COMMUNITY ENERGY SYSTEM PROJECT: ENERGY EVALUATION OF SENIORS HOUSING UNITS

COMMUNITY ENERGY SYSTEM PROJECT

Energy Evaluation of Seniors Housing Units

WHITESAND FIRST NATION

Prepared for
Canada Mortgage and Housing Corporation
Technical Policies and Research Division

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1995

DISCLAIMER

EXECUTIVE SUMMARY

The Whitesand First Nation is proposing to construct an Elders Housing project on their territory near Armstrong Ontario.

This report has determined the energy loads for a small cogeneration facility to serve this 10 unit Seniors housing project as follows.

Design Heat Loss @ -38 °C	kW	67.39
Annual Space Heating	kWh	123836
Annual DHW Heating	kWh	56973
Annual Appliances	kWh	64363
Total Annual Energy	kWh	245172

The report has also identified areas where the First Nations Architect can improve the energy efficiency of building components and design. These modifications, introduced with little additional capital costs, will reduce the annual operation costs by over $4,500. The savings based on an "unsubsidized" electrical energy rate of $0.18 per kWh will be $10,100 per year.

The recommendations present a system compatible with the hot water delivered by the cogeneration facility in an efficient manner. Attention to detail in the construction phase while adhering to these suggestions will provide a comfortable and efficient building complex.

RÉSUMÉ

La Première nation de Whitesand propose la construction d'un ensemble de logements pour personnes âgées sur son territoire, près d'Armstrong (Ontario)

D'après le rapport, voici les caractéristiques énergétiques pour une petite centrale de cogénération qui desservirait un ensemble de 10 logements pour personnes âgées :

Perte de chaleur nominale à -38 °C	kWh	67,39
Consommation annuelle		
Chauffage des logements	kWh	123 836
Chauffe-eau	kWh	56 973
Appareils	kWh	64 363
Quantité annuelle totale d'énergie	kWh	245 172

Le rapport indique également les éléments pour lesquels l'architecte des premières nations peut améliorer le rendement énergétique des composantes du bâtiment. Ces modifications, dont les coûts en immobilisations supplémentaires seront minimes, réduiront de plus de 4 500 $ les coûts de fonctionnement annuels. Les économies, calculées à l'aide d'un prix de l'énergie non subventionné de 0,18 $ le kWh, s'élèveront à 10 100 $ par année.

Les recommandations font état d'une installation utilisant efficacement l'eau chaude distribuée par la centrale de cogénération. Grâce à l'attention apportée aux détails durant la phase de construction et à l'application des suggestions, on aura un ensemble résidentiel confortable et éconergétique.

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Whitesand First Nation

FINAL REPORT

1.0 GENERAL

1.1 Introduction

The Whitesand First Nation is proposing to construct an Elders Housing project on their territory near Armstrong Ontario. The architects have prepared preliminary drawings which indicate that electric heating will be used. The community is remote, off the hydro grid and presently being serviced with electricity from diesel powered generators. Heating with electricity is expected to be extremely expensive.

In order to reduce the O&M costs for the project, Mr. Christopher Ives, Technical Policies and Research CMHC, is investigating the viability of providing a small cogeneration facility which will provide both electrical energy and energy for space heat and domestic hot water.

1.2 Objective of this Report

The objective of this report is to accurately determine the energy loads for a small cogeneration facility to serve a 10 unit Seniors housing project at Whitesand First Nation, near Armstrong, Ontario. The terms of reference are set out in Schedule "A". This report consists of the following parts.

1.0 General	Project Description
2.0 Phase 1	Heat Loss calculations, "what if" scenario
3.0 Phase 2	Recommendations

1.3 Proposed Construction

Excerpts of the project drawings have been included in this report. For further details on construction refer to the proposed drawings as prepared by Ininew Project Management Ltd. (**Note:** The architect's drawings have used the Imperial scale. To remain consistent references to the drawings will also be Imperial. Metric (SI) units have been used elsewhere in this report.)

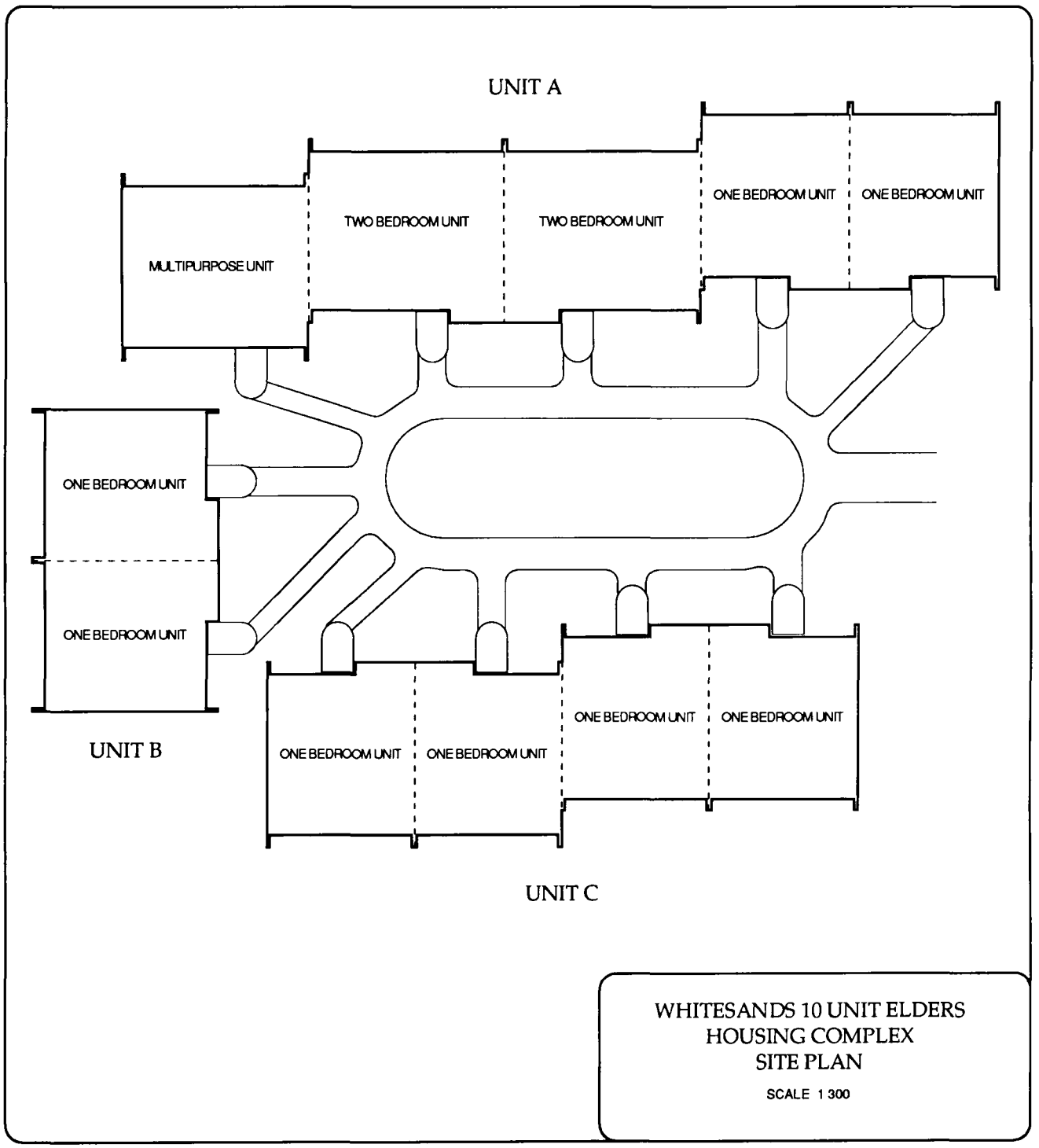
The seniors housing is an arrangement of one and two bedroom apartments in groups referred to as Unit "A", Unit "B" and Unit "C". Unit "A" contains a Multi Purpose room for the common use of all of the tenants.

The proposed construction is single storey wood frame on a concrete foundation in the form of a crawl space. The insulation levels are ceiling R 40, exterior walls R 20, exterior doors R 8, average window R 2.50, header R 10 and below grade walls R 10.

The heating system is proposed to be individually electrically heated baseboard. Domestic hot water is generated in electric hot water tanks. Ventilation air is provided by Heat recovery Ventilators.

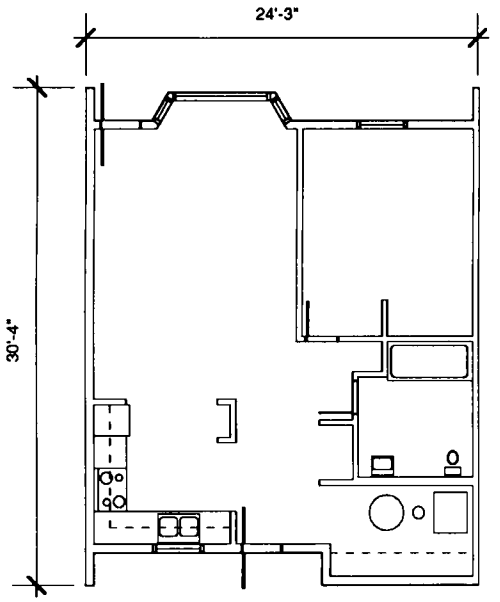
1.4 Site Layout

The proposed arrangement of Unit "A", Unit "B" and Unit "C" which comprises the 10 Unit Elders Housing complex is shown below.

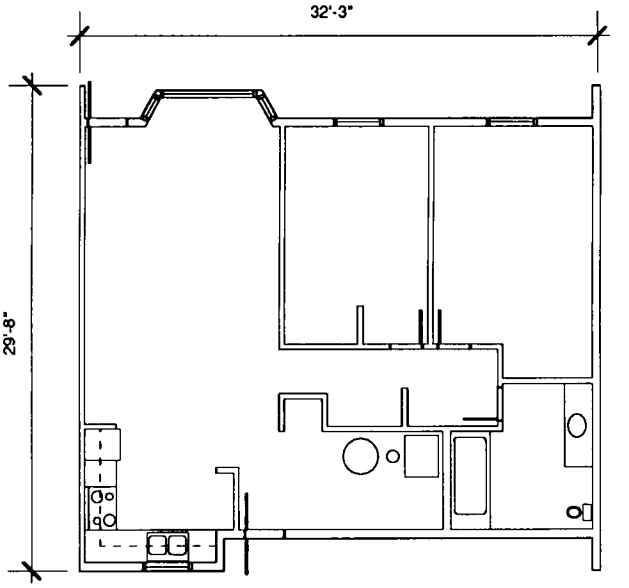


1.5 Typical Floor Plans

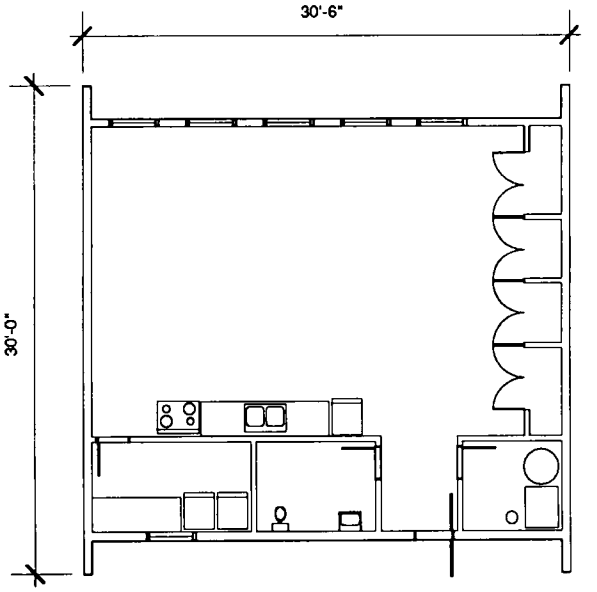
The typical floor plans of the one and two bedroom apartments and the multi purpose room are shown below.



TYPICAL ONE BEDROOM UNIT



TYPICAL TWO BEDROOM UNIT



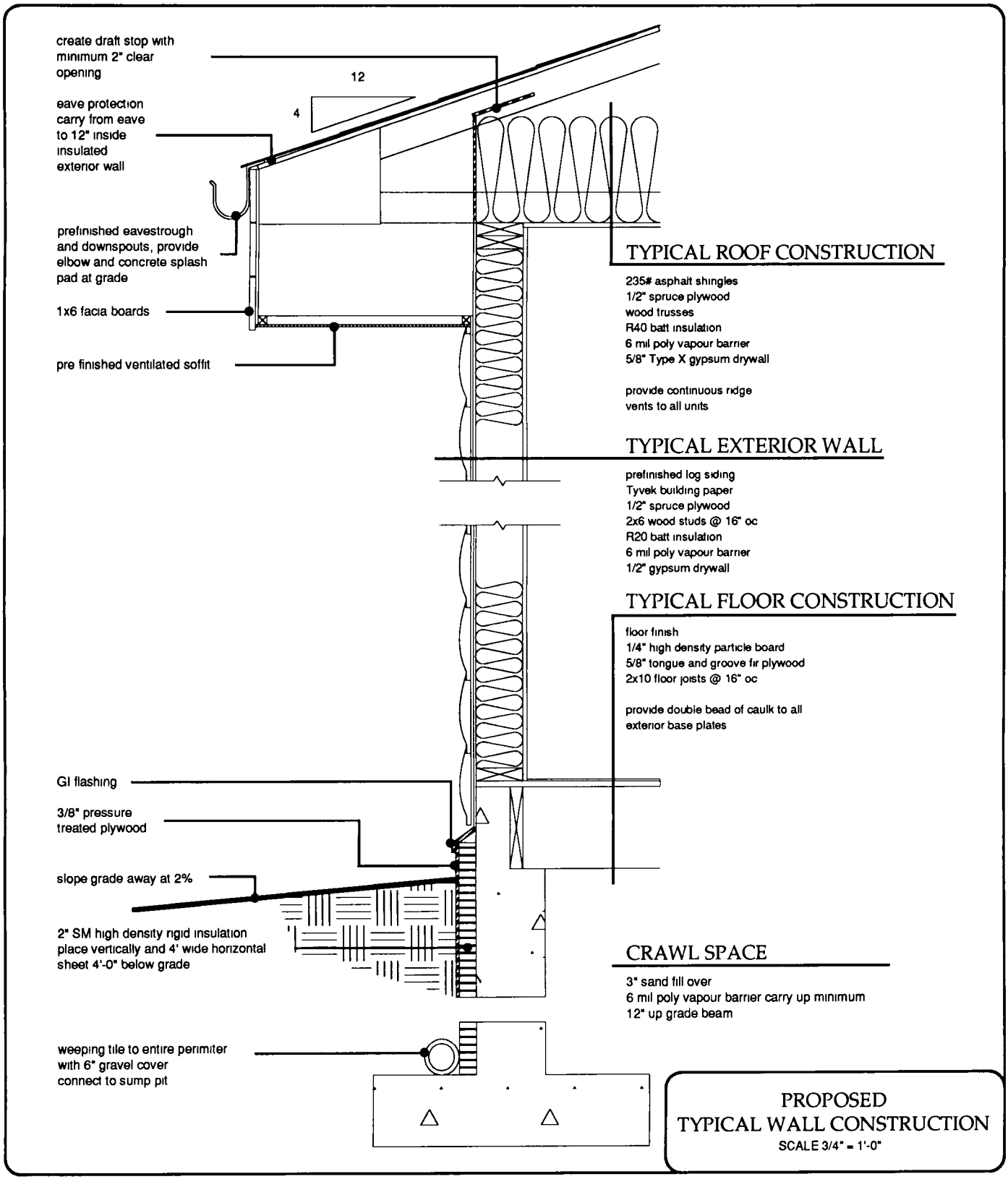
MULTIPURPOSE UNIT

TYPICAL FLOOR PLANS

SCALE 3/32" = 1'-0"

1.6 Typical Wall Section Details

The typical wall section proposed to be used by the Architect is shown below.



