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Proposal for:
Consulting Services for Energy Efficiency Options for Existing Homes

Date: File:

To: Client / Builder Address

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Signed:

Dennis Jenkins

Introduction

On January 1, 2016, an energy evaluation was conducted by *(Advisor Name)* at *(insert property information here)*, to determine the existing conditions of the cottage. Based on standardized conditions, the following report outlines areas of concerns and recommended upgrades to improve occupant comfort, health and safety, reduce cost of home ownership, and reduce the impact of the building on the environment.

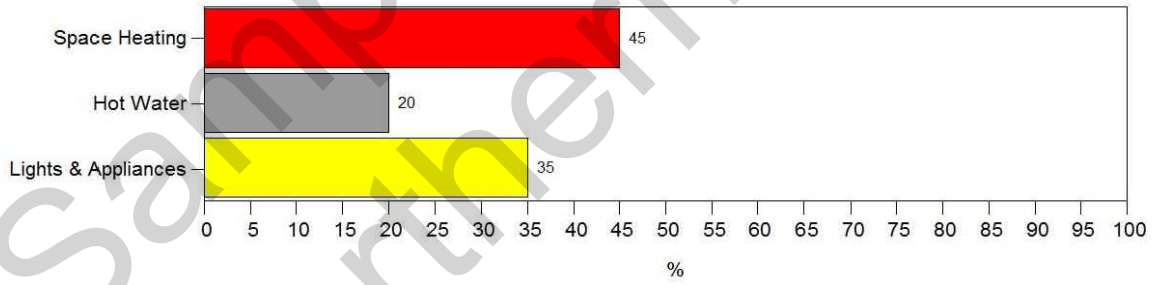
The results presented may be influenced by a number of considerations. Savings and energy consumption can change depending on many factors such as occupants and day to day habits and lifestyles. The rating considers the house's estimated annual energy consumption based on an in-depth evaluation of its characteristics such as location, size, mechanical equipment and systems, insulation levels and air tightness. In addition, standardized operating conditions are used when calculating the rating in order to compare the efficiency of one house to another. These conditions include: a complete indoor air change approximately every three hours; four occupants; a fixed thermostat setting of 21°C on main floors and 19°C in the basement; average hot water consumption of 225 litres per day; average national electricity consumption of 24 kWh per day; and regional weather data averaged over the last 30 years.

Energy Consumption

Houses lose heat to the outdoors during the heating season primarily through air leakage and conduction, such as the transfer of heat through the building envelope (basement and exterior walls, upper floor ceilings, windows and doors). Modifications made to the house, such as drilling holes in walls for new wiring, pipes and lights, all play a part in reducing the efficiency of the building envelope over time. Houses need to be regularly maintained and upgraded to ensure greater energy efficiency, comfort and savings.

Figure 1 breaks down your home's estimated annual energy consumption for space heating, hot water and lights and appliances.

Figure 1. Estimated Breakdown of Energy Consumption



Air Leakage Loss

By conducting a Blower Door Test, we were able to measure the amount of air leakage through the buildings envelope. By calculating air loss, we were able to determine that the home has many small holes which when added all together gave an area of approx. 169 sq. in.

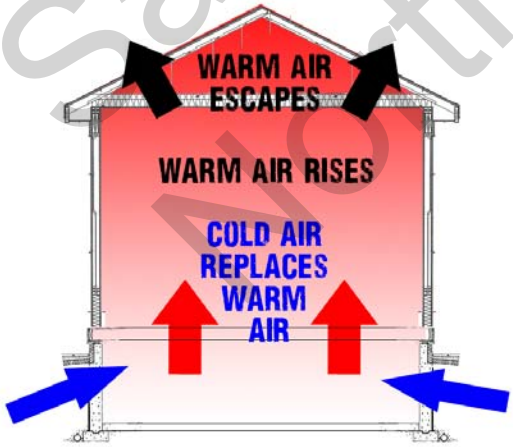
This area is determined by adding all the cracks and holes in the buildings envelope, which would be comparable to having a hole that is 13 inches x 13 inches in size and is equivalent to a picture frame.

