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St George's Church
Modbury

Heating Option Study

Rev – 1

October 2021

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-	Preliminary Issue for Comment	JRL	October 2021
1	Incorporating comments	JRL	November 2021

Contents:

1.0 Executive Summary

Originating from the 14th Century, St George's Anglican Church located in Modbury is looking to replace the existing warm air heating system which has been nurtured along for a number of years and has now failed.

Since this time, a number of Electric Quartz radiant panel heaters have been installed as a temporary solution. The replacement solution needs to suit the needs of the church and the intent to welcome more community groups.

Mechanical and Electrical Consulting Engineers Hulley & Kirkwood have been appointed to undertake an options study for replacement heating throughout the church. Following a site inspection on the 14th October at which time discussions were held with Robin Chambers, representing the Modbury PCC, (including the Church Architect, Jeremy Chadburn), the following report has been produced.

The emphasis of the report is to address the past performance of the existing direct gas fired warm air heater and to consider practical solutions for heating the whole building, functioning during the new operational times and considering long term solutions for Decarbonising the heating.

The existing heating system consists of a direct gas fired warm air heater located in a room over the porch which is accessed from the adjacent tower. Air is entrained into the plantroom from an opening in the top of the tower, through a grille in the door, and into the unit. A burner within the unit heats the air and an integral fan draws the warm air and combustion products discharging them into the rear of the nave at high level.

There is no associated extract from the church and no distribution of air within the body of the church. We are advised that the recently upgraded toilets are heated by electric panel heaters and that there is no other heating in the church following the removal of the gas boilers from the basement rooms.

Key issues with this heating are the poor circulation of heat, inefficient operation and discharge of wet, corrosive flue gasses in the church.

Finned pipe coils remain in situ below grates in the floor, typically along the aisles, transept, crossing and alter. These are not connected to an operational heat source and the floor trenches have, in part been used for the distribution of small power cables.

It has been suggested that these may be used as part of a warm air distribution system, however they are of relatively small cross section and whilst they are suitable for the finned heating coils that they contain, they are of insufficient size for the circulation of adequate warm air heating air volumes.

Following a review of the options available to re-provide heating to the church, there are a number of solutions which will address the functional requirements, improve the distribution of heat and reduce the associated Carbon emissions.

The simplest and most cost effective solution would be to provide a new gas fired boiler(s) feeding 2 separate circuits. The first to serve a traditional radiator circuit to provide back ground heating and a second to serve a fan convector circuit to provide rapid warm up. This is likely to be the most cost effective solution, will have a level of disruption to the building fabric and whilst an improvement on the Carbon emissions, could be better. Key challenges will be the boiler flues and routing of the pipework

The alternative more environmentally friendly solution would be to provide underfloor heating (UFH), either throughout the church, or restricted to distinct areas, linked to an air source heat pump (ASHP) array to provide the back ground heat. Where necessary, finned radiators or fan convectors can be added linked to the UFH pipework, or on a separate circuit.

There are a number of intrusive exercises for which it will be necessary to revert to the Church Architect to advise / direct accordingly, namely the disruption to the floors, integration of heat emitters into the current fixtures and fittings along with the visual impact of the external ASHP units and associated noise from the units. A load assessment will be required to ascertain whether the incoming electrical supply will need to be upgraded to accommodate the change of fuel source.

It is worth highlighting the risk associated with intrusive works in the floor. The age of the building and its use means that it is highly likely that there will need to be a number of archaeological studies and potential risk over the nature of the material that will be under the floor.

Recent project experience suggests that the church may need to be closed completely for several months and due to the delicate nature of the works, the costs are likely to increase potentially adding significantly to the current project.

It is however worth noting that large parts of the floor slabs appear to be relatively new and there are also sections of concrete in fill which suggest that the floor has been disturbed in recent history. Further advice from the Church Architect suggests that there are damp patches on the floor that will require intrusive investigation.

It may be necessary to introduce additional temporary measures into the church whilst the assessment, approvals and funding processes are completed. It its simplest form the introduction of further quartz radiant heaters could be considered with a further option of a temporary external ducted warm air heater.

