KGS GROUP
CONSULTING ENGINEERS

Winnipeg

POOL HEATING AND VENTILATION SYSTEM ASSESSMENT

CINDY KLASSEN POOL - 999 SARGENT AVENUE
PHASE I STUDY - PROJECT NO. 2015-089

FINAL

KGS Group 17-0107-019
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PREPARED BY:

Prasan Silva, P. Eng.
Senior Mechanical Engineer

PROVINCE OF MANITOBA
P. S. SILVA
Member
21131
REGISTERED PROFESSIONAL ENGINEER

APPROVED BY:

Ray Bodnar, P.Eng.
Senior Mechanical Engineer

EXECUTIVE SUMMARY

Existing heating and ventilation equipment serving the original pool building of the Cindy Klassen Recreation Complex has been operating beyond their normal life span and require replacement. KGS Group was retained by the City to assess the existing equipment and provide recommendations for replacement.

The original pool building was built in 1975. A building addition consisting of a Fitness Centre was constructed in 2007 on the south side of the original building. The scope of this assessment is limited to the original building only, and does not consider heating and ventilation equipment in the addition.

The original pool building consists of a central pool space surrounded by support spaces. The main locker rooms are located to the south, canteen to the east, club rooms/garage to the north and a lawn bowling facility to the west. In addition there are north and south mezzanine levels. The south mezzanine level consists of a mechanical room. The north mezzanine level consists of administration spaces, a viewing area, and a mechanical room.

Two main air handling units, one located in the south mechanical room and the other in the north mechanical room, provide heating and ventilation for the pool space. There are two exhaust fans associated with these units located on the roof. The north air handling units is a direct fired natural gas unit which is in poor condition. It is also installed in a manner that does not meet the current code. The south air handling unit consists of a fan and filter section only, with a remotely mounted electric heating coil. The south air handling unit also received pre-heated outdoor air from a solar wall. (The solar wall which was on the south wall of the original building was relocated to the south wall of the new addition in 2007. However, it was not properly tested or commissioned at that time.) The two exhaust fans have rusted housings and are in poor condition. The north air handling unit and the two exhaust fans require immediate replacement.

The main locker rooms are served by a direct fired air handling (makeup air) unit and a roof mounted exhaust fan. Both the air handling unit and the exhaust fan are in poor condition and require immediate replacement. Most other equipment that is original to the building has been operating beyond their normal life expectancy and falls under short term (within next five years) replacement. There are three new air handling units and an associated boiler system (installed in 2007) that is in good condition. This system falls under long term replacement (over 5 years); however the boilers may have shorter life span as they appear to be residential units.

Detailed recommendations for the equipment requiring immediate replacement are presented in this report. The equipment includes the north air handling unit, locker room air handling unit and the three roof mounted exhaust fans. There are two options presented for the replacement of the north air handling unit. One is an outdoor gas fired unit and the other is an indoor hydronically (hot water) heated unit. The indoor option requires an addition of a new high efficiency boiler (the exiting boilers do not have any excess capacity). The indoor option is approximately 5% more capital cost than the outdoor option, however it will have lower operating costs due to the high efficiency boiler. Either option can be implemented based on the preference of the City.

Based on the findings of the assessment, KGS Group recommends the replacement of the equipment identified for immediate replacement at an estimated cost of $730,000 (add $17,000 for the indoor option.). In addition KGS Group recommends the preparation and implementation of a replacement plan for those equipment identified for short them replacement and the recommissioning of the solar wall.

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1.0 INTRODUCTION

Existing heating and ventilation systems serving the original swimming pool building of the Cindy Klassen Recreation Complex have been operating beyond their normal life span and require replacement. KGS Group was retained by the City to conduct an assessment of the heating and ventilation equipment and present replacement options. This report presents the findings of the Study. The report includes the project background, description of the existing units and associated deficiencies, proposed unit replacement options, and associated costs.

This assessment provides a description of the current condition of each piece of equipment or systems, followed by recommended course of action for replacement and associated costs. The report presents the equipment based on its' location within the building starting with the south and north mechanical rooms, followed by the roof and other areas. Depending on the condition of the equipment, the following replacement recommendations are made:

- **Immediate:** Those equipment or systems that are in poor condition and/or not meeting the Manitoba Building Code.
- **Short Term:** Those equipment or systems that have been operating beyond their normal life span.
- **Long Term:** Those equipment or systems that have not exceeded their normal life span and are in relatively good condition.

2.0 BACKGROUND

The original swimming pool building of the Cindy Klassen Recreational Complex was built in 1975. An addition consisting of a fitness facility and a library was built in 2007. Most of the heating and ventilation equipment in the pool building are original and have been operating beyond their normal life expectancy. KGS Group was retained by the City to assess the equipment in the original pool building and provide recommendation for replacement.

The City provided KGS Group the original mechanical and electrical drawings from 1975 as well as a complete drawing set of the 2007 building addition. The assessment consisted of a review of the drawings, site meetings with City staff, as well as on site visual review of the heating and ventilation equipment.

3.0 DISCUSSION

3.1 EXISTING SYSTEMS

The original pool building consists of a central pool space surrounded by support spaces. The main locker rooms are located to the south, canteen to the east, club rooms/garage to the north and a lawn bowling facility to the west. In addition there are north and south mezzanine levels. The south mezzanine level consists of a mechanical room. The north mezzanine level consists of administration spaces, a viewing area, and a mechanical room.

The following sections describe the heating and ventilation equipment located in various areas of the building, including the south mechanical room, north mechanical room and the roof:

SOUTH MECHANICAL ROOM

The equipment in the south mechanical room is described in this section. Figure 1 in Appendix A shows the physical location of the equipment.

Air Handling Unit (AH-2)

Air handling unit AH-2 is located in the south mechanical room provides heating and ventilation to the south portion of the pool. It is original to the building and approximately 42 years old. It has been operating beyond the 30 year normal life expectancy of an air handling unit. The unit consists of a supply fan section and a coil section (for a future coil). There is a built up mixing section at the return connection side of the unit with pneumatically actuated return and outdoor air dampers. The actuators appear to be in poor condition with bent actuator rods. The supply air coming out of this unit is heated using a remotely mounted 75 kW electric coil located in the basement. The City staff indicated that the heating coil has been replaced over time.

PHOTO 1
EXISTING AIR HANDLING UNIT – AH-2

This unit receives outdoor air either directly from an outdoor air intake duct or through the solar wall. (Solar wall can pre-heat outdoor air using the solar energy during daytime.) The solar wall was originally installed in 2005 on the upper portion of the south facing wall of the pool building. The original solar drawings indicate it has an air flow capacity of 15,000 CFM. During the 2007 renovation it was moved to the upper portion of the south facing wall of the new addition. A long intake duct is installed to take air from the solar wall back to air handling unit AH-2.

(***Note:*** The 2007 architectural drawings called for the relocation of the solar wall however the mechanical drawing did not show the solar wall or the intake duct. It is assumed that the intake duct was added by addendum or change order, but did not get added to the drawings. There is no documentation to indicate that AH-2 system was re-balanced or properly commissioned after the solar wall relocation.)

Some of the issues noted on the solar wall system are as follows:

- AH-2 may not have adequate fan power to overcome the pressure losses through long duct that connects AH-2 to the relocated solar wall. (The 2007 air balancing report had no data on AH-2; therefore it is assumed that air flow through the solar wall was never measured).

- There is an existing motorized damper on the solar wall duct where it connects to the normal outdoor air duct; however whether there is a damper on the outdoor air duct could not be confirmed.

- The spiral solar wall duct in the fitness area does not have any external duct insulation. As the original construction drawings do not show this duct, whether there is any internal insulation within the duct could not be confirmed. (The City staff indicated that there used to be water or condensation coming through the seams of the spiral duct. The seams were sealed to prevent this. The duct would have to be cut open to verify if there is any internal insulation).

It is recommended that the City retain the services of an air balance contractor to measure air flow rates of the solar wall. The results from the air balance report can be utilized to properly re-commission the solar wall.

Air Handling Unit (AH-3)

Air handling unit AH-3 is a 6,000 CFM direct fired natural gas makeup air unit that serves the men's and women's locker rooms. The unit is original to the building and approximately 42 years old. It has been operating well beyond the normal 30 year life expectancy of a typical air handling unit. The branches supplying the locker rooms have electric heating coils (EC-3 and EC-4, see below). There is a smaller supply branch from this unit that served the original entrance area. The branch has a booster fan that has no visible tags. The heating coils and the booster fan are not indicated on the original drawings and therefore assumed to be not part of the original design. The unit is in poor condition and appears to need frequent repair.

As this unit is a direct fired makeup air unit, it has to be interlocked with an exhaust fan with the same capacity to meet CSA B149.1 Natural Gas and Propane Installation Code. It appears that this unit is interlocked with the locker room exhaust fan (F-3) located on the roof. There is no documentation to indicate that air flow balance has been tested and adjusted after the installation of the heating coils or the booster fan.

