Riverview Hotel

Whitehorse, Yukon

Energy + Building Systems Analysis

Energy Upgrading Options 2001

April 2002

Prepared by:

***Energy Analysis** + Design* EA+D

Enegry Efficiency, Sustainability and Innovation in Building Design

a joint venture between Kobayashi + Zedda Design Group, Dorward Engineering and Northern Climate Engineering

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1.0 *INTRODUCTION*

The Riverview Hotel is located along the waterfront in downtown Whitehorse. The 53 guest room facility was initially constructed in 1967, replacing a former wood frame hotel building. The complex consists of the following:

- A single story wood frame section of approximately **780 sq. meters** (reception, lobby, kitchen, restaurant, licensed premises.)
- A two storey wood frame (above grade) building with an **894 sq. meter** footprint constructed above a concrete block basement / parking level of approximately **786 sq. meters** in area.
- A north wing was constructed in 1977 extending the two story guest accommodation section. The building is a combination wood frame and concrete block construction. The building consists two separate but identifiable areas.

Total building floor area (not including heated parking): **1,787 sq. meters.**

The Hotel has 53 guest rooms, lobby area, various offices, banquet room, kitchen and dinning area, bar and rental suite which are all above grade. Below grade and under the two storey section is the guest laundry facility, hotel laundry facility, boiler/ mechanical room, storage rooms and underground vehicle parking area.

The wood frame structure was constructed using construction methods typically used in the 1960's and 1970's. The single story section is constructed using both conventional 38mm x 89mm framed walls with RSI 2.1 insulation value and concrete block walls with an approximate RSI 2.1 insulation value. The single story section has flat roof with RSI 7.0 insulation value.

The two-story section is comprised of guest rooms and corridor areas. In the basement area is located the laundry room, boiler/mechanical room, storage areas and vehicle parking/storage. This above grade section of the building is constructed with 38mm x 89mm wood framing having an RSI 2.1 insulation value. North and south walls are constructed with concrete block walls. The below grade level is, for the most part, constructed with a combination of poured concrete and concrete block. The low slope wood frame roof area of this section has an RSI 3.5 insulation value.

The building is heated using two banks of Hydrotherm boilers with three boilers per bank, and one Bryan boiler. These low-pressure boilers work in conjunction with baseboard radiant convectors and unit heaters. Ventilation air is indirectly provided by guest room bathroom exhaust fans, a lounge exhaust fan, a kitchen exhaust hood and a the laundry dryers. There is one new make-up air fan unit located in the southwest portion of the building and behind the kitchen area. Domestic hot water is provided using boilers working in conjunction with a heat exchange unit and a domestic hot water storage tank.

The boiler system controls consist of aquastats with high/low set points for each boiler. The aquastat control set points stage and designate the boiler firing order in their preferred sequence.

2.0 HISTORICAL **ENERGY USE**

The following tables outline the electricity, fuel oil and propane use at the building for a recent one year period.

Electricity Use:

Date	Days	Meas. Demand (kW)	Billed Demand (kW)	Consump. (kWh)	Ave. Daily Consump. (kWh/day)	Cost
24.10.00-22.11.00	29			14,240	491.03	$2,217.06
22.11.00-21.12.00	29			15,200	524.14	$2,412.38
21.12.00-24.01.01	34			15,120	444.71	$2,402.15
24.01.01-21.02.01	28			15,040	537.14	$2,391.92
21.02.01-23.03.01	30			14,320	477.33	$2,243.78
23.03.01-24.04.01	32			15,920	497.50	$2,476.78
24.04.01-24.05.01	30			15,120	504.00	$2,374.46
24.05.01-25.06.01	32			20,960	655.00	$3,177.53
25.06.01-25.07.01	30			22,240	741.33	$3,362.27
25.07.01-24.08.01	30			20,880	696.00	$3,188.30
24.08.01-24.09.01	31			18,800	606.45	$2,943.24
24.09.01-24.10.01	30			14,480	482.67	$2,264.24
Total	***365***			***202,320***	***554.78***	***$31,454.11***

Propane Use:

Date	**Consumption *(litres)***	***Cost***
03.01.02	235.1	$105.80
23.11.01	217.7	$97.97
04.10.01	167.9	$75.56
13.07.01	450.9	$202.91
Total	***1071.6***	***$482.24***

Fuel Oil Consumption

Date From – To	***Days***	***Consumption (Litres)***	***Cost per fill-up***
12.10.00 – 07.11.00	27	4,527	$1,885.50
08.11.00 – 28.11.00	21	5,990	$2,494.84
29.11.00 – 27.12.00	29	8,804	$3,666.87
28.12.00 – 28.01.01	32	8,100	$3,373.65
29.01.01 – 25.02.01	28	6,725	$2,800.96
26.02.01 – 28.03.01	31	7,293	$3,037.53
29.03.01 – 29.04.01	32	5,711	$2,378.63
30.04.01 – 29.05.01	30	6,113	$2,546.06
30.05.01 – 04.07.01	36	3,756	$1,564.37
05.07.01 – 25.07.01	21	2,476	$1,031.25
26.07.01 – 04.09.01	40	4,094	$1,705.15
05.09.01 – 21.10.01	47	7,304	$3,042.12
Total	***374***	***70,893***	***$29,526.93***

Following the exclusion of anticipated exterior electrical consumption, the interior electricity consumption total is expected to be 195,570 kWh per year or 59.7 kWh per square metre of floor area per annum; exterior electricity consumption totals approximately 6750 kWh per annum. The most recent cost averages to $0.155 per kWh. The propane use of 1071.6 litres per year is equivalent to 34,223 kWh annum. While the cost of propane fluctuates throughout the year, a cost per litre of $0.45 has been used for calculations in this report. This equates to an annual cost of $482.24. The fuel oil use of 69,494 litres per year is equivalent to 710,099 kWh or 216.7 kWh per square meter per annum. While the cost of fuel oil also fluctuates throughout the year, a cost per litre of $0.4165 has been used for calculations in this report. This equates to an annual cost of $29,526.93. The total energy consumption at the building is consequently 946642.3 kWh or 288.9 kWh per square metre per annum. Total annual heating cost is $61,463.28 or $18.76 per sq. meter of total floor area, basement included.

3.0 *BREAKDOWN OF* ***EXISTING ENERGY USE***

The table on the following page indicates the breakdown of the existing total electricity and propane use by component, based on computer simulation of the building heating requirements and industry standard formulae for domestic hot water use.

