.65, Sa(1.0) = 0.34, Sa(2.0) = 0.17, PGA 0.483
Wind Loads:	q10 = .36 kPa q50 = .48 kPa
Importance factor:	High (Required for buildings likely to be used as shelters after a disaster.)

2. Foundations

A geotechnical investigation for the proposed community centre site was carried out by GeoPacific Consultants Ltd. Their report dated February 14, 2011 indicates that an allowable bearing pressure of 120kPa may be used for footings founded in undisturbed native sand or silt material and also for the engineered fill. For footings founded on dense glacial till an allowable bearing pressure of 600kPa may be used for design.

The geotechnical report also indicates that the subgrade conditions at the site are classified as Site Class C for seismic design of the building.

The foundations will be designed as a conventional shallow reinforced concrete foundation located a minimum of 450mm below ground elevation for frost protection. Strip footings will be located at the building perimeter and load bearing walls while pad footings will support interior columns. Braced frames will be supported by rectangular footings the length of the braced bay.

3. Suspended and On-Grade Floors

The suspended floors will be of concrete construction using slab and slab bands. Final column locations and spans will determine the required thickness of each element. The mass of the concrete will serve to provide better floor vibration performance for the multipurpose rooms. This will also provide a relatively thin floor structure maximizing available volume within the 3.0m floor to floor height.

Radiant heating and cooling elements will be located within the concrete floors. This will reduce the requirement for mechanical ducting within the limited ceiling space below these suspended floors.

On grade floors are to be placed on a layer of compacted fill as per the geotechnical report. These floors will also have piping for radiant heating and cooling.

4. **Gymnasium Structure**

The gymnasium will be constructed using an innovative wood panel system. This panel will consist of edge beams which span longitudinally to support points with transverse framing between them at about 600mm on centre. Integrated into these panels will be acoustical insulation and radiant tubing. These will be concealed within the panel by a perforated metal panel. Thus these panels will provide structural, acoustical and thermal solutions for the gymnasium.

Similar panels will also be used for the upper walls of the gymnasium except that in these locations the panels will not include the radiant piping.

The lower 3.0m high potion of the walls of the gymnasium along its long sides will be constructed using precast concrete panels. These panels will provide a robust wall finish as well as incorporate embedded tubing to provide additional radiant heating and cooling to the gymnasium.

The roof panels will be supported by custom trusses which span across the gymnasium at about 4.8m on centre. These trusses in turn will be supported by tilted frames. These frames will consist of nominal 7” round HSS tubes in triangular planar frames which are tilted towards the interior of the gymnasium. These frames will support the wall panels in addition to the roof trusses.

The tilted frames at the ends of the gymnasium will span across the its full width in order to provide a clear opening at either end.

5. **Typical Roofs**

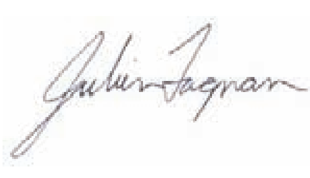
The sloped main roofs which are not exposed will consist typically of 22Ga steel deck on OWSJ on steel wide flange beams. This economical system will be concealed within a ceiling space.

At the perimeter of the community centre the large roof overhangs will be supported by tilted HSS columns similar to the tilted HSS frame members in the gymnasium structure.

5. **Lateral Support System**

The typical primary means of lateral support of the roof structure will consist of braced steel frames. The lateral loads will be transferred to these frames by the steel deck roof diaphragms.

In the gymnasium, the triangular frames which support the roof structure and the wall panels will also provide lateral resistance to lateral loads.



Julien Fagnan, P.Eng.
March 25, 2010

MECHANICAL AND ELECTRICAL SCHEMATIC DESIGN BRIEF

ISSUED FOR SCHEMATIC DESIGN

FOR

MARPOLE / OAKRIDGE COMMUNITY CENTRE

AT

VANCOUVER, BC

PREPARED BY

COBALT ENGINEERING LLP
#180 - 200 Granville Street
Vancouver, BC V6C 1S4

Project Architects

Patkau Architects Incorporated
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PROJECT NO: 10-1249-M01

DATE: March 30, 2011

TABLE OF CONTENTS

1. INTRODUCTION

Cobalt Engineering has been engaged to provide mechanical and electrical consulting engineering services for the new Marpole / Oakridge Community Centre project in Vancouver, BC.

The intent of this report is to describe the building design parameters and the mechanical and electrical design concept for the new Marpole / Oakridge Community Centre project. This document is provided for coordination within the consultant team.

This report focuses on the major components of the building systems that require a significant level of coordination with other disciplines from the earliest stage of the design. Minor and conventional systems components that do not require the same level of coordination are not discussed in detail as part of this report. Nevertheless, these systems are not being omitted from the mechanical and electrical scope; they are required for proper building operation and will be included in the final systems design.

Another use of this report is to assist the cost consultant in providing a more detailed schematic design feasibility cost estimate of the proposed building systems.

2. PROJECT DESCRIPTION

The Marpole / Oakridge Community Centre will provide the Marpole and Oakridge neighbourhoods with a recreational facility including a gymnasium, fitness rooms, multipurpose rooms, childcare and administrative spaces. The building occupied floor area will be approximately 3,800 m^2. There will be no underground parking at this site.

3. DESIGN OBJECTIVES

The building, mechanical and electrical system design will incorporate as many passive features and energy saving measures to help the building achieve a LEED® Gold certification.

The plumbing, mechanical and electrical systems will be designed to provide a reliable, comfortable environment for the facility and meet the following criteria:

- Provide for passive thermal and indoor air quality control whenever possible using shading and natural ventilation;
- Provide for occupancy and day light harvesting control whenever possible using natural and artificial lighting systems
- Use 22% less energy than the ASHRAE Standard 90.1-2007 reference (or 33% less than the Model National Energy Code of Canada for Buildings, MNECB, reference);
- Incorporate as many energy and water saving strategies as practical;
- Achieve LEED® Gold certification; and
- Provide a robust and simple-to-operate mechanical system

4. APPLICABLE CODES AND GUIDELINES

The mechanical and electrical systems will be designed and installed by following principles of good engineering practice and meeting or exceeding requirements of all applicable codes, including but not limited to the following list of codes, ordinances and guidelines:

British Columbia Building Code (BCBC)
B.C. Fire Code
Canadian Electrical Code CSAC22.1 (current edition)
Model National Energy Code of Canada for Buildings (MNECB)
City of Vancouver Bylaws
Ministry of Environment (MOE)
American Standards for Testing and Materials (ASTM)
American National Standards Institute (ANSI)
ASHRAE 90.1, Energy Efficient Design of New Buildings
ASHRAE 62, Ventilation for Acceptable Indoor Air Quality
ASHRAE 55, Thermal Environment Conditions for Human Occupancy
NFPA – National Fire Protection Association
National Fire Code (NFC)
CSA B52 Refrigeration Code
British Columbia Gas Safety Code
British Columbia Boiler and Pressure Vessel Code
LEED®
Electrical Safety Branch Regulations and Bulletins (current edition)
Overhead systems, CSA-CAN3-C22.3, No. 1 (current edition).
Underground systems CSA-CAN3-C22.3, No. 7 (current edition).
Emergency Power Supply, CAN/CSA C282 (current edition)
Emergency battery unit, CSA C22.2 No. 141 (current edition)
CAN/LUC S524 Standard for the Installation of Fire Alarm Systems
CAN/LUC S537 Standard for the Verification of Fire Alarm Systems
Illuminating Engineering Society of North America (IESNA)
Institute of Electrical and Electronic Engineers (IEEE) Inc. Standards
Underwriters Laboratories of Canada (ULC)

5. DESIGN CONDITIONS

5.1. EXTERNAL DESIGN CONDITIONS

The most stringent design parameters prescribed by either the MNECB or City of Vancouver Parks Board will be used for the mechanical system design and building energy analysis.

Season	MNECB	COV Parks Board
Winter	-9°C	-10°C
Summer	26°C db; 19°C wb	28°C db; 19°C wb

5.2. INTERNAL DESIGN CONDITIONS

In general, indoor design conditions will meet the comfort conditions outlined in ASHRAE Standard 55-2004, which allows for the following range of operative temperatures. Also referred to as resultant temperature, operative temperature is the average of the surrounding surface temperatures and the air temperature. This measurement is the best indication of the temperature perceived by an occupant.

Season	Minimum Indoor Temperature	Maximum Indoor Temperature
Winter	20 °C	25 °C
Summer	24 °C	27 °C

More specifically, the target indoor design conditions will be as requested by the COV Parks Board and outlined in the table below:

Area	Season	Operative Temperature	General Notes
Gymnasium	Summer Winter	24°C 19°C	1
Lobbies & Corridors	Summer Winter	26°C 18°C	1
Washrooms & Change Rooms	Summer Winter	26°C 19°C	1
Offices & Admin.	Summer Winter	24°C 20°C	The front desk is open to the lobby so additional localized heating and cooling may be needed to keep the receptionist comfortable. The option of vestibule will be reviewed during design development 2, 3
Multipurpose Rooms	Summer Winter	24°C 18°C	2, 3
Aerobics & Fitness	Summer Winter	23°C 19°C	Aerobics room could have activities like yoga which are less tolerant of colder temperatures. 1, 2, 3
Childcare	Summer Winter	24°C 21°C	1, 2, 3

General Notes:
1. Summer time temperature in non-air conditioned spaces will vary according to the outdoor air temperature.
2. Design for maximum relative humidity of 50% in air conditioned spaces.
3. Generally allow an additional float of +/- 2°C for most spaces. Consider the differential between inside and outside temperatures for cooled spaces.

