KGS GROUP

CITY OF WINNIPEG

Pan Am Pool - 25 Poseidon Bay

Solar Energy Opportunities Reassessment

PROVINCE OF MANITOBA
D.S. OLMSTEAD
Member
32175
REGISTERED PROFESSIONAL ENGINEER
2023-01-18

Revision:

Final Rev. 0

KGS Group Project:

22-0107-012

Date:

January 18, 2023

Prepared by:

David Olmstead, B.Sc., P.Eng.
Mechanical Engineer

Approved by:

Chris Sararas, B.Sc., P.Eng.
Electrical Engineer

EXECUTIVE SUMMARY

KGS Group was retained by the City of Winnipeg to update the previous 2018 study of solar energy opportunities for the Pan Am Pool. The intent of implementing solar energy opportunities is to reduce the operating costs of the facility and reduce Greenhouse Gas (GHG) emissions, while taking advantage of current Provincial and Federal Government funding opportunities. This report builds on the previous report, revisiting the proposed solar ventilation air heating systems and providing recommendations and opinions on probable costs for replacing five of the building's original air handling units (F-1 to F-5).

The Pan Am Pool does not currently utilize any solar, geothermal, or any other non-traditional source of energy. All energy is currently sourced from natural gas and electricity. The building provides a good opportunity for solar energy capture because of its large South facing wall.

Two options for solar ventilation air heating are considered. A solar wall covering the majority of the main pool area's south facing elevation offers a considerable saving in Greenhouse Gas (GHG) emissions of 137.0 tC02 per year, at an estimate capital cost of $630,000 resulting in a payback period of 22 years. Solar ducts installed on the lap pool addition's roof offer a 47.5 tCO2 reduction in annual GHG emissions at an estimated capital cost of $198,000 resulting in a payback period of 20 years. These payback times are less than the anticipated life expectancy of the solar ducts of 30 years.

As the existing air handling units that serve the main pool area are at end of life and in various states of failure, replacement and relocation options are considered. Due to structural and accessibility constraints, new structural mezzanines to support the replacement air handling equipment are recommended. These mezzanines would be located above the building's existing office spaces, stairwells or track areas and would be accessed independently of the existing ceiling level catwalks. The estimated cost for the proposed new mezzanines, air handling units, and associated equipment is $3.2M (class 4 estimate) including installation.

Based on the findings of this study, KGS Group recommends the consideration of both solar ventilation air heating options on the basis of considerable GHG emission reduction and minimal maintenance requirements. KGS Group also recommends the replacement of the existing air handling units prior to the recommended solar opportunities installation as this equipment is end of line and replacement would ensure a complete, modern and fully functional system is provided.

TABLE OF CONTENTS

List of Tables

List of Appendices

STATEMENT OF LIMITATIONS AND CONDITIONS

Limitations

This report has been prepared for the City of Winnipeg in accordance with the agreement between KGS Group and the City of Winnipeg (the "Agreement"). This report represents KGS Group's professional judgment and exercising due care consistent with the preparation of similar reports. The information, data, recommendations and conclusions in this report are subject to the constraints and limitations in the Agreement and the qualifications in this report. This report must be read as a whole, and sections or parts should not be read out of context.

This report is based on information made available to KGS Group by the City of Winnipeg. Unless stated otherwise, KGS Group has not verified the accuracy, completeness or validity of such information, makes no representation regarding its accuracy and hereby disclaims any liability in connection therewith. KGS Group shall not be responsible for conditions/issues it was not authorized or able to investigate or which were beyond the scope of its work. The information and conclusions provided in this report apply only as they existed at the time of KGS Group's work.

Third Party Use of Report

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.

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 Group 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 Group does not assume any responsibility to the City of Winnipeg, in contract, tort or otherwise in connection with such estimates and shall not be liable to the City of Winnipeg if such estimates prove to be inaccurate or incorrect.

1.0 INTRODUCTION

The City of Winnipeg retained KGS Group to reassess the solar energy opportunities for the Pan Am Pool. The City intends to implement solar energy opportunities to reduce the facility's energy consumption; therefore, reducing its operating costs and Greenhouse Gas (GHG) emissions. This assessment also reviews the replacement of five existing air handling units that are at end of life and located inaccessibly. These five air handling units are candidates for solar energy opportunity implementation.

Background information on the Pan Am Pool facility, its existing mechanical systems, and on the previously conducted solar energy opportunities study are outlined in the background section below. A discussion of the updated solar energy opportunities and the details regarding the air handling unit's replacement follows. This study considers the mechanical, electrical and structural impacts of the installations. The energy provided by the solar installation and the resulting offset in energy costs and GHG emissions are reanalyzed in the context of 2022.

2.0 BACKGROUND

The Pan Am Pool was originally constructed in 1966 to host the Pan American Games in 1967. Many renovations and several additions have been completed at the facility since its original construction. An addition containing a lap pool and children's (kiddie) pool was built in 1994 at the east end of the original pool area. This addition is generally referred to as the "Lap Pool Addition". Parts of the original pool area's east wall were removed for the lap pool addition. The lap pool addition is open to the main pool area at the pool deck and track levels; therefore, the main pool area and the lap pool addition function as one building in practice.

As part of the above-mentioned renovations, many of the building's original mechanical and electrical systems have been replaced. Several recent mechanical renovations include the replacement of the facility's boiler plant, domestic water heaters, pool water heat exchangers, lap pool air handling units and boiler room combustion make up air units. Where possible, equipment has been configured to provide redundancy.

Currently, the building does not utilize solar, geothermal, or any other non-traditional source of energy. All energy is sourced from natural gas and electricity. A summary of the building's total natural gas consumption for the past eight years is provided in Table 1 below.

TABLE 1: TOTAL ANNUAL NATURAL GAS CONSUMPTION

Year	Natural Gas Consumption (m^3)
2014	781,905
2015	701,964
2016	661,568
2017	700,887
2018	679,075
2019	852,300
2020	728,649
2021	693,041

These values can provide a useful reference when evaluating the amount of energy provided by the various solar opportunities.

KGS Group conducted a study assessing solar energy opportunities at the Pan Am Pool in 2018 (final report issued January 2019). This study concluded that the building has good potential for implementation of solar technologies on its roof and south facing elevation. The study noted that the installation of solar ducts on the main pool area roof is not feasible due to the additional structural loads that the roof was not designed to handle; therefore, the study recommended the installation of a solar wall on the south wall of the main pool area to serve its air handling units, and the installation of solar ducts on the roof of the lap pool addition to serve its air handling units.

Solar domestic water heating and photovoltaic systems were investigated by the 2018 study and were ruled out due to incompatibilities with the current operation of the building's mechanical systems, long payback periods and increased maintenance costs. The final recommendation of the 2018 study was to implement ventilation air heating via a solar wall serving the main pool area and solar ducts serving the lap pool addition based on a reasonable payback period, a considerable reduction in GHGs and minimal maintenance requirements.

In addition to the study of solar energy opportunities, KGS Group is also reviewing the replacement of five air handling units serving the main pool area and the associated spectator areas, locker rooms, showers and ancillary spaces. Air handling units F-1 through F-5 are original to the building, at end of life and in various states of failure. These existing air handling units are located within the main pool area's ceiling space and are only accessible via the catwalk network that runs within the roof structure of the building. As part of the replacement of these units, relocation for greater ease of maintenance is to be considered.

Units F-1 through F-4 serve to condition the pool area and to provide ventilation to its occupants and spectators. F-1 and F-2 supply air onto the curtain walls at each end of the main pool area. F-3 and F-4 supply air to the spectator areas on each side of the main pool. Exhaust fans F-7 through F-10 operate in conjunction with these four air handling units to ventilate and maintain the appropriate pressure within the main pool area. Reportedly, the outdoor air and return air mixing dampers within these 4 air handling units have failed and are now manually locked in the fully recirculating position by facility operation staff. As they are not supplying the correct amount of fresh air to the facility, this does not meet the ASHRAE 62.1 standard. Further to this, the reduced ventilation also means that there may be a buildup of chloramines from the pool, which will increase the rate of metal corrosion around the facility and in the air handling systems. The pneumatic controls serving each of the air handling units and exhaust fans are not operating correctly. New replacement air handling units and supporting equipment, and the existing exhaust fans are to be tied into the existing DDC system.

Unit F-5 operates in conjunction with exhaust fan F-15 to ventilate the locker/change rooms and other pool operation ancillary spaces. The unit's distribution ductwork also contains booster fans and hydronic reheat coils for better control of each zone that it serves. This unit has completely failed and has reportedly been out of operation for several years. Its distribution ductwork appears to have been partially disconnected, and it's KGS Group's understanding that the system currently relies on the booster fans and reheat coils to redistribute ambient air from the main pool area to the locker/change rooms and other pool area ancillary spaces. The pneumatic controls serving air handling unit F-5 are to be replaced by electronic controls tied into the existing DDC system.

In its current operating state, the existing main pool area HVAC system is not meeting the minimum ventilation requirements of the building code.