Breakdown of Existing Energy Use, By Component:

Annual Energy Input:

Electricity (Interior Usage)	195,570 kWh
Electricity (Exterior Usage)	6,750 kWh
Propane	10,745 kWh
Fuel Oil	710,099 kWh
Total	***923,164 kWh***

Annual Energy Consumption:

Zone 1: Above Grade		
Ceiling	55,899 kWh	5.9%
Main Walls	155,591 kWh	16.3%
Doors	1,986 kWh	0.2%
Windows	56,148 kWh	5.9%
Floor System	11,375 kWh	1.1%
Zone 2: Shallow/Full Bsmt.		
Walls	29,752 kWh	3.1%
Floor System	39,326 kWh	4.1%
Zone 3: Crawl Space Fdn.		
Walls	13,200 kWh	1.4%
Floor System	99,651 kWh	10.4%
Infiltration	172,635 kWh	18.1%
Domestic Hot Water	67,819 kWh	7.1%
Summer Electrical Use	120,960 kWh	12.7%
Exterior Electrical Use	6,750 kWh	0.7%
Bar Fireplace Propane Use	10,745 kWh	1.1%
Chimney Losses	113,616 kWh	11.9%
Total	***955,453 kWh***	***100% of energy use***

Note: The annual energy consumption is approximately 3.5% more than the annual energy input. This is an acceptable margin of inaccuracy.

4.0 ENERGY CONSERVATION MEASURES & CONCLUSIONS

The energy conservation measures which follow are recommended for implementation at this building. The measures are presented in ascending order of simple payback period. It should be noted that each measure that is implemented will affect the economics of any subsequent measures. For example, if the heating system efficiency is upgraded, subsequent measures that are designed to save propane will be diminished. If the lighting is upgraded, resulting in additional propane consumption due to reduced internal heat gain from lights, then the effectiveness of measures designed to reduce heating energy consumption will improve.

4.1 Architectural:

Architectural options focus on the upgrade of the existing building envelope. These include the addition of insulation to both the roof (hotel wing) and walls. The insulation levels in this building, while adequate, are not up to current standards in all locations. Despite the high cost of energy, the somewhat low insulation levels found cannot be economically upgraded at current estimated construction costs and the current value of saved energy. However, If one were to upgrade the exterior of the building by applying new siding, for instance, then the incremental cost of additional insulation might be justified. Another option that has been considered is the replacement of the existing windows with double glazed, low-e units. The insulation values plus the air leakage at the operating window were researched and compared to new double-glazed low-E units (typically the most cost-effective replacement unit). While the energy consumption dropped in half, the simple payback period for a $500 replacement cost was 16 years. As noted in the table below, the options suggested have considerable payback periods and are thus not economically feasible.

There are areas of the building below grade level which are constructed with concrete blocks and are uninsulated according to drawings and site reviews. One area in particular is the southeast corner in the guest laundry facility area. This wall is very cold to the touch, indicating significant thermal bridging. The surface area of the concrete wall in the laundry room is approximately 14.4 sq. meters with an effective RSI value of 0.5 where as the main walls are predominantly RSI 2.1.

Measure	Estimated Cost of Measure	Calculated Savings	Simple Payback Period
Insulate Concrete Block Walls	$1000.00	$150.00 / year	6.7 years
Replace Windows with Double Glazed Low-e (or equal)	$500.00 / window	$31.25 /window/year	16 years

4.2 Mechanical Measures:

Option 1: Install Low Flow Shower Heads

Approximately half the guest room showerheads have been replaced with low flow heads leaving the remaining rooms with standard heads that use approximately 30 litres per minute on average. Low flow showerheads use about half the water without compromising the quality of the shower. There are several brands of these devices and like any product; there will be preferences on function. Independent reviews for personal opinion may be sought prior to installation of large numbers. The savings indicated below is based on 25 of the 53-room hotel.

Estimated Cost:	**$875.00** (for 40 heads incl. annex)
Calculated Saving:	**$1450 litres fuel oil/yr. or $603.00**
Simple Payback Period:	less than **1.5** years

4.3 General Comments

Infiltration

Infiltration is the single largest energy loss component in this building, consuming approximately 18.1% of its annual energy input at a total cost of approximately **$5,470.00.**

Some areas requiring focus on a building envelope-sealing program consist of the exterior doors weather stripping and guest rooms window seals. Precise energy losses and rates of return for repairs for each given area would be very difficult to determine or quantify. This does not mean that corrective measures should not be taken, as they would still provide reasonably fast returns. The largest gain may in-fact be increased comfort for hotel guests; therefore providing potential revenue increases.

Ventilation & Make-up Air

The building has no mechanical make-up air provisions in place other than one recently installed make-up unit in the rear of the kitchen area, which according to the duct sizing, may supply approximately 750cfm. The remaining make-up air is provided through uncontrolled infiltration to supply the buildings exhaust systems.

The infiltration occurs when the envelope is de-pressurized either by mechanical exhaust systems, differential pressurization resulting from prevailing winds and/or by stack effect when warm air rises, escapes and cold air replaces it. A review of this buildings envelope (shell) indicates there are many sources of infiltration that contribute to substantial heat losses that are not required as make-up for exhausters. However, keeping in mind that if the buildings envelope is tightly sealed, provisions will be necessary to interface outside air intakes with the main exhaust fans in order to prevent an even greater negative pressurization syndrome than what this building is currently experiencing. The current negative pressure in the building has resulted in spot freezing of sprinkler piping due to infiltration.

The kitchen range hood is potentially the single largest exhauster in the hotel with an estimated 2644 L/s capacity according to face area and typical surface velocities. The actual airflow measurement of the kitchen exhaust was 182 L/s. The reason for the low exhaust rate is not known at this time and may be due to one or a combination of reasons. In order for the range hood exhaust system fan to comply with current building codes, the exhaust airflow must be increased and a tempered make-up air system must be installed and interlocked with the exhaust fan operation. This will result in increased energy consumption.

Boiler Room Upgrade

Currently the hotel heating system consists of a six module Hydrotherm boiler system and one Bryan boiler. Most of the Hydrotherm boiler bank is not operational. The Bryan boiler is operational and appears to be working fine with a net operating efficiency of 84%. The seasonal efficiency would be substantially less in the shoulder seasons when the boiler cycles more often due to decreased demand, the seasonal efficiency of this boiler would likely be in the low 70's.

The Hydrotherm boiler bank is essentially useless and serious consideration should be given to replacing this system. A new boiler bank consisting of four 300MBH boilers with a primary/secondary piping loop system would significantly increase net seasonal efficiency of the heating system. The current antiquated boiler system offers lower seasonal efficiencies and higher standby losses, (heat rejected into boiler room).