Units are available to hire from a number of local companies on long term leases and would either connect to the existing gas or electrical supply and deliver the heat to the church from the external unit via flexible ducting.

2.0 Introduction

Consulting Engineers, Hulley & Kirkwood have been appointed to look at options for a sustainable replacement heating system that meets the requirements of the church today and into the future.

The existing heating system has failed and did not provide a well distributed environment throughout the building and was introducing potentially damage corrosive moist air.

The following report reviews the existing installation and considers options for the replacement of the central plant, distribution systems and heat emitters.

The key aspirations of the project are to provide comfortable, reliable conditions for the parishioners with a view to expand the groups using the church and to protect the building fabric and historic artefacts within the church. A preference for a sustainable solution that addresses / prepares for the Zero Carbon future.

3.0 Review of the current installation

The existing heating installation consists of a single central direct gas fired warm air heater located above the porch in a dedicated plantroom. The now failed unit draws air from an opening at the top of the tower stair case and through a grille in the access door and into the unit. This air is entrained by the integral fan in the warm air heater,

A gas burner at the front of the unit warms the air inside the heater and also discharges its flue gasses directly into the air stream which is then blown into the nave at high level via a single wall diffuser. There is no further distribution of air, or high level destratification fans and no extract system provided.

A wall mounted "Niche" controller is located at low level in the nave on the outside wall of the porch and provides on/off, time and extension operation.

The gas supply to the plantroom has been previously extended from the customer side of the meter in the basement rooms (adjacent to where the now removed boiler plant was located).

The gas pipe runs below ground before entering the porch rising to the plantroom above. There is no safety provision on the incoming gas supply pipes, with manual isolation only nor are there any Carbon Monoxide Detection/ Alarms.

The wall grille is a simple 9 segment egg crate unit and as such has no ability to direct the air.

The warm wet air will discharge straight out of the grille towards the wall on the opposite side of the nave and being considerably warmer than the air within the church, will only drop to low level as it starts to cool.

There are no motive effects to direct the air along the nave towards the alter and in fact the open tower adjacent the porch, being the high point is likely to be the destination for the air supply, pulling warm air away from the alter.

With the "cool radiant" effects of the building fabric, the tendency for the air to remain at high level / be drawn away from circulating to the open plan area and the introduction of wet corrosive air from the gas combustion products we do not consider a like for like replacement to be appropriate.

Appendix 1 shows elements of the current installation indicating the extent and the condition of the existing systems.

4.0 Review of the alternative central plant and heat emitter options

There are numerous options for the replacement of the central plant and the selection will be based upon the key drivers such as cost, (be that capital or operational), environmental aspirations, physical space, operational use, level of intrusion, archaeology, timescales and statutory / planning legislation, including archaeological impact.

Typical plant that might be considered as a source of heat are –

- Gas fired boilers (either LPG or Mains gas)
- Oil fired boilers
- Biomass boilers
- Air source heat pumps
- Ground source heat pumps
- Electric heating
- Combined Heat and Power

There are a number of limiting factors that will have to be taken into account, which will limit the range of central plant that can be used as follows –

- Operating temperatures
- Physical space of the plant / collectors
- Noise issues
- Fluing issues
- Regulation compliance
- Archaeology

Hand in hand with the central plant are the heat emitters that are to be used. Different heat emitters require different operating temperatures and depending on what these are, only some of the central plant options will be able to supply these temperatures.

A typical wet heating installation operates at temperatures for church buildings and other public buildings, i.e. roughly 82°C flow and 71°C return, depending on the age with new systems operating at lower temperatures with a wider flow and return temperature difference to improve efficiency. This allows the radiator and pipe emitter sizes to the optimised whilst also providing relatively safe temperatures for able bodied people. Where less able bodied people and very young children are frequent users, lower temperatures are often used to limit the risk of burns from prolonged contact.

Safe temperatures for these circumstances are deemed to be in the region of 43°C. This is achieved either by alternative plant / emitters, or protective cases to the emitters/ and insulation / boxing of the pipework. This can also be achieved through the use of underfloor heating.