3.0 DISCUSSION

The implementation of solar ventilation air heating equipment on the building's large flat rooftop and south facing elevation are reviewed, building on the findings of the 2018 study completed by KGS Group. The energy and cost savings, GHG reduction, construction cost and payback are reassessed in the context of 2022 pricing and rates. Solar thermal energy installations are eligible for government incentives and grants. This report accounts for the Green Energy Equipment Tax Credit from the Manitoba Provincial Government, which is a credit of 10% of the capital cost of installation.

New air handling unit selections based on the updated ventilation rates discussed below are also reviewed, as are possible options for relocating the air handling units for greater accessibility and ease of maintenance. The replacement unit costs including installation and the provision of structure to support the units in their proposed new location is provided.

3.1 Solar Ventilation Air Heating

Details regarding the rationale behind the selection of a solar wall to supply pre-heated ventilation air to air handling units F-1 through F-5 and solar ductwork to supply pre-heated ventilation air to air handling units AHU-1 and AHU-2 can be found in the 2018 study report prepared by KGS Group. Explanations of the operation of the solar ducts and solar wall and considerations regarding their installation, operation and maintenance can also be found in the 2018 study report.

3.1.1 EXISTING AIR HANDLING SYSTEMS WITH SOLAR HEATING POTENTIAL

The existing HVAC systems within the building where solar ventilation pre-heating could potentially be applied include:

- Air handling units F-1 to F-4, which serve the main pool area;
- Air handling unit F-5, which serves locker/change rooms and ancillary spaces below the spectator areas; and
- Air handling units AHU-1 and AHU-2, which serve the lap pool addition.

Air handling units F-1 to F-4 are located within the ceiling space of the main pool area and are original to the building. The outdoor air connections are currently located on the rooftop and terminated with low silhouette intake hoods. Each unit is designed for a total airflow rate of 20,000 CFM (cubic feet per minute). Based on the original construction drawings units F-1 and F-2 are designed to provide up to 100% outdoor air at 20,000 CFM each, while units F-3 and F-4 are only designed to provide up to 50% outdoor air at 10,000 CFM each.

The calculated minimum ventilation rate for the pool, deck and spectator areas based on ASHRAE Standard 62.1 is 34,000 CFM. It is assumed that new air handling units would be sized to satisfy this calculated ventilation requirement to meet code, therefore; the replacement air handling units are to provide 8,500 CFM of ventilation air each.

Air handling unit F-5 is also located within the ceiling space of the main pool area and is original to the building. This unit also draws outdoor air from a rooftop mounted low silhouette intake hood. It’s designed for a total flow rate of 13,000 CFM and up to 100% outdoor air during occupied hours. The distribution ductwork serving F-5 includes booster fans and reheat coils in various branch ducts to provide greater control over zone temperature.

Air handling units AHU-1 and AHU-2 are located at grade on raised platforms adjacent to the east end of the lap pool addition. Exterior supply and return air ductwork connect each air handling unit to distribution ductwork with in the lap pool area. The exterior ductwork enters/exits the building at the roof of the lap pool area and is routed along the building’s exterior wall down to each unit. The design total and outdoor airflows for AHU-1 and AHU-2 are 16,000 CFM and 6,500 cfm each respectively. The outdoor airflow rate is provided continuously during occupied hours, and intermittently as required for dehumidification during unoccupied hours.

All air handling units considered for solar ventilation air heating have hydronic heating coils that are served by the building’s central natural gas fired boiler plant. The amount of available ventilation air associated with each air handling system considered for solar pre-heating is summarized in the table below:

TABLE 2: VENTILATION RATES AVAILABLE FOR SOLAR PRE-HEAT

Air Handling Unit	Ventilation Rate (CFM)
F-1	8,500
F-2	8,500
F-3	8,500
F-4	8,500
F-5	13,000
AHU-1	6,500
AHU-2	6,500
Total	**60,000**

3.1.2 PROPOSED SYSTEMS

As per the conclusions and recommendations of the 2018 assessment conducted by KGS Group, two proposed solar ventilation air heating options are considered:

- Solar wall on the south face of the main pool area to serve air handling units F-1 to F-5.
- Solar ducts on the roof of the lap pool to serve AHU-1 and AHU-2.

Both options are similar with respect to operation, configuration and construction methods. In each case, ventilation air would be drawn through a solar collector to pre-heat it as much as possible prior to drawing it into each air handling unit via roof mounted insulated ductwork. The life expectancy of the solar wall systems are 30 years.

A summer bypass system would be included in the outdoor air ductwork serving each unit and would consist of a gooseneck intake hood tied into the main duct run from the associated solar collector to the respective air handling unit intake. Motorized dampers would be provided in each of the two duct branches, allowing for each unit to retain economizer (free cooling) operation during the times of year where it is required, bypassing the solar wall or ducts to prevent excess heating of outdoor air. Controls for the motorized dampers would be tied into the building's DDC system and would act in sequence with the associated air handling unit.

All ductwork between the solar collectors and air handling units would be insulated complete with aluminum jacketing to withstand the outdoor conditions. The ducts would be supported on the rooftop by sleepers.

3.1.2.1 Option 1 – Main Pool Area South Solar Wall

The solar wall would span across the majority of main pool area's south exterior wall, extending from it's base just above the main floor overhang up to the underside of the disused ventilation air openings (See Photo 1). This southern exterior elevation presents the best opportunity for the installation of a solar wall for this building because it is large, has no obstructions, and it has the most solar exposure. The available dimensions for a solar wall installation result in a total area of approximately 16,640 ft^2. Based on a combined airflow rate of 47,000 CFM for all connected air handling units, the resulting airflow per unit surface area is 2.8 CFM/ft^2. This is within the industry standard best practice airflow range of 2-10 CFM/ft^2 and allows the wall to provide a relatively high temperature rise for incoming outdoor air.

Pre-heated air would be ducted up to roof level from the top of the solar wall. From there, distribution ductwork would connect to each associated air handling unit as described above.

Photo 1: Main Pool Area South Wall

The weight of the solar wall cannot be supported from the existing wall structure; therefore, a dedicated standalone structural support system would be required. The support system would be constructed upon piles at the base, with steel columns extending up to the underside of the overhanging wall. A steel beam would span across the columns to fully support the underside of the new solar wall which would also be affixed to the existing exterior pool area wall for additional stability.

The construction cost of this option is estimated to be $700,000. The Provincial Government tax incentive is equal to 10% bringing the total capital cost down to an estimated $630,000.

3.1.2.2 Option 2 - Lap Pool Addition Rooftop Solar Ducts

Two solar duct arrays would serve air handling units AHU-1 and AHU-2, with one array serving each unit. Each array would include seven 48-foot-long solar duct sections resulting in a total surface area of 1,344 ft^2 surface area for each array. Based on a total outdoor airflow rate of 6,500 CFM per array, the resulting airflow per unit surface area is 4.8 CFM/ft^2. This is within the industry standard best practice airflow range of 2-10 CFM/ft^2 and allows the wall to provide a relatively high temperature rise for incoming outdoor air.

Pre-heated air would be drawn from each array into the associated air handling unit's existing return air duct near where it exits the building at the addition's roof. The new rooftop solar ductwork would rest upon sleepers supported by the lap pool addition's existing roof structure.

Photo 2: Lap Pool Addition Roof

The construction cost of this option is estimated to be $220,000. The Provincial Government tax incentive is equal to 10% bringing the total capital cost down to an estimated $198,000.

The approximate locations of both solar ventilation air heating options and the associated ductwork is shown on Figure 1 in Appendix B.

3.1.3 ANALYSIS – SOLAR VENTILATION AIR HEATING

Analysis of the solar ventilation systems was completed using RETScreen software and electronic spreadsheets, utilizing local climactic data for Winnipeg.

For this analysis, the following assumptions have been made:

- Heat loss from insulated ductwork is negligible.
- The summer bypasses are utilized to limit the supply air temperature to 79°F. Energy that could be collected to increase the air temperature beyond this value is not included in the energy savings calculations.
- Operating hours for the pool are from 5:30 AM to 10:30 PM on weekdays, and 6:30 AM to 8:30 PM on weekends.
- The facility operates 365 days of the year.
- The cost of natural gas varies yearly as shown Appendix C – Payback Analysis.
- The thermal efficiency of the boiler plant is constant at 88%, based on manufacturer data for a return temperature of 140°F and input of 50%.

- There is no shading of the solar wall or solar ducts by adjacent structures.

The results of the analysis are summarized in Table 3 below. The table shows the total amount of natural gas required to heat the ventilation air for the current configuration with no solar heating (baseline), and the amount required if each solar ventilation air heating was implemented.

TABLE 3: VENTILATION AIR HEATING ANNUAL NATURAL GAS CONSUMPTION

Option	Baseline (m^3)	With Solar Option (m^3)	Reduction (m^3)
Option 1 – Solar Wall (F-1 to F-5)	263,858	193,961	69,897
Option 2 – Solar Duct (AHU-1 & AHU-2)	81,953	57,724	24,229

The energy consumption values were used to determine the costs, cost savings, and payback period, which are shown in Appendix C and summarized in Table 4. The construction costs shown factor in government incentives and grants.