5.3. ELECTRICAL LOAD CALCULATIONS

The basis used for designing the power distribution system is as follows:

Load Conditions

- Normal Power: 10W/m^2 (Code Requirement) plus mechanical and equipment loads
- Mechancial: 25W/m^2
- Lighting Power Density: 13W/m^2
- Ancillary and Owner Equipment
- 25% Spare Capacity

The estimated building load is based upon a gross floor area (GFA) of 3,800 m^2 and is as follows:

- Total Building Load:
- Code Load = 240 kW
- Ancillary and Owner Equipment = 30 kW
- Total Load (with diversification) = 300 kVA (approximately)

6. BUILDING ENVELOPE

The building envelope plays a large role in the overall energy efficiency of the building because it is a critical component of a low energy mechanical system. The envelope performance targets in the table below indicate an improvement over the ASHRAE Standard 90.1-2007 baseline for Vancouver, BC which will facilitate the achievement of LEED® Gold.

All of the below values refer to the full assembly of the building envelope, not just the insulation value. Therefore, the term overall U- or R-value is used. This term encompasses all the materials of the assembly: from the outer layers (such as brick or metal panel), steel studs, clips, foam insulation, to drywall.

One of the services that Cobalt can provide is to use advanced building energy modeling software to facilitate the selection of the building envelope. The simulations conducted will compare the design envelope performance with the benchmark case prescribed by ASHRAE Standard 90.1 to determine a working combination of glazing areas and assembly thermal properties.

Assembly	ASHRAE 90.1-2007 W/(m²K) [K·m²/W]	Proposed W/(m²K) [K·m²/W]
Roof	U_{SI} - 0.28 (R_{SI} - 3.52)	U_{SI} - 0.19 (R_{SI} – 5.28)
Walls	U_{SI} - 0.50 (R_{SI} – 2.01)	U_{SI} - 0.38 (R_{SI} – 2.64)
Slab-on-Grade	U_{SI} - 0.38 (R_{SI} – 2.64)	U_{SI} - 0.28 (R_{SI} - 3.52)
Glazing	U_{SI} – 2.56 SHGC – 0.40	U_{SI} – 1.99 SHGC – 0.31

7. SUSTAINABLE DESIGN STRATEGIES

The following design features will be considered and integrated where applicable between disciplines.

Building Envelope

The building envelope performance is critical to comfort, passive building operation and the efficiency of the overall building. Increased insulation levels in the building envelope and effective external shading elements will reduce heating and cooling loads respectively.

The following architectural and space requirements must be addressed to successfully implement a high performance building envelope.

- Allowance for thicker walls, roofs and exposed floors for additional insulation; and
- Continuous insulation on the exterior side of the envelope to reduce thermal bridging.

South and West Elevation Solar Gain Control

The south and west elevations have two conflicting requirements: high window-to-wall ratios to maximize the view and low window-to-wall ratios to limit summer solar heat gains and winter heat losses. These needs can both be met by high performance glazing in combination with exterior shading, either operable or fixed. The purpose of the shade is to block summer sun and admit low angle winter sun. In addition, retractable (roller) insulating shutters could be considered for large expanses of glazing to limit heat loss during winter night-time.

The following architectural and space requirements must be addressed to successfully implement the south and west elevation solar control:

- Provide wide (or several) overhangs and vertical fins; and
- Consider insulating shutters for winter night-time use.

Thermal Mass

Thermally massive materials have the ability to absorb and store heat energy. Exposed interior thermal mass stabilizes temperatures within the space and can reduce cooling energy requirements. Mass also absorbs solar heat on winter days and slowly releases it to the space during the evening.

The following architectural and space requirements must be addressed to successfully implement thermal mass;

- Sufficient building mass (wall, floor, ceiling, green roof), increases structural requirements and thicknesses if integrated;
- Insulation on the exterior side of the envelope, increases wall thickness; and requires Floor Space Ratio (F.S.R.) dispersment.

Displacement Ventilation

Passive ventilation involves a whole-building design concept that relies on natural forces (stack effect, buoyancy and wind pressure) to bring outdoor air flow into buildings in controlled manner, for ventilation and space cooling. Displacement ventilation uses those natural forces to reduce the energy required to provide fresh air to any space. Large spaces such as the gymnasium will have fresh air supplied at low level, bringing the air to the occupant rather than forcing the air from the ceiling. This allows the warmer air to flow to the ceiling area. The lobby and adjacent corridor space will also implement displacement ventilation. High level exhaust throughout these spaces will allow warm exhaust air to be easily extracted.

The following architectural and space requirements must be addressed to successfully implement displacement ventilation:

- Limit interior wall partitions to achieve a higher percentage of interior open areas for effective circulation

Radiant Heating and Cooling

Hydronic radiant systems use large surface areas and moderate water temperatures to achieve effective space heating and cooling. Radiant systems can be implemented either as systems fully integrated into the structural elements (i.e. heavy mass radiant slabs) or as more flexible systems in the form of capillary mats attached to the structural slab or suspended ceiling surface.

The following architectural and space requirements must be addresses to successfully implement the radiant heating and cooling system;

- A high-performance building envelope (solar control, lower U-values, and generally thicker walls) with sufficient thermal insulation values;
- Strategically design glazing areas to limit heat loss and provide high performance glazing;
- Radiant surfaces must be exposed to the space, limiting ceiling and/or floor coverings.

Geothermal Heat Exchange

A geothermal heat exchange system uses the earth as a source/sink to provide heating and cooling for the building load. Often this system is paired with heat pumps to increase the energy of the available heating water. The system can be implemented either as a vertical borehole system, thus reducing the area required for the geothermal field, or as a horizontal loop system, reducing the work required from drilling but increasing the necessary size of the field.

The following architectural and space requirements must be addressed to successfully implement geothermal heat exchange system:

- Coordination of size/type of geothermal field to be applied on project site;
- Sufficient space for additional set of geothermal piping.

Solar Water Heating

Evacuated tube or flat plate solar collectors can be used to generate high temperature water, even during cloudy days. The water heated by this system will provide domestic hot water heating or tempering during the winter, The following architectural and space requirements must be addressed to successfully implement solar hot water heating;

- Coordinate locations for the solar collectors as they must be located with full exposure to the sun, south, or south-west facing preferably on the roof; and
- Sufficient space within the mechanical room for the additional solar water storage tanks.

Site Lighting

All site lighting luminaires will comply with Dark Sky policy and design based on IES recommendation. Luminaires will be placed away from the property line to minimize light intrusion into neighborhood.

Day Light Harvesting

Glazing along the perimeter of the building will be designed to maximize natural light into the interior. In addition, photocell will be installed in the gym to reduce artificial lighting requirement during day time. Photocell will control the perimeter luminaires and adjust artificial lighting to supplement the natural light.

Commissioning

This building by the nature of the work undertaken requires a high level of commissioning to take place. It will be a requirement of the mechanical and electrical specification to fully commission the building with a return to site from the commissioning authority to optimize and adjust if necessary the systems to ensure the optimization of these systems.

Measurement and Verification

It is intended that all electrical systems will be metered and be recorded/measured with information being sent to the central DDC system.

8. HEATING AND COOLING PLANT

The mechanical heating and cooling plant and systems will be configured to transfer thermal energy within the building (from one space to another). This will be achieved by combining several energy efficient space heating, cooling, and ventilation subsystems into a single fully integrated mechanical system, including a variable refrigerant flow (VRF) system.

Two options, Option A and B, have been provided as a cost comparison. Refer to drawing M-3a and M-3b in Appendix A for a schematic description.

The main heating and cooling plant will consist of heat pumps, fluid coolers and condensing boilers. The heat pumps can be configured into two options: water-to-water or air-to-water.

With Option A, the water-to-water configuration, the heat pumps would extract heat from or reject heat to the water-based source system, which would include fluid coolers – to provide cooling – and boilers – to provide heating.

The heat pumps shall be specified as two (2) WaterFurnace NXW360 [105 kW] and one (1) WaterFurnace NXW240 [70 kW] or equivalent.

Option B, the air-to-water configuration, the heat pumps would be extracting heat from or rejecting heat to the air. With this configuration the heat pumps would have to be located on the roof or externally at ground level.

The heat pumps shall be specified as four (4) Aermec Model NRL 0900 [72kW] or equivalent.

An optional component to Option A is the inclusion of a geothermal field, providing a natural source to heat and cool the building, thus minimizing the size of the fluid cooler and boiler. The main consideration for geothermal field is its capacity and thus its physical size. which depends on the field's orientation. For the current capacity of the heat pump system, a vertical borehole geothermal field would require to 25 boreholes, running approximately 90m deep, covering a field area of approximately 400 m^2. A horizontal loop field, requiring 5m deep trenches, would require an area of approximately 8,000 m^2.

The second major component of the main heating and cooling plant is the condensing boilers. In Option A, the boilers would be used to provide supplementary heat to the building via the heat pumps as well as heating the domestic hot water for the plumbing fixtures throughout the community centre. The supplementary heat provided by the boilers would be used to maintain the optimal operating temperature range for the heat pumps.

The condensing boiler are to be specified as two (2) Viessmann Vitodens W2SB-105 [103 kW] or equivalent.

In Option B, the boilers would only be required for heating the domestic hot water for the community centre. The condensing boiler is to be specified as one (1) Viessmann Vitodens WB2B-26 [25kW] or equivalent.