PHOTO 2
EXISTING AIR HANDLING UNIT – AH-3

Electric Duct Heaters (EC-3 and EC-4)

There are two 20 kW electric duct heater, one on the branch supplying the women's locker room and the other on the branch supplying men's locker room. The site staff indicated that these were put in as the locker room air handling unit (AH-3) did not have adequate heating capacity. The coil housing appears to be in good condition however it was not possible to see the coil itself. According to on site staff, the coils were installed approximately 10 years ago. The normal life span of an electric heating coil can vary depending on usage, however on average they can last up to 20 years.

PHOTOS 3 AND 4
ELECTRIC DUCT HEATERS

Air Handling Unit (AH-5)

Air handling unit AH-5 appears to be a built up unit consisting of a fan with an inlet filter, electric heating coil(s) and what appears to be a built up mixing box. According to the drawings this unit supplies 750 CFM to the family change area and Room M:84.

PHOTO 5
AIR HANDLING UNIT AH-5

Fan F-6

Fan F-6 exhausts air from the family change area. (The original drawings identify this fan as F-6, however the physical tag on the unit state Fan 310.) This is a belt driven centrifugal exhaust fan with an air flow capacity of 750 CFM. It is original to the building and therefore approximately 42 years old. The exterior of the fan appears to be in average condition. Normal life expectancy of a fan of this type is about 35 years, however it can operate beyond that based on good maintenance.

PHOTO 6
FAN 310

Fan (no tag)

This fan has no identification tag or name plate data (See Photo 7 below). From the exterior, it appears to be a direct drive inline centrifugal unit. It is on one of the duct branches originating from air handling unit AH-3. The fan is not shown in the original drawings, therefore it is assumed to be installed after the original construction. The duct branch supplies a single grille with a 275 CFM airflow rating located at the entrance/reception area of the original building. (The 2007 renovation drawings identify this area as Corridor 108). As the installation of this fan is not documented, its' intended purpose is unclear. It can be assumed that the air flow into the original building entrance/reception area may have been inadequate. As the reception area is now located in the new addition, this fan may no longer be needed.

PHOTO 7
FAN (NO TAG)

NORTH MECHANICAL ROOM

The equipment in the north mechanical room is described in this section. Figure 1 in Appendix A shows the physical location of the equipment.

Air Handling Unit AH-1

Air handling unit AH-1 is a direct fired natural gas air handler. The direct fire burner is located in the outdoor air section of the unit before the return air duct connections. The unit has a total air flow capacity of 15,000 CFM. The unit is original to the building and approximately 42 years old. It has been operating beyond its' 30 year normal life expectancy. The unit is in poor condition and said to have frequent breakdowns. Furthermore, the unit as installed does not comply with current CSA B149.1 code. There is no provision in the code that allow direct fired burners to be installed in air handling unit that have return air. (The reason is to prevent carbon monoxide (CO) poisoning. CO is created due to incomplete combustion.) Due to the unit being non-code compliant, it requires immediate replacement.

PHOTO 8
AIR HANDLING UNIT AH-1

Air Handling Unit AH-6 and Remote Condensing Unit

Air handling unit AH-6 serves the north side second floor spectator area and offices. It has hydronic (hot water) heating and mechanical (DX) cooling. The remote condensing unit associated with AH-6 is located outside at ground level. The air handling unit and the associated remote condensing unit are installed in 2007 and currently 10 years old. The units appear to be in good condition and with good maintenance can last up to another 20 years.

PHOTO 9
AIR HANDLING UNIT AH-6 AND REMOTE CONDENSING UNIT

Air Handling Unit AH-7 and Remote Condensing Unit

Air handling unit AH-7 serves the main floor areas identified as Club Rooms. Similar to AH-6 system, it has hydronic (hot water) heating and mechanical (DX) cooling. The remote condensing unit associated with AH-7 is located outside at ground level. The air handling unit and the associated remote condensing unit are installed in 2007 and currently 10 years old. The units appear to be in good condition and with good maintenance can last up to another 20 years.

PHOTO 10
AIR HANDLING UNIT AH-7

Air Handling Unit AH-8 and Remote Condensing Unit

Air handling unit AH-8 serves the main floor area identified as Exercise Room. Similar to AH-6 and 7 systems, it has hydronic (hot water) heating and mechanical (DX) cooling. The remote condensing unit associated with AH-8 is located outside at ground level. The air handling unit and the associated remote condensing unit are installed in 2007 and currently 10 years old. The units appear to be in good condition and with good maintenance can last up to another 20 years.

PHOTO 11
AIR HANDLING UNIT AH-8

Fan F-13 (320)

This fan serves the staff locker rooms located on the north side of the main floor. The fan is original to the building and therefore 42 years old. The exterior of the fan appears to be in good condition. Normal life expectancy of a fan of this type is approximately 35 years, however with good maintenance can operate beyond the normal life expectancy.

PHOTO 12
FAN 320

Fan F-11

This is a 7000 CFM axial fan supplying air to the “Vault Room” located in the basement. Its’ function appears to be providing cooling for electrical equipment located within the vault. This fan is original to the building and approximately 42 years old. It appears to be in average condition. Normal life expectancy of a fan of this type is approximately 35 years, however with good maintenance can operate beyond the normal life expectancy.

PHOTO 13
FAN F-11

Hydronic Heating System

A hydronic heating system consisting of 5 wall mounted natural gas fired boilers provides heating to air handling units AH-6, AH-7, and AH-8. In addition to the boiler, there are two circulating pumps and a hydronic system feeder associated with this system.

Boilers

The boilers are installed in 2007 and currently 10 years old. These boilers appear to be residential units which are used in a commercial application. In a residential application these boiler would have approximately 20 year life span. However, the normal life may be considerably reduced in a commercial application. Most likely these boilers would require replacement within the next five years.

PHOTO 14
BOILERS

Pumps

The circulation pumps are installed in 2007 and currently 10 years old. Both pumps rust stains perhaps indicative of a leak at some point. One of the pump motors appears to have been replaced. Typical life expectancy of a circulation pump is 25 years. However these pumps may have a reduced life due to various failures. The maintenance history of the pumps should be reviewed to see if there are any ongoing failures.

PHOTO 15
PUMPS

System Feeder

The hydronic system feeder is installed in 2007 and currently 10 years old. It appears to be in average condition. A normal life span of a system feeder is approximately 25 years. (Note: The unit was not plugged into the wall outlet at the time of the site visit.)

PHOTO 16
SYSTEM FEEDER

ROOF

Fans (F-1, F-2, and F-3)

Fans F-1, F-2, and F-3 are original to the building and currently 42 years old. Fans F-1 and F-2 exhaust the pool and are rated at 15,000 CFM each. Fan F-3 rated at 5,900 CFM exhausts the locker rooms. All three fans have rusted housing and appear to be in poor condition. It was indicated that the fan motors required replacement from time to time. The fans have been operating beyond their normal 35 year lifespan.

According to site staff, fans F-1 and F-2 operated continuously with a total exhaust rate of 30,000 CFM. The ventilation requirement of the pool and deck per current code (ASHRAE 62.1) is only 7,500 CFM. The current exhaust rate is four times higher than the required rate. Heating costs can be significantly reduced in the winter if the exhaust rates reduce to minimum rate of 7,500 CFM. This can be achieved using variable frequency drives (VFD). The VFD's will allow

the exhaust rate to be increased in the summer time to provide cooling and de-humidification. (***Note:*** Exhaust fan F-3 rate cannot be varied as it is exhausting the men's and women's change rooms at the rate required by code.)

It is recommended that exhaust fans EF-1, EF-2, and EF-3 be replaced at the same time as the direct fired air handling units AH-1 and AH-3.

PHOTO 17
FAN (TYP)

OTHER AREAS

There are several smaller exhaust fans located throughout the facility. These include;

- Fan F-4 – Canteen exhaust (Located in ceiling space. Could not access)
- Fan F-5 – Canteen area washroom exhaust (Located in ceiling space. Could not access)

- Exhaust Fans F-7 and F-8 – Located on northeast low roof – Serves Club Rooms/Men's & Women's Showers/Washrooms.
- Fans F-9 and F-10 – Supplies air to men's and women's showers (Located in ceiling space of Club Room 1 and 2. Could not access.)
- Fan F-11 - Fan located on northeast low roof. Exhausts from second floor northeast viewing area
- Fan F-15 – Exhausts air from the men's and women's washrooms/locker rooms serving the carpet bowling club room.

All fans located throughout the facility appear to be original and therefore 42 years old. As these fans have been operating beyond their normal life expectancy of 35 years, consideration should be given to developing a planned replacement program.

3.2 POOL SPACE TEMPERATURE AND HUMIDITY REQUIREMENTS

This section presents the temperature / humidity requirements for pool and the calculated heating and ventilation loads of the pool space (pool and deck area). This area is served by the two main air handlers AH-1 and AH-2. The main purpose of the calculations is to determine the heating and ventilation loads. It should be noted that the heating load of the pool space has been reduced due to the 2007 building addition. The air conditioning and de-humidification loads are provide for information only as the existing pool is not air conditioned or mechanically de-humidified.