We have been advised that a heating solution that provides both background heating and also quick warm up heating is desirable and potentially zoned to enable the different functionality intended in the various areas of the church. Further the compartmentation of the nave to provide separate spaces is being considered which will further impact on the recommended solutions.

Higher Operating Temperature solutions

Gas Fired Boilers

Gas fired boilers are familiar technology for most people, they simply burn gas to generate a heat source for heating water which is then circulated to a heating circuit in the occupied space. The gas can either be from a town network, or from bottles / cylinders. We understand that there is a Mains Gas supply to the building and as such LPG (bottled / tank gas) will not be considered further.

Key points to note are the products of combustion need to be vented to outside and there needs to be a supply of combustion air. Depending upon the local regulations, this can either be discharged at low level away from passing people, or may have to be discharged at high level.

This form of heating is very efficient and cleaner than any other form of combustion heating with the exception of Hydrogen.

There is a move away from gas fired heating solutions to greener fuels, but it is likely that gas will be available for the lifespan of any replacement plant and the intended introduction of hybrid gas / Hydrogen to the mains gas infrastructure will result in reduced emissions going forward.

Mains gas would be suitable for the replacement plant to the preferred emitters and operation.

Oil Fired boilers.

In a similar way to gas fired boilers, oil is burnt to generate hot water via a heat exchanger (indirect heating) for circulation through the emitters. The products of combustion include other contaminants which require alternative fluing solutions and are subject to further regulation than gas.

As mains gas is available, oil as a more expensive and more polluting fuel source is not considered further.

Biomass Boilers

A biomass boiler operates in a similar way to an older gas or oil boiler. Wood pellets, wood chips or miscanthus are combusted to heat typically a cast iron water vessel from where water is circulated to a radiator or underfloor heating system. Biomass is considered to be carbon neutral due to the short carbon cycle of the fuel source, but there are other products of combustion which require more onerous arrangements.

An external fuel store, typically a hopper would be required along with a fuel transfer mechanism, typically an auger to carry the fuel from the store to the combustion chamber. In addition, there is a requirement for the ashes to be removed and disposed of. The combustion emissions also require the flues to be discharged at high level away from windows or air intakes.

Biomass boilers are appropriate where there is a strong environmental driver to be included and there are a team which are suitable trained in their management/operation.

Biomass boilers do require continuous care and regular extensive servicing and as such the Modbury PCC should consider if they have a suitable team to do this now and into the future before further consideration.

Combined Heat and Power

Combined Heat and power utilises a small engine / turbine to generate electricity and a waste product of heat which would be suitable for use in a heating system. Fundamentally it is the same as having a small scale power station but rather than 2/3 of the energy being lost as heat and electrical transmission losses, this lost energy is mostly captured and remains as a benefit to the building.

The units are either sized on the heating or electrical demand and backed up by mains (grid) electrical supply, or an alternative heat source. Excess energy, (normally electricity) can be sold back to the grid subject to agreement with the local network provider.

CHP would be a sensible option for a building with a continuous heat and electrical demand which are matched. It is unlikely that this would be the case with the church and as such this system is excluded from further consideration.

Higher operating Temperature systems - Heat Emitters

These solutions are best pared to heat emitters that operate most efficiently at higher temperatures such as Radiators, Radiant panels and Fan convectors. The size of the emitter is based upon the difference between the average surface temperature and room temperature and as such the emitters are smaller as the distribution temperature increases.

Lower Operating Temperature solutions

Air source and ground source heat pumps

Air source and ground source heat pumps utilise low grade energy either from the air, or from the ground in combination with a refrigeration cycle to generate low grade heat in the form of warm water which is typically paired to underfloor heating.

It is possible to utilise multiple refrigeration cycles to increase the heat output to be suitable for use in radiator circuits, but this increases capital cost and reduces the efficiency of the system.

Both systems utilise an electrical supply to drive the refrigeration cycle and can be extremely efficient, particularly in mild conditions. However, air source heat pumps are least efficient when the external conditions are coldest and require fans to transfer air across the heat exchangers and as such generate a constant external noise source whilst operating.