An optional component for use with the domestic hot water heating is solar hot water collectors. The solar collectors would use the solar energy collected to pre-heat the domestic hot water, thus reducing the load on the condensing boilers. Ideally, the solar energy provided would be enough to offset the boiler load for domestic hot water heating completely. Preliminary analysis shows that a maximum of 158 kWh of energy required for domestic hot water heating could be offset by the solar hot water heating system.

The solar hot water collectors are to be specified as seven (7) Viessmann Vitosols 300-T-SP3 or equivalent.

The third major component of the main heating and cooling plant is the fluid coolers. Only present in Option A, fluid coolers are the primary source of cooling for the building via the heat pumps. Again, the optional component of a geothermal field can be considered, providing a natural source of cooling for the building, thus minimizing the size of the fluid cooler.

The fluid coolers are to be specified as one (1) Recold JW-25B [515kW] or equivalent.

9. HVAC SYSTEMS

General Description

Many spaces will be heated and cooled with radiant floors with variable refrigerant flow adding supplementary heating and cooling, such as offices, multipurpose rooms, fitness rooms and childcare areas. The radiant system will provide base building temperature control and spaces with dynamic internal loads and varying thermal comfort settings will be supplemented by a VRF system. The VRF system will allow fine adjustment of each space thermal comfort and provide effective heat recovery.

All ventilation air will be provided by a mixed-mode system, combining natural and mechanical 100% outdoor air. The mechanical ventilation will consist of a heat recovery ventilation (HRV) unit providing heat recovery from the exhausted air. When outdoor conditions allow, windows and doors will be opened to allow natural ventilation.

A centralized HRV unit will provide mechanical outdoor air ventilation for the entire facility. Air will be supplied to the back of the VRF fan coil units and at low level for other spaces. Ventilation air will be exhausted from the washrooms, change rooms, and kitchen through the centralized HRV unit before leaving the building.

Radiant Slab Heating and Cooling

The radiant slab heating and cooling system will consist of small diameter plastic tubing configured in a closed loop hydronic system embedded in the concrete slabs. Heated or cooled water circulates through the embedded piping to maintain the exposed floor surfaces at a set temperature. Typically, with a properly designed high-performance building envelope, the floor surface temperatures are 18°C (64°F) during summer and 30°C (86°F) during winter. Large exposed radiant ceiling surfaces absorb or radiate “low-intensity” heat from or into the occupied space to compensate for the cooling or heating loads within the space. Radiant heat transfer is the main factor assuring superior thermal comfort, as radiant temperature dominates comfort levels perceived by people.

Radiant space heating and cooling can operate effectively with windows open. Unlike conventional all-air heating and cooling, the space tempering function is less dependent of the temperature air in the space, allowing windows to be opened during a wide range of outdoor temperatures.

With sufficient amounts of actively conditioned mass within the building an evaporative fluid cooler and heat exchanger can be effectively used to pre-cool the radiant slabs during the night time when outdoor wet bulb temperatures fall below the slab temperature set-point. In the mild Vancouver climate, with relatively large daily temperature swings and sufficiently low wet bulb temperatures during the cooling season and having the overall building energy performance optimized during the integrated design process, this type of “free nocturnal pre-cooling” could provide the majority of the overall annual cooling energy in a very efficient and sustainable manner, without relying on highly energy intensive mechanical refrigeration that uses ozone depleting refrigerants.

Radiant slab heating and cooling would be utilized throughout the community centre, except in the gymnasium, administrative spaces and dance studio, where a radiant ceiling / wall system will be utilized.

Refer to drawing M-2a and M-2b for a diagram detailing the proposed systems for each space in the community centre.

Ventilation & Heat Recovery

Ventilation is provided throughout the building through the centralized HRV in two forms: displacement ventilation and outdoor air via the VRF fan coil units.

Displacement ventilation systems, utilized in the gymnasium, lobbies and corridors, supply a relatively small volume of 100% outdoor air at low air flow rates resulting in a non-mixed “displacement ventilation” air flow pattern. The smaller volume of air reduces the overall size of equipment required to ventilation a space, but also reduces the energy required to deliver the air to the space. The ventilation air disperses across the floor and stratifies as it is warmed by people and other internal heat gains. This warm, contaminated air stratifies and is exhausted at high level effectively removing pollutants from the space and the occupant breathing zone, providing ventilation effectiveness and indoor air quality unmatched by other types of “all-air” HVAC systems. This strategy is utilized in the gymnasium, lobbies and corridors as noted on drawing M-2a and 2b.

The centralized HRV draws in outdoor air and expels exhaust air from the building. As the HRV produces these two flows of air, it allows the energy from the warmer exhaust air to be transferred to the colder incoming air. The HRV unit would then heat the incoming air to a minimum supply air temperature of 16°C.

The HRV is to be specified as one (1) Vision Air Handling Unit CAH014GBAC [3370 L/s] or equivalent.

Refer to drawing M-5 in Appendix A for a schematic description and refer to drawing M-2a and M-2b for a diagram detailing the proposed systems for each space in the community centre.

Variable Refrigerant Flow (VRF)

VRF systems are highly energy efficient modular direct expansion refrigerant based heating and cooling systems. Because the system is modular with a large number of interconnected terminal refrigerant fan-coil units served by a single compressor unit (air or water based), the system can deliver heating and/or cooling simultaneously with very high efficiency. The system is capable of accurately modulating the required heating and cooling output for each zone across the entire range of its nominal capacity (0-100%), by adjusting the compressor speed.

The VRF system units can quickly change their mode of operation (heating or cooling) and adjust their capacity to meet the space load requirements. The system is well suited for applications with highly dynamic variation in space heating or cooling requirements or for spaces with variable thermal comfort settings (i.e. multi-purpose room).The system can also be implemented to “share” their energy, where one area’s rejected heat can be reused to provide heating for another.

VRF will be utilized throughout the building: in offices, multi-purpose rooms, fitness / wellness rooms, and kitchen areas. The system would consist of three (3) condensing units and twenty-five (25) distributed fan coil units. As with the heating and cooling plant, the condensing units for the VRF system can be configured as two options: refrigerant-to-water (Option A) and air-to-water (Option B).

For Option A, the VRF condensing units are to be specified as three (3) Mitsubishi PQHY-P192TSHMU-A [56 kW] or equivalent. And for Option B, the VRF condensing units are to be specified as three (3) Mitsubishi PUHY-P288YSJMU-A [84 kW] or equivalent.

Refer to drawing M-3a and M-3b in Appendix A for a schematic description and refer to drawing M-2a and M-2b for a diagram detailing the proposed systems for each space in the community centre.

10. PLUMBING SYSTEMS

Service Connections

New water, sanitary, storm, and natural gas connections will connect to existing municipal site services. The scope of this report covers these services extending 1m (3 feet) from the building outline.

Refer to drawing M-1 in Appendix A for preliminary proposed locations.

Cold Water Service

A new single 150ø (38L/s) incoming water line, originating from West 59th Avenue, used as a combined domestic water and fire protection water supply will connect to the site water main downstream of the site backflow prevention.

The domestic cold water supply line will rise into the building in the incoming water entry room where it will split to serve the fire protection, detailed later in the report, and the site domestic water. The site water meter and pressure reducing set will be located in the incoming water entry room.

The domestic cold water will distribute to serve the building fixtures, domestic hot water system, mechanical systems and irrigation. The building is served by the city water pressure.

Refer to drawings M-4 in Appendix A for a system schematic.

Domestic Hot Water Service

Domestic hot water will be heated in an indirect fired storage tank in three stages. Heat energy will first be recovered from radiant/heat pump system or heat will be added from the solar water heating system (DHW preheating). If additional heat energy is required it will be provided by high efficiency condensing boilers. Water will be generated and stored at 65^{o}C. A recirculation pump and piping system will circulate the hot water on a scheduled basis to ensure 57^{o}C water at each fixture. For fixtures that will be accessible to the public, the hot water supply temperature will be regulated to 40° - 50°C, to avoid scalding..

The DHW preheat storage tank shall be specified as a Viessmann Vitocell B-100 [120USG] or equivalent and the DHW storage tank shall be specified as a Viessmann Vitocell V-300 [120USG, 739 L/hr; 43kW]

Refer to drawings M-4 in Appendix A for a system schematic.

Storm System

The storm water system currently collects water from the roof and landscape areas and directs this through the building and out to the cities storm system by gravity through a storm. A new single 250ø (44,888L) outgoing storm line will connect to the existing municipal site services on Fremlin Street.

All storm water piping in the building shall be insulated to prevent condensation, as per BC building code requirements.

Sanitary System
The sanitary system collects all waste from the building fixtures and directs this through the building and out to the cities sanitary system by gravity. Any fixture drainage that can not be drained by gravity will pumped out, via a sump, to the cities sanitary system. A new single 150ø (227 FU) outgoing sanitary line will connect to the existing municipal site services on Fremlin Street.

Natural Gas Service
Natural gas will be required for the condensing boilers located in the mechanical room. A new single 50ø (750 CFH) service will connect to the existing municipal service. This will be metered prior to entry to the building and then distributed through the mechanical risers to the boilers.