Air leakage is based on a calculation of air changes per hour which means we determine the total air volume of the home and how many times that air leaks out. Our testing and modeling of the home in the approved software by NRCan (Natural Resources of Canada), calculated the homes air leakage rate at 2.27ACH (air change per hour). 2.27ACH means the homes total air volume leaks out that many times an hour, which also means the furnace needs to run that many times an hour to reheat the air volume which is approx. 50,000 cubic inches to maintain temperature.

By NRCan standards, the home is considered to be energy tight, and mechanical ventilation is required. An energy-efficient, HRV (heat recovery ventilator) is one of the best ways to control indoor air quality. It is advisable to hire a contractor that is certified in ventilation system design and installation by an industry-recognized organization.

Energy Loss Locations

As we completed a walk around of the exterior building and a thorough interior inspection, our home analysis identified the following areas for heat loss:



- 2nd floor loft - top right hand side of the cold air duct. Due to this being a cold air return, this heat loss location is allowing the return air to draw the cold air from the attic and allowing warm air to escape.
- Dog door frame.
- Electrical outlets on exterior walls.
- Kitchen hide-away door.
- Pot lights through out ceilings allows warm air to escape.
- PVC lines for water in header to the right of the electrical panel wall allows cold air to enter building.

Problem #1 – Ice Damning on Roof

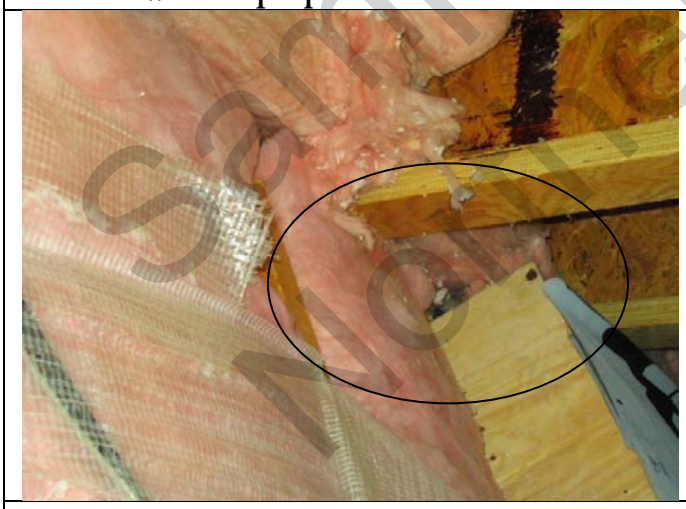
North-West Corner of Cottage

Ice damning is a result of warm air entering the attic space which warms up the exterior roof and melts the snow creating icicles. Damage could result in water backing up under shingles and leaking which would damage the insulation and possibly ceiling finishes.

The second problem with warm air entering the attic space is … Warm air carries humidity, this humidity condenses once it cools down. (otherwise known as reaching the Dew point, a temperature where water is changed from vapour to a solid form) This water in the winter can be seen with frost forming on the under side of the roof. In the fall and spring this location becomes a great location for mould growth and or wood rot. Correcting the air leakage problem is very important to the environment in the attic.

The result of the air leakage is due to poorly sealed light fixtures and improper insulation values.

Problem #2 – Improper Insulation Installation

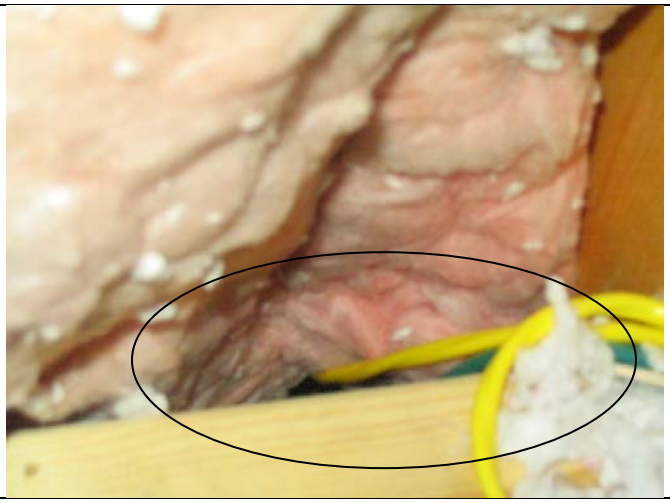


Cold Air Return in Loft

Daylight can be seen in the attic through this space at the top of the cold air return.

The result of the air leakage allows warm air into the attic space which results in condensing.