A new retrofit with associated piping, controls, venting, labour and miscellaneous items would cost in the neighborhood of **$75,000.00**. An expected seasonal efficiency would be in the high 70's with an increase of about 8% over the current boiler system. The stack losses currently run about 113616 kWh per annum, which is about 12,682 litres of fuel oil. An 8% savings translates to 1,014 litres fuel oil or **$423.00**. This does not seem to be near enough to consider retrofitting a boiler room, though they are needed for the most important reason of all, i.e. prevention of system failure in the event the Bryan boiler fails at an inopportune time.

Heat Recovery

Heat recovery from the current standby losses in the boiler room for use in adjacent areas has been considered. The laundry room dryers expel approximately 425 L/s each when in operation; this air is currently made up through infiltration as previously mentioned. The buildings efficiency would increase dramatically if a proper make-up air system were in place. One option is to implement a split heat pump unit, which would transfer heat generated by standby losses through the boilers and boiler room components, and transfer it into the laundry room(s) as needed. For every hour of each commercial dryer operation at –40C, the boiler(s) system would use one-gallon fuel oil to heat make-up air. A budgetary cost for this type of system would be approximately $15,000.00. Payback would be difficult to establish as dryer operation varies along with the temperatures during their daily operation times.

Solar Hot Water Heating Analysis

Computer "RETScreen" energy modeling has been used for analysis of solar collectors to contribute to the domestic hot water energy load.

Three types of collectors were analysed, Evaluated, Unglazed, and Glazed. Included in the analysis was a 40% incentive grant towards all capital expenditures.

Several modeling attempts were made in the past, including various combinations, types and numbers of solar panels, annual energy requirements and alterations of any variables key in the selection of a RETScreen modeling system that would provide economic viability with a quick payback period.

Solar hot water heating capital costs for a building of this size and domestic hot water requirements usually cost approximately $50,000.00. Annual fuel oil consumption for domestic hot water presently is approximately 10,000 litres with an annual cost of about **$4,150.00**. It is important to note that the solar panel heating for DHW cannot replace the oil-fired system due to the low sunlight during winter months. RETScreen modelling system generally shows a 20-year payback with the 40% incentive included.

Solar Wall Modeling

The intent of the Solar Wall is to draw outdoor air for ventilation through a perforated metal panel adjacent to a south wall. The intake to the air-handling unit is located in the cavity behind the solar wall. The preheated air is further tempered with a coil at the air-handling unit. Though this concept sounds simple or basic, the capital cost versus energy savings makes it non-feasible. The capital cost for this project is **$61,801** for 51.4 MWh of energy with a simple payback period of **23.8** years.

4.3 Electrical Measures:

Electrical consumption is comprised of:

- lighting
- kitchen equipment
- general purpose outlets

Because the loading of the general outlets is not a fixed load, this report will focus on the buildings lighting loads.

Lighting load consists of:

- 31 T12 strip lights
- 11 4′ surface mounted T12 fluorescent fixtures.
- 293 incandescent lamps (wattage's range from 40 to 60W)

For purposes of calculation, it is assumed that:

- room lights are on 15 % of the time
- main floor washrooms are on 100% of the time
- laundry and staff areas are on 80% of the time

Option 1: Upgrade Incandescent Lighting

The existing incandescent lamps should be replaced with more energy efficient compact fluorescent lamps. Compact fluorescent lamps consume less energy and output approximately the same level of light, when the correct replacement is used. Care should be given in choosing replacement lamps for existing incandescent fixtures. Common sense is required of the installer to determine which lamps to replace and which to leave. For example, rooms having pot lights which are rarely used, would not be good candidates. Currently compact fluorescent lamps are not readily available with dimmable ballasts. Therefore re-lamping should not be done on any fixture controlled by a dimmer switch. As dimmable fluorescent lamps become more readily available future replacement for such fixtures may become a viable option.

The cost and saving below assumes the replacement of all 293 lamps, with an average saving of 70 percent of the current incandescent lamp consumption. The number of lamps actually installed will affect the capital cost but not the payback period. It should also be noted that compact fluorescent lamps have a longer lamp life then incandescent lamps, savings due to the longer lamp life was not taken into consideration for this report. We have used an installation cost of $15 per lamp. A lower installation cost will significantly reduce the payback period.

Estimated Cost:	**$10, 841**
Calculated Saving:	**$3,336**
Simple Payback Period:	**3.25** years

Option 2: Upgrade Existing T12 Fixtures

The existing two lamp 34W fluorescent fixtures use approximately 80W each due to ballast losses. A New two lamp T8 electronic ballast fixture would use approximately 60W per fixture. It is recommended to replace all existing T12 fixtures with new electronic ballast T8 fixtures.

Estimated Cost:	**$3,946**
Calculated Saving:	**$723**
Simple Payback Period:	**5.46** years