3.2.1 Code Requirements

TABLE 1
TYPICAL POOL DESIGN CONDITIONS (From ASHRAE Handbook1)

TYPE	AIR TEMPERATURE	RELATIVE HUMIDITY (%)
Recreational	24°C to 29°C	50 to 60
Competition	25.5 to 29°C	50 to 60

[1] *ASHRAE Applications – 2015 Chapter 5*

3.2.2 Calculated Loads

The calculated heating, ventilation, air conditioning (HVAC) and de-humidification loads are as follows:

TABLE 2
HVAC AND DE-HUMIDIFICATION LOADS

DESCRIPTION	RATE
Heating Load:	645 kW (2,200,000 BTUH)
Air Conditioning Load:	170 kW (580,000 BTUH)
De-humidification Load:	186 kgs/hr (410 lbs/hr)
Ventilation Rate:	3,300 l/s (7,000 CFM)

3.3 PROPOSED REPLACEMENT OPTIONS

3.3.1 Air Handling Unit AH-1 (North Mechanical Room)

Two replacement options are considered and presented below. Option 1 is to replace the existing unit with an indirect natural gas fired outdoor air handling unit. Option 2 is to replace existing unit with an indoor hydronically heated air handling unit.

Option 1 – Outdoor Natural Gas Air Handling Unit

In this option the existing air handling unit would be replaced with a new outdoor air handling unit. The new unit would be located on a concrete pad at ground level. It would have two indirect fired natural gas heating sections, one for normal space heating and one outdoor air heating. The total air flow of the unit would be 15,000 CFM to match the existing air flow rate. The unit would have capacity to bring in 3,500 CFM (50% of the total ventilation requirement of the pool) in the winter. The new unit would have a heated maintenance vestibule to facilitate maintenance and repair in the winter. It would not have air conditioning or mechanical dehumidification as the existing pool is not air conditioned or mechanically dehumidified. (Proposed location of the unit is shown in Figure 2 in Appendix A).

New supply and return air ductwork from the unit would be routed through the roof into the north mechanical room. The ductwork would then be connected to the existing supply and return ducts. There may be a possibility of utilizing the existing outdoor air ductwork which terminates at the soffits for returning air back to the new unit. This would have to be explored during the detailed design. All outdoor ductwork would be insulated and jacketed. Natural gas piping would be extended from the north mechanical room to the new unit.

Due to humid air returning from the pool, there is a possibility of condensate forming within the mixing section of the new air handling unit. To mitigate this, the mixing section would be equipped with a drip pan. A condensate removal pump would have to be provided to remove any condensation that collects in the drip pan. The condensate would be pumped to a drain in the north mechanical room. The outdoor portions of the piping would have to be insulated and heat traced to prevent freezing in the winter.
Note: Installation of a gas fired unit inside the north mechanical room was found to be not feasible due to the physical space required by the indirect fired heating sections.

Pros:

- Capital less than option 1.
- One piece of equipment, less complex.

Cons:

- Equipment located outside.
- Existing parking area will be taken by the unit.
- Less fuel efficient than the boiler system in Option 2.
- Roof penetrations will be required to run new ductwork into the north mechanical room.
- Will require a condensate pump and insulated/heat traced piping. Increased risk of freezing the condensate piping in the winter.

Option 2 – Indoor Hydronic Air Handling Unit

In this option the air handling unit would be replace with a new hydronically heated air handler. (This would be similar to the other air handling units in the north mechanical room). The air handing unit would have two heating coils, one space heating and one for outdoor air heating.

Similar to Option 1, the air handler would have a total air flow rate of 15,000 CFM and an outdoor air rate of 3,500 CFM. The unit would be physically smaller than the gas fired unit and would be able to fit in the space occupied by the existing air handler. The unit would have to be manufactured in section that would fit through the existing doorways and then be assembled onsite.

The existing boilers that serve air handlers AH-6, 7 and 8 do not have excess capacity to handle the heating demand of the new air handling unit. Minimum of 1,000,000 BTUH of boiler capacity would have to be added to serve the new unit. To implement this option, a new high efficiency boiler with a minimum of 1,000,000 BTUH output c/w pumps, piping and controls would have to be installed. As there is no room available within the north mechanical room to install a new boiler, an alternate location would be needed. One potential option is to locate the new boiler in the mezzanine level of the garage where the domestic water heaters are located. (See Figure 3 in Appendix A.)

If this option is selected, consideration should be given to removal of the existing residential type wall mount boilers in the north mechanical room. A second new boiler can be added so that there is a central boiler plant that can serve existing air handlers (AH-6, 7, 8) as well as the new air handling unit. Some existing equipment such as the glycol system feeder can be retained for the new system.

Pros:

- Equipment located inside and therefore easier to maintain during colder weather.
- Higher fuel efficiency than option 1.
- Can be combined with the existing hot water system.

Cons:

- Higher capital cost than option 1.
- No room in the north mechanical room for installation of the new boiler; alternate location is required.
- Several pieces of equipment, more complex.

3.3.2 Air Handling Unit AH-3 (South Mechanical Room)

The existing direct fired makeup air unit replaced with an indirect fired natural gas unit. The replacement unit would have the same air flow rate as the existing. However as it is an indirect fired unit, there would not be any requirement for interlocking it with an exhaust fan. New venting would be provided and would be run up to the roof. A new combustion air intake duct would also be provided and run up to the roof with a gooseneck termination. The unit would be connected to the existing natural gas piping. (The new unit is shown in Figure 4 located in Appendix A.)

3.3.3 Fans F-1, F-2, and F-3 (Roof)

The existing exhaust fans F-1, F-2 and F-3 will be replaced with similar type of fans. The new fans would have appropriate coatings suitable for handling high humidity and chlorine compounds found in swimming pool air. Fans F-1 and F-2 would be variable frequency drive (VFD) controlled, whereas F-3 would operate at constant speed. Fans F-1 and F-2 would have air flow capacity of 15,000 CFM each. Fan F-3 would be 6,000 CFM.

The new control strategy for F-1 and F-2 would differ from the existing. The new strategy is to operate one fan constantly at the minimum required ventilation rate of 7,000 CFM. The fans would be programmed to modulate the exhaust rate between 7,000 and 30,000 CFM as required to control space temperature or humidity when outdoor air conditions permit. (The outdoor air / return air dampers in AH-1 and AH-2 would also be modulated to bring in the amount of air being exhausted by the fans.) This would result in considerable amount of cost savings (mainly outdoor air heating costs and also reduced power consumption by the fans).

4.0 SCHEDULES

The schedule for the design, tender and construction of the proposed work described in Section 3.3 are provided in Appendix B. (Note: As the air handling units have a typical lead time of 16 weeks, the overall construction schedule would not differ depending on the selected AH-1 replacement option).

5.0 CAPITAL COST ESTIMATES

The capital cost estimates for the equipment requiring immediate replacement are shown in Table 3 below. (Detailed cost breakdowns are provided in Appendix C).

TABLE 3
CAPITAL COST ESTIMATES SUMMARY

EQUIPMENT	COST
Air Handling Unit AH-1 Option 1 – Outdoor Gas Fired Unit	$433,000.00
Air Handling Unit AH-1 Option 2 – Indoor Hydronic Unit & Boiler System	$450,000.00
Air Handling Unit AH-3	$151,000.00
Exhaust Fan F-1	$52,000.00
Exhaust Fan F-2	$52,000.00
Exhaust Fan F-3	$42,000.00
Grand Total (w/ Option 1)	**$730,000.00**
Grand Total (w/ Option 2)	**$747,000.00**

6.0 CONCLUSIONS

The following conclusions are made based on the findings of this report:

- Existing direct fired natural gas air handling unit AH-1 and AH-3 are in poor condition. AH-1 is installed in a manner that does not conform to CSA B149.1 Natural Gas and Propane Installation Code of Canada.
- Roof mounted exhaust fans F-1, F-2, and F-3 are also in poor condition.
- Air handling unit AH-6, AH-7, AH-8 and associated condensing units are installed in 2007 and are in good condition. The boilers that provide hot water heating for the air handlers (AH-6, AH-7 and AH-8) are a residential type and may have reduced life expectancy.
- Remaining heating and ventilation equipment that are original to the building have been operating beyond their normal life span.
- Relocated solar wall that provide outdoor air pre-heating for air handling unit AH-2 was not tested or commissioned.

7.0 RECOMMENDATIONS

Based on the findings of the study, KGS Group recommends the following:

- Replace air handling unit AH-1, AH-3 and exhaust fan F-1, F-2, F-3 immediately as described in Section 3.3.
- Prepare a replacement plan for the equipment recommended for short term replacement.
- Conduct air flow testing and commissioning of the solar wall system.