Ground source heat pumps require pipework circuits either horizontally or vertically in the ground around the building to collect heat. These are located in the ground outside the building and would require prohibitive disruption to the churchyard.

For all these reasons ground source air pumps are not considered further.

Air Source heat pumps could be considered further if underfloor heating is going to be utilised as the means of heating the church. Or a combination of UFH and heat emitters that have a significant conductive or blown heat emission such as finned pipe coils and fan convectors.

Electric Heating

Electric heating is often used when there is no alternative fuel source available and when the intrusion of an installation needs to be minimised. Generally, panel heaters or night storage heaters are located in the space served, there is no central plant required and no onsite emissions.

Alternatively, Electric infrared heaters can be used. These are either wall mounted, or suspended, typically associated with a light fitting (chandelier). The emitters will usually emit heat and as they are radiant heat sources, a line of sight is required in order to benefit from the warmth. Of note is that they can be a source of thermal discomfort with the side of your body facing the heat emitter being hot and all other parts of the body potentially being cold due to the ambient air temperature, or experiencing "cold radiation" from the building fabric.

All direct electrical heat sources are very poor from a Carbon emissions perspective and hence building regulations compliance perspective, but can be very quick to respond to varying occupancy loads and controlled individually to further minimise energy usage. Installations are relatively cost effective, but operational costs could be very high when in use.

They place a high demand on the building electrical loads and are likely to require a new upgraded supply to serve the building.

In order to provide adequate heating, it would be necessary to install a significant number of emitters (circa 30 – 40) to meet the heat demands of the church.

For these reasons, electric heating is not considered further as a single solution, but may be beneficial as part of a hybrid solution.

Low Operating Temperature system - Heat emitters

Lower temperature heat generation systems are best suited to low temperature heat emitters such as underfloor heating and not suited to radiators due to the increased size of emitter required to provide the same output at lower circulation temperatures. As such these technologies are typically paired to underfloor heating circuits whose typical circulation temperatures are between 35 – 45^{0}C.

Installing underfloor heating will require the church to be closed for several months as the archaeological studies are undertaken, plus material sampling before the works are undertaken. The entire floor will need to be taken up on the below slab make up. With this level of disruption there is also a significant uplift in the project budget to the tune of a few hundred thousand pounds potentially.

Additional Note – Low Carbon Solutions

In addition to the primary energy solutions, consideration should be given to the provision of supplementary energy sources to reduce the running costs and associated carbon emissions.

Primarily in associations with an electrically driven solution, Photovoltaic (PV) panels can help reduce the Carbon emissions associated operating the heating. It should be noted that the installation will not be able to offset the whole load of the heating, but it has the potential to reduce the operational costs and associated emissions.

Please note, there is no longer any government incentive to generate electricity and as such there is no longer a financial benefit of PV generation when considering capital cost and off set running costs.

Typical installations for the church based upon an approximation of the inner south facing roof are –

Size	Approximate installation Cost	KWh / Annum	Annual saving
• A 3kWp *	- £5,000	2,850kWh	~ £400**
• A 7kWp	- £11,000	6,650kWh	~ £950
• A 10kWp	- £15,000	9,500kWh	~ £2,000

* - (kiloWatt peak (The highest output the panel will generate))
** - If fully utilised or sold back to the grid. (grid purchase rates set by the supplier).

A full assessment of the operational loads would need to be considered, along with discussions with Western Power regarding feeding electricity back into the grid when the operational load of the building will be negligible.

Summary

It should be noted that the above is based upon typical considerations and our understanding of the current and future arrangements for the church. There are always other drivers which may suggest that one of these technologies should be revisited. However, an initial appraisal suggests that there are three principle solutions for further consideration.

Option 1, provision of a new gas fired boiler(s) paired to new radiators for back ground heat and fan convectors for rapid heat up. This solution would be considered the most cost effective solution with least disruption and relatively cost effective operation.