Added damage results in the furnace drawing very cold air into the system and forcing it to work harder.



New wiring was added for the entertainment system and the insulation was pulled back and never properly reinstalled which leads to exposing the 2nd floor header and allowing warm air to draw into the attic space.

Wiring for TV in Loft

This picture is showing pot lights and drywall tape coming loose. All ceiling fixtures are very leaky causing warm air to leak into the attic space and causing items like the plaster compound to degrade. This is a result of air movement from cold to warm.

Ceiling Above Great Room

Problem #3 – Improper Insulation Amount and Installation

Knee Wall at Loft

R-Value and Insulation

The insulation installed is referred to as Blown Fibreglass. On average we determined the depth of insulation to be at approx. 6 inches which is equivalent to R-20. Our current Building Code requires an insulation value of R-50 which is equivalent to 13 inches.

In each picture we are showing the bottom chord of the truss which is a 2x4 member and shows that in those areas we have even less than the R-20 we determined as an average.

Ceiling Above Mudroom

Ceiling Above Bedroom

This improper R-Value and insulation installation causes for heat loss and is a result of the ice damning. It also results in cold rooms which causes discomfort.

Our Recommended Solutions

All of these areas of concerns are completely repairable and our recommendations are as follows.

- Increase R-Value on all flat ceiling sections by topping up to min. 13 inches for an equivalent R factor of R50. Our recommendation is to install a Blown Cellulose product as it has a better insulation factor and the density of the product helps reduce and control air movement.
- Remove Fibreglass batt insulation from knee walls and replace with either a 2lb Icynene or Polyurethane spray foam, ensuring to cover the top of the airduct and any openings created for the media wiring.
- Check all electrical outlets in the ceiling exposed to the attic and ensure they are sealed with spray foam insulation.
- Once all ceiling work is completed, install a proper attic hatch seal like weather stripping.

Other recommendations

- Check and verify that all sloped ceilings have proper insulation values and venting.
- Check all soffits to make sure no insulation is blocking air flow.
- Check ridge vent to make sure it is installed properly.
- Spray foam any protrusions through exterior walls.
- Remove electrical outlet covers and seal on all exterior walls.

Mechanical System

Upon review and investigation, it appears the existing mechanical system is in poor working condition. The heating unit continuously runs and is excessively loud. The supplemental storage tanks for the Geothermal system appeared to be in poor condition and possibly leaking as there was pooling of approx. ½" of water lying in the bottom of the unit. Rust minerals were very noticeable around the tanks.

The HRV (heat recovery ventilator) appeared to be not operating properly and was not running at time of our investigation. There could possibly be a wiring issue as the breaker was tripped and when we turned it back on the HRV did run. It also appeared that the thermostat on the main floor which operates the HRV was not setup to turn it on and off.

It is highly recommended that a licensed mechanical contractor and a certified HVAC designer review and complete heat loss calculations and proper duct sizing for either the existing system or a new heating system before making any alterations. Temperature tests were performed on multiple heat register locations and temperatures differed by as much as 20 degrees which leads to either improper duct sizing or improper damper settings.

The home is equipped with a "Saskatoon Loop" which is added to some homes when there is a demand due to stack effect or fan depressurization. The premise behind this idea is that since cold air falls down such air inlets because it is heavy, it pools at the base of the loop and prevents flow until an exhaust fan creates an air demand. But cold air does not fall down ducts or chimneys because it is heavy; it is sucked down by stack effect or fan depressurization. The Combustion Safety test was performed and failed as it exceeded -5Pa (result is -8.8Pa) which determines a certified HVAC designer needs to ensure proper makeup air is calculated in the design.