2.0 PHASE 1 - HEAT LOSS CALCULATIONS

2.1 Heat Loss

The heat loss calculations were performed on the CANMET Hot 2000 v 6.02 program. The results should give some guidance in recommendations concerning energy efficiency and form the basis for determining the design loads for the cogeneration project.

The heat loss determination evaluates the energy performance for the proposed building envelope. The complete calculations are shown in Appendix "A".

The individual apartments in each of the three housing units have been analyzed separately and the results have been summarized.

SUMMARY of PROPOSED ELDERS HOUSING HEAT LOSS

Building Components	R Value	Elders Unit "A" Area or Volume Imperial sf	Elders Unit "A" Area or Volume Metric sm	Elders Unit "B" Area or Volume Imperial sf	Elders Unit "B" Area or Volume Metric sm	Elders Unit "C" Area or Volume Imperial sf	Elders Unit "C" Area or Volume Metric sm	Total for Complex Area or Volume Imperial sf	Total for Complex Area or Volume Metric sm
Ceiling	40	3592	334	1248	116	2496	232	7337	682
Main Walls	20	2942	273	1225	114	2129	198	6297	585
Doors	8	180	17	80	7	160	15	420	39
Crawl Space Walls above grade	10	306	28	128	12	222	21	656	61
Crawl Space Walls below grade	10	1532	142	638	59	1109	103	3280	305
Crawl Space Perimeter	0	1169	109	452	42	821	76	2442	227
Crawl Space Centre	0	2424	225	796	74	1675	156	4894	455
Windows (average)	2.55	185	17	65	6	130	12	379	35
Volume		46700	1322	16226	459	32452	919	95377	2701
Design Loads and Consumption									
Design Heat Loss @ -36.4°F BTU			108468		41494		80044		230006
Design Heat Loss @ -38.0 °C kW			31.78		12.16		23.45		67.39
Annual Space Heating kwh			60652		22145		41039		123836
Annual DHW Heating kwh			27994		9660		19320		56973
Annual Appliances kwh			29262		11700		23400		64363
Annual Total kwh			117908		43505		83759		245172
Annual Space + DHW kwh			88642		31805		60359		180806
R-2000 Target kwh			62047		22898		45797		130742

2.1 Heat Loss (Continued)

The summary compares the proposed performance level to the R 2000 target which is used as a benchmark. (Normally the cumulative value of the R 2000 targets is adjusted downward if the unit is to be registered in the R 2000 program, however, in this evaluation no adjustments have been made.)

2.2 Assumptions and Parameters

Building Construction

- Detail of the Party Wall Type 1 shows a 2 inch air space in the main wall. For the purposes of this report (and in keeping with good building practices) it is assumed that this air gap is insulated and sealed to prevent outside air from entering the space.
- The Typical Wall Construction detail shows no insulation on a portion of the concrete header. This report assumes the rigid insulation extends upward over the entire header.
- No dimension is shown for the exterior grade wall and it is assumed to be 5'-0" which is the depth of the center piers.

Occupancy

- One bedroom units 2 adults for 80% of the time
- Two bedroom units 2 adults for 80% of the time, 1 child for 50% of the time
- Multi Purpose unit 6 adults for 20% of the time, 2 children for 20% of the time

Domestic Hot Water Consumption

A low value of 49 Igpd was used for the One Bedroom units and a medium value of 62 Igpd was used for the Two Bedroom and Multi Purpose units.

Base Loads

The base electrical loads for each unit were 16.0 kW per day for lighting and appliances
2.0 kW per day for exterior use

Location and Weather Data

The weather data used is for Armstrong and is shown below.

Latitude	50.33°N	Annual Degree Days below 18°C	6991
Dry Bulb Temp	28.0 °C	Wet Bulb Temp	21.0°C

January Design Temperature (2 1/2%)	-38°C
January Design Temperature (1%)	-42°C
Design Temperature Difference	59.0 °C
Ave Deep Ground Temp	5.9 °C
f-value Solar index	0.95

Air Tightness

- The air tightness level is for present type of construction or 3.57 ACH @ 50 Pa. (The R-2000 level is 1.50 ACH @ 50 Pa)

2.3 "What If" Scenario

In this "What If", various component of the building construction have been altered to show how some improvements in energy efficiency can be made. The example included is for the Elders Housing Unit "A". The changes to the components are as follows:

- Substituted a slab on grade for the crawl space. The slab has been insulated on the perimeter to R 10 and the centre to R 5.
- Increased main wall insulation to R 30.
- Reduced air infiltration to R 2000 level (i.e. 1.50 ACH @ 50 Pa).
- Reduced building volume.

The Hot 2000 Run and the calculation sheet for Unit "A" are shown in Appendix "B". The results are compared in the table below.

COMPARISON of HEAT LOSS with DIFFERENT INSULATION LEVELS
(Slab on Grade Substituted for Crawl Space)

	Elders Unit "A"			Elders Unit "A" Revised			
	R Value	Area or Volume Imperial sf	Area or Volume Metric sm	R Value	Area or Volume Imperial sf	Area or Volume Metric sm	
Building Components							Building Components
Ceiling	40	3592	334	40	3592	334	Ceiling
Main Walls	20	2942	273	30	2942	273	Main Walls
Doors	8	180	17	8	180	17	Doors
Crawl Space Walls above grade	10	306	28	10	1169	109	Slab Perimeter
Crawl Space Walls below grade	10	1532	142	5	2424	225	Slab Centre
Crawl Space Perimeter	0	1169	109				
Crawl Space Centre	0	2424	225				
Windows (average)	2.55	185	17	2.55	185	17	Windows
Volume		46700	1322		28778	815	
Design Loads and Consumption							
Design Heat Loss @ -36.4°F BTU			108468			82499	
Design Heat Loss @ -38.0 °C kW			31.78			24.17	
Annual Space Heating kwh			60652			33100	
Annual DHW Heating kwh			27994			27994	
Annual Appliances kwh			29262			29262	
Annual Total kwh			117908			90356	
Annual Space + DHW kwh			88642			61094	
R-2000 Target kwh			62047			48023	

Space Heat Reduction kWh
27552

2.3 "What If" Scenario (Continued)

The reduction in the annual space heat requirements in the "What If " scenario is 27552 kWh. If this reduction in space heat requirements is prorated on an area basis this could amount to 56300 kWh annually for the Complex.

At a rate of $0.0802 per kWh, this will mean a saving of $4515 annually. In addition to this consumption charge is an Ontario Hydro service charge for the complex of $5062 per year, a portion of which may be saved with a cogeneration system

2.4 Cost Implications

A detailed cost analysis is not part of the scope of work for this report, however, the following table shows the component cost to be reviewed.

Cost Implications

Item	Component	Increase in Cost	Decrease in cost
1	Exterior Wall		
	Exterior Sheathing		Delete Sheathing cost @ $ 4.50 per l.f. of wall
	Studs		Increase spacing to 24" from 16"
	Interior Strapping	$2.30 per l.f. of wall (material)	
	Inner Insulation	$1.45 per l.f. of wall (material)	
2	Slab on Grade		
	Site Preparation	No increase	
	Excavation		Reduced excavation costs
	Imported Fill	Additional fill may be required	
	Concrete Form work		Reduced forming costs
	Concrete	No Increase in concrete cost	
	Rigid Insulation	No Increase in material cost	
3	Plumbing and Drainage	Small increase for excavation and material	Delete weeping tile, Drainage sumps
4	Hydronic System	Capital Cost Heat Exchanger for DHW	Credit for Electrical Credit for electric DHW tanks

In general terms, it would appear that deleting the exterior sheathing will almost off set the additional cost of upgrading the exterior walls and the slab on grade uses no more material than the proposed crawl space with the exception of cost for any additional fill that may be required. Labour costs are not expected to rise appreciably.

2.5 Other Comments

- Armstrong has the lowest design temperatures listed in the "Climatic Data" of the Ontario Building Code.
- The percentage of the total building annual heat loss through the crawl space is 29.8 %
- Several variations to insulation levels are possible although all will increase the capital cost.
- If hydronic heating is to be considered, the slab on grade will lend itself to in floor radiant heat.

3.0 PHASE 2 - RECOMMENDATIONS

3.1 Introduction

The purpose of Phase 2 is to offer suggestions to the Owner's Architect as to how the Elders housing building envelope may be improved to provide better energy efficiency. The discussions are general in nature and are for information only. Increases in insulation levels may add to the capital cost of the project, however, decreased energy consumption will greatly reduce the operation costs and improve the life cycle cost of the complex. Cost Implications, which are modest, are shown on Page 8.

3.2 Suggested Changes to Building Components

Ceiling Insulation.

The heat loss through the combined ceilings of the housing units is 72.8 mil BTU (21332 kWh) annually. Adding insulation to this component is probably the least costly way to reduce heat loss. A cost evaluation should be done prior to final plan preparation to determine what extent insulation should be added, however, the material cost of R 20 Fibre Glass Batt insulation is approximately $0.38 per square foot.

Exterior Walls.

The heat loss through the combined main walls of Units "A", "B", and "C" is 104.6 mil BTU (30635 kWh) annually and some upgrading of the insulation levels should be considered. The Ontario Building Code requires a **minimum** of R22 in exterior wall in areas where the annual degree days below 18°C exceed 5000. Two methods to be considered are:

a) Provide additional insulation to the exterior of the walls. This could be in the form of rigid SM insulation board (R 5 per inch) or glass fiber stock board (R 4.2 to 4.5 per inch).

See Figure 1

The advantages of using insulative sheathing are:

- Plywood or similar sheathing on the walls can be eliminated if diagonal bracing of wood or preformed metal "Tee" is used.
- Incremental costs over standard framing are relatively small.
- Construction materials are readily available.

The disadvantages are:

- Some backing problems may be encountered when installing siding.
- Electrical boxes and plumbing penetrations require separate sealing.
- "Build out" around windows and doors is required.

Exterior Walls. (Continued)

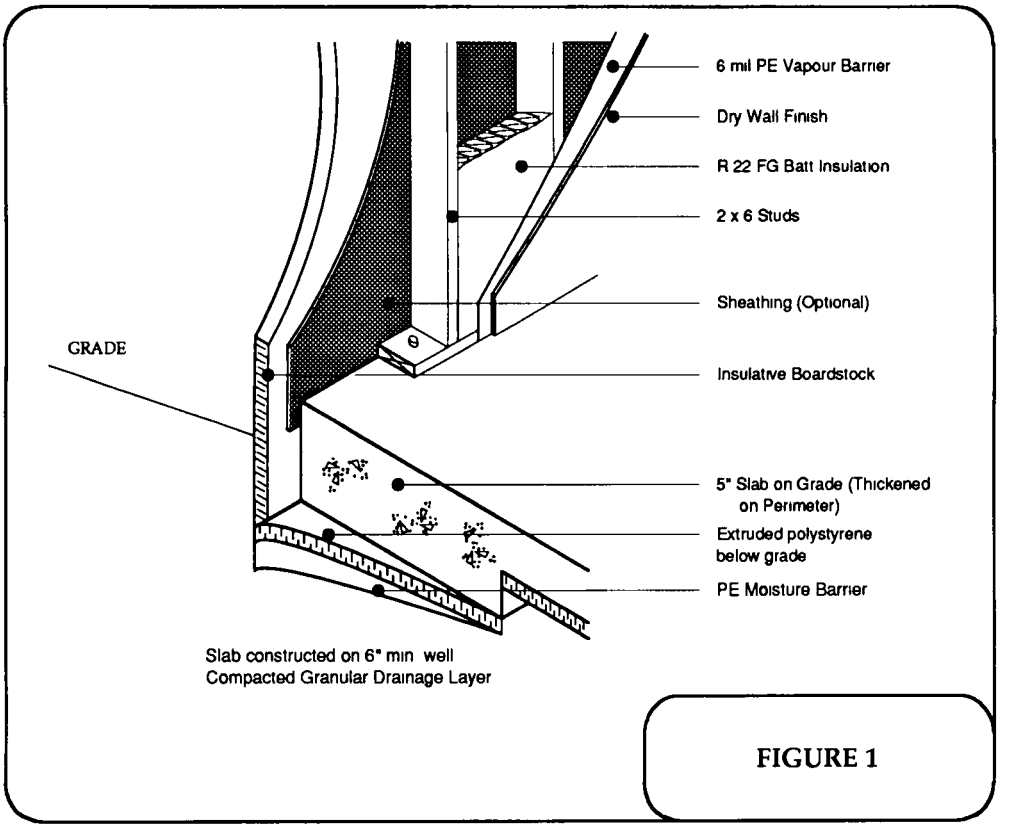


FIGURE 1

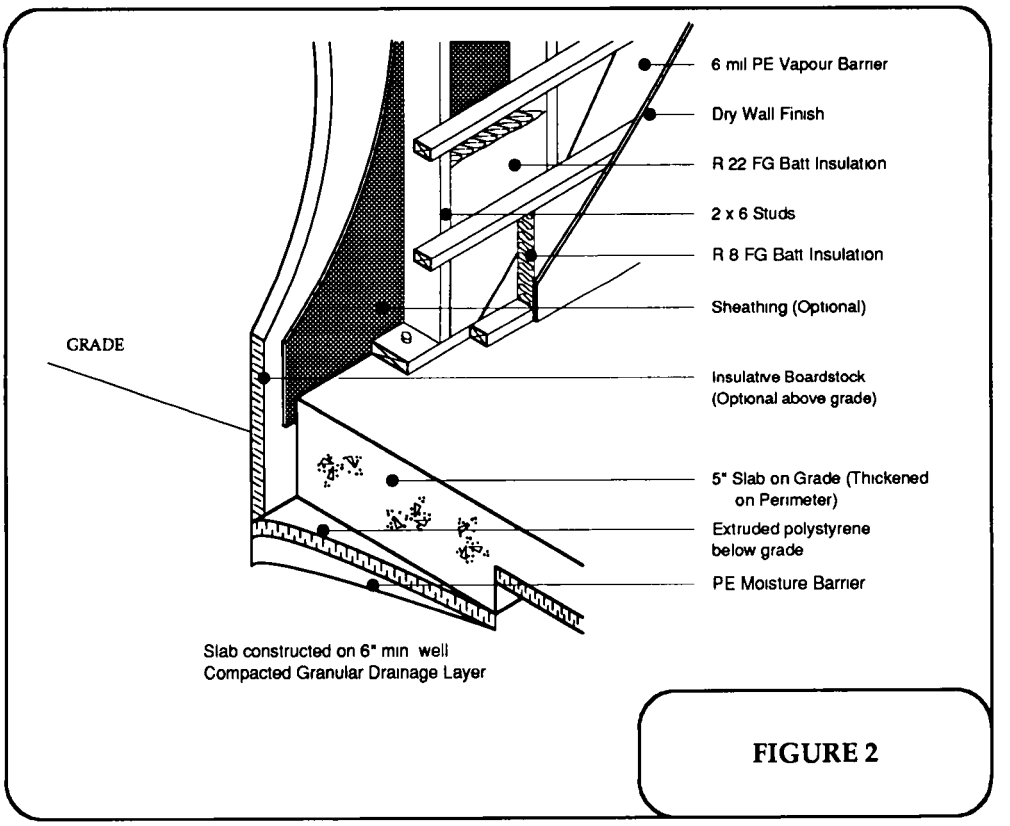


FIGURE 2

Exterior Walls. (Continued)