11. FIRE PROTECTION SYSTEM

The building sprinkler system will be a fully operational stand alone system. As stated above, a new 150ø combined water service line will connect to the existing municipal services. The expected flow for the fire protection system is The entire building will be sprinklered in accordance with NFPA 13:

- A fire department Siamese connection provided at the entrance of the building.
- Multi-purpose portable hand held fire extinguishers will be provided and installed in recessed wall cabinets for each 300 m2 of floor area.
- The fire protection installation shall meet seismic code requirements.
- The sprinkler system complete with inspector's test stations will consist of a wet system for the whole building. The main building wet sprinkler system is to be zoned on a per floor basis according to the building occupancy.
- Equivalencies may be required to serve the glazed exposures.
- An exterior dry sprinkler system will be provided due to the overhangs present throughout the building

12. LIFE SAFETY SYSTEMS DESIGN CRITERIA AND DESCRIPTIONS

Fire Alarm

The fire alarm system shall be complete in every respect to meet or exceed the requirements of the latest/current releases of CAN.4-S524, S537, the BC Building Code, and requirements of the Local Fire Marshall.

The main control panel shall be modular type complete with all necessary plug-in modules or plug-in cords, and shall contain zone indication and all manual operated functions in the front cover behind a lockable door with viewing window.

The main control panel shall contain detection zone modules, trouble module, audible signal modules, and contacts for magnetic door holders, fan shutdown, and remote monitoring connections to monitoring company.

The system shall be addressable type, incorporating addressable devices.
Zone and trouble modules will be incorporated to suit the building sprinkler system zoning and valve modules. Supervision of excess pressure pumps and/or air compressors will be initiated on the remote annunciator.

The remote annunciator will be provided at the main entrance in coordination with the requirements of the local Fire Marshall. The unit shall consist of a graphic design layout with zone designations highly visible when illuminated.

Automatic devices (heat and smoke detectors) will be incorporated in conjunction with the sprinkler alarm system in order to ensure the desired zoning requirements are implemented. Smoke detectors, duct detectors, pull stations, strobe lights and gongs will be provided in compliance with all regulations of the Code and Local Fire Marshall.

Emergency Lighting

Emergency power will be provided by self-testing 12 volt battery power supplies and remote 24 watt dual tungsten heads. Emergency power will also be extended to each exit sign to provide illumination upon power failure.

All exit signs will be LED type and comply with CSA C860.

13. STRUCTURED CABLING SYSTEM DESIGN CRITERIA AND DESCRIPTIONS

Provision consisting of conduit, outlet boxes, cabling, and jack termination will be incorporated within the multi-purpose rooms and staff areas for installation of computers and monitors, etc. by others.
At the direction of the Architect/Owner, selected television and computer outlets will be wired and terminated complete with necessary distribution equipment to facilitate operation of these selected outlets. Structured cabling system will be Cat 6A certified. All data and telephone outlets will be terminated on rack mounted RJ 45 patch panel. T.V. (R.F.) cables will consist of RG6U terminated at a coupler/splitter. All cabling will be installed on Cat. 6A J-hooks/basket tray and will be separately identified.

14. SPECIALTY SYSTEMS DESIGN CRITERIA AND DESCRIPTIONS

Communication System

The base communications system for the P/A portion of the installation will consist of a simplified public address system (Rauland ICS or equivalent) based on City of Vancouver Standards. The P/A system will provide two-way communications between the offices and various areas of the Facility via the Facility speakers. The base building P/A system will consist of an amplifier sized to suit the speaker layout, AM/FM radio receiver, CD/cassette player, and independent program call feature to each area. Clocks shall be battery operated, provided throughout facility.

Intruder Alarm

A complete intruder alarm system will be installed and it will DSC Maxsys System. It is proposed all exterior doors be provided with concealed door contacts. Passive infrared units will be installed throughout corridors and designated ground floor rooms/areas.

Card Access and Camera Monitoring

The facility will be provided a complete CCTV camera system, including indoor and outdoor camera, Digital Video Record and the associated control. A access control system will be installed. Key entrance/access doors will be equipped with card reader and electric door strikes.

15. LIGHTING AND CONTROL SYSTEMS DESIGN CRITERIA AND DESCRIPTIONS

The general lighting will be provided using T5 28 watt tri-phosphor fluorescent lamp technology along with Philips or Motorola electronic ballasts. All lighting products will be commercial grade or better. The lighting designs throughout the project will follow the recommendations of the Illuminating Engineering Society of North America, the rules and regulations of the Workers' Compensation Board, the City of Vancouver Standards and BC Building Code Energy Management/use recommendations. The lighting designs will also follow the energy use recommendations as set out by ASHRAE/IES 90.1 as a base maximum.

Interior Lighting

ADMINISTRATION/OFFICES: Office lighting will consist of suspended direct / indirect fluorescent lighting products containing 2 x F28 watt T-5 lamps to provide 35 footcandle average lighting level. Control will consist of occupancy sensors or light sensors with local manual override.

MULTI-PURPOSE: Multi-Purpose rooms will consist of suspended direct / indirect fluorescent lighting products containing 2 x F28 watt T-5 lamps to provide 45 footcandle average lighting level. Control will consist of window and interior components separated. Interface with occupancy sensors, or light sensors will be implemented subject of available budget and for LEED Credit 1 accreditation. These products would utilize dimming ballasts where applicable. Control will be provided to permit multi-functional use.

GYMNASIUM: Fluorescent lighting utilizing the “gym light” T5HO fixture is provided in order to ensure multi-level lighting is provided within the Gymnasium/Activity Room areas. Motion sensors, with a ten (10) minute delay, are to be incorporated into the Gymnasium lighting system. Photosensor will be installed in selected areas of the gym and luminaires will be incorporated with dimming ballasts for daylight harvesting.

AUXILIARY SPACE: Lighting system for auxiliary space, such as service rooms and storage rooms, will consist of 600 x 1200 T-bar luminaires with 28 watt T-5 lamps and K12 acrylic lenses or chain suspend industrial luminaires. Control will consist of low voltage switches and occupancy sensors. Lighting system will be designed to provide an average of 30 footcandle.

CORRIDOR: Lighting system will consist of fluorescent luminaires utilizing 28 watt T-5 lamps. Control will consist of low voltage switches and arranged for 1/3 and 2/3 switching. Corridor lighting will be designed to provide average 10 fc.

Compact fluorescent and/or LED light sources will only be installed within areas where standard fluorescent lighting is not possible and to suit the architectural construction in the area.

Exterior Lighting

Perimeter building lighting outside exits will be provided utilizing surface/wall mounted metal halide units rated 70 or 150W, compact fluorescent, and/or LED. Soffit style fixtures will only be used in those areas where an adequate mounting height is not available at the exit locations. Site lighting will be mounted away from the building, as practical, with sharp cut-off luminaires located throughout the project site. The “area” lighting source will be pole-mounted H.P.S. Two (2) pole heights will be incorporated, the parking area at 6 metres and the pedestrian areas at 5 metres. The sharp cut-off post top luminaires will ensure light trespass onto neighbouring properties is minimal. Where practical, pole and luminaires matching the City of Vancouver

Standards will be used. Parking lot lighting will be designed to provide an average of 0.5 footcandle.

Lighting Control
A master low voltage switching station will be located in/at the office area to control lobby, corridor and washroom lighting. For interim and after-hour use the Gymnasium lobby, corridors, and washroom will be switched with DDC system controls. Multi-level line voltage control switches will be located throughout all remaining rooms to provide lighting control of the destination. The exterior lighting control will be via a photocell DDC system utilizing low voltage components or line voltage contactors.

16. POWER DISTRIBUTION SYSTEM

Incoming Service

The incoming service will be via primary overhead service along 59th Avenue. It will then drop to Pad Mounted Transformer (BC Hydro owned) via underground ducts. The service will be entering Building Main Electrical in the Basement Level. The incoming service will then be rated 1200A 120/208V 3-phase 4-wire.. The power distribution will be organized to facilitate metering and monitoring of different load types, i.e. lighting, mechanical, and general purpose loads. Surge Protection will be provided at the service entrance panel and the critical electrical panels. Distribution for lighting and convenience power circuits will be provided utilizing bolt on circuit breaker panelboards and will be located to suit the architectural arrangement and equipment loads of the project.

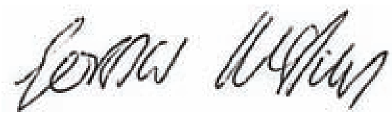
Wiring Methods

Main service entrance raceways shall be direct buried rigid PVC complete with concrete skim coat and warning tape. Feeders to sub-distribution panelboards and MCC's shall be copper. All branch circuit conductors to be R90 copper. Branch circuit home-runs shall be EMT conduit. Drops to receptacles shall be BX. Wiring for lighting fixtures and switches shall be BX (or Nocom).