Mechanical System Continued

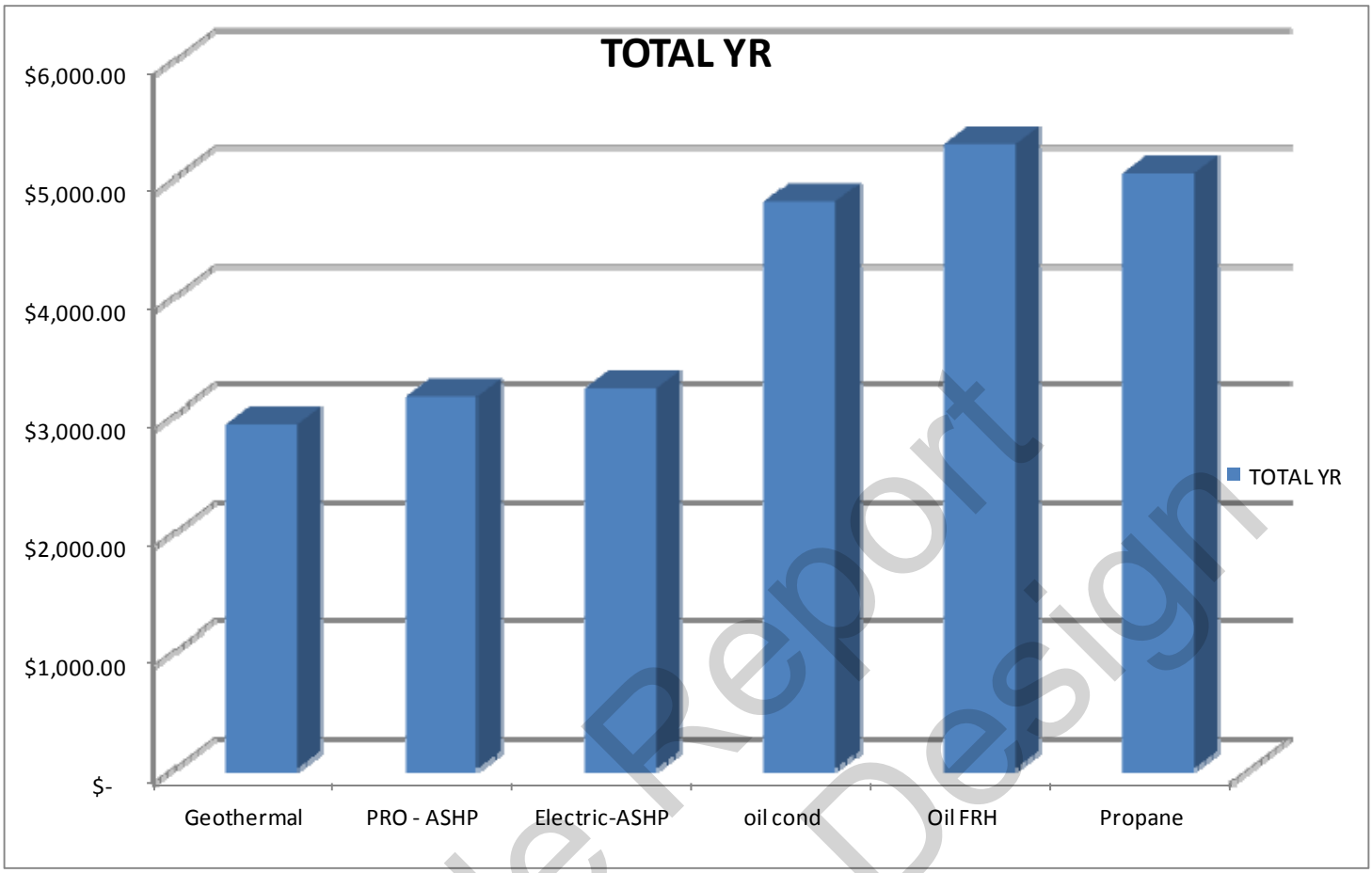
Water Source Heat Pump

Saskatoon Loop

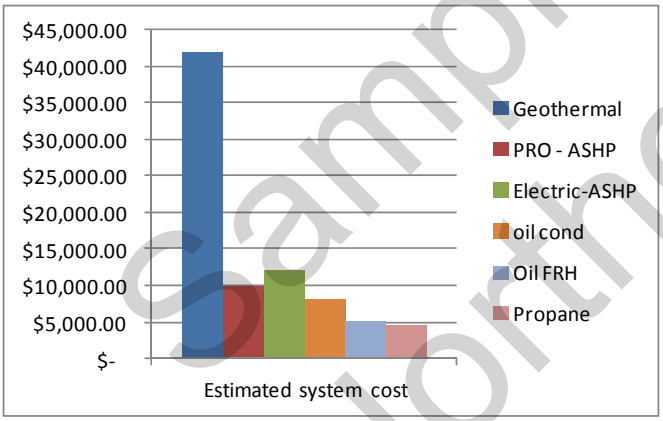
It is estimated that your home's design heat loss be 76,704 Btu/hour (22,480 Watts) and its design cooling load be 44,117 Btu/hour (3.7 tons). If you are considering replacing your space heating and/or cooling system, provide this information to your heating/cooling contractor to help ensure a properly-sized system. However, the figures will only serve as an estimate based on the data that was collected on your home at the time of the evaluation.