b) Install an inner wall (either horizontal strapping or staggered vertical studs). Using 2x3 material will provide a space for an additional R8 in the form of fiber glass batts. The air barrier or vapor barrier is placed between the studs and strapping.

See Figure 2

The advantages are:

- The inner layer of insulation covers the studs and reduces thermal bridging.
- Insulation levels of R28 or higher can be achieved.
- Electrical boxes can be installed without penetrating the vapor barrier.
- Backing difficulties for siding installation are avoided.
- This method can be used with the insulative sheathing described in a)

The disadvantages are:

- If horizontal strapping is used, blocking to support kitchen cabinets, baseboards, etc. must be considered.
- "Build outs or extensions" are required around windows and doors.
- Some interior floor space area will be lost.

Windows.

The combined annual heat loss though the windows is 58.4 Mil BTU (17125 kWh). These heat losses have been calculated using a fairly lenient R value of 2.52. The windows being proposed are triple pane with the outer layer of lexan. The Architect should be encouraged to investigate high performance windows.

Long-wave radiative heat transfer is the major heat loss mechanism in conventional windows. This heat transfer is reduced by including a low emissivity (Low-E) coating in the window construction. Another source of heat transfer often overlooked is the spacers used to separate the glazings. Various insulative values for these spacers are available from window manufacturers.

It is not the intention here to investigate all the available window products but some attention should be given to the performance of various types of windows and a cost vs. benefit comparison made.

Floor, Foundation and Crawl Space

Almost one third of the annual heat loss on the buildings proposed is through the foundation and crawl space. The combined annual heat loss is 170.5 Mil BTU (49943 kWh).

Before considering possible upgrades to this building component, it would be wise to discuss the various heating systems. Since the intent of the cogeneration project is to deliver electricity and hot water to the Elder's complex, it is assumed that the heating system will be a hydronic type. The types of systems generally used are radiant floor, radiant ceiling, radiant baseboard panels, hydronic convectors or fin tube radiators and forced air (using hot water coils in an air handling unit).

Floor, Foundation and Crawl Space (Continued)

The following table makes some comparisons of these systems.

Type	Pros	Cons	Relative Operating Cost
Radiant floor	occupant comfort best cost performance system not visible	higher capital cost	1.00
Radiant ceiling	good for retrofits	not common	1.08
Radiant baseboard Panels	easily installed attractive	not widely used high cost	1.08
Convectors	widely used	capital cost visible	1.27
Forced air	lowest installation cost	moves dust & micro organisms about dwelling	1.47

The preferred system is generally thought to be radiant in floor which provides comfort as well as economy of operation. Initial reaction from some designers is that this type of system is too expensive, however, recently introduced Pex pipe (a cross linked polyethylene plastic), simple manifolds and related equipment have reduced the cost of materials and labor requirements.

Slab on Grade

Details of the slab on grade are shown in **Figure 1 and Figure 2**

A slab on grade consists of a concrete slab with a thickened perimeter edge reinforcing, or a slab with a perimeter foundation wall. This type of foundation can be insulated beneath the slab and on the edge.

Advantages of a slab on grade.

- Can be less expense than traditionally framed and poured foundation
- Properly insulated the slab can be used for thermal storage
- A slab on grade is less susceptible to moisture damage than crawl spaces
- The heating system can be placed in the floor. (i.e. radiant in floor)

When considering a slab on grade foundation the following points should be addressed.

- The designer should thoroughly investigate the site conditions.
- The slab shall be designed to resist frost heave.
- The slab should be placed on a well draining granular layer
- Care should be taken to properly insulate the slab edge and lower wall plates.

3.3 Recommendation Summary

It is recommended that the insulation levels in the ceiling be upgraded to R 60. The cost of insulation material will be approximately $0.38 for an additional 6" layer.

The insulation in the exterior walls must be upgraded to R22 in order to meet the Ontario Building code and should be at least R 30.

With the assumption that a hydronic heating system is to be installed for the Elders Housing Complex, in-floor radiant heat with a slab on grade foundation is the preferred choice. The higher capital cost of the heating system is offset by the time and material savings of installing a slab on grade rather than a crawl space. Superior comfort and the best cost performance are also factors in the choice of this system.

The combined annual heat loss through the windows of the Elders Housing complex accounts for over 8% of total concentrated heat loss. Therefore, in order to keep heating costs down and to maintain an environment of comfort, care must be taken in choosing an appropriate item.

The plans that represent the proposed building construction are typical of minimum building requirements and should be checked to see if they conform to the current Ontario Building Code.

The suggestions forwarded represent a system compatible with the hot water delivered by the cogeneration facility in an efficient manner. Attention to detail in the construction phase while adhering to these suggestions will provide a comfortable and efficient building complex.

APPENDIX "A"

Heat Loss of Proposed Buildings

Contents

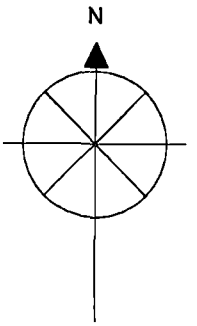
- Typical Component Take Off
- Typical Hot 2000 Run
- Calculation Sheet for Unit "A"
- Calculation Sheet for Unit "B"
- Calculation Sheet for Unit "C"

DESIGN EVALUATION TAKE OFF

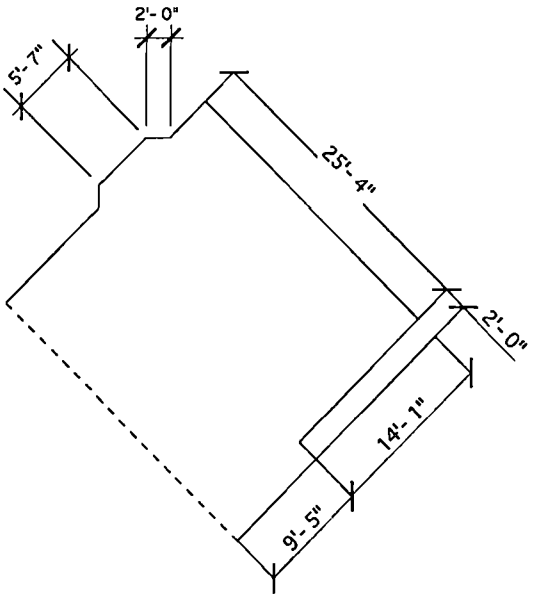
Dimensions are Interior

Elders Unit "A" Apartment 1 contains:

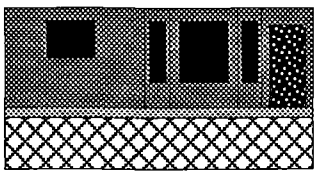
- 1 Living room
- 1 Kitchen
- 1 Bedroom
- 1 Bath
- 1 Other



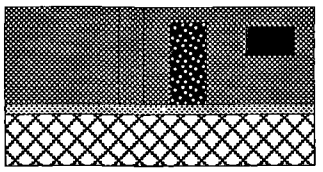
File:	Armstrong	Date:	January 1995
Builder:	n/a	Builder N°:	
		Attention:	C. Ives
		Tel:	613-748-2312
House:	Elders Unit "A" Apartment 1	Owner:	Whitesand First Nation
Location:	Whitesand First Nation	Address:	Armstrong Ontario



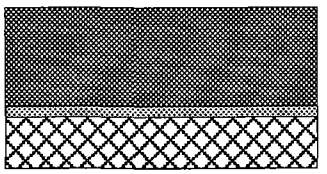
MAIN FLOOR PLAN



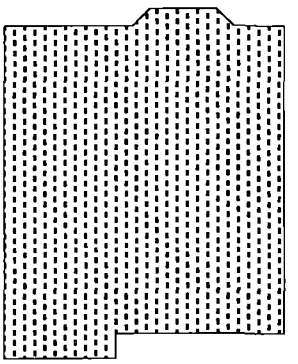
NORTH WEST WALL



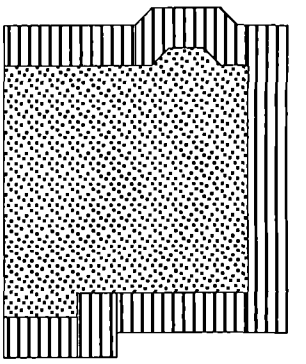
SOUTH EAST WALL



NORTH EAST WALL



CEILING AREA



CRAWL SPACE AREAS

Volume	Area	Height	c.f.
V1	624.07	13.0	8112.9

NOTE: Dimensions plotted and Areas calculated on MiniCAD+ integrated spread sheet

	Component	Code	R Value	Area		
Ceilings						
	Flat Ceiling	C1	40.0	624.07		
	Cathedral Ceiling	C2		0.00		
	Other	C3		0.00		
Main Walls	Gross Area	M1	20.0	612.57		
	Windows			54.67	42.09	77% of R.O.
	Less Doors & Windows			530.48		
Doors	Gross Area- Main Wall	D1	8.0	40.00		
	Door Windows			0.00	0.00	77% of R.O.
	Doors less Windows			40.00		
Header	Gross area	B1	10.0	63.81		
Overhangs		OH1		0.00		
Crawl Space	Walls above Grade	CR1		0.00		
	Walls below Grade	CR2		319.05		
Shallow Basem't	Walls above Grade	B2		0.00		
	Windows			0.00	0.00	77% of R.O.
	Less windows			0.00		
	Walls below Grade	B3		0.00		
Full Basement	Walls above Grade	B4		0.00		
	Windows			0.00	0.00	77% of R.O.
	Less Doors & Windows			0.00		
	Doors Gross Area			0.00		
	Door Windows			0.00		
	Doors less Windows					
	Upper Wall Below Grade			0.00		
	Lower Walls Below Grade			0.00		
Slab on Grade	Perimeter Area		0.0	0.00		
	Centre Area		0.0	0.00		
Basement slab	Perimeter Area	S1	0.0	0.00		
	Centre Area	S2	0.0	0.00		
Crawl Space	Perimeter Area	CS1	0.0	226.19		
	Centre Area	CS2	0.0	397.88		
Building Envelope				2243.56		

For Use with Hot 2000 version 6.02 or 5.07

NOTE: Dimensions plotted and Areas calculated on MiniCAD+ integrated spread sheet