8.0 STATEMENT OF LIMITATIONS AND CONDITIONS

8.1 THIRD PARTY USE OF REPORT

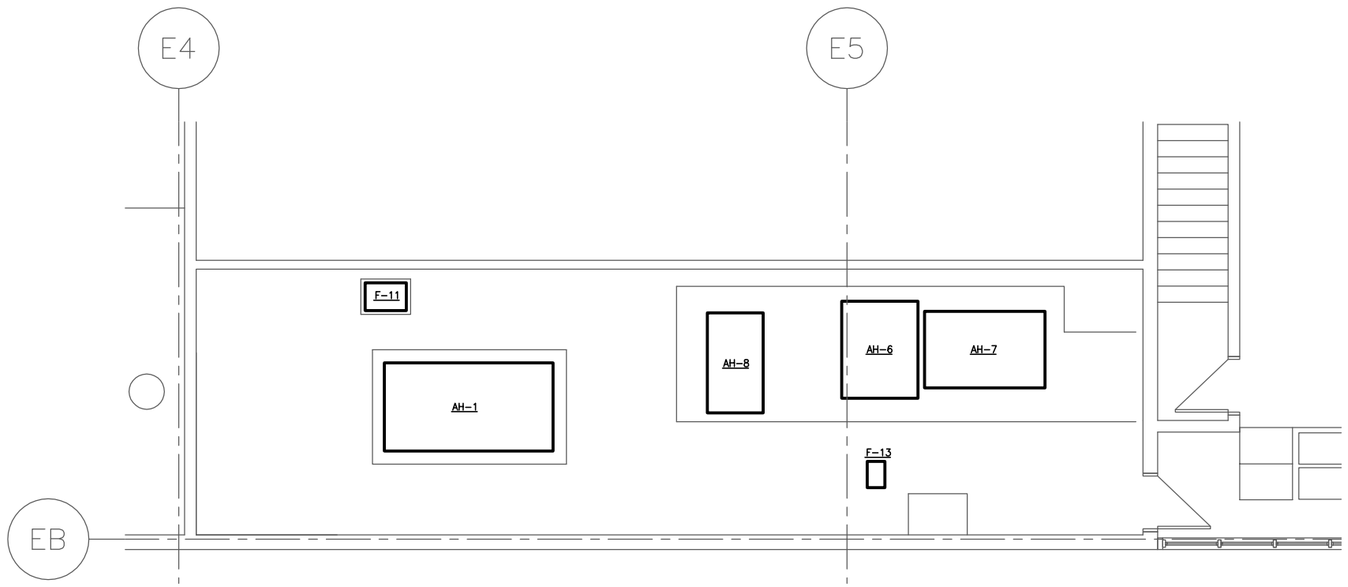
This report has been prepared for the City of Winnipeg to whom this report has been addressed and any use a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. KGS Group accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions undertaken based on this report. This report has been prepared for the Client to whom this report has been addressed and any use a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. KGS Group accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions undertaken based on this report.

8.2 CAPITAL COST ESTIMATE STATEMENT OF LIMITATIONS

The cost estimates included with this report have been prepared by KGS Group using its professional judgment and exercising due care consistent with the level of detail required for the stage of the project for which the estimate has been developed. These estimates represent KGS Group's opinion of the probable costs and are based on factors over which KGS has no control. These factors include, without limitation, site conditions, availability of qualified labour and materials, present workload of the Bidders at the time of tendering and overall market conditions. KGS does not assume any responsibility to the Client, in contract, tort or otherwise in connection with such estimates and shall not be liable to the Client if such estimates prove to be inaccurate or incorrect.

APPENDIX A

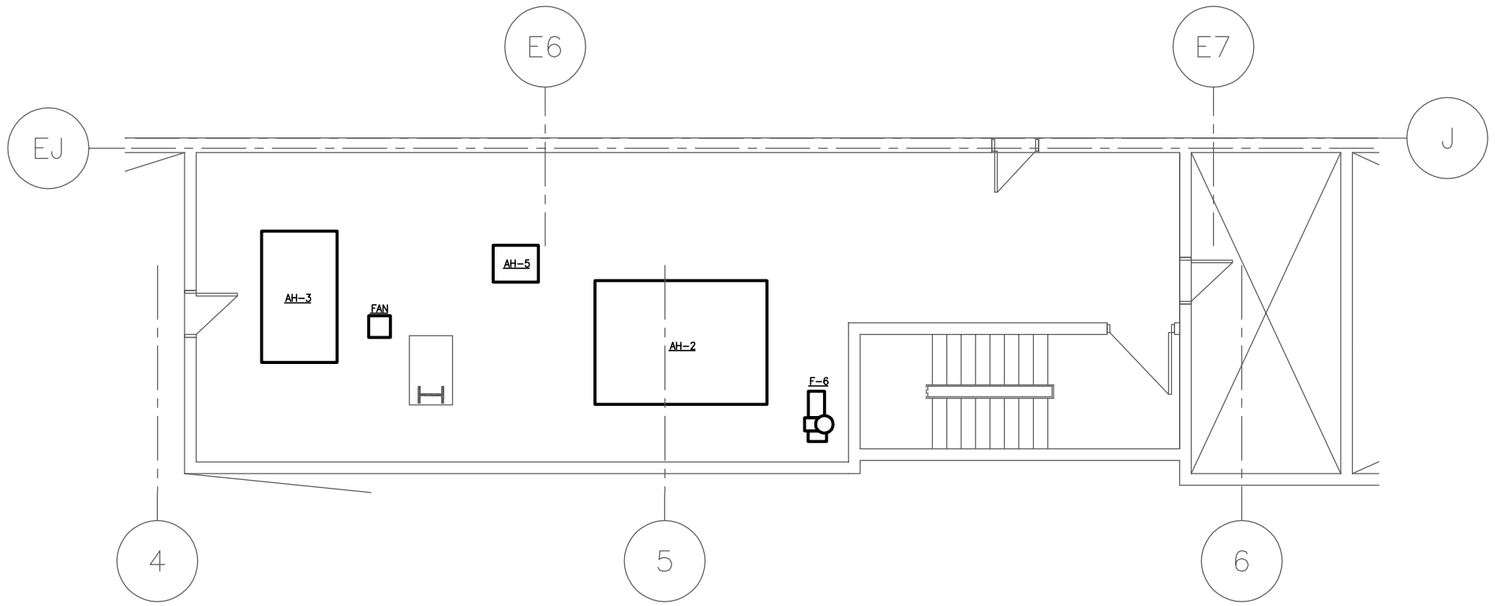
FIGURES



1 — NORTH MECHANICAL ROOM HVAC EQUIPMENT PLAN

5 0 5 10 FT.

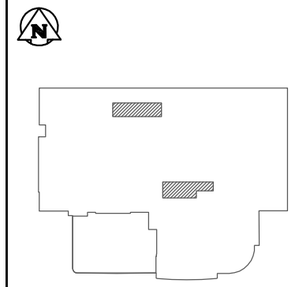
SCALE: 1/4"=1'-0" (24"x36")



2 — SOUTH MECHANICAL ROOM HVAC EQUIPMENT SECTION

5 0 5 10 FT.

SCALE: 1/4"=1'-0" (24"x36")



KEY MAP:

No.	REVISION/DESCRIPTION	BY	DATE
1	ISSUED FOR REPORT	PSS	17.12.19

SEAL

DRAWN	CHECKED	DESIGNED	APPROVED
DPM		PSS	
DATE 17.11.27	USER APPROVAL		

THE CITY OF WINNIPEG
PLANNING, PROPERTY AND DEVELOPMENT DEPARTMENT
MUNICIPAL ACCOMMODATIONS DIVISION
3-65 GARRY STREET, R3C 4K4

PROJECT
CINDY KLASSEN POOL
POOL HEATING AND VENTILATION SYSTEM ASSESSMENT
999 SARGENT AVE.