17. CLOSURE

We trust that the foregoing provides the information required at this time. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Report Prepared By:
COBALT ENGINEERING



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Sr. Mechanical Designer

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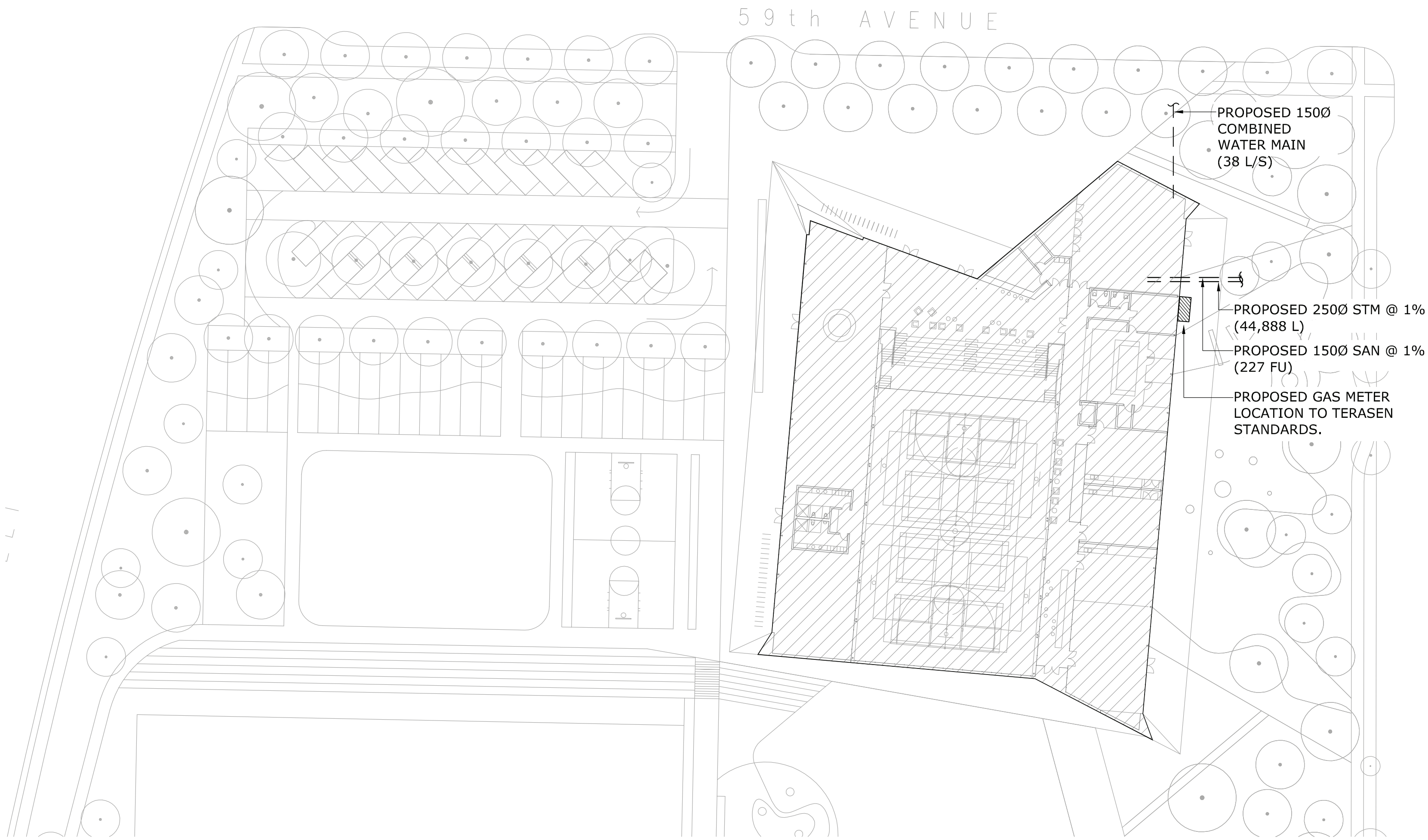
18. APPENDIX A – CONCEPT SKETCHES

M-1	SITE SERVICES – SITE PLAN
M-2a	MECHANICAL SYSTEM LAYOUT – LOWER LEVEL
M-2b	MECHANICAL SYSTEM LAYOUT – ENTRY LEVEL
M-3a	HYDRONIC SCHEMATIC – OPTION 1
M-3b	HYDRONIC SCHEMATIC – OPTION 2
M-4	DOMESTIC HOT WATER SCHEMATIC
M-5	VENTILATION SCHEMATIC
E-1	SITE PLAN – INCOMING SERVICES
E-2	SCHEMATICS



SITE SERVICES - SITE PLAN

0 10 20 30 50

SCALE: 1:500

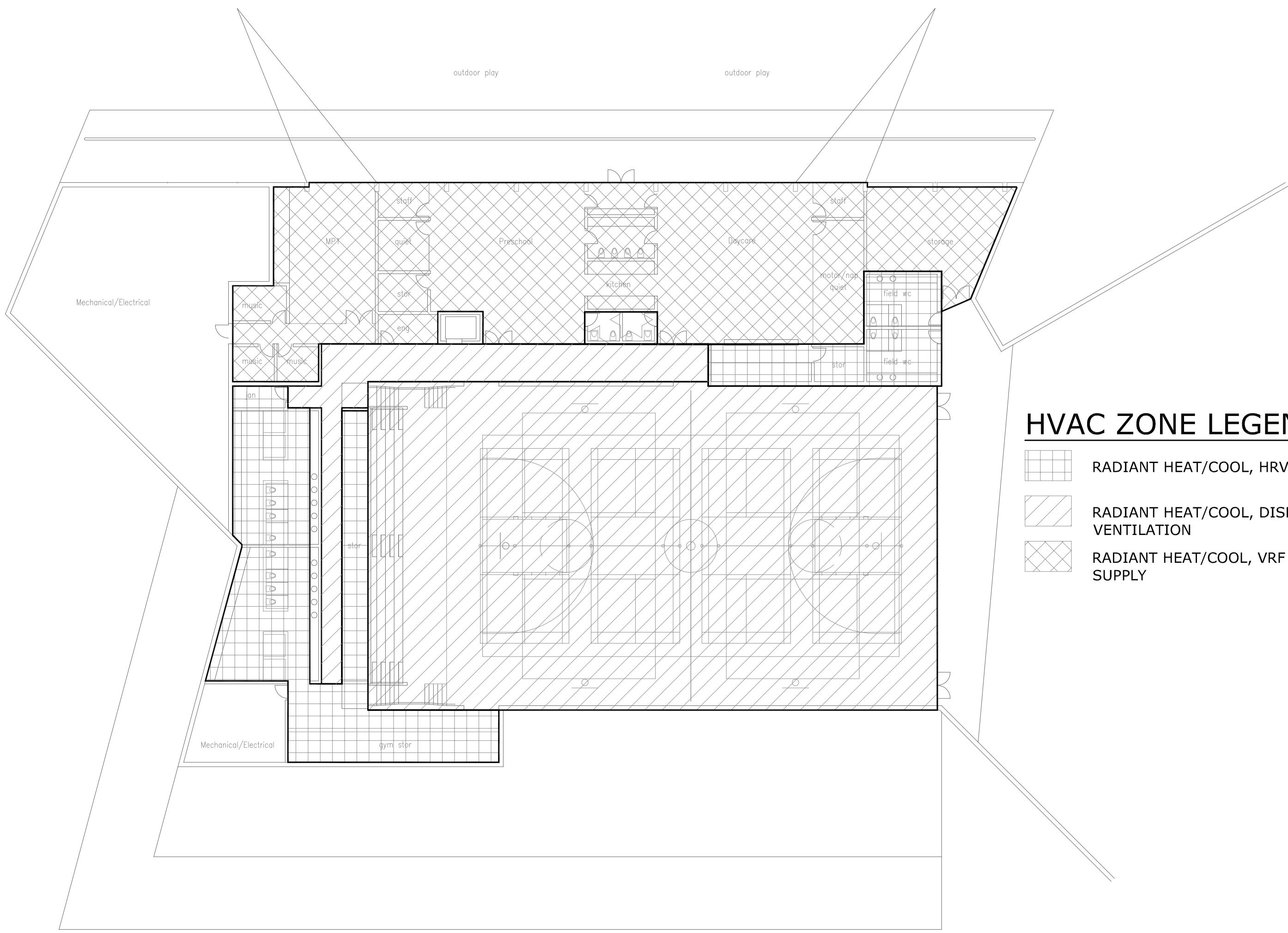
ISSUED FOR SCHEMATIC DESIGN

cobalt
Cobalt Engineering LLP

SITE SERVICES - SITE PLAN
Marpole Oakridge Community Centre
Patkau Architects Inc