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*****************************************
*                                       *
*              Hot2000                  *
*            Version 6.02               *
*              CANMET                   *
*  Energy, Mines and Resources CANADA   *
*            July 1, 1991               *
*                                       *
*****************************************
```

House Data Filename=Scott:H2k:H2k:Dat:ELDERA1.HDF

Weather Data is for ARMSTRONG, ONTARIO

Builder Code =n/a Data Entry by:RDM

Client name: CMHC C Ives
Street address: for Whitesand F N
City: Region:
Postal code: Telephone:

*** GENERAL HOUSE CHARACTERISTICS ***

House type: (Individual) Apartment unit
Number of storeys: One storey
South side obstruction: 1% to 25% obstruction by Buildings
Wall construction: Single stud wall

SOIL TYPE: Normal Conductivity: dry sand, loam, clay, low water table

HOUSE THERMAL MASS LEVEL: (A) Wood frame construction, 0.5 in. gyproc walls and ceiling, wooden floor

Occupants : 2 Adults for 80.0 % of the time
0 Children for 20.0 % of the time

*** HOUSE TEMPERATURES ***

Heating Temperatures	Main Floor	= 72.0 F
	Basement	= 68.0 F
	TEMP. Swing from 72.0 F	= 6.3 F

*** FOUNDATION CONSTRUCTION CHARACTERISTICS ***

Foundation Construction	Attachment Sides	Insulation Placement
Shallow Basement	None	Exterior

*** WINDOW CHARACTERISTICS ***

Direction	Seq #	Location Code	# of Windows	Type	Window Width Ft	Window Height Ft	OverHang Width Ft	Header Height Ft	SHGC
Southeast	1	M1	1	300013	3.080	1.796	2.000	1.000	.4284
North	1	M1	1	300003	1.026	3.850	2.000	.500	.4999
Northwest	1	M1	1	300003	3.080	3.850	.500	.500	.6037
	2	M1	1	300013	3.080	2.310	2.000	.500	.4639
West	1	M1	1	300003	1.026	3.850	2.000	.500	.4999

*** WINDOW PARAMETER CODES SCHEDULE ***

	Code	Description (Glazings, Coatings, Fill, Spacer, Type, Frame)
1	300013	Triple (TG), Clear, 13 mm Air, Metal, Hinged, Alum. Clad Wood
2	300003	Triple (TG), Clear, 13 mm Air, Metal, Picture, Alum. Clad Wood

*** BUILDING PARAMETERS ***

Component		Area (Ft2) Gross	Area (Ft2) Net	R	Heat Loss Mil.BTU	% Annual Heat Loss
Above Grade Components						
Ceiling						
C1		624.07	624.07	40.00		
	TOTAL:	624.07	624.07	40.00	6.193	10.20
Main Walls						
M1		612.57	540.17	20.00		
	TOTAL:	612.57	540.17	20.00	10.274	16.93
Doors						
D1	Location: M1	40.00	40.00	8.00		
	TOTAL:	40.00	40.00	8.00	1.985	3.27
Basement walls above grade						
B1		63.81	63.81	10.00		
	TOTAL:	63.81	63.81	10.00	2.314	3.81
Shallow Basement Area						
Basement walls below grade						
		319.05		10.00		
	TOTAL:	319.05		10.00	7.500	12.36
Perimeter area						
		226.19		1.14		
	TOTAL:	226.19		.00	5.203	8.57
Centre area						
		397.88		1.14		
	TOTAL:	397.88		.00	3.248	5.35

WINDOWS

Orientation Location	Number	Type (Code)	Total Area(Ft2)	R Window	(Shutter)	Heat Loss Mil.BTU	% Annual Heat Loss
Southeast							
M1	1	300013	5.53	2.63			
TOTAL:			5.53	2.63		.833	1.37
North							
M1	1	300003	3.95	2.32			
TOTAL:			3.95	2.32		.676	1.11
Northwest							
M1	1	300003	11.86	2.66			
M1	1	300013	7.11	2.68			
TOTAL:			18.97	2.67		2.820	4.65
West							
M1	1	300003	3.95	2.32			
TOTAL:			3.95	2.32		.676	1.11

Ventilation

House Volume	Air Change	Heat Loss Mil.BTU	% Annual Heat Loss
8112.9 Ft3	.58 ACH	18.968	31.25

*** AIR LEAKAGE AND VENTILATION ***

Building Envelope Surface Area = 2243.6 Ft2
Air Tightness Level is Present (3.57 ACH @50 Pa.)
Building Envelope is NOT Sheltered from the Wind.
Estimated Equivalent Leakage Area = 44.2 in2
Normalized Leakage Area = .0197 in2/ft2
Estimated Airflow to cause a 5 Pa Pressure Difference = 38 cfm
Estimated Airflow to cause a 10 Pa Pressure Difference = 60 cfm
ELA used to calculate Estimated Airflows = 17.7 in2

F-326 VENTILATION REQUIREMENTS:

Kitchen,living,dining:	3 rooms @ 10 cfm	= 30 cfm
Bedrooms:	1 rooms @ 20 cfm	= 20 cfm
Bathrooms:	1 rooms @ 10 cfm	= 10 cfm
Basement Rooms:		0 cfm

F-326 Required continuous ventilation rate = 53.0 cfm (.39 ACH)
Average Ventilation Supply Rate (Balanced) = 55.0 cfm (.41 ACH)

Ventilation System: Heat recovery ventilator (HRV)
Manufacturer: Flair
Model Number: 3055

Fan and Preheater Power at 32.0 F	=	97. Watts
Fan and Preheater Power at -13.0 F	=	76. Watts
PreHeater Capacity:	=	0. Watts
Sensible Heat Recovery Efficiency at 32.0 F	=	61. %
Sensible Heat Recovery Efficiency at -13.0 F	=	60. %
Total Heat Recovery Efficiency in Cooling mode	=	0. %
Low Temperature Ventilation Reduction	=	16. %
Low Temperature Ventilation Reduction: Airflow Adjustment	=	10 cfm (18.4 %)

NO Vented combustion appliance specified

Gross Air Leakage and Ventilation Energy Load	=	35.577 Mil.BTU
Seasonal Heat Recovery Ventilator Efficiency	=	60.074 %
Estimated Ventilation Electrical Load: Heating Hours	=	2.711 Mil.BTU
Estimated Ventilation Electrical Load: Non-Heating Hours	=	.035 Mil.BTU
Net Air Leakage and Ventilation Energy Load	=	20.324 Mil.BTU

*** SPACE HEATING SYSTEM ***

PRIMARY Heating Fuel	: Electricity
Equipment	: Baseboard/Hydronic/Plenum (duct) heaters
Manufacturer	:
Model	:
Output Capacity	= 50000.0 BTU/hr
Steady State Efficiency	= 100.0 %

*** ANNUAL SPACE HEATING SUMMARY ***

Design Heat Loss at -36.4 F = 2.56 BTU/hr/Ft3 = 20747. BTU/hr

Gross Space Heating Load	=	60.691 Mil.BTU
Sensible Daily Heat Gain From Occupants	=	2.56 kWh/day
Usable Internal Gains	=	21.883 Mil.BTU
Usable Internal Gains Fraction	=	36.1 %
Usable Solar Gains	=	2.384 Mil.BTU
Usable Solar Gains Fraction	=	3.9 %
Ventilation Equipment Electrical Contribution	=	1.356 Mil.BTU
Auxiliary Energy Required	=	36.425 Mil.BTU
Space Heating System Load	=	36.425 Mil.BTU
Furnace/Boiler Seasonal efficiency	=	100.0 %
Furnace/Boiler Annual Energy Consumption	=	36.425 Mil.BTU

*** DOMESTIC WATER HEATING SYSTEM ***

PRIMARY Water Heating Fuel : Electricity
Water Heating Equipment : Electric tank

Manufacturer :
Model :
Tank Capacity = 40.0 Imp Gal
Seasonal Efficiency = 93.0 %

*** ANNUAL DOMESTIC WATER HEATING SUMMARY ***

Daily Hot Water Consumption = 49.0 Imp Gal /day
Estimated Domestic Water Heating Load = 15.327 Mil.BTU

PRIMARY Domestic Water Heating Energy Consumption = 16.480 Mil.BTU

*** LIGHTING AND APPLIANCES SUMMARY ***

Total Electrical Load = 16.0 kWh/day
Average External Electrical Load = 2.0 kWh/day
Total Annual Energy Consumption = 5840. kWh

*** FAN OPERATION SUMMARY (kWh) ***

Hours	HRV/Exhaust Fans	Space Heating	Space Cooling
Heating	794.6	.0	.0
Neither	10.1	.0	.0
Cooling	.0	.0	.0
Total	804.8	.0	.0

*** R-2000 HOME PROGRAM ENERGY CONSUMPTION SUMMARY REPORT ***

Estimated Annual Space Heating Energy Consumption = 38430. MJ = 10675.1 kWh
Ventilator Electrical Consumption: Heating Hours = 2861. MJ = 794.6 kWh
Estimated Annual DHW Heating Energy Consumption = 17388. MJ = 4829.9 kWh

ESTIMATED ANNUAL SPACE + DHW ENERGY CONSUMPTION = 58678. MJ = 16299.6 kWh
ANNUAL R-2000 SPACE + DHW ENERGY CONSUMPTION TARGET = 41217. MJ = 11449.2 kWh

Estimated Annual Base Electrical Energy Consumption= 21024. MJ = 5840.0 kWh
Ventilator Electrical Consumption: Non Heating Hours= 36. MJ = 10.1 kWh

*** ESTIMATED ANNUAL FUEL CONSUMPTION SUMMARY ***

Fuel	Space Heating	Space Cooling	DHW Heating	Appliances	Total
Electricity (kWh)	11469.7	.0	4829.9	5850.1	22149.7

*** MONTHLY ENERGY PROFILE ***

Month	Energy Load Mil.BTU	Internal Gains Mil.BTU	Solar Gains Mil.BTU	Aux. Energy Mil.BTU	HRV Eff. %
Jan	9.612	1.991	.111	7.510	60.0
Feb	8.127	1.798	.182	6.148	60.3
Mar	7.248	1.991	.315	4.942	61.2
Apr	4.904	1.926	.384	2.594	61.4
May	3.474	1.962	.290	1.221	59.9
Jun	2.185	1.649	.270	.266	57.1
Jul	1.540	1.347	.185	.008	53.2
Aug	1.769	1.481	.206	.082	55.2
Sep	2.845	1.830	.156	.859	58.9
Oct	4.290	1.991	.119	2.180	60.7
Nov	6.055	1.926	.085	4.044	61.6
Dec	8.641	1.991	.080	6.570	60.3
Ann	60.691	21.883	2.384	36.425	60.1

*** SPACE HEATING SYSTEM PERFORMANCE ***

Month	Space Heating Load kWh	Furnace Input kWh	Pilot Light kWh	Indoor Fans kWh	Heat Pump Input kWh	Total Input kWh	System Cop
Jan	2201.0	2201.0	.0	.0	.0	2201.0	1.000
Feb	1801.7	1801.7	.0	.0	.0	1801.7	1.000
Mar	1448.5	1448.5	.0	.0	.0	1448.5	1.000
Apr	760.2	760.2	.0	.0	.0	760.2	1.000
May	357.9	357.9	.0	.0	.0	357.9	1.000
Jun	78.0	78.0	.0	.0	.0	78.0	1.000
Jul	2.2	2.2	.0	.0	.0	2.2	1.000
Aug	24.0	24.0	.0	.0	.0	24.0	1.000
Sep	251.8	251.8	.0	.0	.0	251.8	1.000
Oct	638.9	638.9	.0	.0	.0	638.9	1.000
Nov	1185.3	1185.3	.0	.0	.0	1185.3	1.000
Dec	1925.5	1925.5	.0	.0	.0	1925.5	1.000
Ann	10675.1	10675.1	.0	.0	.0	10675.1	1.000

****

Energy units: MIL.BTU = Million British Thermal Units (3413 BTU = 1 kWh)

The calculated heat losses and energy consumptions are only estimates, based upon the data entered and assumptions within the program. Actual energy consumption and heat losses will be influenced by construction practices, localized weather, equipment characteristics and the lifestyle of the occupants.

Whitesands First Nation

HEAT LOSS SUMMARY ELDERS HOUSING UNIT "A"

REVISED

R. Donn Milligan, P.Eng.

	Unit	Ap't #1			Ap't #2			Ap't #3			Ap't #4			Multi Purpose			SUMMARY			
		R Value	H Loss MilBTU	Area or Volume	R Value	H Loss MilBTU	Area or Volume	R Value	H Loss MilBTU	Area or Volume	R Value	H Loss MilBTU	Area or Volume	R Value	H Loss MilBTU	Area or Volume	H Loss MilBTU	Area or Volume Imperial	Area or Volume Metric	Percentage of Annual Heat Loss
1 Building Components																				
Ceiling	sf	40	6.193	624.07	40	6.193	624.07	40	7.972	803.32	40	7.972	803.32	40	7.319	737.50	35.649	3592.28	333.72	17.1
Main Walls	sf	30	6.849	612.57	30	4.851	455.03	30	6.312	577.30	30	6.312	577.30	30	8.354	720.00	32.678	2942.20	273.33	15.7
Doors	sf	8	1.985	40.00	8	1.985	40.00	8	1.985	40.00	8	1.985	40.00	8	0.992	20.00	8.932	180.00	16.72	4.3
Slab on Grade Perimeter	sf	10	3.329	226.19	10	2.766	184.43	10	3.472	236.75	10	3.617	247.51	10	3.971	273.74	17.155	1168.62	108.57	8.2
Slab on Grade Centre	sf	5	4.032	397.88	5	4.455	439.64	5	5.741	566.57	5	5.632	555.80	5	4.699	463.76	24.559	2423.65	225.16	11.8
Windows	sf	2.52	5.005	32.40	2.52	5.005	32.40	2.55	6.058	39.52	2.55	6.058	39.52	2.64	6.192	41.11	28.318	184.95	17.18	13.6
Volume	cf			5002.67			5002.67			6436.3			6436.3			5900.0		28777.94	814.90	
Ventilation	Mil. BTU/hr		13.402			13.402			13.950			13.950			6.741		61.445			29.4
																	208.736			100.0
Building Envelope	sf			1860.70			1703.20			2183.90			2183.90			2195.00		10126.70		
2 Loads																				
Design Heat Loss @ -36.4°F	BTU/hr		15983			15393			17027			17036			17060			82499		
Design Heat Loss @ -38.0 °C	kW/hr		4.68			4.51			4.99			4.99			5.00			24.17		
Annual Space Heating	kwh		6248.6			5711.9			7146.0			7155.9			6837.6			33100.0		
Annual DHW Heating	kwh		4829.9			4829.9			6111.3			6111.3			6111.3			27993.7		
Annual Appliances	kwh		5850.1			5850.1			5850.1			5850.1			5861.9			29262.3		
Annual Total	kwh		16928.6			16391.9			19107.4			19117.3			18810.8			90356.0		
3 Other																				
Occupants Adults		2	80% of the time		2	80% of the time		2	80% of the time		2	80% of the time		6	20% of the time		14	Various Time		
Children		0			0			1	50% of the time		1	50% of the time		2	20% of the time		4	Various Time		
Lights and appliances	kW/day	16.0			16.0			16.0			16.0			16.0				80.0		
External Electrical Load	kW/day	2.0			2.0			2.0			2.0			2.0				10.0		
Annual Appliance Consumption	kWh	5840			5840			5840			5840			5840				29200		
4 Summary																				
Annual Space + DHW	kwh		11078.5			10541.8			13257.3			13267.2			12948.9			61093.7		
R-2000 Target	kwh		9015.5			9015.5			10137.3			10137.3			9717.6			48023.2		

HEAT LOSS SUMMARY ELDERS HOUSING UNIT "B"

R. Donn Milligan, P.Eng.

	Unit	Ap't #5 R Value	Ap't #5 H Loss MilBTU	Ap't #5 Area or Volume	Ap't #6 R Value	Ap't #6 H Loss MilBTU	Ap't #6 Area or Volume	SUMMARY H Loss MilBTU	Area or Volume Imperial	Area or Volume Metric	Percentage of Annual Heat Loss
1 Building Components											
Ceiling	sf	40	6.193	624.07	40	6.193	624.07	12.386	1248.14	115.95	10.2
Main Walls	sf	20	10.274	612.57	20	10.274	612.57	20.548	1225.14	113.82	16.9
Doors	sf	8	1.985	40.00	8	1.985	40.00	3.970	80.00	7.43	3.3
Crawl Space Walls above grade	sf	10	2.314	63.81	10	2.314	63.81	4.628	127.62	11.86	3.8
Crawl Space Walls below grade	sf	10	7.500	319.05	10	7.500	319.05	15.000	638.10	59.28	12.4
Crawl Space Perimeter	sf	0	5.203	226.19	0	5.203	226.19	10.406	452.38	42.03	8.6
Crawl Space Centre	sf	0	3.248	397.88	0	3.248	397.88	6.496	795.76	73.93	5.4
Windows	sf	2.52	5.005	32.40	2.52	5.005	32.40	10.010	64.80	6.02	8.2
Volume	cf			8112.90			8112.90		16225.80	459.47	
Ventilation	Mil. BTU/hr		18.968			18.968		37.936			31.3
								121.380			100.0
Building Envelope	sf			2243.60			2243.60		4487.20		
2 Loads											
Design Heat Loss @ -36.4°F	BTU/hr		20747			20747			41494		
Design Heat Loss @ -38.0°C	kW/hr		6.08			6.08			12.16		
Annual Space Heating	kwh		11072.6			11072.6			22145.2		
Annual DHW Heating	kwh		4829.9			4829.9			9659.8		
Annual Appliances	kwh		5850.10			5850.10			11700.2		
Annual Total	kwh		21752.6			21752.6			43505.2		
3 Other											
Occupants Adults		2	80% of the time		2	80% of the time		10	Various Time		
Children		0			0			4	Various Time		
Lights and appliances	kW/day	16.0			16.0				32.0		
External Electrical Load	kW/day	2.0			2.0				4.0		
Annual Appliance Consumption	kWh	5840			5840				11680		
4 Summary											
Annual Space + DHW	kwh		15902.5			15902.5			31805.0		
R-2000 Target	kwh		11449.2			11449.2			22898.4		

HEAT LOSS SUMMARY ELDERS HOUSING UNIT "C"

R. Donn Milligan, P.Eng.

	Unit	Ap't #7			Ap't #8			Ap't #9			Ap't #10			SUMMARY			
		R Value	H Loss MilBTU	Area or Volume	R Value	H Loss MilBTU	Area or Volume	R Value	H Loss MilBTU	Area or Volume	R Value	H Loss MilBTU	Area or Volume	H Loss MilBTU	Area or Volume Imperial	Area or Volume Metric	Percentage of Annual Heat Loss
1 Building Components																	
Ceiling	sf	40	6.193	624.07	40	6.193	624.07	40	6.193	624.07	40	6.193	624.07	24.772	2496.28	231.91	10.7
Main Walls	sf	20	10.219	609.70	20	7.277	455.03	20	7.277	455.03	20	10.219	609.70	34.992	2129.46	197.83	15.2
Doors	sf	8	1.985	40.00	8	1.985	40.00	8	1.985	40.00	8	1.985	40.00	7.940	160.00	14.86	3.4
Crawl Space Walls below grade	sf	10	2.303	63.51	10	1.719	47.40	10	1.719	47.40	10	2.303	63.51	8.044	221.82	20.61	3.5
Crawl Space Walls below grade	sf	10	7.465	317.55	10	5.571	236.99	10	5.571	236.99	10	7.465	317.55	26.072	1109.08	103.03	11.3
Crawl Space Perimeter	sf	0	5.203	226.19	0	4.403	184.43	0	4.403	184.43	0	5.203	226.19	19.212	821.24	76.29	8.3
Crawl Space Centre	sf	0	3.248	397.88	0	3.589	439.64	0	3.589	439.64	0	3.248	397.88	13.674	1675.04	155.61	5.9
Windows	sf	2.52	5.005	32.40	2.52	5.005	32.40	2.52	5.005	32.40	2.52	5.005	32.40	20.020	129.60	12.04	8.7
Volume	cf			8112.90			8112.90			8112.90			8112.90		32451.60	918.93	
Ventilation	Mil. BTU/hr		18.968			18.968			18.968			18.968		75.872			32.9
														230.598			100.0
Building Envelope	sf			2238.90			1987.60			1987.60			2238.90		8453.00		
2 Loads																	
Design Heat Loss @ -36.4°F	BTU/hr		20722			19300			19300			20722			80044		
Design Heat Loss @ -38.0°C	kW/hr		6.07			5.65			5.65			6.07			23.45		
Annual Space Heating	kwh		11045.3			9474.2			9474.2			11045.3			41039.0		
Annual DHW Heating	kwh		4829.9			4829.9			4829.9			4829.9			19319.6		
Annual Appliances	kwh		5850.1			5850.1			5850.1			5850.1			23400.4		
Annual Total	kwh		21725.3			20154.2			20154.2			21725.3			83759.0		
3 Other																	
Occupants Adults		2	80% of the time		2	80% of the time		2	80% of the time		2	80% of the time		10	Various Time		
Children		0			0			0			0			4	Various Time		
Lights and appliances	kW/day	16.0			16.0			16.0			16.0				64.0		
External Electrical Load	kW/day	2.0			2.0			2.0			2.0				8.0		
4 Summary																	
Annual Space + DHW	kwh		15875.2			14304.1			14304.1			15875.2			60358.6		
R-2000 Target	kwh		11449.2			11449.2			11449.2			11449.2			45796.8		

APPENDIX "B"

Heat Loss of Revised Unit "A"

Contents

- Hot 2000 Run
- Calculation Sheet for Unit "A"

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*****************************************
*                                       *
*              Hot2000                  *
*            Version 6.02               *
*               CANMET                  *
*  Energy, Mines and Resources CANADA   *
*            July 1, 1991               *
*                                       *
*****************************************
```