SHEET TITLE
HVAC EQUIPMENT
MECHANICAL ROOM PLANS
EXISTING

SCALE	PROJECT No:	SHEET No:
AS SHOWN	17-0107-019	FIGURE 1

SCALE VERIFIED BY: _____

ISSUED FOR INFORMATION
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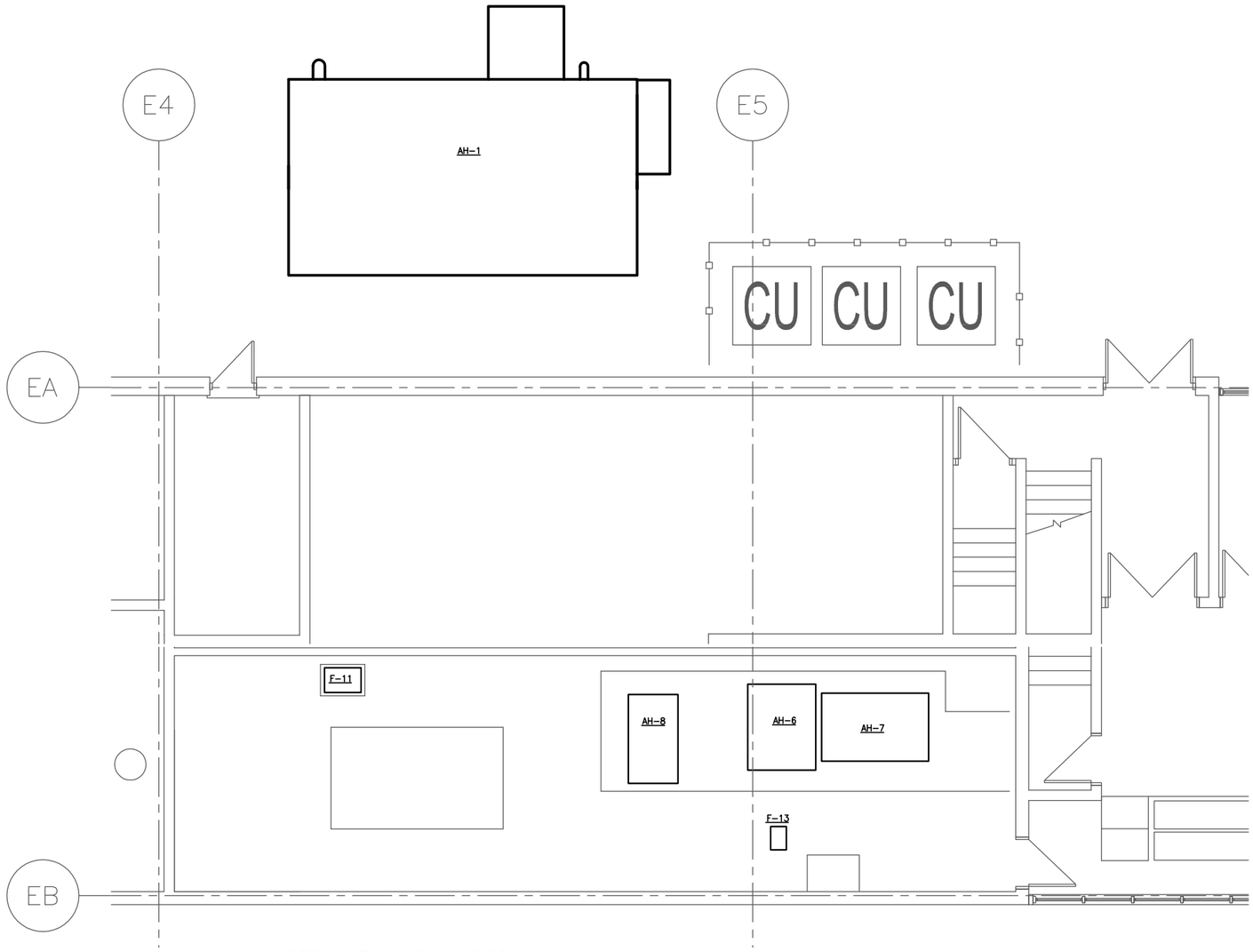
KGS GROUP CONSULTING ENGINEERS

ADDRESS: 999 SARGENT AVE. PROJECT No: 17-0107-019 SHEET TITLE: HVAC EQUIPMENT MECHANICAL ROOM PLANS EXISTING DATE: 2017-11-27 FILE NAME: 17-0107-019_Figure1.dwg

KGS GROUP FileName: U:\FMS\17-0107-019\17-0107-019_Figure1.dwg – Tab: Figure 1 Plotted By: dmclarty 17/12/19 [Tue 8:49am]

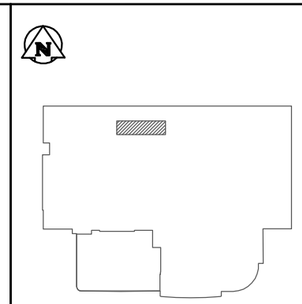
DRAWING SHEET SIZE: B (431mm x 280mm) PLOT 1:2.15



1 NORTH MECHANICAL ROOM
HVAC EQUIPMENT PLAN – OPTION 1

5 0 5 10 FT.

SCALE: 1/4"=1'-0" (24"x36")



KEY MAP:

No.	REVISION/DESCRIPTION	BY	DATE
1	ISSUED FOR REPORT	PSS	17.12.19

SEAL

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DPM		PSS	
DATE 17.11.27	USER APPROVAL		

THE CITY OF WINNIPEG
PLANNING, PROPERTY AND
DEVELOPMENT DEPARTMENT
MUNICIPAL ACCOMMODATIONS DIVISION
3-65 GARRY STREET, R3C 4K4

PROJECT
CINDY KLASSEN POOL
POOL HEATING AND VENTILATION
SYSTEM ASSESSMENT
999 SARGENT AVE.

SHEET TITLE
HVAC EQUIPMENT
MECHANICAL ROOM PLAN
OPTION 1

SCALE	PROJECT No:	SHEET No:
AS SHOWN	17-0107-019	FIGURE 2

SCALE VERIFIED BY: _____

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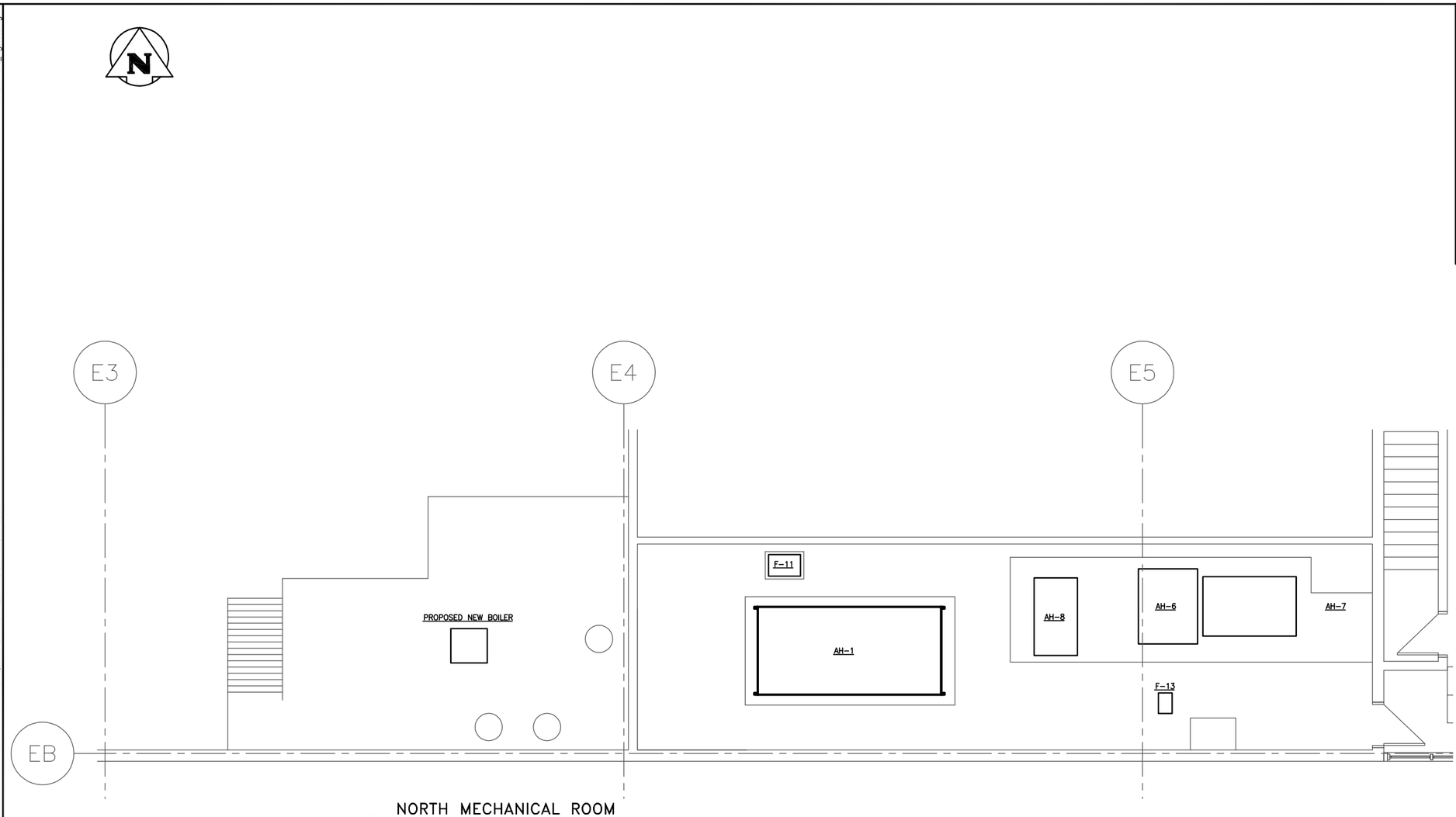
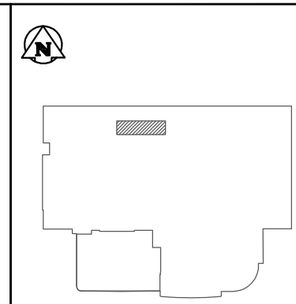
KGS GROUP CONSULTING ENGINEERS

ADDRESS: 999 SARGENT AVE. PROJECT No: 17-0107-019 SHEET TITLE: HVAC EQUIPMENT MECHANICAL ROOM PLAN OPTION 1 DATE: 2017-11-27 FILE NAME: 17-0107-019_Figure2.dwg





KEY MAP:

1 NORTH MECHANICAL ROOM
HVAC EQUIPMENT PLAN – OPTION 2

5 0 5 10 FT.