Option 3: Install Occupancy Sensors in Washrooms for Lighting Control

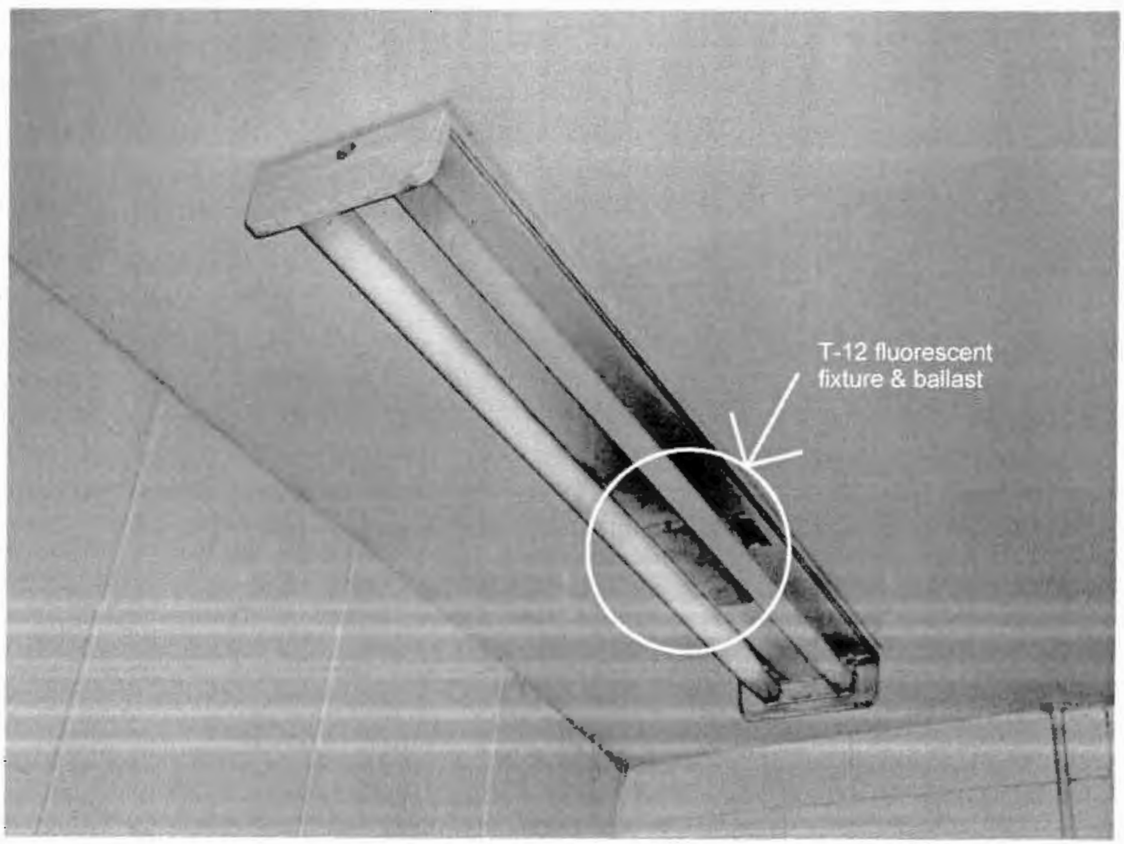
Manual light switches currently control the lighting in the main floor washrooms. The installation of multi-technology occupancy sensors in the washrooms would prevent the lights from being left on unnecessarily. It is therefore recommended to install occupancy sensors to control the lighting in the 2 main floor washrooms.

Estimated Cost:	**$730**
Calculated Saving:	**$213**
Simple Payback Period:	**3.42** years

5.0 APPENDICES

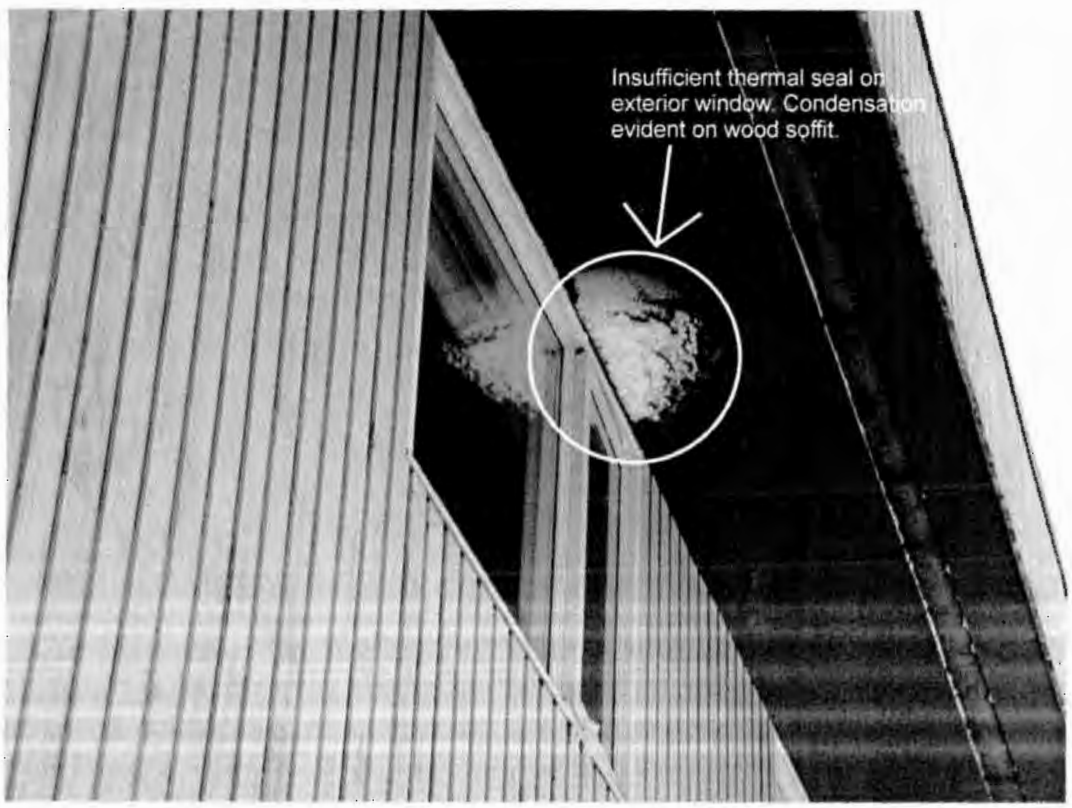
APPENDIX A: *Photo Documentation*

Photograph One
Typical guest room 40-60W incandescent bulb to be replaced with 7W compact fluorescent.