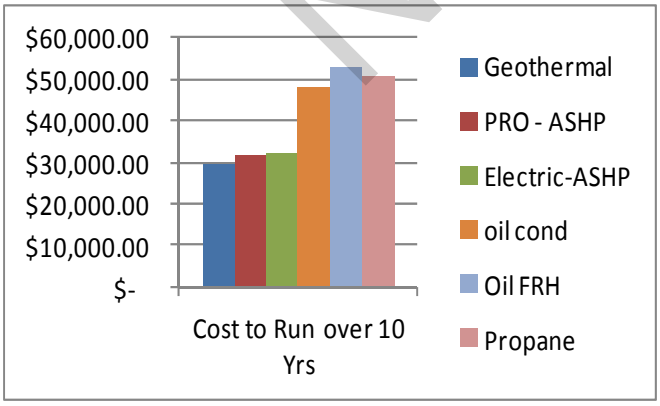
The design heat loss and cooling load can vary depending on different factors, Prior to having a new heating/cooling system installed; have your heating/cooling contractor perform a heat loss/heat gain calculation on your home to determine the capacity and distribution flows for the new equipment. It is advisable to hire a contractor that is certified in heat loss and heat gain calculations by an industry recognized organization (HRAI certified designer). The current system is a 68,260 BTU Geothermal unit. The following page has Heat calculations on multiple units based on this homes energy modeling. This information could aid in the selection of heating systems looked at in the future.

Mechanical Chart for Replacement Systems Options



Total Yearly Operating Costs





Legend:
Geothermal - Water Source Heat Pump
Pro ASHP - Propane Air Source Heat Pump
Elec ASHP - Electric Air Source Heat Pump
Oil Cond - Oil Condensing
Oil FRH - Oil Fire Resistant Hydronic
Propane - High Efficiency Forced Air Furnace

Geothermal
Low yearly cost, Very high system cost, complicated install and tuning required, limited resources required.

Air Source Heat Pump
With propane or Electric back up. Low yearly cost, high to average system cost. Can be expensive to heat if season is very cold, limited heat level. Requires propane tanks for propane model.

Condensing & FRH Oil Furnace
High yearly cost, mid to lower initial cost for system, requires oil tanks that are changed every 10 years.

Water Damage on Foundation

The foundation wall along the east side has extensive white powder like stains which is referred to as Efflorescence as well as it's very wet above grade. Despite its solid form, concrete is designed to allow water to pass through it freely. When concrete is in continuous contact with damp, wet earth, a portion of that moisture is continually going to enter the concrete, making its way through the micropores in the concrete.

As water passes through the concrete, it brings minerals with it. The moisture then evaporates into the basement, leaving these minerals behind. Due to the basement being insulated with a closed cell spray foam, it is not allowing the proper evaporation which is causing the foundation to remain wet. Over time, the buildup on the concrete creates the efflorescence that you see. This is happening because the eaves trough has no extension to dissipate away from the building and is depositing water directly to the concrete. It is recommended that extensions be installed at least 4 to 6 feet away from the building.

The constant wetness of the foundation may also be caused by poor materials backfilled like clay which holds water and does not drain properly. Another recommendation is to excavate the existing materials and import sand fill then top off with top soil. Inspection of dampproofing and perimeter drain at footing would be suggested while it's opened up.