SCALE: 1/4"=1'-0" (24"x36")

No.	REVISION/DESCRIPTION	BY	DATE
1	ISSUED FOR REPORT	PSS	17.12.19

SEAL

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DPM		PSS	
DATE 17/11/27	USER APPROVAL		

THE CITY OF WINNIPEG
PLANNING, PROPERTY AND
DEVELOPMENT DEPARTMENT
MUNICIPAL ACCOMMODATIONS DIVISION
3-65 GARRY STREET, R3C 4K4

PROJECT
CINDY KLASSEN POOL
POOL HEATING AND VENTILATION
SYSTEM ASSESSMENT
999 SARGENT AVE.

SHEET TITLE
HVAC EQUIPMENT
MECHANICAL ROOM PLAN
OPTION 2

SCALE	PROJECT No:	SHEET No:
AS SHOWN	17-0107-019	FIGURE 3

SCALE VERIFIED BY: _____

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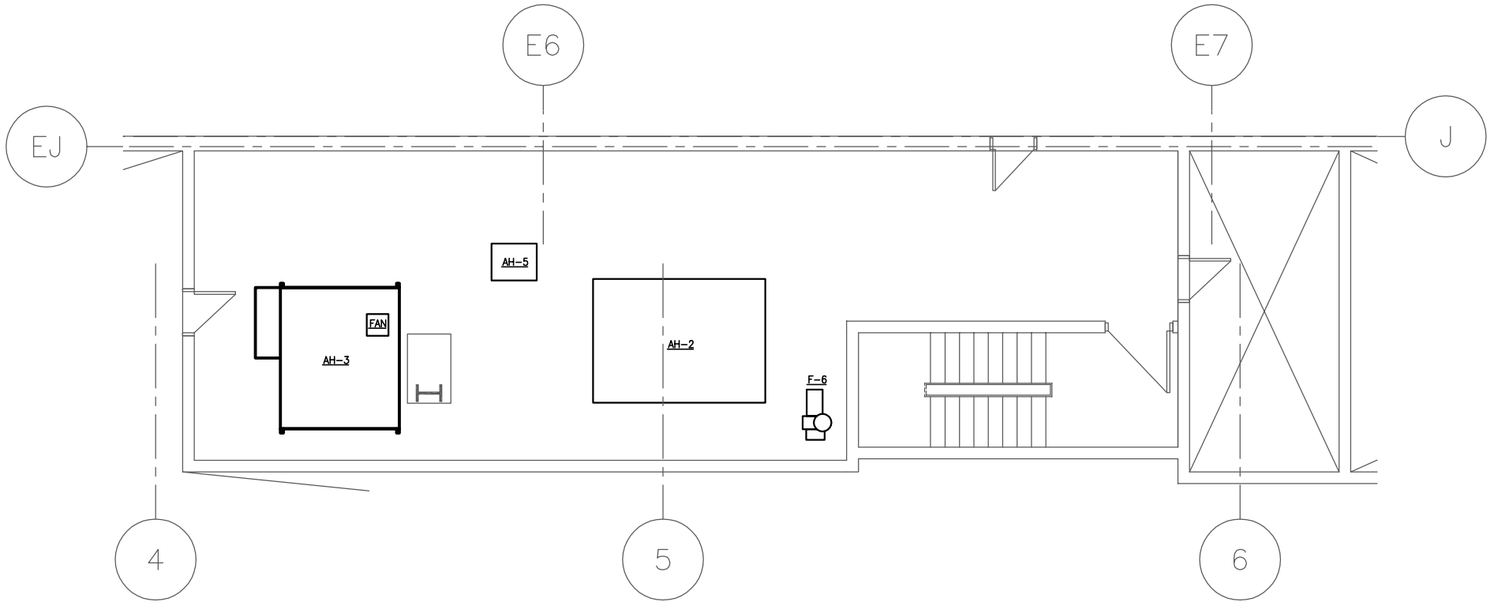
ADDRESS: 999 SARGENT AVE. PROJECT No: 17-0107-019 SHEET TITLE: HVAC EQUIPMENT MECHANICAL ROOM PLAN OPTION 2 DATE: 2017-11-27 FILE NAME: 17-0107-019_Figure3.dwg

KGS GROUP FileName: U:\FMS\17-0107-019\17-0107-019_Figure3.dwg – Tab: Figure 3 Plotted By: dmclarty 17/12/19 [Tue 8:48am]

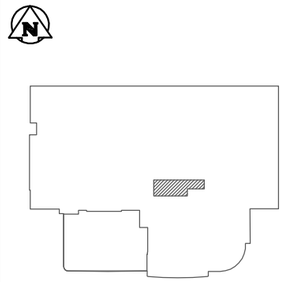
DRAWING SHEET SIZE: B (431mm x 280mm) PLOT 1:2.15



2 — SOUTH MECHANICAL ROOM HVAC EQUIPMENT SECTION

5 0 5 10 FT.

SCALE: 1/4"=1'-0" (24"x36")



KEY MAP:

No.	REVISION/DESCRIPTION	BY	DATE
1	ISSUED FOR REPORT	PSS	17.12.19

SEAL

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DPM		PSS	
DATE 17.11.27	USER APPROVAL		

THE CITY OF WINNIPEG
PLANNING, PROPERTY AND DEVELOPMENT DEPARTMENT
MUNICIPAL ACCOMMODATIONS DIVISION
3-65 GARRY STREET, R3C 4K4

PROJECT
CINDY KLASSEN POOL
POOL HEATING AND VENTILATION SYSTEM ASSESSMENT
999 SARGENT AVE.

SHEET TITLE
HVAC EQUIPMENT MECHANICAL ROOM PLAN

SCALE	PROJECT No:	SHEET No:
AS SHOWN	17-0107-019	FIGURE 4

SCALE VERIFIED BY: _____

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DRAWING SHEET SIZE: B (431mm x 280mm) PLOT 1:2.15

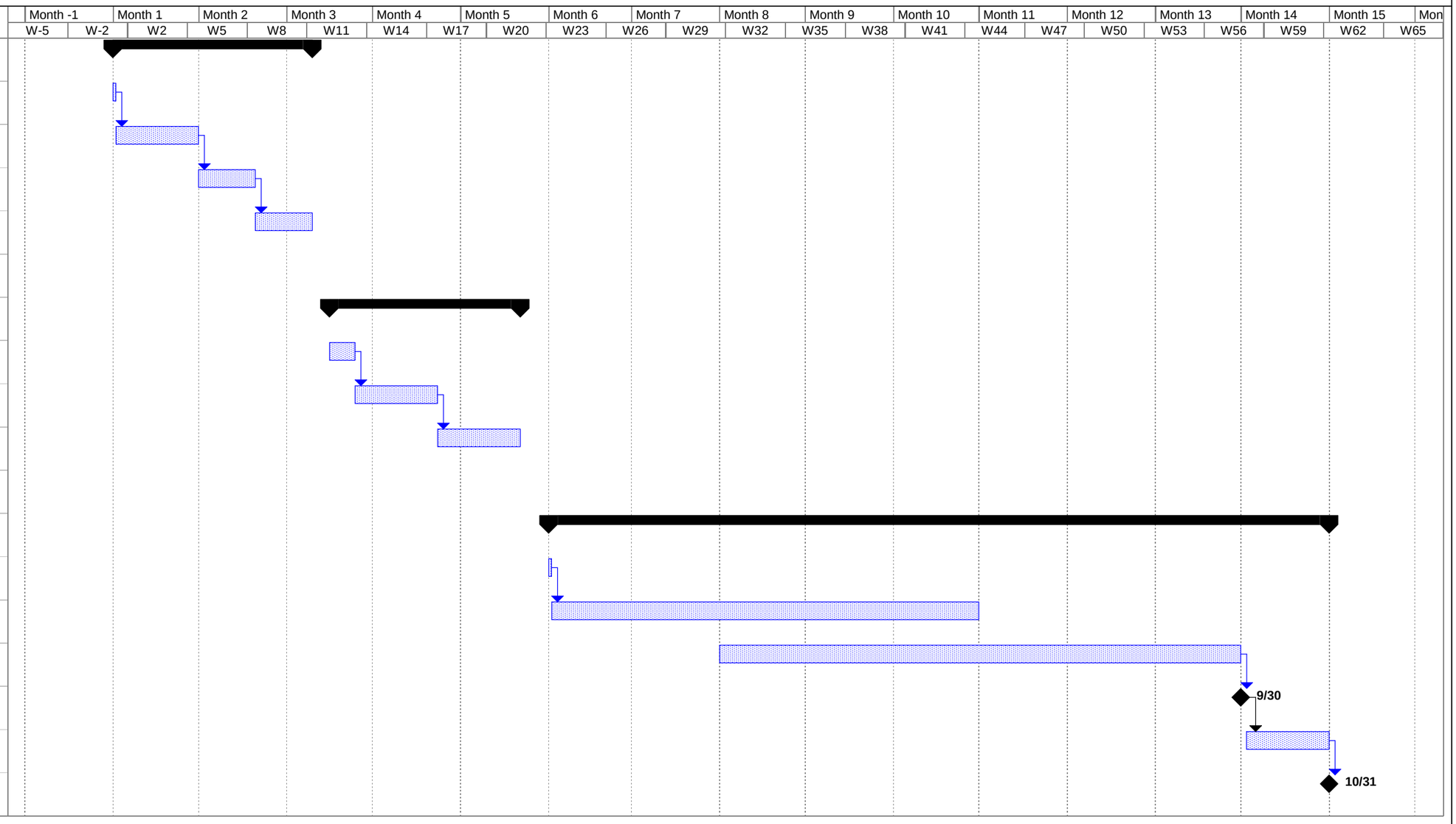
ADDRESS: 999 SARGENT AVE. PROJECT No: 17-0107-019 SHEET TITLE: HVAC EQUIPMENT MECHANICAL ROOM PLAN DATE: 2017-11-27 FILE NAME: 17-0107-019_Figure4.dwg