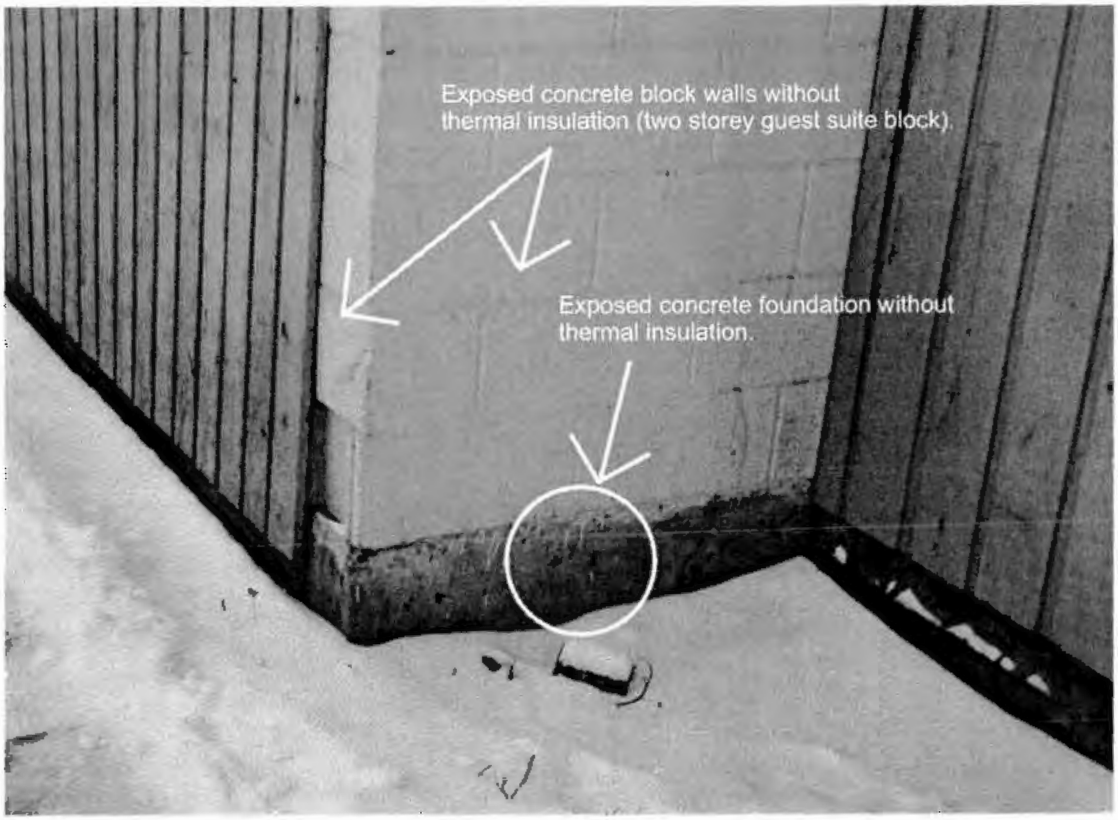


Photograph Two
T-12 fluorescent fixture to be replaced with T8 electronic ballast fluorescent fixtures .

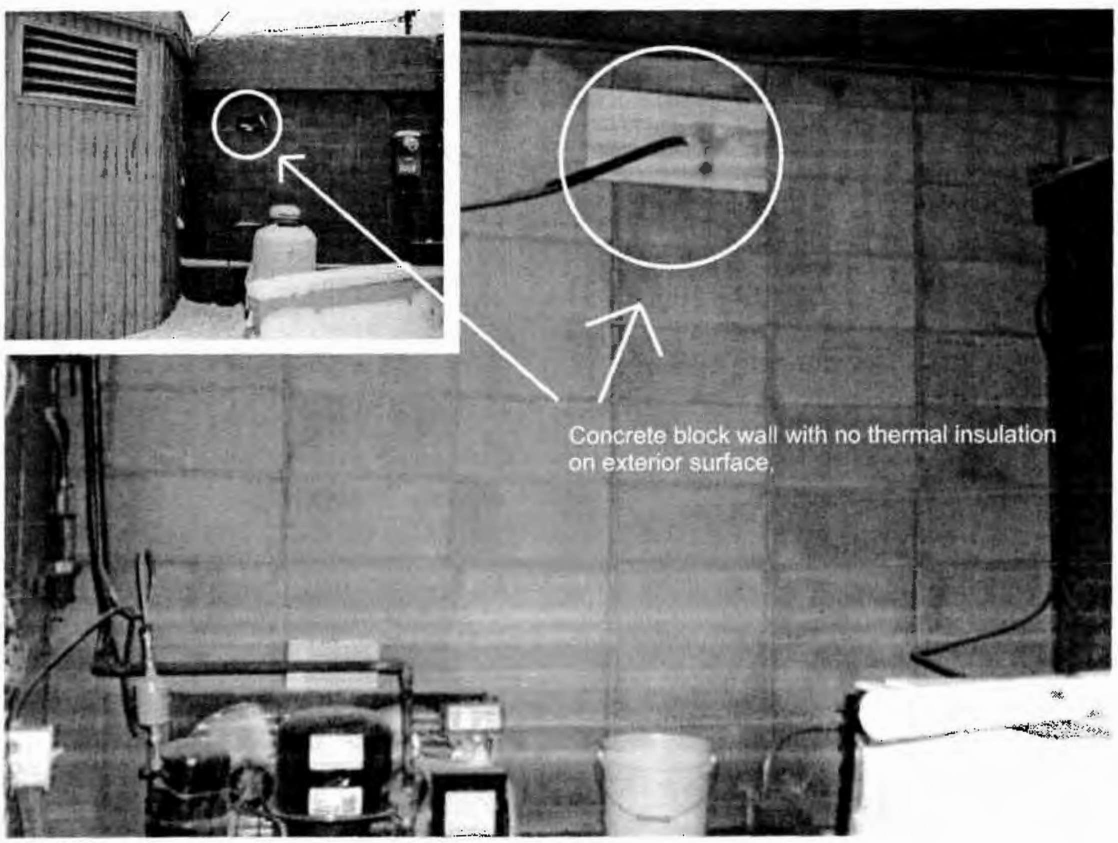
Photograph Three
Existing double glazed wood casement window unit in guest suite.



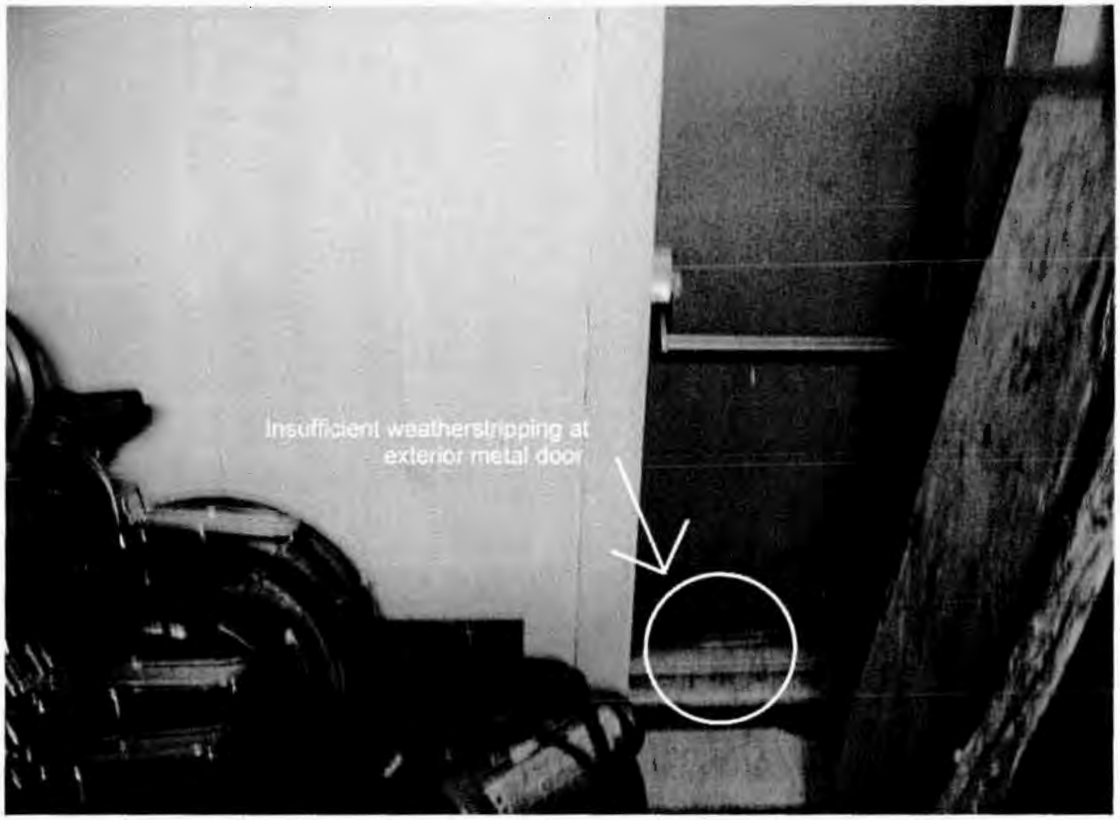
Photograph Four
Exterior view of typical wood casement window with condensation.