TABLE 4: VENTILATION AIR HEATING PAYBACK ANALYSIS

Option	Estimated Construction Cost	Payback considering Increasing Gas and Carbon Tax Costs
Option 1	$630,000	22 years
Option 2	$198,000	20 years

Based on a GHG emission factor of 0.00196 tonnes CO_2/m^3 of natural gas, the greenhouse gas emissions and reductions were calculated for each option on an annual basis and are summarized in Table 5 below.

TABLE 5: VENTILATION AIR HEATING ANNUAL GREENHOUSE GAS EMISSIONS

Option	GHG Emissions -Baseline (tCO_2)	GHG Emissions - with Solar Ventilation (tCO_2)	GHG Reduction (tCO_2)
Option 1	517.2	380.2	137.0
Option 2	160.6	113.1	47.5

3.1.4 SUMMARY OF SOLAR OPTIONS

The solar options considered in the above sections are summarized below for comparison purposes. Based on the comparison, the main pool area solar wall option has the longer payback and the higher capital cost per ton of greenhouse gas (GHG) reduction. The lap pool addition solar duct option has the higher payback and the lower capital cost per ton of greenhouse gas (GHG) reduction.

TABLE 6: VENTILATION AIR HEATING OPTION SUMMARY

Option	Estimated Construction Cost	Payback considering Increasing Gas and Carbon Tax Costs (Years)	GHG Reduction (tCO_2)	Construction Cost / tCO_2 Reduction
Option 1 Solar Wall – Main Pool Area	$630,000	22	137	$4,599
Option 2 Solar Ducts – Lap Pool Addition	$198,000	20	47.5	$4,169

3.2 Air Handling Units Replacement

This portion of the study focuses on the replacement of air handlers F-1, F-2, F-3, F-4, and F-5. These units are original to the building, are difficult to maintain due to their location, and are being evaluated for replacement at the City of Winnipeg's request.

3.2.1 EQUIPMENT LOCATIONS

A primary objective in the replacement of the existing five air handling units that serve the main pool area and its ancillary spaces is the improvement of maintenance access. KGS Group have reviewed several options with respect to the new air handling units' locations. Commentary relating to each considered option follows:

3.2.1.1 Option 1 – New Air Handling Units in Existing Unit Locations

Replacing the existing air handling units with new units installed in the same locations was quickly eliminated as an option due to the extremely limited space for installation and maintenance of the units. Complete pool area shutdown would likely be required to facilitate this option. Additionally, physically reaching the mezzanines upon which the current units are located is extremely inconvenient, less ergonomic, and less safe than the City of Winnipeg building operation staff would prefer.

3.2.1.2 Option 2 – New Air Handling Units on Main Pool Area Roof

Replacing the existing air handling units with new exterior units installed on the roof of the main pool area was also eliminated as an option due to insufficient structural capacity to accommodate the snow loading that exterior units would create and insufficient roof access to facilitate convenient maintenance of the units.

Snow clearing on the building's roof would be a concern, and additional roof access points would need to be provided above the locations of the existing units. The structural and access provisions required to facilitate option 2 would be costly, and the physical access concerns outlined in option 1 above would not be appreciably improved.

Additionally, the significant humidity in the pool air poses a freezing risk for any extended unit shutdown (maintenance, component failure, etc.). The frozen condensation could make restarting the air handling unit a maintenance heavy process. To mitigate this risk and improve maintenance access, a service corridor within each unit would be required at a significant increase in unit capital cost.

3.2.1.3 Option 3 – New Air Handling Units at Grade Below the Track

Replacing the existing air handling units with new exterior units located at grade beneath the overhangs created by the track surrounding the main pool area was considered. This option was eliminated due to the extensive and expensive highly insulated ductwork that would be required to connect the new air handling units to the existing distribution ductwork in the main pool area's ceiling space. Similar pool air humidity related concerns to those expressed for option 2 apply to this option as well. To mitigate this risk and improve maintenance access, a service corridor within each unit would be required at a significant increase in unit capital cost.

3.2.1.4 Option 4 – New Air Handling Units on New Indoor Mezzanines

Replacing the existing air handling units with new interior units located on new mezzanines above existing meeting/office spaces, stairwells or parts of the track was considered. The proposed mezzanines would be constructed in a similar manner to the mezzanine built for the boiler combustion air make-up unit replacement project designed by KGS Group and constructed in 2018.

Locating the new units indoors on new mezzanines improves maintenance space and physical accessibility while eliminating the need for extensive additional insulated outdoor ductwork or expensive unit features/construction.

Replacement unit F-5 would be installed on the existing mezzanine that was constructed as part of the 2018 air handler F-6 replacement project.

Photo 3: Proposed Location For F-5
(Existing Mezzanine Above Meeting Room)

Replacement units F-2 and F-4 along with their associated replacement pump and heat exchanger would be installed on a new mezzanine of similar construction above the meeting/office spaces adjacent to the opposite stairwell.

Photo 4: Proposed Mezzanine Area For F-2 & F-4
(Above Existing Office Space)

Replacement units F-1 is suggested to be located above the existing track on a new mezzanine, while F-3 could be located on a new mezzanine in one of two possible locations:

- New extended mezzanine above the stairwell adjacent to the existing mezzanine next to F-6 and the proposed location for F-5, or
- New mezzanine over the track on the north side of the main pool area

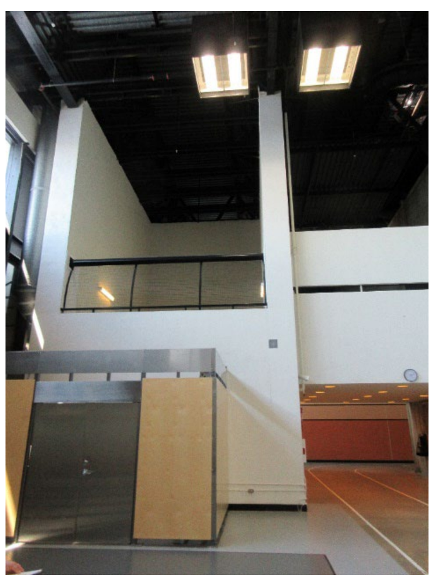


Photo 5: Proposed Mezzanine Area For F-3
(Above Existing Stairwell)

Photo 6: Proposed Mezzanine Area For F-1 & Alternate Location for Unit F-3 (Above Existing Track)

The proposed locations of all new mezzanines are outlined on Figure 1 attached in Appendix B.

3.2.2 EQUIPMENT CONFIGURATIONS AND CAPACITIES

New air handling units are designed to match the total airflow capacities of the existing units while adjusting the heating performance to meet current code ventilation rates. Equipment data sheets for the proposed equipment selections are attached in Appendix A. To match the existing original design, heating coils are sized based on the following assumed design temperatures:

- Preheat Coil Outdoor Entering Air Temperature = -30°F
- Preheat Coil Leaving Air Temperature = 50°F
- Reheat Coil Mixed Air Entering Temperature = 50°F
- Reheat Coil Leaving Air Temperature = 80°F

Supporting equipment for each group of replacement air handling units has also been selected. Pumps and heat exchangers are required to convert the heating medium from hot water to hot glycol. This is necessary to prevent risk of freezing in coils that heat outdoor air directly. Equipment data sheets for new pumps and heat exchangers is also attached in Appendix A. To match the existing building systems operation, heating coils, heat exchangers and pumps are sized based on the following assumed fluid types and temperatures:

- Main Boiler Hot Water Loop Supply Temperature = 160°F
- Main Boiler Hot Water Loop Return Temperature = 120°F
- Local 50% Propylene Glycol Loop Supply Temperature = 140°F
- Local 50% Propylene Glycol Loop Return Temperature = 100°F

Based on the above conditions that are common to all selections, replacement air handling units, heat exchangers and pumps were selected with the following capacities:

- F-1 & F-2
  - 20,000 CFM @ 2” W.C. External Static Pressure
  - 8500 CFM Maximum Outdoor Air
- F-3 & F-4
  - 20,000 CFM @ 2.25” W.C. External Static Pressure
  - 8500 CFM Maximum Outdoor Air
- F-5
  - 13,000 CFM @ 1.75” W.C. External Static Pressure
  - 13,000 CFM Maximum Outdoor Air
- Heat Exchanger & Pump Serving F-1 & F-3
  - 2850 Mbh Total Capacity
  - 5 hp Pump, 160 GPM @ 39 feet
- Heat Exchanger & Pump Serving F-2 & F-4
  - 2850 Mbh Total Capacity
  - 5 hp Pump, 160 GPM @ 39 feet
- Heat Exchanger & Pump Serving F-5
  - 1450 Mbh Total Capacity
  - 3 hp Pump, 81 GPM @ 42 feet

3.2.3 ANTICIPATED AIR HANDLING UNIT REPLACEMENT COSTS

The effort to demolish the existing air handling units and install replacement air handling units is considerable. This is due to the size and capacity of the equipment locations and structural constraints of the existing building. The requirement for two new structural mezzanines has been included. Based on our analysis and review of equipment vendors quotes and previous project actual construction costs the class 4 (-30% to +60%) estimated cost of construction for the replacement air handling units, associated structures and equipment (not including the solar ventilation systems) is $3.2M in 2022.