House Data Filename=Scott:H2k:H2k:Dat:ELDERA1R.HDF

Weather Data is for ARMSTRONG, ONTARIO

Builder Code =n/a Data Entry by:RDM

Client name: CMHC C Ives
Street address: for Whitesand F N
City: Region:
Postal code: Telephone:

*** GENERAL HOUSE CHARACTERISTICS ***

House type: (Individual) Apartment unit
Number of storeys: One storey
South side obstruction: 1% to 25% obstruction by Buildings
Wall construction: Single stud wall

SOIL TYPE: Normal Conductivity: dry sand, loam, clay, low water table

HOUSE THERMAL MASS LEVEL: (A) Wood frame construction, 0.5 in. gyproc walls and ceiling, wooden floor

Occupants : 2 Adults for 80.0 % of the time
0 Children for 20.0 % of the time

*** HOUSE TEMPERATURES ***

Heating Temperatures	Main Floor	= 72.0 F
	Basement	= 68.0 F
	TEMP. Swing from 72.0 F	= 6.3 F

*** FOUNDATION CONSTRUCTION CHARACTERISTICS ***

Foundation Construction	Attachment Sides	Insulation Placement
Slab on Grade	None	Edge/Exterior

*** WINDOW CHARACTERISTICS ***

Direction	Seq #	Location Code	# of Windows	Type	Window Width Ft	Window Height Ft	OverHang Width Ft	Header Height Ft	SHGC
Southeast	1	M1	1	300013	3.080	1.796	2.000	1.000	.4284
North	1	M1	1	300003	1.026	3.850	2.000	.500	.4999
Northwest	1	M1	1	300003	3.080	3.850	.500	.500	.6037
	2	M1	1	300013	3.080	2.310	2.000	.500	.4639
West	1	M1	1	300003	1.026	3.850	2.000	.500	.4999

*** WINDOW PARAMETER CODES SCHEDULE ***

	Code	Description (Glazings, Coatings, Fill, Spacer, Type, Frame)
1	300013	Triple (TG), Clear, 13 mm Air, Metal, Hinged, Alum. Clad Wood
2	300003	Triple (TG), Clear, 13 mm Air, Metal, Picture, Alum. Clad Wood

***.BUILDING PARAMETERS ***

Component		Area (Ft2) Gross	Net	R	Heat Loss Mil.BTU	% Annual Heat Loss
Above Grade Components						
Ceiling						
C1		624.07	624.07	40.00		
	TOTAL:	624.07	624.07	40.00	6.193	15.18
Main Walls						
M1		612.57	540.17	30.00		
	TOTAL:	612.57	540.17	30.00	6.849	16.79
Doors						
D1	Location: M1	40.00	40.00	8.00		
	TOTAL:	40.00	40.00	8.00	1.985	4.87
Slab on Grade						
Perimeter area		226.19		10.00		
	TOTAL:	226.19		10.00	3.329	8.16
Centre area		397.88		5.00		
	TOTAL:	397.88		5.00	4.032	9.88

WINDOWS

Orientation Location	Number	Type (Code)	Total Area(Ft2)	R Window	(Shutter)	Heat Loss Mil.BTU	% Annual Heat Loss
Southeast							
M1	1	300013	5.53	2.63			
TOTAL:			5.53	2.63		.833	2.04
North							
M1	1	300003	3.95	2.32			
TOTAL:			3.95	2.32		.676	1.66
Northwest							
M1	1	300003	11.86	2.66			
M1	1	300013	7.11	2.68			
TOTAL:			18.97	2.67		2.820	6.91
West							
M1	1	300003	3.95	2.32			
TOTAL:			3.95	2.32		.676	1.66

Ventilation

House Volume	Air Change	Heat Loss Mil.BTU	% Annual Heat Loss
5002.7 Ft3	.87 ACH ?	13.402	32.85

*** AIR LEAKAGE AND VENTILATION ***

Building Envelope Surface Area	=	1860.7 Ft2
Air Tightness Level is Energy tight (1.5 ACH @50 Pa.)		
Building Envelope is NOT Sheltered from the Wind.		
Estimated Equivalent Leakage Area	=	11.9 in2
Normalized Leakage Area	=	.0064 in2/ft2
Estimated Airflow to cause a 5 Pa Pressure Difference	=	10 cfm
Estimated Airflow to cause a 10 Pa Pressure Difference	=	16 cfm
ELA used to calculate Estimated Airflows	=	4.7 in2

F-326 VENTILATION REQUIREMENTS:

Kitchen,living,dining:	3 rooms @ 10 cfm	= 30 cfm
Bedrooms:	1 rooms @ 20 cfm	= 20 cfm
Bathrooms:	1 rooms @ 10 cfm	= 10 cfm
Basement Rooms:		0 cfm

F-326 Required continuous ventilation rate	=	63.6 cfm (.76 ACH)
Average Ventilation Supply Rate (Balanced)	=	64.0 cfm (.77 ACH)

Ventilation System:	Heat recovery ventilator (HRV)
Manufacturer:	Flair
Model Number:	3055

Fan and Preheater Power at 32.0 F	=	97. Watts
Fan and Preheater Power at -13.0 F	=	76. Watts
PreHeater Capacity:	=	0. Watts
Sensible Heat Recovery Efficiency at 32.0 F	=	61. %
Sensible Heat Recovery Efficiency at -13.0 F	=	60. %
Total Heat Recovery Efficiency in Cooling mode	=	0. %
Low Temperature Ventilation Reduction	=	16. %
Low Temperature Ventilation Reduction: Airflow Adjustment	=	12 cfm (18.4 %)

NO Vented combustion appliance specified

Gross Air Leakage and Ventilation Energy Load	=	32.294 Mil.BTU
Seasonal Heat Recovery Ventilator Efficiency	=	60.135 %
Estimated Ventilation Electrical Load: Heating Hours	=	2.711 Mil.BTU
Estimated Ventilation Electrical Load: Non-Heating Hours	=	.035 Mil.BTU
Net Air Leakage and Ventilation Energy Load	=	14.757 Mil.BTU

*** SPACE HEATING SYSTEM ***

PRIMARY Heating Fuel : Electricity
Equipment : Baseboard/Hydronic/Plenum (duct) heaters
Manufacturer :
Model :
Output Capacity = 50000.0 BTU/hr

Steady State Efficiency = 100.0 %

*** ANNUAL SPACE HEATING SUMMARY ***

Design Heat Loss at -36.4 F = 3.19 BTU/hr/Ft3 = 15983. BTU/hr

Gross Space Heating Load	=	40.796 Mil.BTU
Sensible Daily Heat Gain From Occupants	=	2.56 kWh/day
Usable Internal Gains	=	20.161 Mil.BTU
Usable Internal Gains Fraction	=	49.4 %
Usable Solar Gains	=	2.025 Mil.BTU
Usable Solar Gains Fraction	=	5.0 %
Ventilation Equipment Electrical Contribution	=	1.356 Mil.BTU
Auxiliary Energy Required	=	18.610 Mil.BTU
Space Heating System Load	=	18.610 Mil.BTU
Furnace/Boiler Seasonal efficiency	=	100.0 %
Furnace/Boiler Annual Energy Consumption	=	18.610 Mil.BTU

*** DOMESTIC WATER HEATING SYSTEM ***

PRIMARY Water Heating Fuel : Electricity
Water Heating Equipment : Electric tank

Manufacturer :
Model :
Tank Capacity = 40.0 Imp Gal
Seasonal Efficiency = 93.0 %

*** ANNUAL DOMESTIC WATER HEATING SUMMARY ***

Daily Hot Water Consumption = 49.0 Imp Gal /day
Estimated Domestic Water Heating Load = 15.327 Mil.BTU

PRIMARY Domestic Water Heating Energy Consumption = 16.480 Mil.BTU

*** LIGHTING AND APPLIANCES SUMMARY ***

Total Electrical Load = 16.0 kWh/day
Average External Electrical Load = 2.0 kWh/day
Total Annual Energy Consumption = 5840. kWh

*** FAN OPERATION SUMMARY (kWh) ***

Hours	HRV/Exhaust Fans	Space Heating	Space Cooling
Heating	794.6	.0	.0
Neither	10.1	.0	.0
Cooling	.0	.0	.0
Total	804.8	.0	.0

*** R-2000 HOME PROGRAM ENERGY CONSUMPTION SUMMARY REPORT ***

Estimated Annual Space Heating Energy Consumption = 19634. MJ = 5454.0 kWh
Ventilator Electrical Consumption: Heating Hours = 2861. MJ = 794.6 kWh
Estimated Annual DHW Heating Energy Consumption = 17388. MJ = 4829.9 kWh

ESTIMATED ANNUAL SPACE + DHW ENERGY CONSUMPTION = 39883. MJ = 11078.5 kWh
ANNUAL R-2000 SPACE + DHW ENERGY CONSUMPTION TARGET = 32456. MJ = 9015.5 kWh

Estimated Annual Base Electrical Energy Consumption= 21024. MJ = 5840.0 kWh
Ventilator Electrical Consumption: Non Heating Hours= 36. MJ = 10.1 kWh

*** ESTIMATED ANNUAL FUEL CONSUMPTION SUMMARY ***

Fuel	Space Heating	Space Cooling	DHW Heating	Appliances	Total
Electricity (kWh)	6248.6	.0	4829.9	5850.1	16928.6

*** MONTHLY ENERGY PROFILE ***

Month	Energy Load Mil.BTU	Internal Gains Mil.BTU	Solar Gains Mil.BTU	Aux. Energy Mil.BTU	HRV Eff. %
Jan	6.468	1.991	.111	4.366	60.0
Feb	5.491	1.798	.182	3.511	60.3
Mar	4.911	1.991	.315	2.605	61.1
Apr	3.331	1.896	.376	1.058	61.3
May	2.397	1.753	.273	.371	60.0
Jun	1.531	1.329	.181	.021	57.6
Jul	1.072	1.010	.062	.000	54.2
Aug	1.194	1.106	.088	.000	55.9
Sep	1.873	1.516	.152	.205	59.2
Oct	2.766	1.855	.119	.792	60.8
Nov	3.962	1.926	.085	1.952	61.5
Dec	5.800	1.991	.080	3.730	60.3
Ann	40.796	20.161	2.025	18.610	60.1

*** SPACE HEATING SYSTEM PERFORMANCE ***

Month	Space Heating Load kWh	Furnace Input kWh	Pilot Light kWh	Indoor Fans kWh	Heat Pump Input kWh	Total Input kWh	System Cop
Jan	1279.5	1279.5	.0	.0	.0	1279.5	1.000
Feb	1029.0	1029.0	.0	.0	.0	1029.0	1.000
Mar	763.4	763.4	.0	.0	.0	763.4	1.000
Apr	310.0	310.0	.0	.0	.0	310.0	1.000
May	108.7	108.7	.0	.0	.0	108.7	1.000
Jun	6.1	6.1	.0	.0	.0	6.1	1.000
Jul	.0	.0	.0	.0	.0	.0	.000
Aug	.0	.0	.0	.0	.0	.0	.000
Sep	60.1	60.1	.0	.0	.0	60.1	1.000
Oct	232.1	232.1	.0	.0	.0	232.1	1.000
Nov	572.0	572.0	.0	.0	.0	572.0	1.000
Dec	1093.1	1093.1	.0	.0	.0	1093.1	1.000
Ann	5454.0	5454.0	.0	.0	.0	5454.0	1.000

****

Energy units: MIL.BTU = Million British Thermal Units (3413 BTU = 1 kWh)

The calculated heat losses and energy consumptions are only estimates, based upon the data entered and assumptions within the program. Actual energy consumption and heat losses will be influenced by construction practices, localized weather, equipment characteristics and the lifestyle of the occupants.