Photograph Five
Existing View of exposed concrete block wall

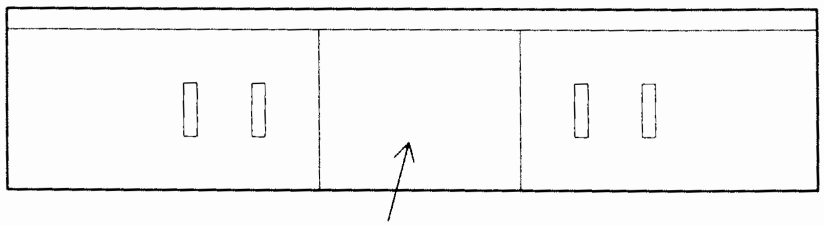


Photograph Six
Interior / Exterior view of uninsulated concrete block walk-in cooler compressor and storage area.



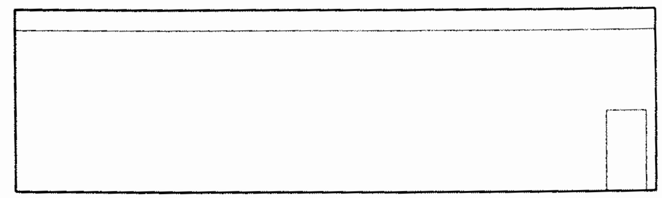
Photograph Seven
Interior view of service area at exterior door

APPENDIX B: *Architectural Building Elevations – Glazing & Wall Areas*

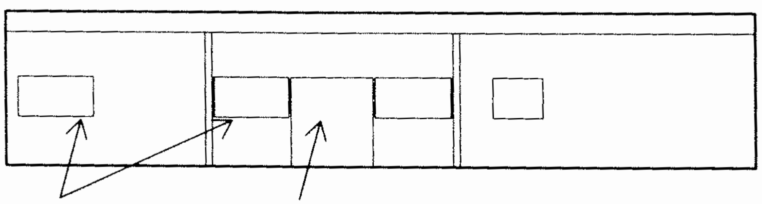


total 180 sq. ft.
glazing 0 sq. ft
2 x 4 wood frame
R12 insulation

total 540 sq. ft.
glazing 16 sq. ft
uninsulated concrete
block wall



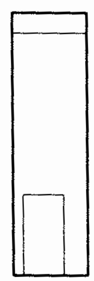
total 570 sq. ft.
glazing 18 sq. ft
uninsulated concrete
block wall



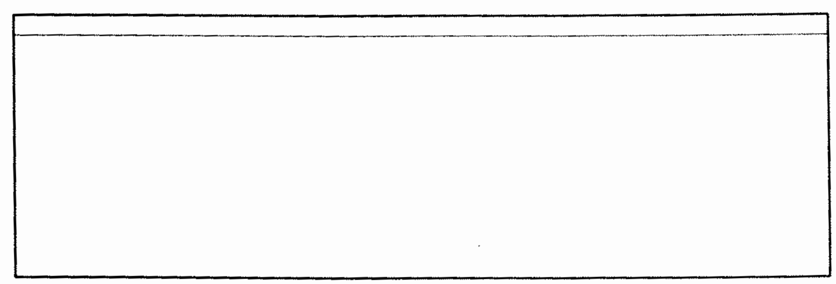
Wood Frames
(fixed units - Typ.)
Double Glazed

Alum. storefront
frame
double door glazed

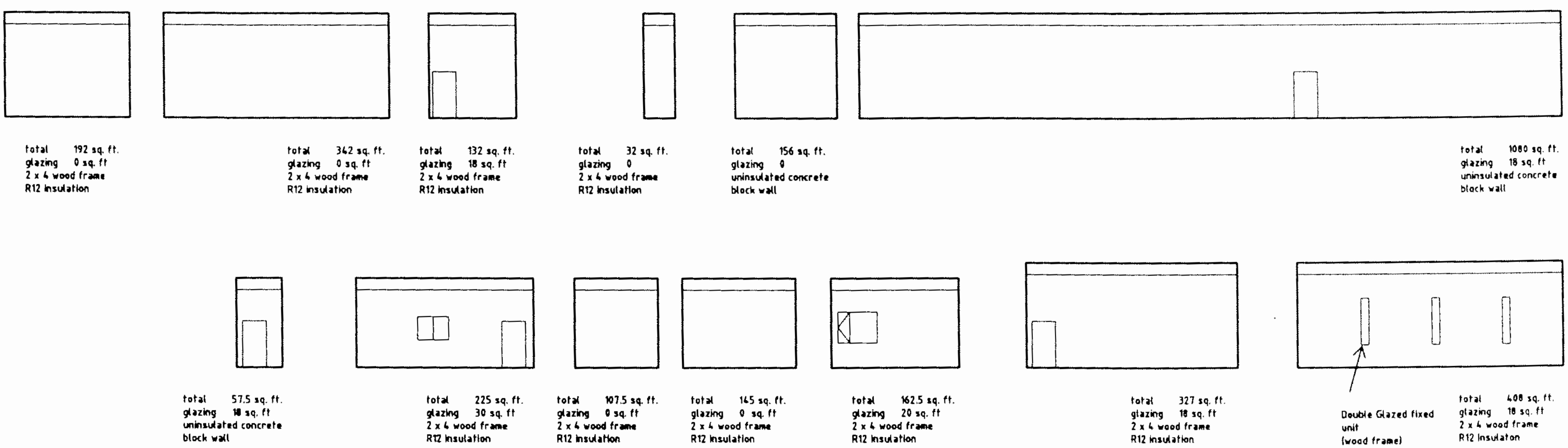
total 552.5 sq. ft.
glazing 100 sq. ft
2 x 4 wood frame
R12 insulation