4.0 CONCLUSIONS

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

- The Pan Am Pool currently utilizes natural gas and electricity as its sole sources of energy and does not utilize any alternative sources of energy.
- The building has a good potential for implementation of solar technologies on the roof and south facing wall, which are large and unobstructed.
- Solar ventilation air heating could potentially be implemented on the south facing wall via the installation of a solar wall.
- Solar ventilation air heating could potentially be implemented on the lap pool addition roof via the installation of solar ducts.

- Existing air handling units F-1 to F-4 are beyond their life expectancy and require replacement. Air handling unit F-5 has failed and is abandoned in place.
- The existing air handling units are inaccessible for maintenance; therefore, new replacement units are to be installed in alternative locations offering improved accessibility. Several new interior mezzanines are proposed to achieve this.

5.0 RECOMMENDATIONS

Based on the findings of the study, KGS Group recommends the consideration of implementing solar ventilation air heating 3.1.2.1 Option 1 – Main Pool Area South Solar Wall, and 3.1.2.2 Option 2 - Lap Pool Addition Rooftop Solar Ducts. Although the simple payback period for each option is longer than owners would typically consider favourable, the implementation of these options is based upon a considerable reduction in GHGs and the minimal maintenance requirements of the solar wall and solar ducts.

KGS Group also recommends the installation of new replacement air handling units F-1 through F-5 and their associated pumps and heat exchangers on new mezzanines within the main pool area, based on the following benefits:

- Adequate ventilation to meet the minimum requirements of the building code.
- Reduced maintenance requirements and improved maintenance access.
- Improved temperature and humidity control of pool area.
- Improved energy efficiency with low temperature heating coils and operational controls.
- The ability to connect the air handlers into a building wide control system upgrade.

APPENDIX A

Equipment Datasheets

Trane Performance Climate Changer Air Handler

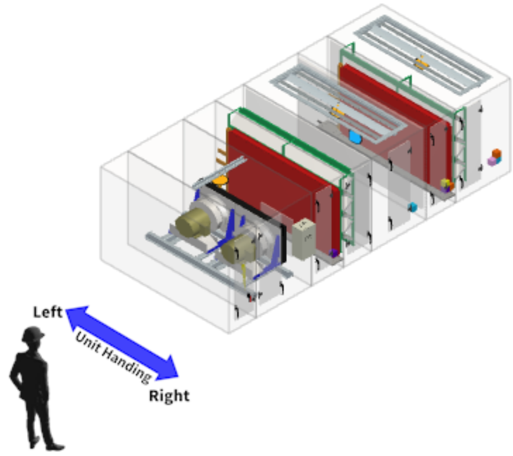
Unit Overview - F-4

Application	Unit Size	External Dimensions			Weight	
		Height	Width	Length	Installed	Rigging
Indoor unit	CSAA040	70.8 in	112.5 in	247.4 in	6301 lb	6170 lb
Quantity of Shipping Sections		Largest Ship Split			Heaviest Ship Split	Elevation
		Height	Width	Length		
4 piece(s)		70.8 in	112.5 in	73.8 in	2649 lb	0.00 ft

Supply Fan			
Airflow	20000 cfm	Total Static Pressure	4.106 in H2O

Construction Features

Panel	2in. foam injected R-13 with thermal break
Panel Material	All unit inner panels - stainless steel
Integral Base Frame	6in. integral base frame
Short Circuit Current Rating	5 kA
Agency Approval	UL listed unit



Unit Electrical

Circuit	Voltage/Phase/Frequency	FLA	MCA	Max Fuse Size
Circuit number 1 Supply fan + controls-LL	575/3/60	22.52 A	28.02 A	50.00 A

Unit Controls

Factory Controls Package	Variable volume
Controller Type	UC600
Controller mounting	Unit mounted
Controller location	Right

Warranty

Warranty section	Std. warranty only

Air mixing section - Position: 1

Openings							
Face	Path	Type	Airflow	Face Velocity	Area	Pressure Drop	Hood
Top	Outside	Opposed blade damper	20000 cfm	1228 ft/min	16.29 sq ft	0.126 in H2O	N/A

Filter				
Type	Frame	MERV Rating	Quantity	Size
Throwaway filters - MERV 5	2"	MERV 5	24.00 6.00	16in.x20in. 16in.x25in.
Pressure Drop	Condition	Face Velocity	Airflow	Area
0.507	Mid-life	143 ft/min	10000 cfm	70.00 sq ft

Section Options	
Door Location	Right

Heating coil section - Position: 2

Coil Construction	
Model	Hot water - 5/8" Shipping Coil, General (5W)
Rows	1
Tube Diameter	5/8in. tube diameter (15.875 mm)
Coil Connection	Standard
Tube Matl/Wall Thickness	.020" (0.508 mm) copper tubes
Fin Spacing	156 Per Foot
Fin Material	Aluminum fins
Fin Type	Prima flo E (energy efficient)
Face Area	37.50 sq ft
Coil (top/single) H x L	54 in. (1372 mm) X 100" (2540 mm) finned length
Casing	Stainless steel
Turbulators	Yes
Rigging Weight	179.5 lb
Installed Weight	227.0 lb
Coil Section Options	
Extended Drain and Vent	Holes only
Drain Pan	Stainless steel
Drain Pan Size	Small
Drain Connection	Left
Minimum Trap Height (L)	6.324 in
H Trap Dimension	3.382 in
J Trap Dimension	1.691 in
Door Location	Right

Coil Performance	
Capacity	
Total	737.46 MBh
Air	
Flow	8500 cfm
Entering Dry Bulb	-30.00 F
Leaving Dry Bulb	50.00 F
Pressure Drop	0.031 in H2O
Face Velocity	227 ft/min
Fluid	
Flow	42.18 gpm
Entering	140.00 F
Leaving	100.00 F
Pressure Drop	6.96 ft fluid
Tube Velocity	2.59 ft/s
Reynolds Number	5587.52
Type	Propylene glycol
Concentration	50.00 %
Fouling Factor	0.00025 hr-sq ft-deg F/Btu
Volume	5.71 gal
AHRI 410 Classification	
AHRI 410 Classification	NOT Certified by AHRI
Data Generation Date	11/16/2022
Trane Select Assist update number	2650

Note: Coil is NOT certified by AHRI. Coil is within the scope of AHRI Standard 410.

Air mixing section - Position: 3

Openings							
Face	**Path**	**Type**	**Airflow**	**Face Velocity**	**Area**	**Pressure Drop**	**Hood**
Top	Return	Opposed blade damper	20000 cfm	1228 ft/min	16.29 sq ft	0.126 in H2O	N/A

Section Options	
Door Location	Right

Filter section - Position: 4

Primary Filter									
Type	**Frame**	**Loading**	**Airflow**	**Face Area**	**Face Velocity**	**Condition**	**Pressure Drop**	**Filter Quantity**	**Filter Size**
Pleated media - MERV 8	2in. filter frame	Side load filters	20000 cfm	70.00 sq ft	286 ft/min	Mid-life	0.569 in H2O	24.00 6.00	16x20 16x25

Filter Section Options	
Door Location	Right

Heating coil section - Position: 5

Coil Construction	
Model	Hot water - 1/2" Unit Optimized, General (UW)
Rows	2
Tube Diameter	1/2in. tube diameter (12.7 mm)
Coil Connection	Standard
Tube Matl/Wall Thickness	.016" (0.406 mm) copper tubes
Fin Spacing	124 Per Foot
Fin Material	Aluminum fins
Fin Type	Delta flo E (energy efficient)
Face Area	39.93 sq ft
Coil (top/single) H x L	57 in. (1448 mm) X 100" (2540 mm) finned length
Casing	Stainless steel
Turbulators	Yes
Rigging Weight	246.2 lb
Installed Weight	330.0 lb
Coil Section Options	
Extended Drain and Vent	Holes only
Drain Pan	Stainless steel
Drain Pan Size	Small
Drain Connection	Left
Minimum Trap Height (L)	8.260 in
H Trap Dimension	4.673 in
J Trap Dimension	2.337 in
Door Location	Right

Coil Performance	
Capacity	
Total	650.70 MBh
Air	
Flow	20000 cfm
Entering Dry Bulb	50.00 F
Leaving Dry Bulb	80.00 F
Pressure Drop	0.165 in H2O
Face Velocity	501 ft/min
Fluid	
Flow	37.22 gpm
Entering	140.00 F
Leaving	100.00 F
Pressure Drop	2.35 ft fluid
Tube Velocity	1.42 ft/s
Reynolds Number	2457.00
Type	Propylene glycol
Concentration	50.00 %
Fouling Factor	0.00025 hr-sq ft-deg F/Btu
Volume	10.06 gal
AHRI 410 Classification	
AHRI 410 Classification	NOT Certified by AHRI
Data Generation Date	10/20/2022
Trane Select Assist update number	2640

Note: Coil is NOT certified by AHRI. Coil is within the scope of AHRI Standard 410.