Results and Summary

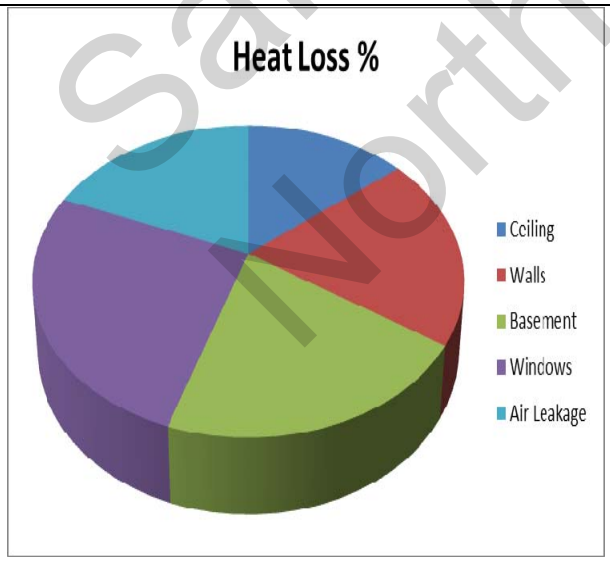
The results of the evaluation indicate that your home rates 85 points on the EnerGuide Rating System (ERS) scale.

An EnerGuide rating shows a standard measure of your home's energy performance. It shows you (and future buyers) exactly how energy efficient your home is. The rating is calculated based on standard operation assumptions so that you can compare the energy performance of one house against another. The home's energy efficiency level is rated on a scale of 0 to 100. A rating of 0 represents a home with major air leakage, no insulation and extremely high energy consumption. A rating of 100 represents a house that is airtight, well insulated, sufficiently ventilated and requires no purchased energy on an annual basis.

If you implement all of the recommendations in this report you could reduce your energy consumption by up to 20% and increase your houses rating to 86 points. The average home built at the same time frame rates from 74 points to 89 points. The modeling completed was based on a geothermal system. When you reduce the amount of energy used in your home, you also reduce the production of greenhouse gases (GHG) such as carbon dioxide. By improving your home's energy efficiency rating to 86 points, you could reduce its GHG emissions by 1.4 tonnes per year. (Current Estimated GHG emissions 14.419 tonnes/year)

If we input a simple propane unit (96 AFUE condensing propane, 72,000 BTU with 15 SEER A/C unit) with air conditioner the rating will change as follows. Your estimated heating cost could increase by 50% with propane VS geothermal, and the EnerGuide rating will move to 69. The rating increases to 74 points with our recommendations and you will save 22% of the propane cost from the as is scenario. If you invest in a higher preforming Heating/Cooling unit such as an Air Source Heat Pump with propane back up, the EnerGuide rating will be 83 and the cost to heat will increase by 30% VS geothermal. If the recommendations are completed the rating will be 84 points and the heating cost will decrease by 10%

According to our modeling the homes heat loss percentage is as follows. Recommendations above are based on items that can be easily upgraded and actually administered, such as increasing the R value in the attic to decrease heat loss in the ceiling.



14.27% heat loss in the ceiling (Increasing the insulation changes to 6.37% heat loss)
20.02% heat loss in the walls (increasing the upper walls changes to 17.8% heat loss)
20.8% heat loss in the basement (no changes recommended, this heat loss is due to the amount of uninsulated floors, low R-Value Bsmt walls and Header space low r-value)
26.11% heat loss in the windows (lots of windows very low r-value not recommending changing windows)
18.80% heat loss in the air leakage (decreasing air leakage locations changes to 13.62% heat loss)

Conclusion

Upon our on site review and inspection of the cottage with the complete walk around of the exterior and our in depth investigation of the interior, we were able to visually examine that the existing cottage has some major and minor air leakage problems that if properly sealed can reduce the ACH (air change per hour) which in turn will reduce the energy consumption and lead to occupant comfort, health and safety, and reduce the buildings impact on the environment. .

The air tightness test scored a rate of 2.27ACH which if the cottage is properly sealed and insulated can be reduced. At this time, it is not necessary for us to conduct another site inspection and blower door test as the cottage is considered energy tight by NRCan's standards. Should the homeowner and or contractor wish to have the cottage tested again, we would be more than happy to assist.

It is with great pleasure to have conducted the Energy Analysis for *(client & or builder name)* and in order for Northern Designs to continue to make a difference in the construction industry; we ask that a referral be given to others who want to make a difference.

Please Note
Even though our advisor strives to provide accurate information, the above details are accurate to the knowledge of the advisor and are to be taken as recommendations and suggestions. The advisors suggestions are for informational purposes and qualified trade professionals should be considered for structural and mechanical details. The auditor is in no way liable for the selection of materials, contractors, performance or workmanship of a product or service.

Signed for the Advisor:

Company Name: _____

Print Name: _____

Signature: _____

Date: _____