scale: As Shown
reference: 10-1249-M01
issued: March 28, 2011

M-1



HVAC ZONE LEGEND

- RADIANT HEAT/COOL, HRV EXHAUST
- RADIANT HEAT/COOL, DISPLACEMENT VENTILATION
- RADIANT HEAT/COOL, VRF WITH HRV SUPPLY

MECHANICAL SYSTEM LAYOUT – LOWER LEVEL

0 3 6 10 30

SCALE: 1:300

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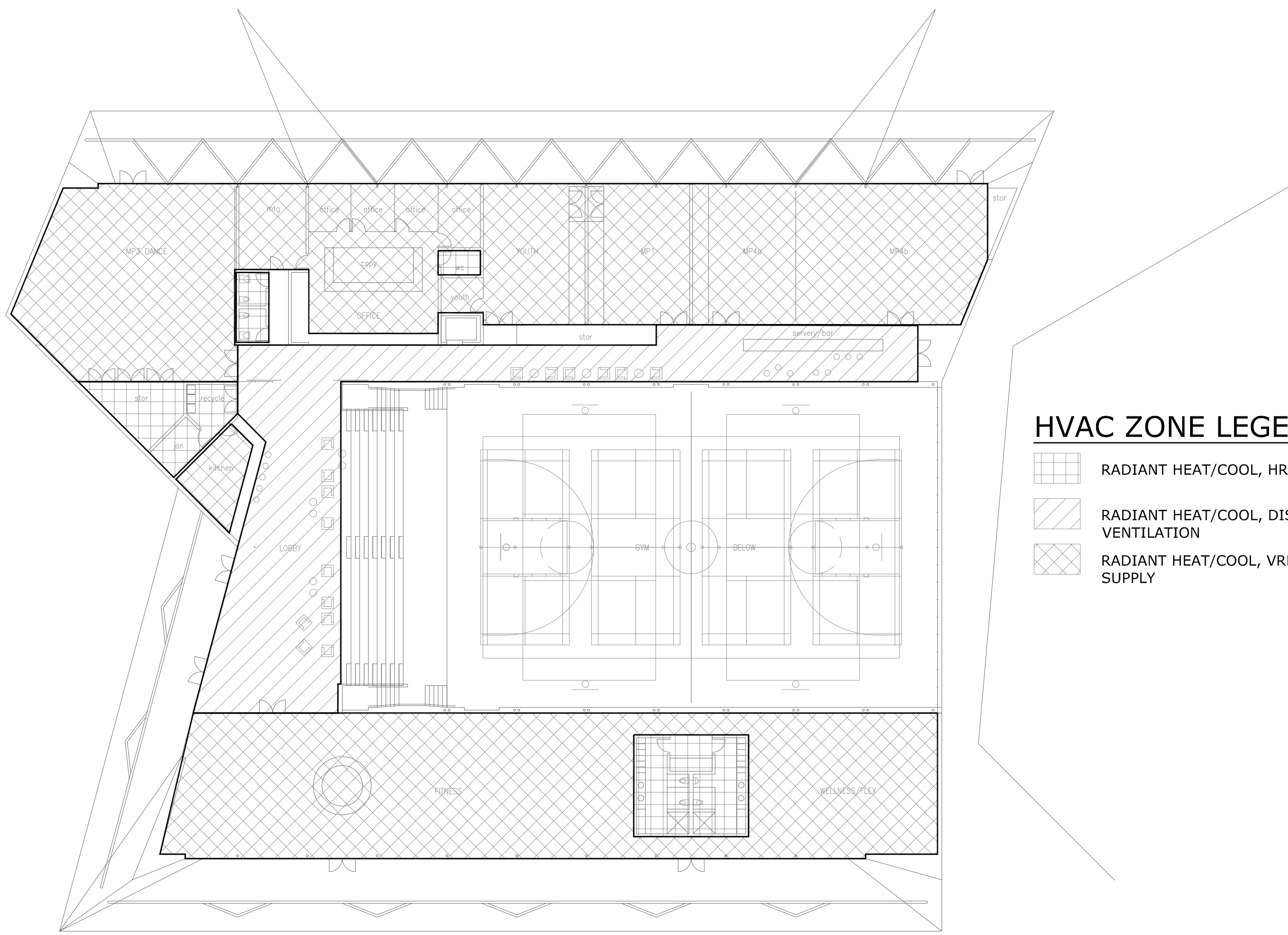
LOWER LEVEL HVAC ZONES
Marpole Oakridge Community Centre
Patkau Architects Inc

scale: As Shown
reference: 10-1249-M01
issued: March 28, 2011

M-2a



HVAC ZONE LEGEND

- RADIANT HEAT/COOL, HRV EXHAUST
- RADIANT HEAT/COOL, DISPLACEMENT VENTILATION
- RADIANT HEAT/COOL, VRF WITH HRV SUPPLY

MECHANICAL SYSTEM LAYOUT – ENTRY LEVEL

0 3 6 10 30

SCALE: 1:300

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MAIN LEVEL HVAC ZONES
Marpole Oakridge Community Centre
Patkau Architects Inc

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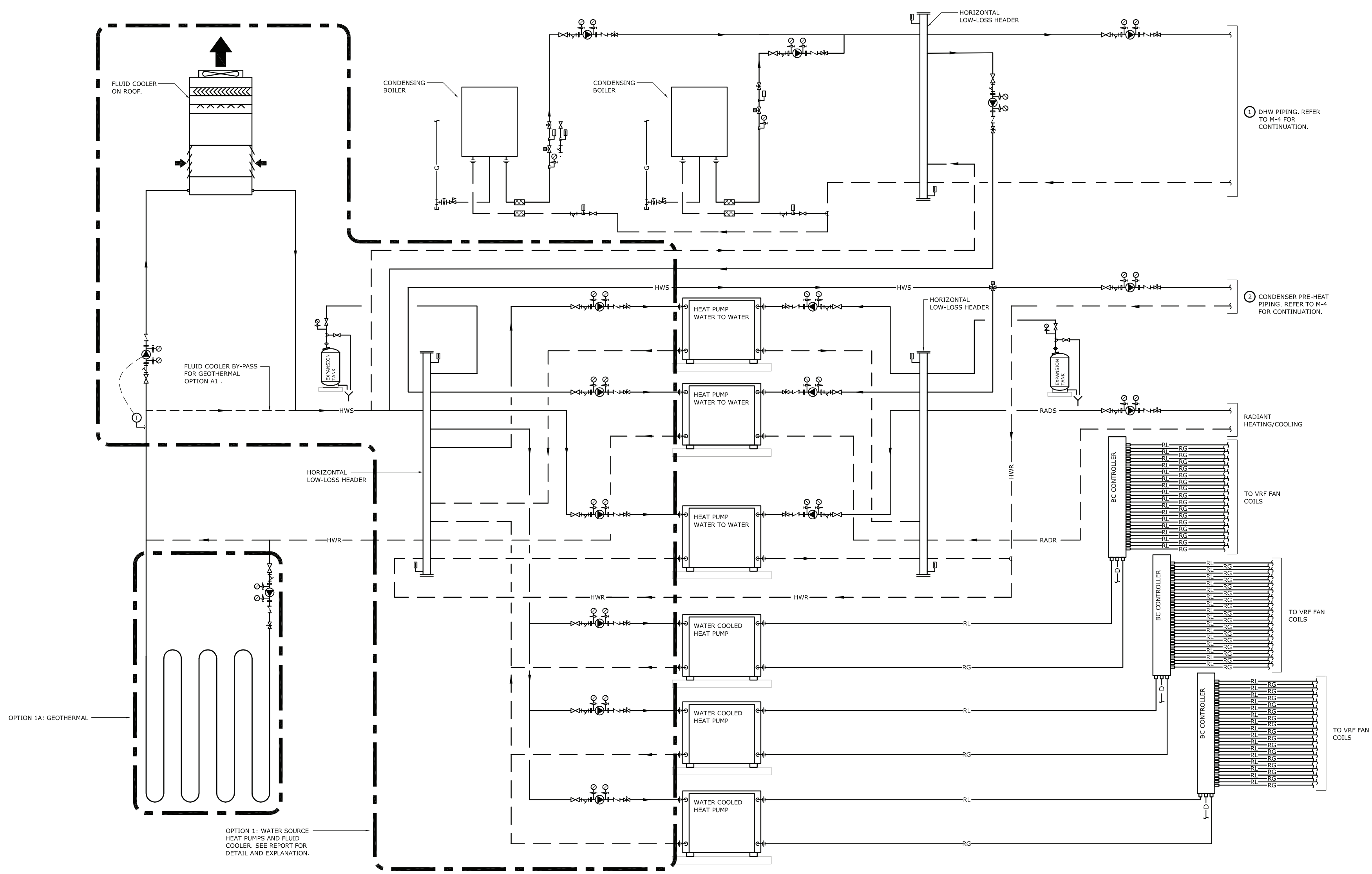
issued: March 28, 2011

M-2b



HYDRONIC SCHEMATIC - OPTION 1

SCALE: N.T.S.

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Cobalt Engineering LLP

HYDRONIC SCHEMATIC - OPTION 1
Marpole Oakridge Community Centre
Patkau Architects Inc

scale: As Shown
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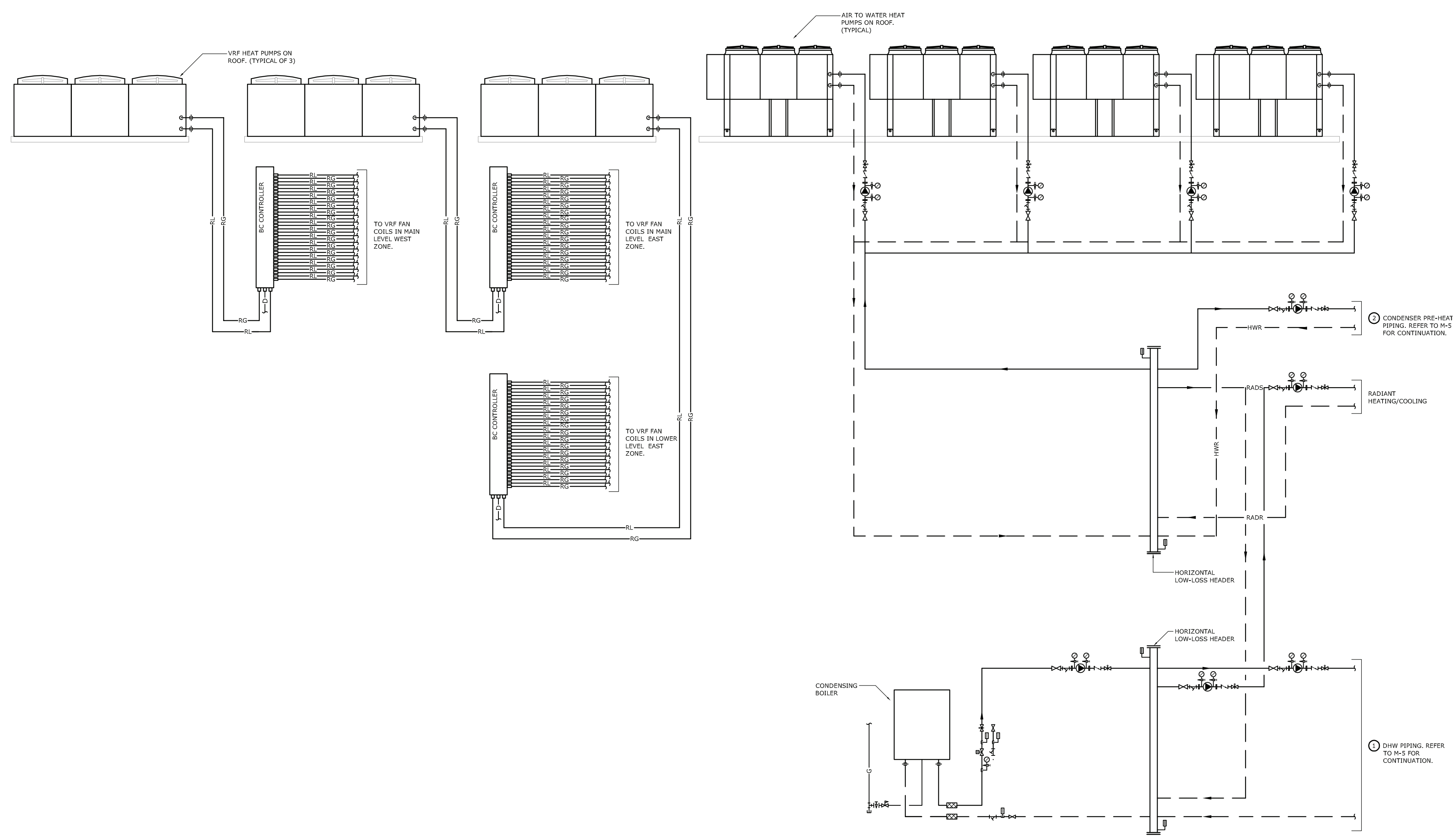
issued: March 28, 2011