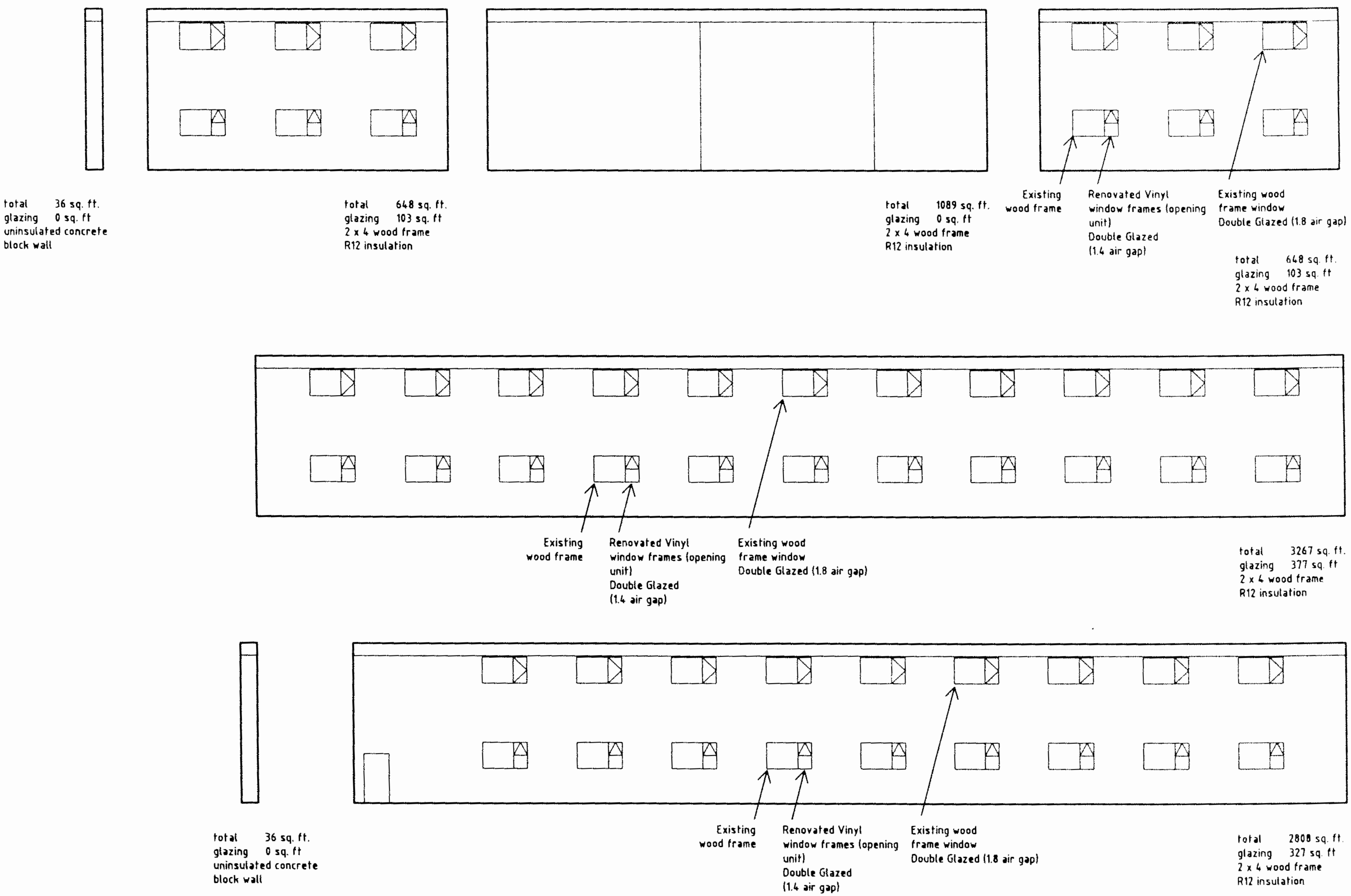
total 99 sq. ft.
glazing 18 sq. ft
2 x 4 wood frame
R12 insulation



total 1089 sq. ft.
glazing 0 sq. ft
uninsulated concrete
block wall



total 192 sq. ft.
glazing 0 sq. ft
2 x 4 wood frame
R12 insulation
total 342 sq. ft.
glazing 0 sq. ft
2 x 4 wood frame
R12 insulation
total 132 sq. ft.
glazing 18 sq. ft
2 x 4 wood frame
R12 insulation
total 32 sq. ft.
glazing 0
2 x 4 wood frame
R12 insulation
total 156 sq. ft.
glazing 0
uninsulated concrete
block wall
total 1080 sq. ft.
glazing 18 sq. ft
uninsulated concrete
block wall
total 57.5 sq. ft.
glazing 18 sq. ft
uninsulated concrete
block wall
total 225 sq. ft.
glazing 30 sq. ft
2 x 4 wood frame
R12 insulation
total 107.5 sq. ft.
glazing 0 sq. ft
2 x 4 wood frame
R12 insulation
total 145 sq. ft.
glazing 0 sq. ft
2 x 4 wood frame
R12 insulation
total 162.5 sq. ft.
glazing 20 sq. ft
2 x 4 wood frame
R12 insulation
total 327 sq. ft.
glazing 18 sq. ft
2 x 4 wood frame
R12 insulation
Double Glazed fixed
unit
(wood frame)
total 408 sq. ft.
glazing 18 sq. ft
2 x 4 wood frame
R12 insulaton


total 36 sq. ft.
glazing 0 sq. ft
uninsulated concrete
block wall
total 648 sq. ft.
glazing 103 sq. ft
2 x 4 wood frame
R12 insulation
total 1089 sq. ft.
glazing 0 sq. ft
2 x 4 wood frame
R12 insulation
Existing
wood frame
Renovated Vinyl
window frames (opening
unit)
Double Glazed
(1.4 air gap)
Existing wood
frame window
Double Glazed (1.8 air gap)
total 648 sq. ft.
glazing 103 sq. ft
2 x 4 wood frame
R12 insulation
Existing
wood frame
Renovated Vinyl
window frames (opening
unit)
Double Glazed
(1.4 air gap)
Existing wood
frame window
Double Glazed (1.8 air gap)
total 3267 sq. ft.
glazing 377 sq. ft
2 x 4 wood frame
R12 insulation
total 36 sq. ft.
glazing 0 sq. ft
uninsulated concrete
block wall
Existing
wood frame
Renovated Vinyl
window frames (opening
unit)
Double Glazed
(1.4 air gap)
Existing wood
frame window
Double Glazed (1.8 air gap)
total 2808 sq. ft.
glazing 327 sq. ft
2 x 4 wood frame
R12 insulation