Supply fan section - Position: 6

Fan Data	
Wheel Diameter/Type/Class	24.5in. dd plenum, full width, H press
Fan Quantity	2
Discharge Location	Top front
Motor Location	Right side drive
Blades	Higher eff.(some bands lower,more spike)
Drive Service Factor	Direct drive
Fan Performance	
Airflow	20000 cfm
Total Static Pressure	4.106 in H2O
Total Brake Power	18.637 hp
Operating Speed	1756 rpm
AMCA FEG	FEG85
Bare fan peak total efficiency	76.70 %
Unit Static Efficiency	69.46 %
Motor Interface Options	
Selection Type	VFD
Voltage	575/3
Mounting Location	Internal mounting
Motor Wire In Conduit	Motor wiring conduit
VFD Frequency	60.00 Hz

Motor Data	
Power / Fan	10 hp
Voltage	575/3
Speed	1800
Class	NEMA premium compliant TEFC
Efficiency	92.12 %
Part Load Efficiency	89.40 %
Fan electrical power (FEP)	15.76 kW
AHRI VFD HP	20.000 hp
Wire to air static efficiency	61.16 %

Note: VFD driven motor fan electrical power calculated in accordance with AHRI 430.

Fan Section Options	
Fan Wheel Balance	Inverter balance with shaft grounding
Door Location	Right
Door Guard	Yes

Fan Discharge Options

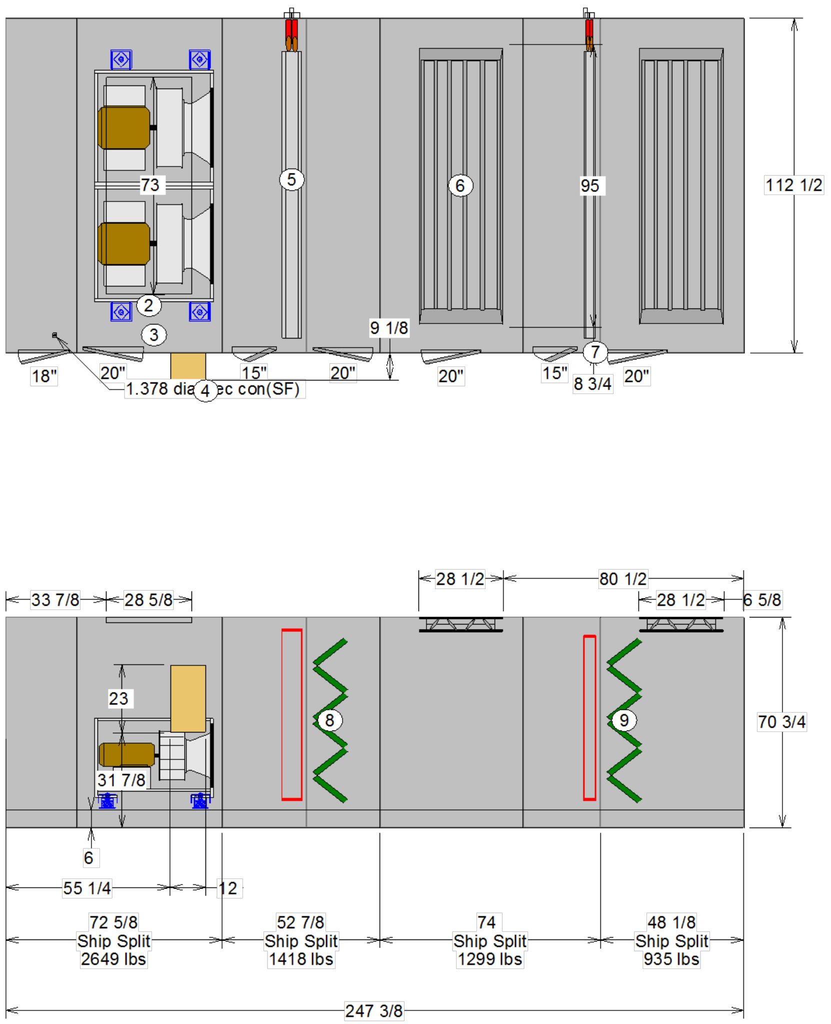
Face	Type	Airflow	Face Velocity	Area	Pressure Drop	Exhaust Hood	Damper Torque Requirement
Top Face Feature	Sizeable rectangular opening	20000 cfm	1361 ft/min	14.70 sq ft	0.231 in H2O	N/A	N/A

Note: Certified by the AHRI Central Station Air-Handling Unit (AHU) Certification Program, based on AHRI Standard 430/431. AHRI certified units are subject to rigorous and continuous testing, have performance ratings independently measured and are third party verified. Certified units may be found in the AHRI Directory at www.ahridirectory.org.

AHRI CERTIFIED® www.ahridirectory.org
Central Station Air-Handling Unit Supply Fans
AHRI Standards 430/431

Pressure Drop in (in w.g.)	
Supply fan	
Air mixing section	0.63
Coil section	0.13
Air mixing section	0.13
Filter section	0.57
Coil section	0.17
Fan section	0.23
Internal Static Pressure	**1.86**
External Static Pressure	**2.25**
Total Static Pressure	**4.11**

Starter/VFD only section - Position: 7	
Supply Fan Motor Interface Door	Right



1	1.378 dia elec con(SF)
2	Opening top 73 x 28.625
3	Plenum fan - 24.5in. dd plenum, full width, H press Supply fan 10 hp 575/3
4	External unit controller RH
5	Heating coil - 2 Rows Coil type 1/2" Unit Optimized, General (UW)
6	Damper top-opposed blade 95 x 28.5 (2)
7	Heating coil - 1 Rows Coil type 5/8" Shipping Coil, General (5W)
8	Angled filters - Pleated media - MERV 8
9	Angled filters -
	Doors 18 width x 61 height 20 width x 61 height 15 width x 61 height

For maneuvering purposes, include 1.125 inches to each ship split length for overlapping panel flange. Flange will not add to overall installed unit length shown.

OPENING AND DIMENSIONS MAY VARY FROM CONTRACT DOCUMENTS / RETURN OF APPROVED DRAWINGS CONSTITUTES ACCEPTANCE OF THESE VARIANCES / NOT TO SCALE

Unit size: 40	Job Name: Pan Am Pool Air Handler Upgrade	Unit Casing: 2in Double Wall Foam	TRANE Performance Climate Changer Air Handlers
Product group: Indoor unit	Actual airflow: 20000	Proposal Number:	
Integral base frame: 6in. integral base frame	Sales Office:	Tags: F-4	
Paint:		Rigging weight: 6169.7 / Installed weight: 6301.1	

Trane Performance Climate Changer Air Handler

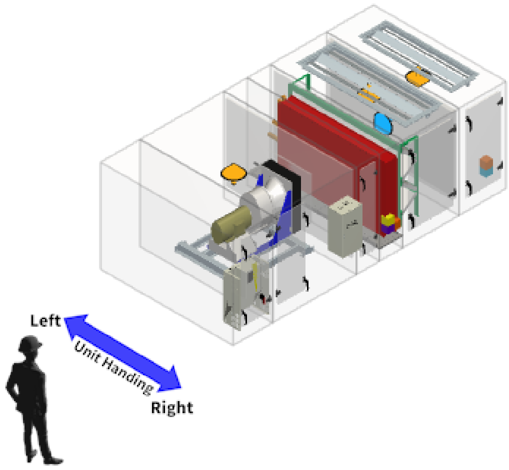
Unit Overview - F-5

Application	Unit Size	External Dimensions			Weight	
		Height	Width	Length	Installed	Rigging
Indoor unit	CSAA021	56.3 in	80.0 in	165.1 in	3119 lb	3016 lb
Quantity of Shipping Sections		Largest Ship Split			Heaviest Ship Split	Elevation
		Height	Width	Length		
3 piece(s)		56.3 in	80.0 in	88.5 in	1817 lb	0.00 ft

Supply Fan			
Airflow	13000 cfm	Total Static Pressure	4.678 in H2O

Construction Features

Panel	2in. foam injected R-13 with thermal break
Panel Material	All unit inner panels - stainless steel
Integral Base Frame	6in. integral base frame
Short Circuit Current Rating	5 kA
Agency Approval	UL listed unit



Unit Electrical

Circuit	Voltage/Phase/Frequency	FLA	MCA	Max Fuse Size
Circuit number 1 Supply fan + controls-LL	575/3/60	22.52 A	28.02 A	50.00 A

Unit Controls

Factory Controls Package	Variable volume
Controller Type	UC600
Controller mounting	Unit mounted
Controller location	Right

Warranty

Warranty section	Std. warranty only

Air mixing section - Position: 1

Openings							
Face	Path	Type	Airflow	Face Velocity	Area	Pressure Drop	Hood
Top	Outside	High velocity opposed damper	13000 cfm	2486 ft/min	5.23 sq ft	1.115 in H2O	N/A

Section Options	
Door Location	Right

Air mixing section - Position: 2

Openings							
Face	Path	Type	Airflow	Face Velocity	Area	Pressure Drop	Hood
Top	Return	Opposed blade damper	13000 cfm	1505 ft/min	8.64 sq ft	0.246 in H2O	N/A

Filter				
Type	**Frame**	**MERV Rating**	**Quantity**	**Size**
Pleated media - MERV 8	2"	MERV 8	12.00	16in.x25in.
Pressure Drop	**Condition**	**Face Velocity**	**Airflow**	**Area**
0.607	Mid-life	390 ft/min	13000 cfm	33.33 sq ft