Whitesands First Nation

HEAT LOSS SUMMARY ELDERS HOUSING UNIT "A"

R. Donn Milligan, P.Eng.

	Unit	Ap't #1			Ap't #2			Ap't #3			Ap't #4			Multi Purpose			SUMMARY			
		R Value	H Loss MilBTU	Area or Volume	R Value	H Loss MilBTU	Area or Volume	R Value	H Loss MilBTU	Area or Volume	R Value	H Loss MilBTU	Area or Volume	R Value	H Loss MilBTU	Area or Volume	H Loss MilBTU	Area or Volume Imperial	Area or Volume Metric	Percentage of Annual Heat Loss
1 Building Components																				
Ceiling	sf	40	6.193	624.07	40	6.193	624.07	40	7.972	803.32	40	7.972	803.32	40	7.319	737.50	35.649	3592.28	333.72	11.4
Main Walls	sf	20	10.274	612.57	20	7.277	455.03	20	9.467	577.30	20	9.467	577.30	20	12.532	720.00	49.017	2942.20	273.33	15.7
Doors	sf	8	1.985	40.00	8	1.985	40.00	8	1.985	40.00	8	1.985	40.00	8	0.992	20.00	8.932	180.00	16.72	2.9
Crawl Space Walls above grade	sf	10	2.314	63.81	10	1.719	47.40	10	2.181	60.14	10	2.181	60.14	10	2.720	75.00	11.115	306.49	28.47	3.5
Crawl Space Walls below grade	sf	10	7.500	319.05	10	5.571	236.99	10	7.068	300.68	10	7.068	300.68	10	8.816	375.00	36.023	1532.40	142.36	11.5
Crawl Space Perimeter	sf	0	5.203	226.19	0	4.403	184.43	0	5.406	236.75	0	5.612	247.51	0	6.115	273.74	26.739	1168.62	108.57	8.5
Crawl Space Centre	sf	0	3.248	397.88	0	3.589	439.64	0	4.625	566.57	0	4.537	555.80	0	3.786	463.76	19.785	2423.65	225.16	6.3
Windows	sf	2.52	5.005	32.40	2.52	5.005	32.40	2.55	6.058	39.52	2.55	6.058	39.52	2.64	6.192	41.11	28.318	184.95	17.18	9.0
Volume	cf			8112.90			8112.90			10443.2			10443.2			9587.5		46699.70	1322.39	
Ventilation	Mil. BTU/hr		18.968			18.968			22.457			22.457			14.727		97.577			31.2
																	313.155			100.0
Building Envelope	sf			2243.60			1987.60			2544.80			2544.80			2645.00		11965.80		
2 Loads																				
Design Heat Loss @ -36.4°F	BTU/hr		20747			19300			22649			22668			23104			108468		
Design Heat Loss @ -38.0 °C	kW/hr		6.08			5.65			6.64			6.64			6.77			31.78		
Annual Space Heating	kwh		11469.7			9855.3			12972.8			13004.2			13349.6			60651.6		
Annual DHW Heating	kwh		4829.9			4829.9			6111.3			6111.3			6111.3			27993.7		
Annual Appliances	kwh		5850.1			5850.1			5850.1			5850.1			5861.9			29262.3		
Annual Total	kwh		22149.7			20535.3			24934.2			24965.6			25322.8			117907.6		
3 Other																				
Occupants Adults		2	80% of the time		2	80% of the time		2	80% of the time		2	80% of the time		6	20% of the time		14 Various Time			
Children		0			0			1	50% of the time		1	50% of the time		2	20% of the time		4 Various Time			
Lights and appliances	kW/day	16.0			16.0			16.0			16.0			16.0			80.0			
External Electrical Load	kW/day	2.0			2.0			2.0			2.0			2.0			10.0			
Annual Appliance Consumption	kWh	5840			5840			5840			5840			5840			29200			
4 Summary																				
Annual Space + DHW	kwh		16299.6			14685.2			19084.1			19112.5			19460.9			88642.3		
R-2000 Target	kwh		11449.2			11449.2			13272.7			13272.7			12603.1			62046.9		

APPENDIX "C"

Pragmatic Engineering

"Our Product is Knowledge and Experience"

Our discipline is Civil Engineering and our base is Knowledge and Experience. Today's new and rapidly changing technology has given us the tools to establish a unique place in the Engineering Service Sector in Canada and Abroad. Our dynamic, efficient, personal firm offers expert solutions to many of the Engineering enigmas which exist in these times of business streamlining and uncertain economy.

Problem solving by the use of careful study and research techniques followed by intelligent cost effective design is Practical Engineering. Our firm is dedicated to Practical Engineering.

We welcome the opportunity to assess new challenges. Your inquiries for proposals and preliminary discussions will receive prompt attention.

PRAGMATIC ENGINEERING

Box 1680
Kenora, ON.
P9N 3X7

Tel 807-548-5672

Fax 807-548-8149

milligan@voyageur.ca

PERSONNEL

SENIOR ENGINEER

Donn Milligan, B.Sc., P.Eng. has been practicing Engineering for over 35 years. He has been engaged in the construction industry as project engineer or contractor since 1963 in Northwestern Ontario. During that time he has applied practical engineering fundamentals to construction and project management. He has seen a variety of designs used on a large number of projects with varying degrees of difficulty. This varied experience has provided Mr. Milligan with ability to assess not only the proper design for the client, but the sensible approach to keep construction costs to a minimum. In short, a completely balanced design.

EDUCATION

Bachelor of Science in Civil Engineering, University of Alberta, 1957

PROFESSIONAL STATUS

Registered Professional Engineer in Ontario

MEMBERSHIP

Association of Professional Engineers of Ontario
Chamber of Commerce
Kenora Construction Association

PROFESSIONAL EXPERIENCE

Studies

Project Development Proposals, Land Use, Community Plans, Capital Plans, Cost Estimates and Analysis, Evaluation of Existing Services, Terrain and Topography Analysis, Environmental Impact and Assessment, Investigative and Feasibility Reports.

Design

District Heating Systems, Residential Subdivisions, Municipal Works, Roads, Water Supply, Water Distribution, Water Treatment, Sewage Collection and Waste Water Treatment.
Energy Efficient Housing.
Small Commercial, Educational and Community Buildings.
Recreational Facilities such as marinas, docks, cottages, small water systems and septic treatment systems.

Construction

° **Municipal** ° Installation of piped services by open cut, rock excavation, wood and steel sheeting, well points and boring for such works as extensions to existing water and sewer systems, storm sewers, interceptor sewers, force mains and outfalls. Municipal Plants such as water pumping stations, sewage lift stations, elevated water storage tanks and standpipes, sewage treatment plants and lagoons.
° **Industrial** ° Construction of irrigation systems, process piping, installation of pre-fabricated treatment plants and treatment lagoons, outfalls, land fill site work, excavations and dewatering for Mines, Paper companies and Government agencies.
° **Commercial** ° Excavation and preparation of foundations, site work, road access, parking lots, storm drainage, landscaping for numerous commercial buildings.

Field Services

Topographical and construction surveys, site layouts, technical inspections, construction supervision, project management and contract administration, start-up monitoring, operation and maintenance manuals.

Energy Conservation

Energy efficiency in housing and small buildings, R-2000 evaluation and inspections, air tightness testing, heat loss calculations, energy efficiency audits, efficiency retrofitting, efficient lighting, HRAI ventilation design.

Computer

Computer assisted drafting and design, modelling, graphics, word and data processing.

SPECIALISTS

Mr. Milligan has a good understanding of the fundamentals of specialized fields such as architecture, soil mechanics, structural design and mechanical and electrical processes, however to ensure quality projects, the expertise of specialists may be required and engaged.

EMPLOYMENT HISTORY

1956 - 62 During this period, Mr. Milligan was employed in the Yukon and Northern British Columbia on a variety of Engineering projects with the following firms or agencies:

Northwest Power & Industries Ltd. - Party chief and Topographical Surveyor.
Yukon Territorial Government - Highway Inspector/Designer
T Newton Engineering - Resident Engineer.

1963 - 65 L. W. Wardrop and Associates, Consulting Engineers, - Project Engineer on various projects in Fort William (Thunder Bay) and Fort Frances, Ontario; Rankin Inlet, NWT

1965 - 82 President and General Manager of Sub-Strata Construction Ltd., Thunder Bay. Mainly concerned with construction of municipal services in Northwestern Ontario

1983 - Self employed as an Engineer in Private Practice

RESOURCE PERSON

Irene Milligan has established herself as a very capable Resource Person. Her expertise includes accounting, finance and administration.

EDUCATION

Secondary School Diploma, St. Patrick High School, Fort William (Thunder Bay).
2 Credits, Fine Arts - Lakehead University.
1 Credit, Native People and the Law - Confederation College.
Various non credit courses in computers, time management and business relations.

PROFESSIONAL EXPERIENCE

Accounting

Accounting Procedures for Businesses, Construction Companies, Mining Exploration firms and First Nations Bands. Use of ACCPAC software.

Studies

Community Surveys, Needs Assessment, Housing Studies, Natural Resource and Economic Studies, Cost Benefit Analysis, Project Funding Proposals, Business Plans.

Management

Effective Business Management, Continuous Project Quality Control and Monitoring.

Training

Development and Implementation of Training Plans in various Construction Trades, Office Procedures and Management, Proper Accounting Practices, Computers.

Liaison

Consultation and Communication between Client and Political Leaders, Civil Service or Financial Supporters.

EMPLOYMENT HISTORY

1956 - 59	F.H. Black & Co. Chartered Accountants - Auditor Trainee.
1959 - 64	T.A. Jones General Contractor - Bookkeeper/Office Manager.
1964 - 68	Grant & Oja Mining Exploration Company - Office Manager.
1968 - 70	Tom Jones & Sons, General Contractor - Accountant.
1970 - 81	Sub-Strata Construction Ltd. - Secretary/Treasurer, Office Manager /Accountant.
1983 - 87	Waushushk Onigum First Nation - Band Administrator/Accountant.
1987 - 88	Wauzhushk Onigum First Nation - Economic Development Officer.
1988 -	Self employed as a Resource Person.

DESIGN TECHNICIAN

Scott Degagne is the most recent addition to the Corporation. His education and previous work experience have given him a broad base of knowledge and will continue to add yet another dimension to the services provided by the company.

ACADEMIC BACKGROUND

1995 R2000 Builders workshop
Energy efficient systems and building techniques

1994 HRIA Residential air system design
Heat loss calculations, heating, cooling, duct layout and design

1993 Industrial Design Diploma (co-op)
Fanshawe College, London, Ontario
AutoCAD, Technical Illustration, Product Design and Presentation
Textiles, Photography, 3D Model Fabrication

1990 Architectural Design and Technology
Confederation College, Thunder Bay, Ontario.
Drafting, Design Rendering Techniques, AutoCAD