KGS GROUP FileName: U:\FMS\17-0107-019\17-0107-019_Figure4.dwg – Tab: Figure 4 Plotted By: dmclarty 17/12/19 [Tue 8:47am]

APPENDIX B
SCHEDULES

CINDY KLASSEN POOL - AIR HANDLING UNITS AND EXHAUST FANS REPLACEMENT

ID	Task Name
1	**Design Phase**
2	Consultant Contract Award
3	66% Construction Documents
4	99% Construction Documents
5	100% Construction Documents
6	
7	**Tender Phase**
8	Tender Posting
9	Tender Closing
10	Tender Review and Approval
11	
12	**Construction**
13	Contract Award
14	Equipment Delivery
15	Construction
16	Substantial Completion
17	Completion of Outstanding Work
18	Total Performance



Project: Heating and Ventilation Syste
Date: Thu 12/14/17
.

Task Progress Milestone Summary

APPENDIX C
ESTIMATES

REV.:	A
DATE:	12/19/17
BY:	MAP

Client:	City of Winnipeg
Project:	Cindy Klassen Pool AHU Assessment
KGS Project No.:	17-0107-019
Location:	Winnipeg, MB

CLASS 3 - CAPITAL COST ESTIMATE - EQUIPMENT REQUIREING IMMEDIATE REPLACEMENT

FANS:

Tag	Location	Description / Area Served	Year Built	Current Age (Years)	Normal Life Span (Years)	Air Volume (CFM)	Recommendation	Estimated Cost
F-1	Rooftop above Pool	Exhaust from Pool Area	1975	42	35	15000	Immidiate Replacement	$ 52,000.00
F-2	Rooftop above Pool	Exhaust from Pool Area	1975	42	35	15000	Immidiate Replacement	$ 52,000.00
F-3	Rooftop above Pool	Exhaust from Locker Rooms	1975	42	35	5900	Immidiate Replacement	$ 42,000.00
							Total:	**$ 146,000.00**

AIR HANDLING UNITS:

Tag	Location	Description / Area Served	Year Built	Current Age (Years)	Normal Life Span (Years)	Air Flow (C.F.M.)	Recommendation	Estimated Cost	
								Option 1	Option 2
AH-1	Mechanical Room (North)	Supply to Pool Deck (North	1975	42	30	15000	Immidiate Replacement	$ 433,000.00	$ 450,000.00
AH-3	Mechanical Room (South)	Supply Locker Rooms	1975	42	30	6000	Immidiate Replacement	$ 151,000.00	
							Total:	**$ 584,000.00**	

Grand Total:	**$ 730,000.00**	**$ 747,000.00**

Notes:

1. AH-1 Option 1 - Outdoor gas fired unit
2. AH--1 Option 2 - Indoor hydronic unit and boiler system
3. An engineering allowance of 15% is included in the estimates
4. GST and PST are not included

KGS GROUP
CONSULTING ENGINEERS

Client:	City of Winnipeg
Project:	Cindy Klassen Pool AHU Assessment
KGS Project No.:	17-0107-019
Location:	Winnipeg, MB

REV	DATE	BY
A	12/19/17	MAP

CLASS 3 CAPITAL COST ESTIMATES

ITEM	DESCRIPTION	QTY.	UNIT	UNIT COST	MATERIAL		LABOUR			TOTAL COST(1)
					Unit Cost	Cost	Hours	$/hr	Cost	
1.0	**AIR HANDLING UNIT (AH-1) REPLACEMENT - OPTION 1**									
	OUTDOOR GAS FIRED UNIT									
	General Conditions									$ 53,500
	Hoisting / Placement	1	ls.							$ 2,000
	Demolition:									
	Existing Air Handler (AH-1)	1	ls.							$ 4,000
	Mechanical:									
	Air Handling Unit (AH-1)	1	ea.		$ 160,000	$ 160,000	240	$ 110	$ 26,400	$ 186,400
	Ductwork:									
	Galvanized Steel, 50 LF, 36"x36"	1178	lb.	$ 9						$ 10,244
	Duct Insulation:									
	Mineral Wool Board, 30 LF, 36"x36", 8 lb. density, 3" Thick	540	sf	$ 12						$ 6,264
	Natural Gas Piping:									
	Underground Tubing for Bural, 1-1/4"	120	lf.	$ 21						$ 2,520
	Steel Pipe, 1-1/4", Sch 40, Threaded	20	lf.	$ 15						$ 304
	90 Elbow, 1-1/4"	6	ea.	$ 52						$ 315
	Tee, 1-1/4"	1	ea.	$ 84						$ 84
	Cap, 1-1/4"	1	ea.	$ 25						$ 25
	Union, 1-1/4"	1	ea.	$ 79						$ 79
	Ball Valve, 1-1/4"	1	ea.	$ 219						$ 219
	Condensate Piping:									
	Sch 40 PVC, 1"	60	lf.	$ 20						$ 1,173

KGS GROUP
CONSULTING ENGINEERS

Client:	City of Winnipeg
Project:	Cindy Klassen Pool AHU Assessment
KGS Project No.:	17-0107-019
Location:	Winnipeg, MB

REV	DATE	BY
A	12/19/17	MAP

CLASS 3 CAPITAL COST ESTIMATES

ITEM	DESCRIPTION	QTY.	UNIT	UNIT COST	MATERIAL		LABOUR			TOTAL COST(1)
					Unit Cost	Cost	Hours	$/hr	Cost	
	90 Elbow, 1"	8	ea.	$ 21						$ 167
	Condensate Piping Insulation:									
	Mineral wool, 1" wall, 1" pipe size	40	lf.	$ 11						$ 450
	PVC Jacketing, 3"	40	lf.	$ 8						$ 307
	Controls:									
	Air Handler Controls	1	ls.							$ 10,000
	Testing and Balancing:									
	Air Balancing	1	ls.							$ 7,500
	Electrical:									
	Air Handling Unit (AH-1)	1	ls.							$ 15,000
	Condensate Line Heat Trace	1	ls.							$ 1,500
	Structural:									
	Concrete Pad	1	ls.							$ 7,500
	Bollards & Fencing	1	ls.							$ 6,500
	Roof Penetration and Framing (For ductwork)	1	ls.							$ 4,500
	Sub-Total									**$ 321,000**
Engineering	15%									$ 48,000
Contingency	20%									$ 64,000
	Total - AHU Replacement									**$433,000**
2.0	**AIR HANDLING UNIT (AH-1) REPLACEMENT - OPTION 2**									

KGS GROUP CONSULTING ENGINEERS

Client:	City of Winnipeg
Project:	Cindy Klassen Pool AHU Assessment
KGS Project No.:	17-0107-019
Location:	Winnipeg, MB

REV	DATE	BY
A	12/19/17	MAP

CLASS 3 CAPITAL COST ESTIMATES

ITEM	DESCRIPTION	QTY.	UNIT	UNIT COST	MATERIAL		LABOUR			TOTAL COST(1)
					Unit Cost	Cost	Hours	$/hr	Cost	
	INDOOR HYDRONIC UNIT									
	General Conditions									$ 55,500
	Demolition:									
	Existing Air Handler (AH-1)	1	ls.							$ 4,000
	Mechanical:									
	Air Handling Unit (AH-1)	1	ea.		$ 50,000	$ 50,000	180	$ 110	$ 19,800	$ 69,800
	Hydronic Components:									
	Boiler (B-1)	1	ea.		$ 40,000	$ 40,000	200	$ 110	$ 22,000	$ 62,000
	Boiler Pump (BP-1)	1	ea.		$ 5,500	$ 5,500	6	$ 110	$ 660	$ 6,160
	Circulation Pumsp (PU-1 & PU-2)	2	ea		$ 5,500	$ 11,000	16	$ 110	$ 1,760	$ 12,760
	Glycol Make-Up Unit (GMU-1)	1	ea			$ -		$ 110	$ -	$ -
	Air Separator, 4"	1	ea		$ 4,950	$ 4,950	6	$ 110	$ 660	$ 5,610
	Expansion Tank (EXP-1)	1	ea		$ 1,430	$ 1,430	6	$ 110	$ 660	$ 2,090
	Chemical Pot Feeder	1	ea		$ 440	$ 440	6	$ 110	$ 660	$ 1,100
	Glycol (50% Solution), 55 Gal Drum	4	ea.		$ 1,000	$ 4,000	16	$ 110	$ 1,760	$ 5,760
	Glycol System Clean and Test procedures	1	ls.				24	$ 110	$ 2,640	$ 2,640
	Hydronic Piping:									
	4" Pipe, Steel, Sch 40, welded, Includes coup. & hang.	160	lf.	$ 41						$ 6,517
	90 Elbow, 4", welded	24	ea.	$ 238						$ 5,702
	Tee, 4", welded	8	ea.	$ 435						$ 3,483
	Butterfly Valve, 4", lug type, lever actuator	8	ea.	$ 388						$ 3,104
	Triple Duty Valve	2	ea.	$ 1,272						$ 2,544
	Suction Diffuser, 4x4"	2	ea.	$ 1,272						$ 2,544
	Balancing Valve, 3", flanged	2	ea.	$ 1,089						$ 2,178