Section Options	
Door Location	Right

Heating coil section - Position: 3

Coil Construction	
Model	Hot water - 5/8" Shipping Coil, General (W)
Rows	4
Tube Diameter	5/8in. tube diameter (15.875 mm)
Coil Connection	Standard
Tube Matl/Wall Thickness	.020" (0.508 mm) copper tubes
Fin Spacing	107 Per Foot
Fin Material	Aluminum fins
Fin Type	Prima flo H (Hi efficient)
Face Area	19.83 sq ft
Coil (top/single) H x L	42 in. (1067 mm) X 68" (1727 mm) finned length
Casing	Stainless steel
Turbulators	Yes
Rigging Weight	302.8 lb
Installed Weight	405.0 lb
Coil Section Options	
Extended Drain and Vent	Holes only
Drain Pan	Stainless steel
Drain Connection	Left
Minimum Trap Height (L)	8.169 in
H Trap Dimension	4.779 in
J Trap Dimension	2.390 in

Coil Performance	
Capacity	
Total	1409.85 MBh
Air	
Flow	13000 cfm
Entering Dry Bulb	-30.00 F
Leaving Dry Bulb	70.00 F
Pressure Drop	0.544 in H2O
Face Velocity	655 ft/min
Fluid	
Flow	80.63 gpm
Entering	140.00 F
Leaving	100.00 F
Pressure Drop	9.82 ft fluid
Tube Velocity	3.18 ft/s
Reynolds Number	6867.02
Type	Propylene glycol
Concentration	50.00 %
Fouling Factor	0.00025 hr-sq ft-deg F/Btu
Volume	12.28 gal
AHRI 410 Classification	
AHRI 410 Classification	NOT Certified by AHRI
Data Generation Date	10/25/2022
Trane Select Assist update number	2640

Note: Coil is NOT certified by AHRI. Coil is within the scope of AHRI Standard 410.

Access/blank/turning section - Position: 4

Options	
Section Length	14.000 in
Door Location 1	Right

Supply fan section - Position: 5

Fan Data	
Wheel Diameter/Type/Class	24.5in. dd plenum, 80% width, H press
Fan Quantity	1
Discharge Location	Top front
Motor Location	Right side drive
Blades	Higher eff.(some bands lower,more spike)
Drive Service Factor	Direct drive
Fan Performance	
Airflow	13000 cfm
Total Static Pressure	4.678 in H2O
Total Brake Power	16.350 hp
Operating Speed	2331 rpm
Total Brake HP	16.350 hp
AMCA FEG	FEG85
Bare fan peak total efficiency	76.70 %
Unit Static Efficiency	58.63 %
Motor Interface Options	
Selection Type	VFD
Voltage	575/3
Mounting Location	Internal mounting
Motor Wire In Conduit	Motor wiring conduit
VFD Frequency	79.00 Hz

Motor Data	
Power / Fan	20 hp
Voltage	575/3
Speed	1800
Class	NEMA premium compliant TEFC
Efficiency	93.07 %
Part Load Efficiency	89.46 %
Fan electrical power (FEP)	13.51 kW
AHRI VFD HP	20.000 hp
Wire to air static efficiency	52.83 %

Note: VFD driven motor fan electrical power calculated in accordance with AHRI 430.

Fan Section Options	
Fan Wheel Balance	Inverter balance with shaft grounding
Door Location	Right
Door Guard	Yes

Fan Discharge Options

Face	Type	Airflow	Face Velocity	Area	Pressure Drop	Exhaust Hood	Damper Torque Requirement
Top Face Feature	Sizeable rectangular opening	13000 cfm	1826 ft/min	7.12 sq ft	0.417 in H2O	N/A	N/A

Note: Certified by the AHRI Central Station Air-Handling Unit (AHU) Certification Program, based on AHRI Standard 430/431. AHRI certified units are subject to rigorous and continuous testing, have performance ratings independently measured and are third party verified. Certified units may be found in the AHRI Directory at www.ahridirectory.org.

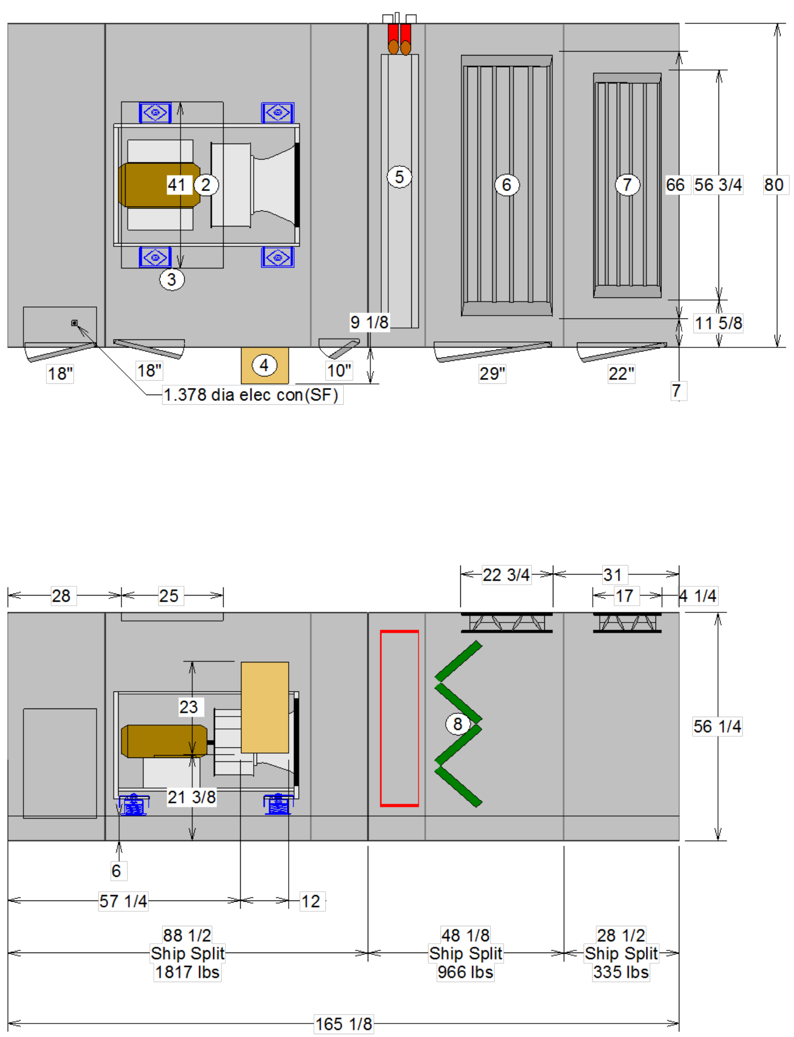
AHRI CERTIFIED® www.ahridirectory.org
Central Station Air-Handling Unit Supply Fans AHRI Standards 430/431

Pressure Drop in (in w.g.)

Supply fan	
Air mixing section	1.11
Air mixing section	0.85
Coil section	0.54
Fan section	0.42
Internal Static Pressure	**2.93**
External Static Pressure	**1.75**
Total Static Pressure	**4.68**

Starter/VFD only section - Position: 6

Supply Fan Motor Interface Door	Right



1 1.378 dia elec con(SF)
2 Plenum fan - 24.5in. dd plenum, 80% width, H press Supply fan 20 hp 575/3
3 Opening top 41 x 25
4 External unit controller RH
5 Heating coil - 4 Rows Coil type 5/8" Shipping Coil, General (W)
6 Damper top-opposed blade 66 x 22.75
7 Damper top-opposed blade 56.75 x 17
8 Angled filters -

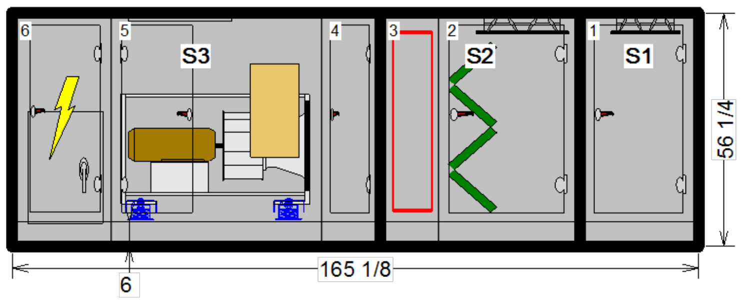
Doors
18 width x 46 height
10 width x 46 height
29 width x 46 height
22 width x 46 height

For maneuvering purposes, include 1.125 inches to each ship split length for overlapping panel flange. Flange will not add to overall installed unit length shown.