Option 2, provision of a new gas fired boiler(s) paired to an underfloor heating circuit throughout, or selectively with convective heat emitters around the perimeter and in separated rooms. This solution would be considered part way between option 1 & 3 providing cheaper central plant than ASHP, less wall mounted heat emitters and low running costs, but more disruptive than a traditional wet heating system due to the works in the ground.

Option 3, provision of an air source heat pump system paired to underfloor heating for back ground heating and a secondary circuit linked to fan convectors for rapid heat up. This solution would be more expensive in terms of plant cost and the works to the church floor with all the associated disruption, but would be the most discrete option with more the most cost effective operation.

Hybrid Option, provision of underfloor heating under the existing seating areas with radiant heating in other areas to minimise the disruption to the solid floor areas.

It has been suggested that the existing system could be renewed / replaced with a modern equivalent. We would not recommend this as an option due to the limited distribution of warm air through the building. The hot, wet and potentially corrosive air has no driving force to circulate it through the nave and to the occupied zone. Instead the warm air will tend to migrate towards the tower and being moist / corrosive, has potential to cause damage to the building fabric.

The suggested use of supplementary electric heating may be an alternative to the convector heaters for rapid heat up. It will be more expensive and Carbon hungry to operate, but provides a solution for areas with limited wall space, or means of distributing pipework. A further note is that electric radiant heating can be a source of thermal discomfort due to the directional nature of the heat source.

Relative Cost comparison

Option 1 is going to be the cheapest to install in the shortest timeframe with least disruption. It should also be noted that although the operational costs are on paper a little more expensive than the other options, the radiator solutions versus UFH operate in very different ways i.e. the radiators and fan convectors is a usage led system, being set to operate when needed, the underfloor heating solution should be operated all day every day with a potential for slightly reduced temperatures during the unoccupied periods. Subsequently the operational costs are potentially going to be higher depending upon the building usage.

An estimate of the installed costs for each option is as follows;

Option 1 – Gas fired boiler, radiators and fan convectors - £85,000 – 95,000 ex VAT

Option 2 – Gas fired boiler with UFH and Convectors - £110,000 – 125,000 ex VAT **

Option 3 – ASHP with UFH and Convectors - £135,000 – 155,000 ex VAT **

Notes -

This does not include for the removal of the existing installation

** For option 2/3, this does not include the cost of removing, excavating or reinstating the floor and any other associated archaeology works.

It is also worth noting that the ASHP solution is likely to require an increased electrical supply to the church which maybe in the order of £5,000 – 10,000 on top of these figures.

5.0 Estimated Running Costs

The following section reviews the running costs of the existing heating system at the last time it was reported as operating correctly, to enable an estimate of the operating hours. This can then be utilised to compare the running costs for the proposed solutions –

The following table summarises the reported heating energy used in the 2019 calendar year.

Year	Amount of Gas used for the year (kWh)	Average annual cost per kWh	Cost of the Gas Used	Associated Carbon Emissions
2019	**26,251kWh**	**3.62p/kWh**	**£950.29**	**5.67 Tonnes per annum**

Notes

- Cost per kWh is based upon details provided by the Church
- Carbon emissions of Main Gas – 0.216kgCO_2/kWh
- Current operational costs have been used as a benchmark for comparison purposes. The recent cost increases are believed to be a short term issue with costs returning to a more normal level, albeit it is expected that these costs will be higher than their previous levels.

These figures are the heat input into the heater and not the output from the heater. However, as all the products of combustion are fed into the air stream the efficiency should be approaching 100% less any heat losses from the unit and uninsulated, ducted air stream. We would suggest the efficiency of the delivered heat to be circa 90%

26,251kWh x 90% = 23, 626 kWh of delivered heat.

Future operation parameters

We understand that the current heating installation is operated on a demand basis, i.e. manually controlled to heat the building to suit when it is being used through the heating season. This has been advised as being October through to March typically.

Of the suggested options for further consideration, there are 2 elements to the heating, the first being the underfloor heating operated as a low level back ground heat throughout the heating season to protect the building fabric. The second is the occupancy led heating via the radiators, convectors, or electric heat emitters.