KGS GROUP
CONSULTING ENGINEERS

Client:	City of Winnipeg
Project:	Cindy Klassen Pool AHU Assessment
KGS Project No.:	17-0107-019
Location:	Winnipeg, MB

REV	DATE	BY
A	12/19/17	MAP

CLASS 3 CAPITAL COST ESTIMATES

ITEM	DESCRIPTION	QTY.	UNIT	UNIT COST	MATERIAL		LABOUR			TOTAL COST(1)
					Unit Cost	Cost	Hours	$/hr	Cost	
	3-Way Modulating Control Valve, incl. Actuator	2	ea.	$ 1,888						$ 3,776
	Piping Insulation:									
	Piping Insulation, fiberglass w ASJ, 1-1/2" wall, 4" pipe	120	lf.	$ 9						$ 1,086
	PVC Jacketing, 7" ID	120	lf.	$ 6						$ 678
	PVC Jacketing, Elbow, 7" ID	32	ea.	$ 16						$ 512
	Natural Gas Piping:									
	Steel Pipe, 1-1/4", Sch 40, Threaded	60	lf.	$ 15						$ 912
	Elbow, 1-1/4"	6	ea.	$ 52						$ 315
	Tee, 1-1/4"	1	ea.	$ 84						$ 84
	Cap, 1-1/4"	1	ea.	$ 25						$ 25
	Union, 1-1/4"	1	ea.	$ 79						$ 79
	Ball Valve, 1-1/4"	1	ea.	$ 219						$ 219
	Painting and Indentification	1	ls							$ 3,500
	Boiler Venting:									
	CPVC Venting	1	ls.							$ 4,000
	Controls:									
	Air Handler Controls	1	ls.							$ 10,000
	Hydronic System Controls (Boiler, Pumps, Valves)	1	ls.							$ 15,000
	Testing and Balancing:									
	Air Balancing	1	ls.							$ 7,500
	Water Balancing	1	ls.							$ 3,500
	Electrical:									
	Air Handling Unit (AH-1)	1	ls.							$ 11,000

KGS GROUP CONSULTING ENGINEERS

Client:	City of Winnipeg
Project:	Cindy Klassen Pool AHU Assessment
KGS Project No.:	17-0107-019
Location:	Winnipeg, MB

REV	DATE	BY
A	12/19/17	MAP

CLASS 3 CAPITAL COST ESTIMATES

ITEM	DESCRIPTION	QTY.	UNIT	UNIT COST	MATERIAL		LABOUR			TOTAL COST(1)
					Unit Cost	Cost	Hours	$/hr	Cost	
	Boiler (B-1)	1	ls.							$ 2,500
	Boiler Pump (BP-1)	1	ls.							$ 2,500
	Circulation Pumps (PU-1 & PU-2)	1	ls.							$ 8,000
	Glycol Make-Up Unit (GMU-1)	1	ls.							
	Structural:									
	Concrete Pad	1	ls.							$ 1,500
	Boiler Venting Roof Penetration	1	ls.							$ 2,500
	Sub-Total									**$ 333,000**
Engineering	15%									$ 50,000
Contingency	20%									$ 67,000
	Total - AHU Replacement									**$450,000**
1.0	**AIR HANDLING UNIT (AH-3) REPLACEMENT**									
	General Conditions									$ 18,700
	Demolition:									
	Existing Air Handler (AH-3)	1	ls.							$ 4,000
	Mechanical:									
	Air Handling Unit (AH-3)	1	ea.		$ 30,000	$ 30,000	160	$ 110	$ 17,600	$ 47,600
	Ductwork:									
	Galvanized Steel,	785	lb.	$ 9						$ 6,830

KGS GROUP
CONSULTING ENGINEERS

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KGS Project No.:	17-0107-019
Location:	Winnipeg, MB

REV	DATE	BY
A	12/19/17	MAP

CLASS 3 CAPITAL COST ESTIMATES

ITEM	DESCRIPTION	QTY.	UNIT	UNIT COST	MATERIAL		LABOUR			TOTAL COST(1)
					Unit Cost	Cost	Hours	$/hr	Cost	
	Duct Insulation:									
	Mineral Wool Board, 30 LF, 36"x36", 8 lb. density, 3" Thick	300	sf	$ 12						$ 3,480
	Natural Gas Piping:									
	Gas piping	1	ls							$ 1,500
	Controls:									
	Air Handler Controls	1	ls.							$ 10,000
	Testing and Balancing:									
	Air Balancing	1	ls.							$ 7,500
	Electrical:									
	Air Handling Unit (AH-1)	1	ls.							$ 6,500
	Structural:									
	Concrete Pad	1	ls.							$ 1,500
	Roof Penetration and Framing (For ductwork)	1	ls.							$ 4,500
	Sub-Total									**$ 112,000**
Engineering	15%									$ 17,000
Contingency	20%									$ 22,000
	Total - AH-3 Replacement									**$151,000**

KGS GROUP CONSULTING ENGINEERS

Client:	City of Winnipeg
Project:	Cindy Klassen Pool AHU Assessment
KGS Project No.:	17-0107-019
Location:	Winnipeg, MB

REV	DATE	BY
A	12/19/17	MAP

CLASS 3 CAPITAL COST ESTIMATES

ITEM	DESCRIPTION	QTY.	UNIT	UNIT COST	MATERIAL		LABOUR			TOTAL COST(1)
					Unit Cost	Cost	Hours	$/hr	Cost	
3.0	**FAN (F-1/F-2) REPLACEMENT**									
	General Conditions									$ 12,890
	Demolition	1	ls.							$ 4,700
	Mechanical:									
	Fan (F-1/F-2)	2	ea.		$ 13,500	$ 27,000	72	$ 110	$ 7,920	$ 34,920
	Controls	1	ls.							$ 7,500
	Electrical:									
	Breaker (15A, 600V, 3Phase)	1	ls.		$ 500	$ 500	4	$ 100	$ 400	$ 900
	VFD + Load Reactor	1	ls.		$ 2,500	$ 2,500	4	$ 100	$ 400	$ 2,900
	Feeder (3c #12AWG TECK90+Ground)	150	lf.		$ 1.5	$ 225	40	$ 100	$ 4,000	$ 4,225
	30A 600V NEMA3R Local Disconnect	1	ls.		$ 400	$ 400	4	$ 100	$ 400	$ 800
	Scissor Lift Rental (1 Week)	1	ls.							$ 2,500
	Coring	1	ls.							$ 1,000
	Roof-top Receptacle	1	ls.							$ 2,000
	Structural:									
	Roof Curb Modification	1	ls.							$ 3,000
	Sub-Total									**$ 77,000**
Engineering	15%									$ 12,000
Contingency	20%									$ 15,000
	Total - F-1/F-2 Replacement									**$104,000**

KGS GROUP CONSULTING ENGINEERS

Client:	City of Winnipeg
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KGS Project No.:	17-0107-019
Location:	Winnipeg, MB

REV	DATE	BY
A	12/19/17	MAP

CLASS 3 CAPITAL COST ESTIMATES

ITEM	DESCRIPTION	QTY.	UNIT	UNIT COST	MATERIAL		LABOUR			TOTAL COST(1)
					Unit Cost	Cost	Hours	$/hr	Cost	
4.0	**FAN (F-3) REPLACEMENT**									
	General Conditions	1	ls.							$ 4,940
	Demolition	1	ls.							$ 2,600
	Mechanical:									
	Fan (F-3)	1	ea.		$ 11,600	$ 11,600	30	$ 110	$ 3,300	$ 14,900
	Controls	1	ls.							$ 3,500
	Electrical:									
	Disconnect-Reconnect	1	ls.							$ 3,500
	Structural:									
	Roof Curb modifications	1	ls.							$ 1,500
	Total - F-3 Replacement									**$ 31,000**
Engineering	15%									$ 5,000
Contingency	20%									$ 6,000
	Total - F-3 Replacement									**$ 42,000**

Legend:

ea.=each, ls=lump sum, lf = linear foot

Notes:

(1) Total values are rounded to nearest 1000

(2) GST and PST not included