OPENING AND DIMENSIONS MAY VARY FROM CONTRACT DOCUMENTS / RETURN OF APPROVED DRAWINGS CONSTITUTES ACCEPTANCE OF THESE VARIANCES / NOT TO SCALE

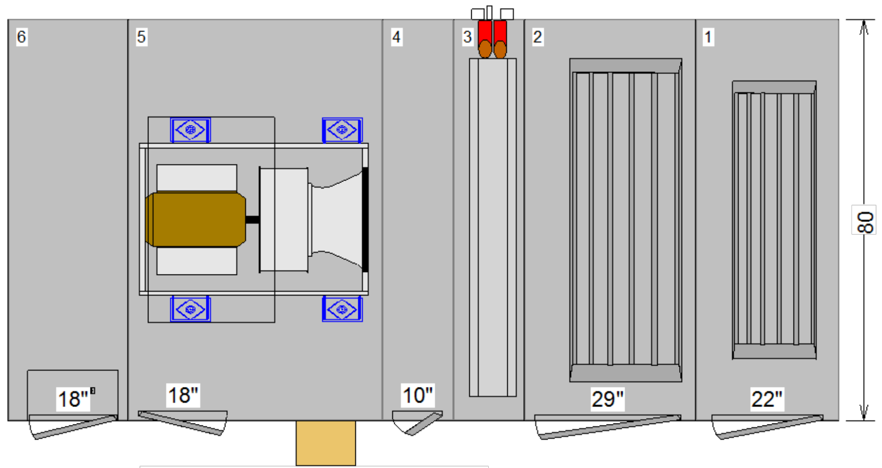
Unit size: 21	Job Name: Pan Am Pool Air Handler Upgrade	Unit Casing: 2in Double Wall Foam	TRANE Performance Climate Changer Air Handlers
Product group: Indoor unit	Actual airflow: 13000	Proposal Number:	
Integral base frame: 6in. integral base frame	Sales Office:	Tags: F-5	
Paint:		Rigging weight: 3016.5 / Installed weight: 3118.7	

Shipping splits are indicated by thick black lines



For maneuvering purposes, include 1.125 inches to each ship split length for overlapping panel flange. Flange will not add to overall installed unit length sh

Pos #	Module	Length	Weight
1	Air mixing section	28 1/2	335.25
2	Air mixing section	34 1/8	439.78
3	Coil section	14	526.38
4	Access section	14	136.06
5	Fan section	50 5/8	1315.30
6	Controls section	23 7/8	365.95
	Installed Unit Weight	3118.72 lbs	



Basic Overall Plan View: Top - Measurements in inches

OPENING AND DIMENSIONS MAY VARY FROM CONTRACT DOCUMENTS / RETURN OF APPROVED DRAWINGS CONSTITUTES ACCEPTANCE OF THESE VARIANCES / NOT TO SCALE

Unit size: 21	Job Name: Pan Am Pool Air Handler Upgrade	Unit Casing: 2in Double Wall Foam	Performance Climate Changer Air Handlers
Product group: Indoor unit	Actual airflow: 13000	Proposal Number:	
Integral base frame: 6in. integral base frame	Sales Office:	Tags: F-5	
Paint:		Rigging weight: 3016.5 / Installed weight: 3118.7	

APPENDIX B

Figures

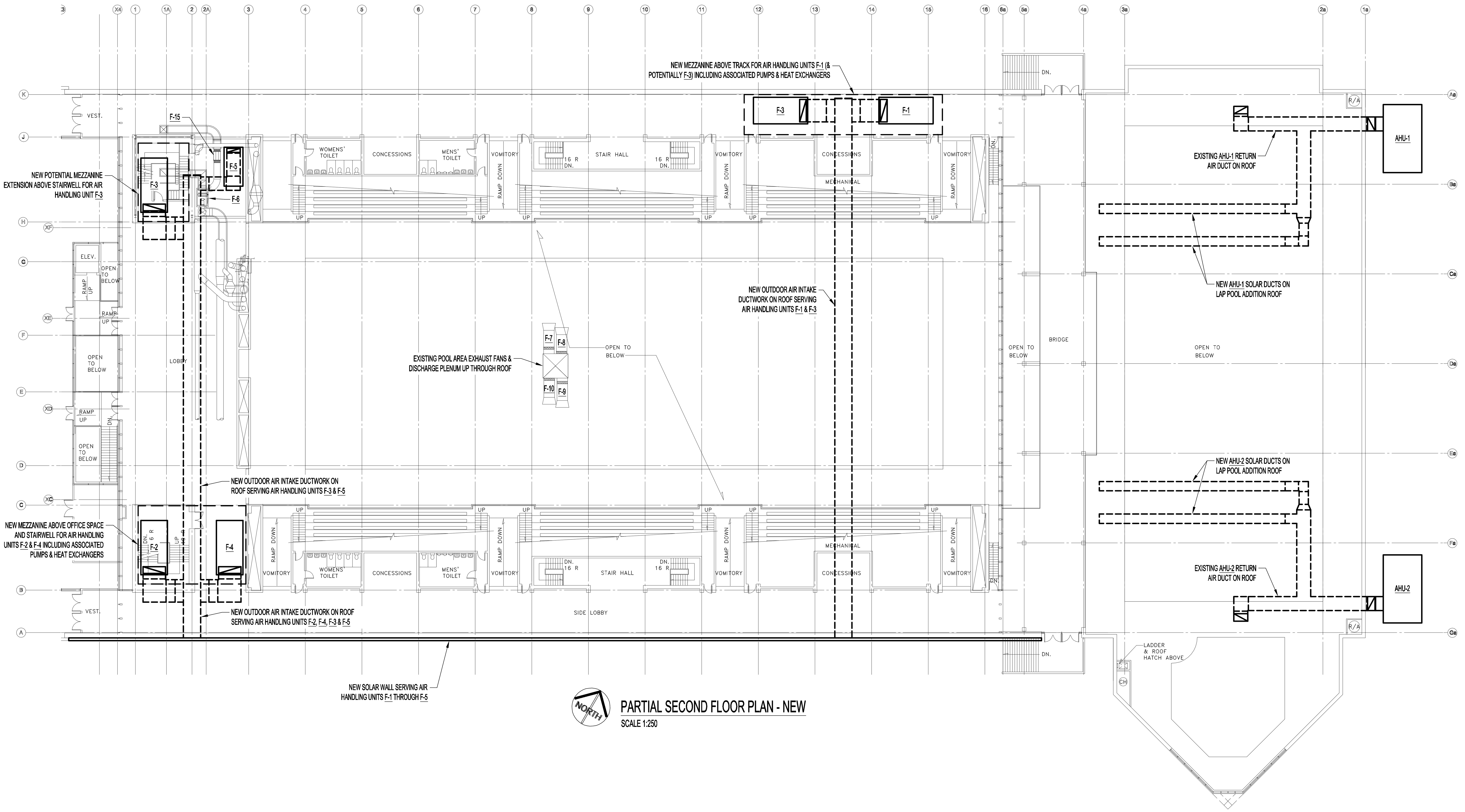
FILE NAME:

DATE:

SHEET TITLE: PROPOSED AIR HANDLING EQUIPMENT LOCATIONS, SOLAR WALL AND SOLAR DUCT ARRAYS

PROJECT No: 22-0107-012

ADDRESS: 25 POSEIDON BAY



PARTIAL SECOND FLOOR PLAN - NEW

SCALE 1:250

5000 0 5000 10000 15000 20000

SCALE: 1:250mm (24"x36")

NOTES:

THESE DRAWINGS SHALL NOT BE SCALED.

THE CONTRACTOR SHALL VISIT THE SITE AND SATISFY ONESELF ALL DIMENSIONS, DATUM, AND DETAILED INFORMATION SHOWN ARE CORRECT.

THE CONTRACTOR IS TO REVIEW AND COORDINATE ALL ARCHITECTURAL, MECHANICAL, ELECTRICAL AND STRUCTURAL DRAWINGS FOR ADDITIONAL OPENINGS THROUGH FLOORS, WALLS, AND CEILINGS FOR DUCT, PIPE & ELECTRICAL RISERS AND ALL OPENINGS NOT SHOWN ON DRAWINGS.

ALL OPENINGS THROUGH THE FIRE SEPARATIONS AS A RESULT OF THE WORK OF THIS CONTRACT ARE TO BE FIRE STOPPED AND SEALED WITH ULC APPROVED FIRE STOPPING TO MAINTAIN THE INTEGRITY OF THE FIRE SEPARATION, AND PROVIDE AND SMOKE-TIGHT BARRIER.

ALL PRODUCTS AND MATERIALS TO BE USED AND INSTALLED SHALL CONFORM WITH MANUFACTURER'S SPECIFICATIONS & APPLICABLE CODES.

THE CONTRACTOR SHALL BE RESPONSIBLE TO PATCH AND MAKE GOOD ALL EXISTING CONSTRUCTION AFFECTED BY THE REMOVAL OF ALL ITEMS FORMING THE PART OF THE RENOVATION WORK.

WHERE NEW FLOORING AND BASE IS TO BE INSTALLED IN EXISTING AREAS (REFER TO FLOOR PLAN AND ROOM SCHEDULE) THE EXISTING FLOORING SURFACE AND BASE MUST BE REMOVED, UNLESS OTHERWISE NOTED. ALL FLOOR SURFACES SHALL BE PREPARED IN ACCORDANCE TO MANUFACTURER'S RECOMMENDATIONS FOR INSTALLATION OF NEW FLOOR.

WHERE PAINTING OF EXISTING WALLS IS INDICATED ON THE ROOM SCHEDULE, THESE WALLS MUST BE CLEANED OF ANY EXISTING WALL COVERING, PATCHED & PREPARED TO ACCEPT NEW MATERIAL, UNLESS OTHERWISE NOTED.