We have estimated a weekly operational run time of 10 hours and used this as the basis of the calculations. The heating season equates to 26 weeks and as such the operational hours for the heating season are 260hrs/annum.

Option 1 – Gas Fired boilers feeding radiators / convector heaters - estimated costs

If we assume the same operational parameters as the existing installation, then the Option 1, replacement boiler with an average efficiency would be –

23,626kWh / 95% = 24,870kWh (5.37 Tonnes of Carbon)

Based upon the gas price provided of 3.62pkWh, the annual occupational costs would be **£900 per annum.**

Note that the heating system can be operated for prolonged periods to provide fabric protection if this is undertaken to be more akin to the underfloor heating operation with 10ºC setback, , then we estimate the energy costs and Carbon to be as follows –

106,007kWh per annum - £3,837 - (22.9 Tonnes of Carbon)

Please note that if the setback temperature is reduced to 8ºC, the fabric protection operation is estimated to drop by 15% and a further reduction to 6ºC will reduce to circa 25%. However there is an increase in the energy required to raise the temperature to the occupied temperature and a significant increase in the time to react to the temperature increase. Typical heat up times are 4 hours.

Option 2 Gas Fired Boilers feeding UFH and Radiators / Convectors estimated costs

For option 2/3, it is not a straight comparison as the underfloor heating tends to operate all day, every day for the heating season, but regulated down to time charging.

Industry bench marks suggest 160kWh/m2 for the annual energy use of UFH. Applying this to the Ground floor of the church, the annual background heating operation would be –

109,200kWh per annum. £3,953 - (23.6 Tonnes of Carbon)

It should be noted that this does not include the costs associated with the increased running hours and the desire to have fast warm up which would be provided by Fan convectors in each case.

Based upon elevating the temperatures from 10ºC to 20ºC during the occupied periods, the estimated total annual UFH and Top up heating, the figures become –

120,000kWh per annum. £4,344 - (25.6 Tonnes of Carbon)

Option 3 ASHP feeding UFH and Radiators / Convectors estimated costs

Akin to Option 2 above and based upon the ASHP providing an average seasonal output of 3 kW output for every 1kW input and a Carbon emission figure of 0.519 $kgCO_2$/kWh**

36,400kWh per annum. £5,211 - (18.9 Tonnes of Carbon)

Again, allowing for the fast heat up convectors from fed from the UDH heating circuit, this would increase to –

37,700kWh per annum. £5,399 - (19.6 Tonnes of Carbon)

By Comparison, if a direct electric solution is used rather than a wet heating system for the occupancy based heating, the figures become -

40,350kWh per annum. £5,776 - (20.9 Tonnes of Carbon)

** Note the Carbon figure for Mains Electricity is predicted to drop to 0.233 and on to 0.136 as the generation of electricity is based on increasing renewable technologies.

In summary, with the relatively low use of the heating system currently, Option 1 run based upon occupancy with no fabric protection, is going to be by far the most cost effective from a capital and operational cost and the lowest Carbon emissions.

As soon as fabric protection is included, both the operational costs an associated emission increase significantly. If this is considered to be a benefit worth adopting, Option 1 with extended operation still provided the best capital and operational costs, but Option 3 the ASHP offers the lowest Carbon emissions, but with the highest capital and operational costs. It also has the added benefit of becoming more sustainable as the Mains Electricity Grid emissions rates improve.

Please note that the figures above are based upon a high level assessment and an interpretation of the current and proposed requirements and operational parameters for comparative purposes. During the design stage, a more detailed set of calculations would be undertaken and will include a more detailed future operation assessment.

6.0 Recommendations & Further considerations

It is of little surprise that the gas fired heating installation is going to be the most cost effective of the proposed solutions. The capital and running costs are going to be the cheapest and the physical impact on the archaeology and building will be the least, noting the fluing arrangements are going to have to be carefully considered following the removal of the previous flue and making good of the roof.

The ASHP solution provides arguably a more sustainable long term solution with the added benefit that the number of emitters (Fan Convectors) will be minimal. However, the cost, level of disruption and associated risks are likely to be extensive and as such is our second choice for the two preferred options, subject to the key drivers of the Modbury PCC.