M-3a



HYDRONIC SCHEMATIC - OPTION 2

SCALE: N.T.S.

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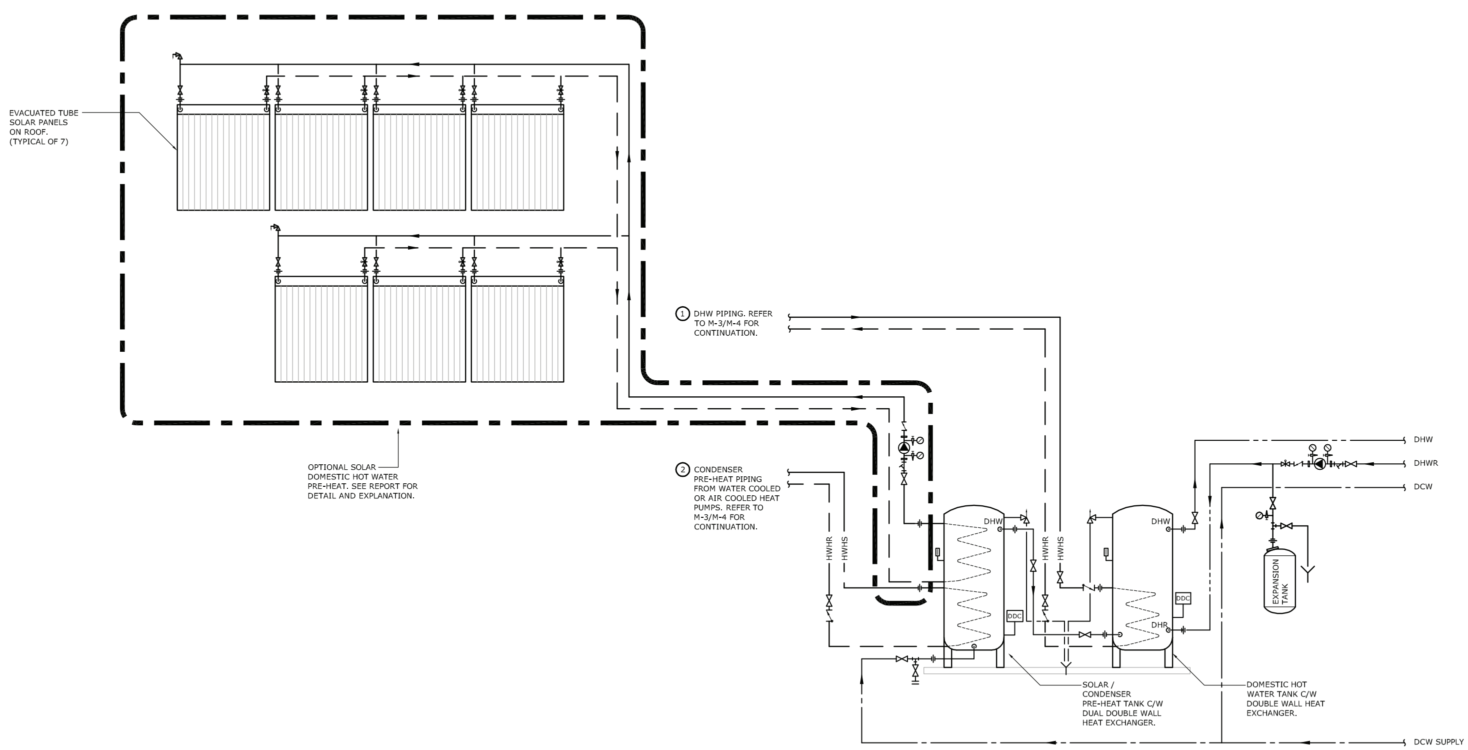
HYDRONIC SCHEMATIC - OPTION 2
Marpole Oakridge Community Centre
Patkau Architects Inc

scale: As Shown
reference: 10-1249-M01
issued: March 28, 2011

M-3b



DOMESTIC HOT WATER SCHEMATIC

SCALE: N.T.S.

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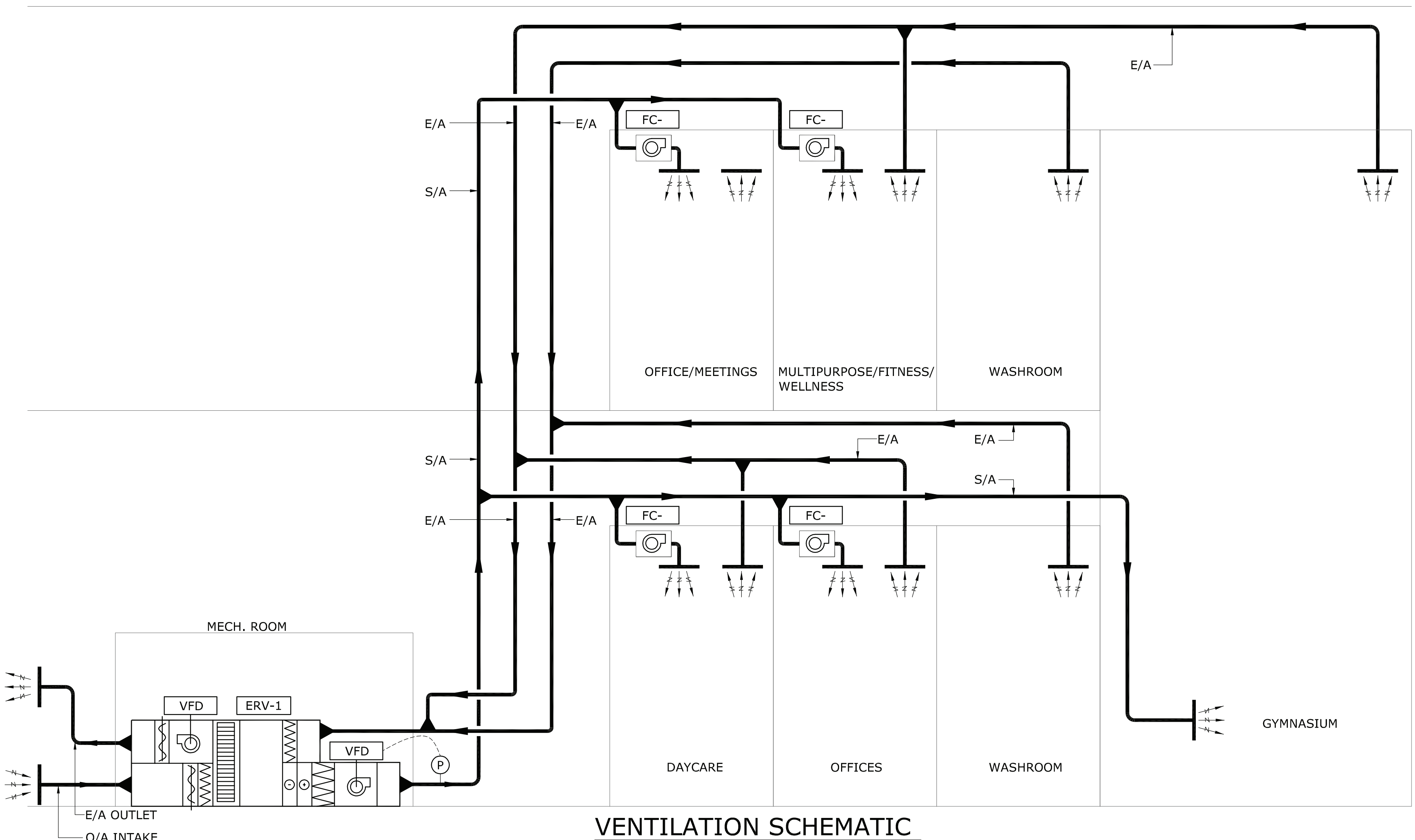
Cobalt Engineering LLP

DOMESTIC HOT WATER SCHEMATIC
Marpole Oakridge Community Centre
Patkau Architects Inc

scale: As Shown
reference: 10-1249-M01
issued: March 28, 2011

M-4



VENTILATION SCHEMATIC

SCALE: N.T.S.