1988 O.A.C. Graduate
Beaver Brae Secondary School, Kenora, Ontario

EMPLOYMENT EXPERIENCE

1995 Design Technician - 1050633 Ontario Inc. (Pragmatic Engineering)

1993 Signage Design and Fabrication - Parkway Gardens, Hyde Park, ON

1992 Handwear / Footwear Specification and Design - D.N.D., Hull, PQ

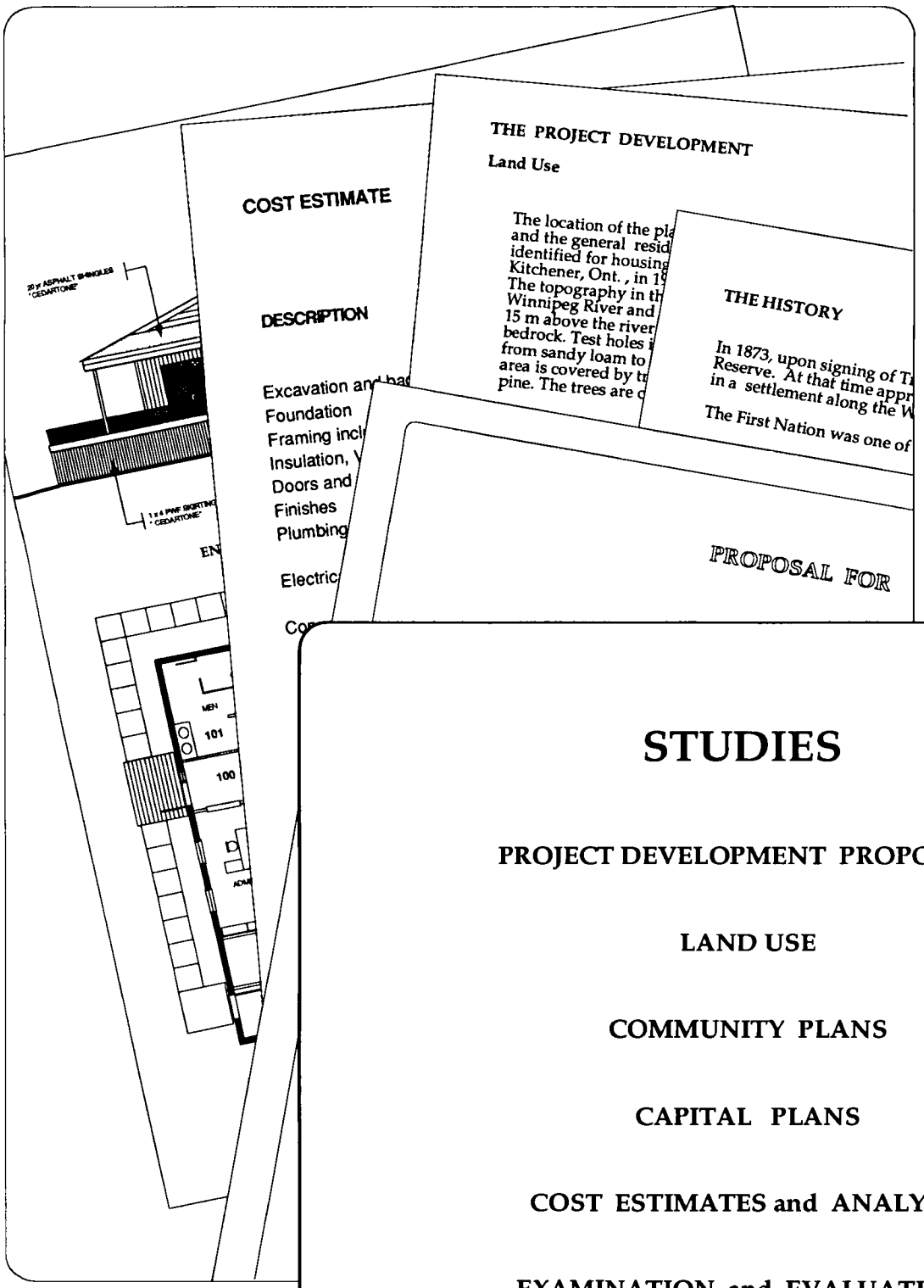
1990 Survey Technicians Assistant - BA Construction, Winnipeg, MB

1988 Hotel Maintenance - Lakeside Hotel, Kenora, ON

MEMBERSHIP

Mr. Degagne was a registered student member of the Association of Chartered Industrial Designers of Ontario (ACIDO) and is in the process of obtaining his professional membership.

SERVICES



STUDIES

PROJECT DEVELOPMENT PROPOSALS

LAND USE

COMMUNITY PLANS

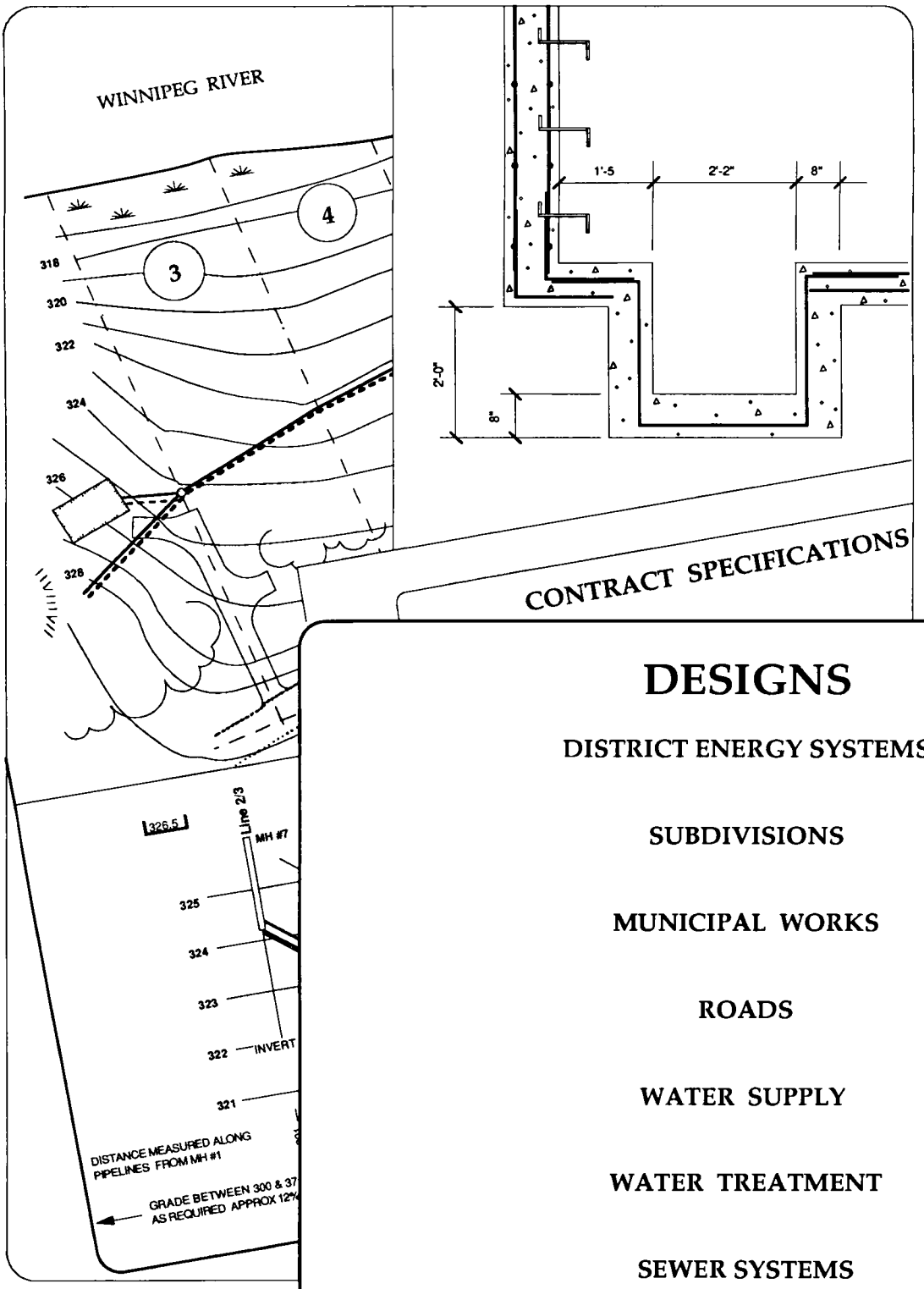
CAPITAL PLANS

COST ESTIMATES and ANALYSIS

EXAMINATION and EVALUATION
of
EXISTING SERVICES

ENVIRONMENTAL IMPACT and ASSESSMENT

PRAGMATIC ENGINEERING ° R. Donn Milligan, P.Eng. ° Box 1680, Kenora, ON, P9N 3X7 ° Tel 807-548-5672 ° Fax 807-548-8149 ° milligan@voyageur.ca



DESIGNS

DISTRICT ENERGY SYSTEMS

SUBDIVISIONS

MUNICIPAL WORKS

ROADS

WATER SUPPLY

WATER TREATMENT

SEWER SYSTEMS

SEWAGE TREATMENT

SPECIFICATIONS

CONTRACT DOCUMENTS

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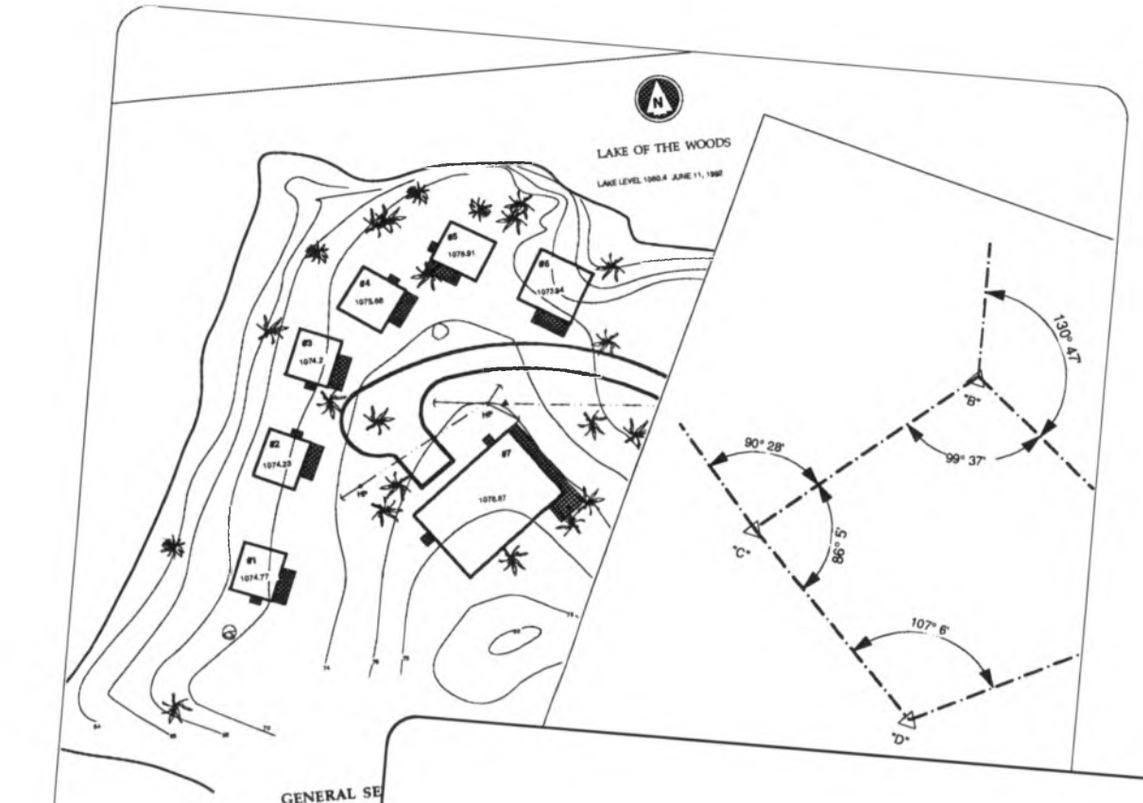
SERVICES



GENERAL SE
SCAL

No C - 2 Line Profile
Date July 8 /1992

STA.	B.S.	
TBM # 5	1.47	
0+00		
0+30		
0+45		
TP #1	0.65	
0+60		
0+85	0.70	
TP #2		
1+00		
1+20		

FIELD SERVICES

SURVEYS

SITE SERVICES LAYOUT

TECHNICAL INSPECTIONS

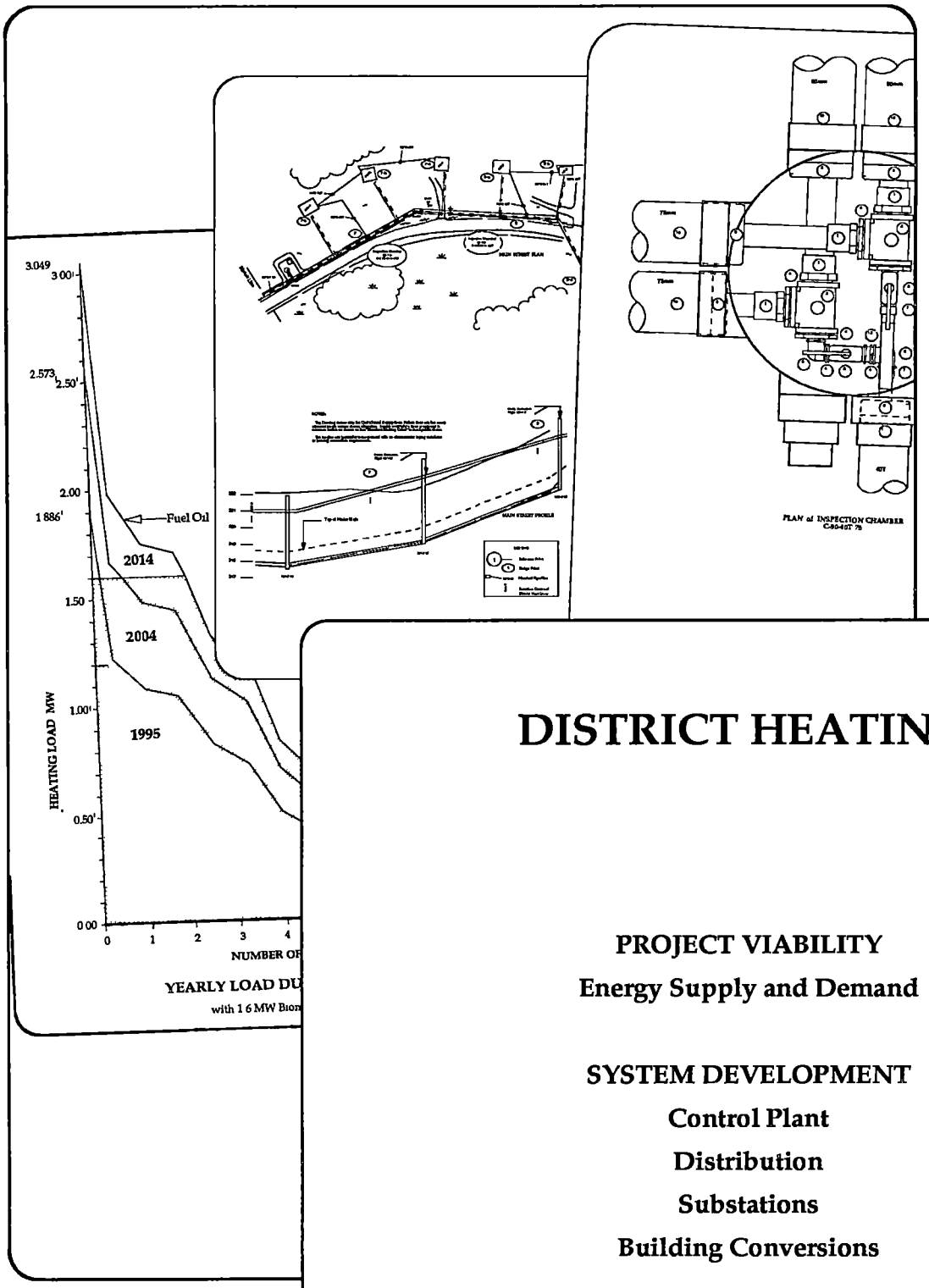
CONSTRUCTION SUPERVISION

CONTRACT ADMINISTRATION

COMMISSIONING WORKS

PROJECT MANAGEMENT

PRAGMATIC ENGINEERING ° R. Donn Milligan, P.Eng. ° Box 1680, Kenora, ON ° Tel 807-548-5672 ° Fax 807-548-8149 ° milligan@voyageur.ca