The option 1 solution is eminently controllable to provide back ground heat to protect the building fabric with the ability to boost the temperature for public events and ceremonies.

We would recommend the boiler(s) be located in the previous boiler plantroom subject identifying a new fluing route. The warm air heater plantroom is another option and is likely to offer a more discrete solution. The new installation can be pressurised, eliminating the need for the F&E tank at high level

Areas for consideration.

Whilst we have provided a technical appraisal of the solutions and made recommendations based upon cost and sustainability, it would be prudent to pause at this stage and for the group to discuss the items raised prior to commencing with the eventual preferred option.

Associated with the replacement of the heating system there are a number of building and archaeological matters to consider as follows –

- Is capital, operational, or sustainability the driving force.
- Is it possible to raise funds to cover any increased running costs?
- The zoning to suit the proposed expanded uses of the Church.
- Integration of the heat emitters into the church furniture.
- The impact of UFH on the church floors
- The noise impact of an ASHP plant in the churchyard.

An ASHP capable of providing the estimated 200kW heating load (to be confirmed in detailed design) is a significant unit. Typical dimensions would be 2m tall 1.1m wide and circa 5m long. They also generate a continuous back ground noise with would typically be around 57 dB(A) at 10m.

We understand that there are existing water ingress issues associated with the existing floor which will require intrusive investigation and also an intent to provide a level floor to ease access throughout the church. This being the case, it increase the logic in undertaking an Underfloor heating solution throughout the ground floor area.

No doubt the church wardens will have a view on the above with support from ourselves and the church Architects.

7.0 Compartmentation

We understand that there is an intention to subdivide the Church to create a number of spaces which for small groups, meetings and storage.

To integrate these spaces, there are a number of points to consider as follows –

We assume the spaces will have walls and ceilings to make them acoustically separate from the main Church.

The Church is naturally ventilated (excluding the warm air heating system) without any opening windows. The subdivided spaces will need to incorporate ventilation to be used as an occupied space.

The spaces may want to be on a separate heating system from the rest of the church due to different timings and functionality. The control and ability to do this will be led by the heating solution adopted.

Any walls should be planned before the heating system is introduced for spacing of radiators, locating of sensors and in particular if UFH is adopted as the walls can not be built directly on top of the buried pipes.

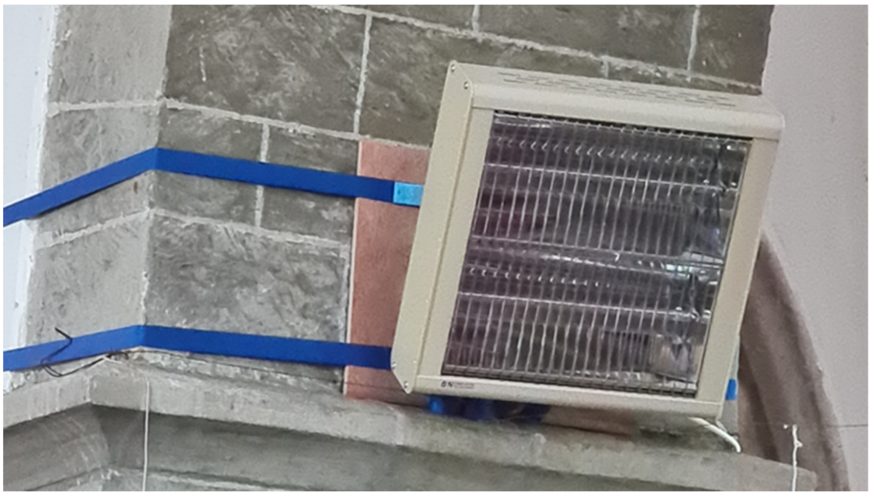
Other services, such as lighting, small power, fire alarms, emergency lighting will need to be considered.

We would be happy to discuss further and review the plans proposed at an appropriate time.

Appendix 1 – Photo Survey

Existing Warm Air Heater Installation

October 2021



Temporary Electric Heating

Mains Gas Installation

Typical finned pipe, grilled floor trenches