No.	REVISION/DESCRIPTION	BY	DATE
A	ISSUED FOR REPORT	DSO	22.01.16

SEAL

PRELIMINARY

NOT TO BE USED FOR CONSTRUCTION

DRAWN LNM	CHECKED DSO	DESIGNED LNM	APPROVED DSO
DATE 22.01.16	USER APPROVAL		

Winnipeg

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

PROJECT

SOLAR ENERGY OPPORTUNITIES REASSESSMENT
PAN AM POOL
25 POSEIDON BAY

SHEET TITLE

PROPOSED AIR HANDLING EQUIPMENT LOCATIONS, SOLAR WALL AND SOLAR DUCT ARRAYS

KGS GROUP

SCALE	PROJECT No:	SHEET No:
AS SHOWN	22-0107-012	FIGURE 1

DRAWING SHEET SIZE: A1 (841mm x 594mm) PLOT 1:1

APPENDIX C

Payback Analysis

Gas Consumption per Year

	Baseline	New
Option 1	263860 m3	193960 m3
Option 2	81952 m3	57720 m3

Install Costs

Option 1	$ 630,000.00
Option 2	$ 198,000.00

			Utility Rate Costs				Option 1					Option 2				
n	P/F @ 2%	Year	Average Rate	Escalation (2%)	Carbon Tax Charge	Total	Baseline Gas Cost	New Gas Cost	Savings	Present Worth	Remaining Payback	Baseline Gas Cost	New Gas Cost	Savings	Present Worth	Remaining Payback
		2018	$ 0.12	$ -	$ 0.02	$ 0.14										
		2019	$ 0.09	$ -	$ 0.04	$ 0.13										
		2020	$ 0.08	$ -	$ 0.06	$ 0.14										
		2021	$ 0.18	$ -	$ 0.08	$ 0.26										
		2022	$ 0.18	$ -	$ 0.10	$ 0.28										
1	0.9804	2023		$ 0.19	$ 0.13	$ 0.31	$ 81,796.60	$ 60,127.60	$21,669.00	$ 21,244.29	$ 608,755.71	$ 25,405.12	$ 17,893.20	$ 7,511.92	$ 7,364.69	$ 190,635.31
2	0.9612	2024		$ 0.19	$ 0.16	$ 0.35	$ 92,351.00	$ 67,886.00	$24,465.00	$ 23,515.76	$ 585,239.95	$ 28,683.20	$ 20,202.00	$ 8,481.20	$ 8,152.13	$ 182,483.18
3	0.9423	2025		$ 0.19	$ 0.19	$ 0.38	$ 100,266.80	$ 73,704.80	$26,562.00	$ 25,029.37	$ 560,210.58	$ 31,141.76	$ 21,933.60	$ 9,208.16	$ 8,676.85	$ 173,806.34
4	0.9238	2026		$ 0.20	$ 0.22	$ 0.41	$ 108,182.60	$ 79,523.60	$28,659.00	$ 26,475.18	$ 533,735.40	$ 33,600.32	$ 23,665.20	$ 9,935.12	$ 9,178.06	$ 164,628.27
5	0.9057	2027		$ 0.20	$ 0.24	$ 0.45	$ 118,737.00	$ 87,282.00	$31,455.00	$ 28,488.79	$ 505,246.60	$ 36,878.40	$ 25,974.00	$10,904.40	$ 9,876.12	$ 154,752.16
6	0.888	2028		$ 0.20	$ 0.27	$ 0.48	$ 126,652.80	$ 93,100.80	$33,552.00	$ 29,794.18	$ 475,452.43	$ 39,336.96	$ 27,705.60	$11,631.36	$ 10,328.65	$ 144,423.51
7	0.8706	2029		$ 0.21	$ 0.30	$ 0.51	$ 134,568.60	$ 98,919.60	$35,649.00	$ 31,036.02	$ 444,416.41	$ 41,795.52	$ 29,437.20	$12,358.32	$ 10,759.15	$ 133,664.36
8	0.8535	2030		$ 0.21	$ 0.33	$ 0.55	$ 145,123.00	$ 106,678.00	$38,445.00	$ 32,812.81	$ 411,603.60	$ 45,073.60	$ 31,746.00	$13,327.60	$ 11,375.11	$ 122,289.25
9	0.8368	2031		$ 0.22	$ 0.33	$ 0.55	$ 145,123.00	$ 106,678.00	$38,445.00	$ 32,170.78	$ 379,432.83	$ 45,073.60	$ 31,746.00	$13,327.60	$ 11,152.54	$ 111,136.71
10	0.8203	2032		$ 0.22	$ 0.33	$ 0.55	$ 145,123.00	$ 106,678.00	$38,445.00	$ 31,536.43	$ 347,896.39	$ 45,073.60	$ 31,746.00	$13,327.60	$ 10,932.63	$ 100,204.08
11	0.8043	2033		$ 0.23	$ 0.33	$ 0.56	$ 147,761.60	$ 108,617.60	$39,144.00	$ 31,483.52	$ 316,412.87	$ 45,893.12	$ 32,323.20	$13,569.92	$ 10,914.29	$ 89,289.80
12	0.7885	2034		$ 0.23	$ 0.33	$ 0.56	$ 147,761.60	$ 108,617.60	$39,144.00	$ 30,865.04	$ 285,547.83	$ 45,893.12	$ 32,323.20	$13,569.92	$ 10,699.88	$ 78,589.91
13	0.773	2035		$ 0.24	$ 0.33	$ 0.57	$ 150,400.20	$ 110,557.20	$39,843.00	$ 30,798.64	$ 254,749.19	$ 46,712.64	$ 32,900.40	$13,812.24	$ 10,676.86	$ 67,913.05
14	0.7579	2036		$ 0.24	$ 0.33	$ 0.57	$ 150,400.20	$ 110,557.20	$39,843.00	$ 30,197.01	$ 224,552.18	$ 46,712.64	$ 32,900.40	$13,812.24	$ 10,468.30	$ 57,444.76
15	0.743	2037		$ 0.24	$ 0.33	$ 0.58	$ 153,038.80	$ 112,496.80	$40,542.00	$ 30,122.71	$ 194,429.47	$ 47,532.16	$ 33,477.60	$14,054.56	$ 10,442.54	$ 47,002.22
16	0.7284	2038		$ 0.25	$ 0.33	$ 0.58	$ 153,038.80	$ 112,496.80	$40,542.00	$ 29,530.79	$ 164,898.68	$ 47,532.16	$ 33,477.60	$14,054.56	$ 10,237.34	$ 36,764.88
17	0.7142	2039		$ 0.25	$ 0.33	$ 0.59	$ 155,677.40	$ 114,436.40	$41,241.00	$ 29,454.32	$ 135,444.36	$ 48,351.68	$ 34,054.80	$14,296.88	$ 10,210.83	$ 26,554.04
18	0.7002	2040		$ 0.26	$ 0.33	$ 0.59	$ 155,677.40	$ 114,436.40	$41,241.00	$ 28,876.95	$ 106,567.41	$ 48,351.68	$ 34,054.80	$14,296.88	$ 10,010.68	$ 16,543.37
19	0.6864	2041		$ 0.27	$ 0.33	$ 0.60	$ 158,316.00	$ 116,376.00	$41,940.00	$ 28,787.62	$ 77,779.79	$ 49,171.20	$ 34,632.00	$14,539.20	$ 9,979.71	$ 6,563.66
20	0.6730	2042		$ 0.27	$ 0.33	$ 0.60	$ 158,316.00	$ 116,376.00	$41,940.00	$ 28,225.62	$ 49,554.17	$ 49,171.20	$ 34,632.00	$14,539.20	$ 9,784.88	-$ 3,221.22
21	0.6598	2043		$ 0.28	$ 0.33	$ 0.61	$ 160,954.60	$ 118,315.60	$42,639.00	$ 28,133.21	$ 21,420.96	$ 49,990.72	$ 35,209.20	$14,781.52	$ 9,752.85	-$ 12,974.07
22	0.6468	2044		$ 0.28	$ 0.33	$ 0.61	$ 160,954.60	$ 118,315.60	$42,639.00	$ 27,578.91	-$ 6,157.94	$ 49,990.72	$ 35,209.20	$14,781.52	$ 9,560.69	-$ 22,534.75
23	0.6342	2045		$ 0.29	$ 0.33	$ 0.62	$ 163,593.20	$ 120,255.20	$43,338.00	$ 27,484.96	-$ 33,642.90	$ 50,810.24	$ 35,786.40	$15,023.84	$ 9,528.12	-$ 32,062.87
24	0.6217	2046		$ 0.29	$ 0.33	$ 0.63	$ 166,231.80	$ 122,194.80	$44,037.00	$ 27,377.80	-$ 61,020.71	$ 51,629.76	$ 36,363.60	$15,266.16	$ 9,490.97	-$ 41,553.84
25	0.6095	2047		$ 0.30	$ 0.33	$ 0.63	$ 166,231.80	$ 122,194.80	$44,037.00	$ 26,840.55	-$ 87,861.26	$ 51,629.76	$ 36,363.60	$15,266.16	$ 9,304.72	-$ 50,858.57

PAYBACK
22 Years

PAYBACK
20 Years

KGS GROUP

Experience in Action