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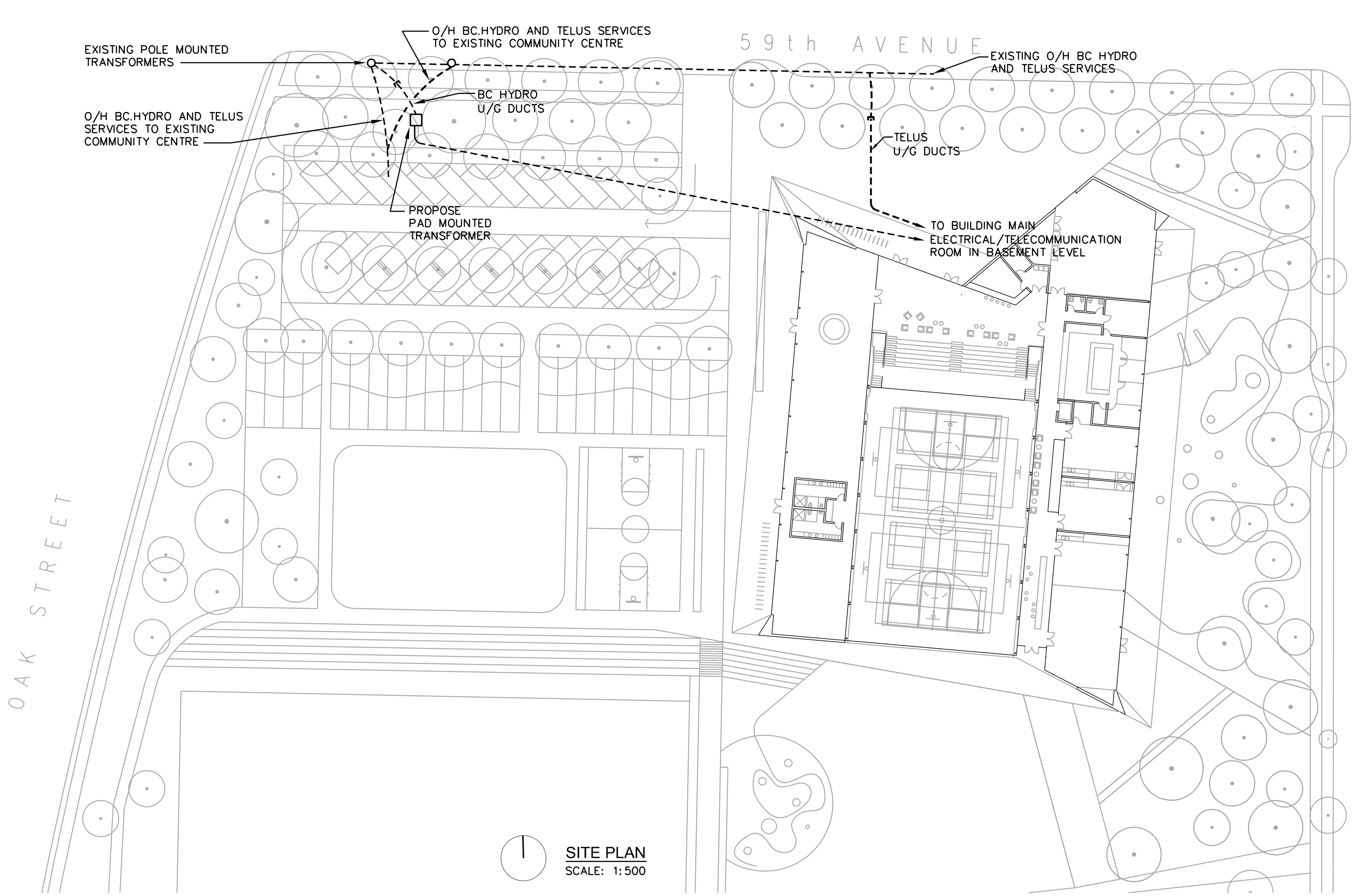
Cobalt Engineering LLP

VENTILATION SCHEMATIC
Marpole Oakridge Community Centre
Patkau Architects Inc

scale: As Shown
reference: 10-1249-M01
issued: March 28, 2011

M-5



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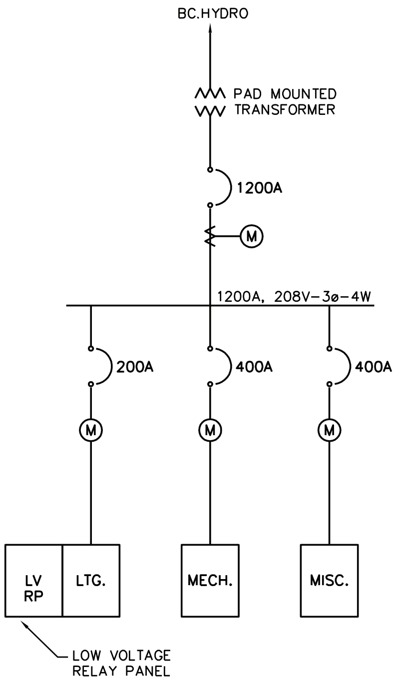
Project Reference No: 10-1249-E01

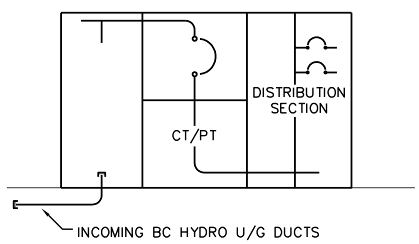
SITE PLAN
Marpole Oakridge Community Centre
Patkau Architects Inc

scale: As Shown
reference: 10-1249-E01
issued: March 24, 2011

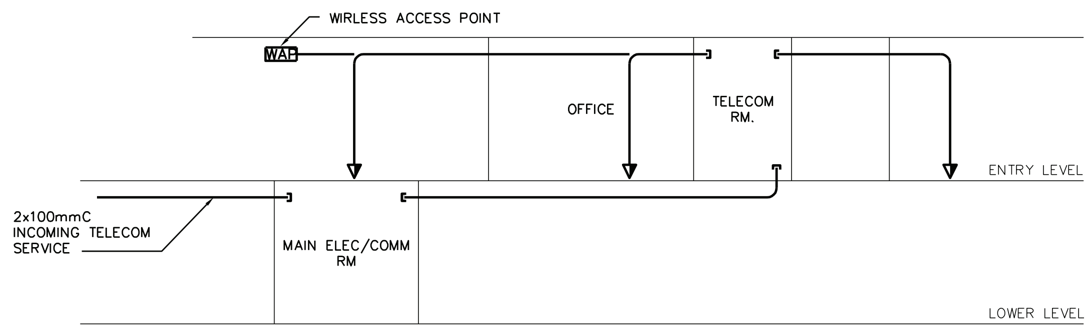
E-1



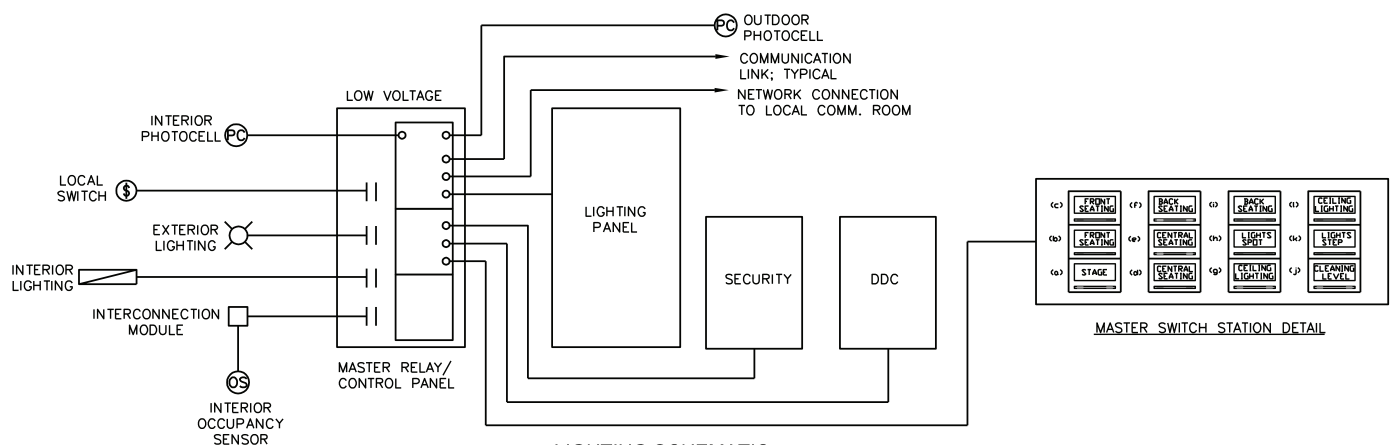
POWER SCHEMATIC
SCALE: NTS



SERVICE ENTRANCE BOARD ELEVATION
SCALE: NTS



TELECOMMUNICATION SCHEMATIC
SCALE: NTS



LIGHTING SCHEMATIC
SCALE: NTS

ISSUED FOR SCHEMATIC DESIGN

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SCHEMATICS
Marpole Oakridge Community Centre
Patkau Architects Inc

scale: As Shown
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issued: March 24, 2011

E-2