APPENDIX C: *Electrical Report Data*

Option 1: Incandescent Lighting

Project Description:

Upgrade interior lighting as follows:

- replace all existing incandescent light lamps with self ballasted compact fluorescent lamps (excluding outdoor and bar fixtures)

Cost Breakdown:

Materials:	
Replacement for Incandescent lamps (293 @ $22)	$ 6,446
Subtotal:	$ 6,446
Labour:	
Installation: 293 fixtures @ 1/4 hour each and $60 per hour	$ 4,395
Subtotal:	$ 4,395
Total Cost:	$ 10,841
Propane Used to compensate for heat loss due to lower wattage bulbs:	$ 1,580
Total Saving:	$ 3,336
Simple Payback:	3.25 years

Option 2: Fluorescent Lighting

Project Description:

Upgrade interior lighting as follows:

- replace all existing T12 fixtures with new electronic ballast T8 fixtures

Cost Breakdown:

Materials:		
T8 surface mounted 1x4 Fixtures (11 @ $71 each)	$	781
T8 8' Strip Lights (3 @ $75 each)	$	225
T8 4' Strip Lights (28 @ $42 each)	$	1,260
Subtotal:	$	2,266
Labour:		
Installation: 42 fixtures @ 2/3 hour each and $60 per hour	$	1,680
Subtotal:	$	1,680
Total Cost:	$	3,946
Propane Used to compensate for heat loss due to lower wattage bulbs:	$	504
Total Saving:	$	723
Simple Payback:		5.46 years

Option 3: Washroom Lighting

Project Description:

Upgrade washroom lighting as follows:

- Add two motion sensors to main floor washrooms

Cost Breakdown:

Materials:		
2 motion sensors @ 245 each	$	490
Subtotal:	$	490
Labour:		
Installation: 2 sensors @ 2 hour each and $60 per hour	$	240
Subtotal:	$	240
Total Cost:	$	730
Propane Used to compensate for heat loss due to lower wattage bulbs:	$	159
Total Saving:	$	213
Simple Payback:		3.42 years

Detailed Energy Audit Calculations

Riverview Hotel

Riverview Hotel

Lighting -- Electricity Use and Demand for Energy Balance & Savings Calculations

Area	#	kW Before	Total kW Before	kW After	Total kW After	Time Before (Hrs/ Wk)	Time After (Hrs/ Wk)	Time (Wks)	Cost/ kW ($)	Cost/ kWh ($)	El. Use Before (kWh)	El. Cost Use & Demand ($)	El. Use Saving ($)	El. Use Saving (kWh)	El. Saving (kW) ($)	El. Saving Total ($)
Restaurant																
Replace 60W incandescent with 11W compact fluorescent	10	0.060	0.600	0.011	0.110	50	50	52	7.49	0.1548	1,560	295	197	1,274	44	241
Washrooms (Restaurant)																
Replace 60W incandescent with 11W compact fluorescent	7	0.060	0.420	0.011	0.077	50	50	52	7.49	0.1548	1,092	207	138	892	31	169
Boiler Room																
Replace 60W incandescent with 11W compact fluorescent	4	0.060	0.240	0.011	0.044	140	140	52	7.49	0.1548	1,747	292	221	1,427	18	238
Hotel Rooms																
Replace 60W incandescent with 11W compact fluorescent	265	0.060	15.900	0.011	2.915	28	28	52	7.49	0.1548	23,150	5,013	2,927	18,906	1,167	4,094
Kitchen Area																
Replace 2 T-12 tubes with 2 T-8 tube & IS ballast	6	0.080	0.480	0.060	0.360	60	60	52	7.49	0.1548	1,498	275	58	374	11	69
Replace 60W incandescent with 11W compact fluorescent	3	0.060	0.180	0.011	0.033	60	60	52	7.49	0.1548	562	103	71	459	13	84
Laundry Room																
Replace 2 T-12 tubes with 2 T-8 tube & IS ballast	1	0.080	0.080	0.060	0.060	140	140	52	7.49	0.1548	582	97	23	146	2	24
Replace 60W incandescent with 11W compact fluorescent	1	0.060	0.060	0.011	0.011	140	140	52	7.49	0.1548	437	73	55	357	4	60
Storage Areas																
Replace 60W incandescent with 11W compact fluorescent	3	0.060	0.180	0.011	0.033	14	14	52	7.49	0.1548	131	36	17	107	13	30
Basement																
Replace 2 T-12 tubes with 2 T-8 tube & IS ballast	8	0.080	0.640	0.060	0.480	168	168	52	7.49	0.1548	5,591	923	216	1,398	14	231
Replace 2 60W T-12 tubes with 2 T-8 tube & IS ballast	2	0.126	0.252	0.060	0.120	168	168	52	7.49	0.1548	2,201	363	179	1,153	12	190
Washrooms (Main Floor)																
Replace 2 T-12 tubes with 2 T-8 tube & IS ballast	4	0.080	0.320	0.060	0.240	168	35	52	7.49	0.1548	2,796	462	365	2,359	7	372
Parking Garage																
Replace 2 T-12 tubes with 2 T-8 tube & IS ballast	5	0.080	0.400	0.060	0.300	140	140	52	7.49	0.1548	2,912	487	113	728	9	122
Replace 1 T-12 tubes with 1 T-8 tube & IS ballast	18	0.040	0.720	0.030	0.540	140	140	52	7.49	0.1548	5,242	876	203	1,310	16	219
Totals			**20.472**		**5.323**						**49,501**	**9,503**	**4,782**	**30,889**	**1,362**	**6,143**

* Compact fluorescent wattage ratings are nominal. Actual wattage is slightly higher due to ballast and varies with manufacturer.