DISTRICT HEATING

PROJECT VIABILITY

Energy Supply and Demand

SYSTEM DEVELOPMENT

Control Plant

Distribution

Substations

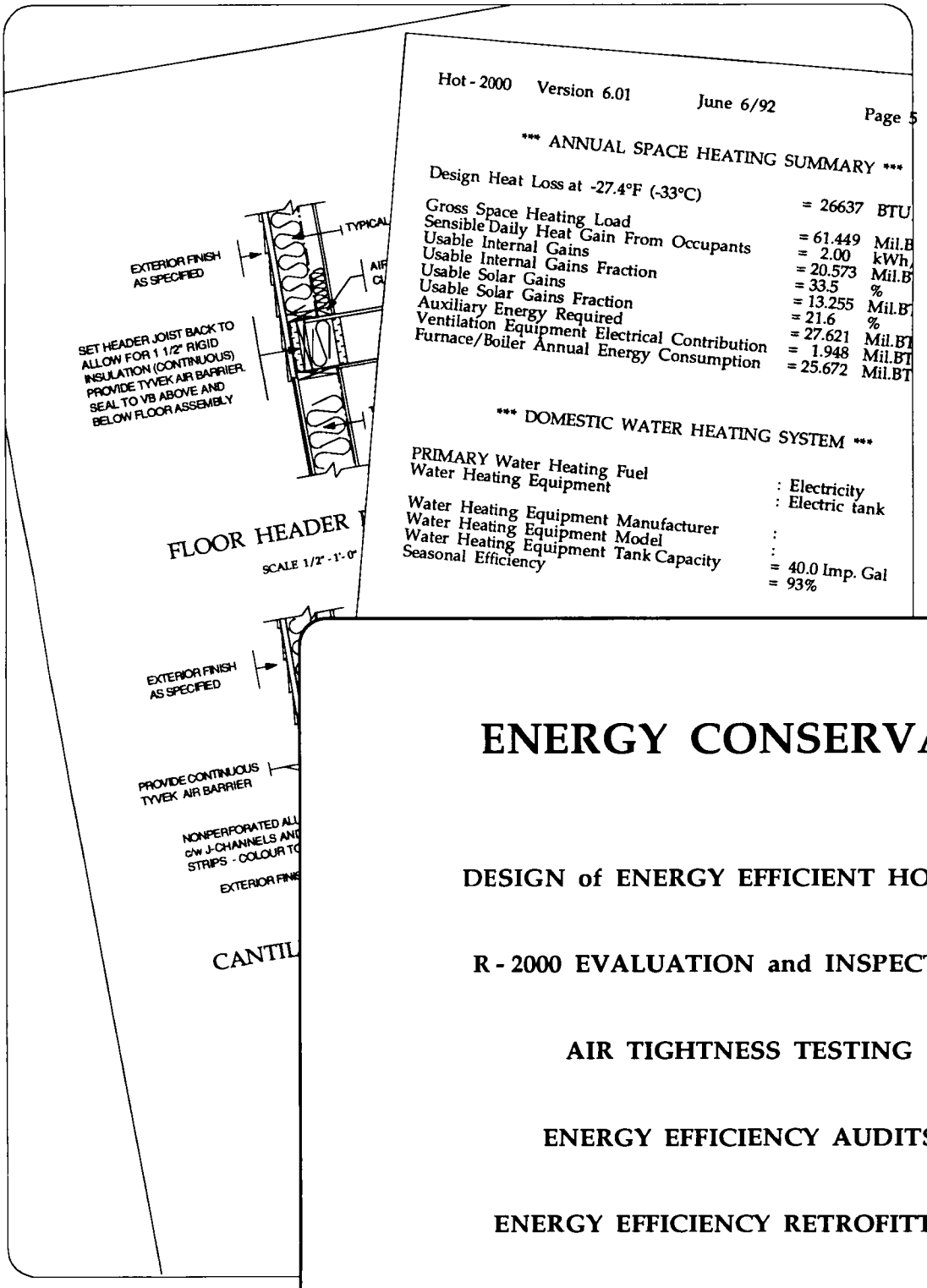
Building Conversions

PROJECT IMPLEMENTATION

CONSTRUCTION

OPERATION

PRAGMATIC ENGINEERING ° R. Donn Milligan, P.Eng. ° Box 1680, Kenora, ON, P9N 3X7 ° Tel 807-548-5672 ° Fax 807-548-8149 ° milligan@voyageur.ca



ENERGY CONSERVATION

DESIGN of ENERGY EFFICIENT HOUSING

R - 2000 EVALUATION and INSPECTIONS

AIR TIGHTNESS TESTING

ENERGY EFFICIENCY AUDITS

ENERGY EFFICIENCY RETROFITTING

HEAT LOSS CALCULATIONS

EFFICIENT LIGHTING

HRAI VENTILATION DESIGN

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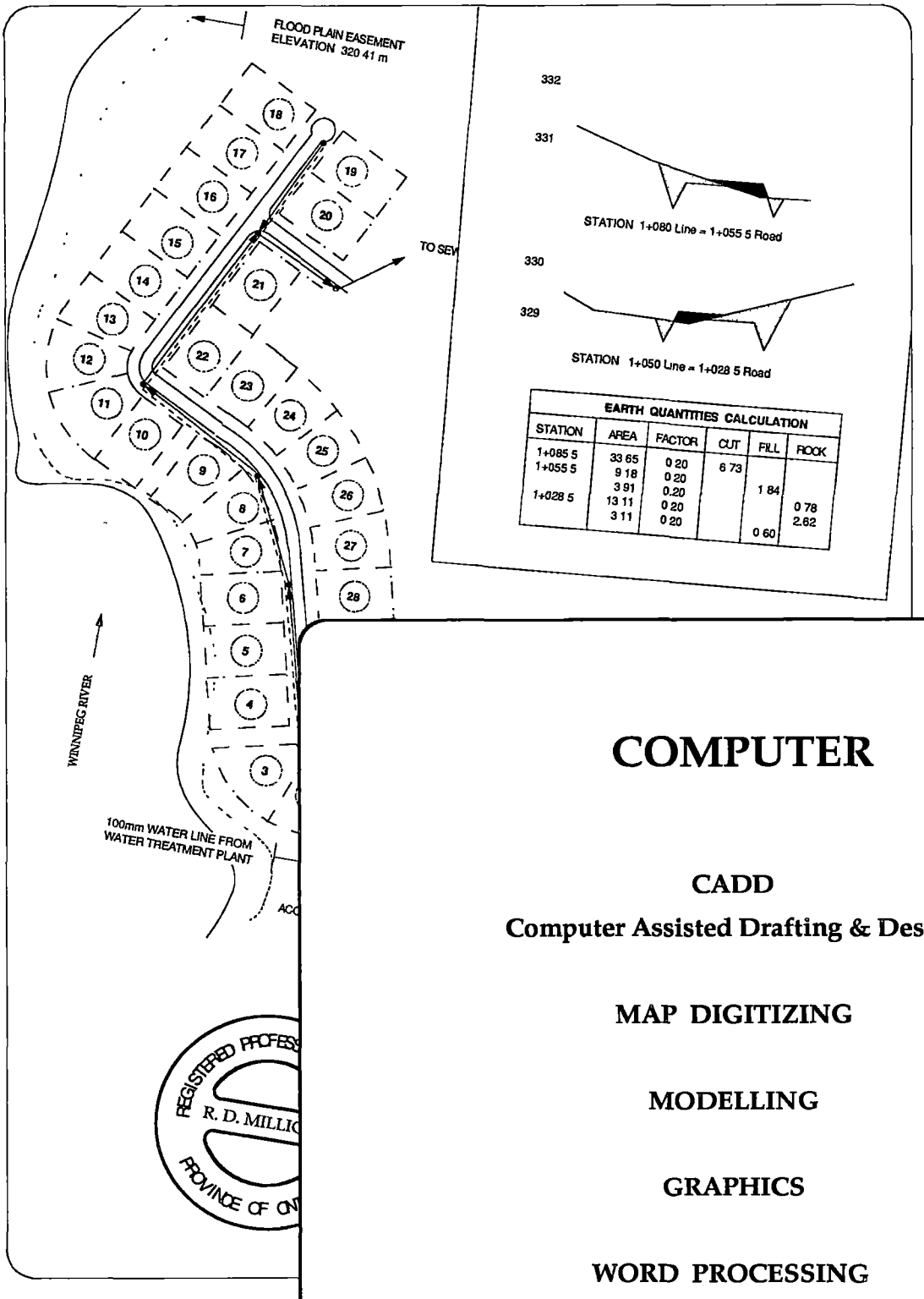


COMPUTER

CADD

Computer Assisted Drafting & Design

MAP DIGITIZING

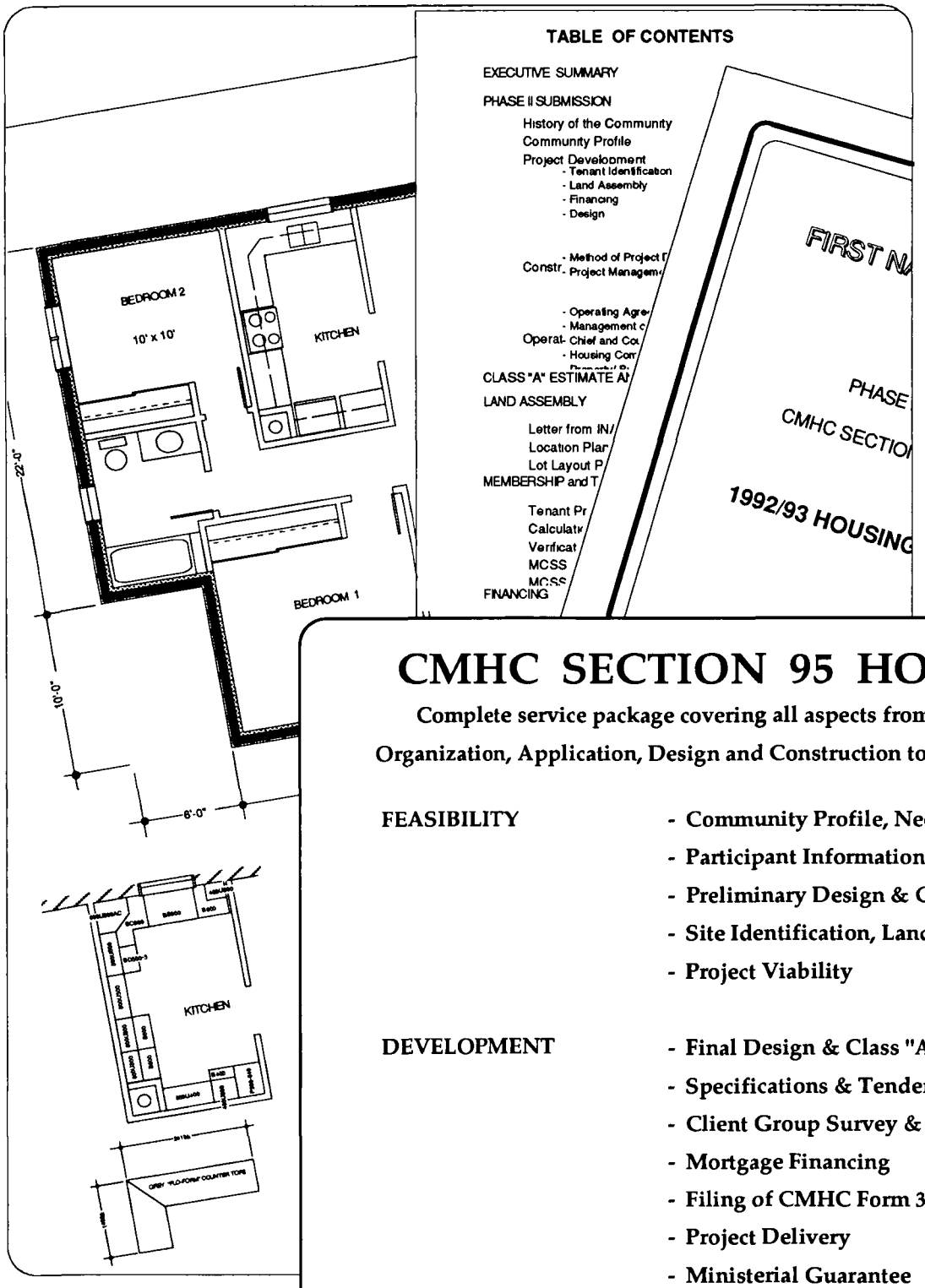
MODELLING

GRAPHICS

WORD PROCESSING

DATABASE

WEB PAGE DESIGN



CMHC SECTION 95 HOUSING

Complete service package covering all aspects from Conception, Organization, Application, Design and Construction to Project Operation

FEASIBILITY

- Community Profile, Needs Assessment
- Participant Information
- Preliminary Design & Cost Estimates
- Site Identification, Land Use, Services
- Project Viability

DEVELOPMENT

- Final Design & Class "A" Estimates
- Specifications & Tender Documents
- Client Group Survey & Budgets
- Mortgage Financing
- Filing of CMHC Form 301
- Project Delivery
- Ministerial Guarantee

CONSTRUCTION

- Financial System & Record Keeping
- Technical Support & Inspections
- Project Management

OPERATION

- Administrative System Placement
- Personnel Training
- Tenant Meetings

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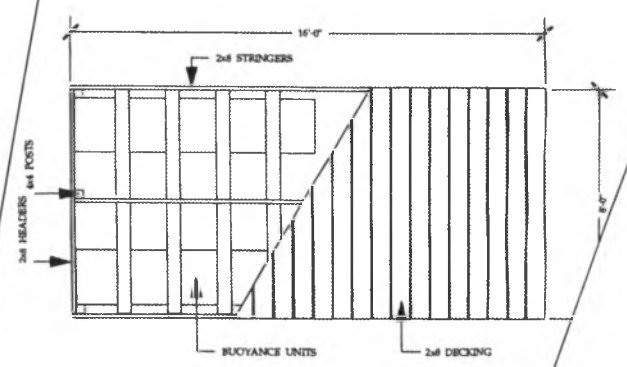
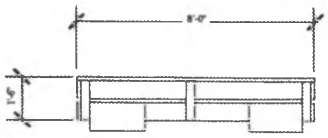
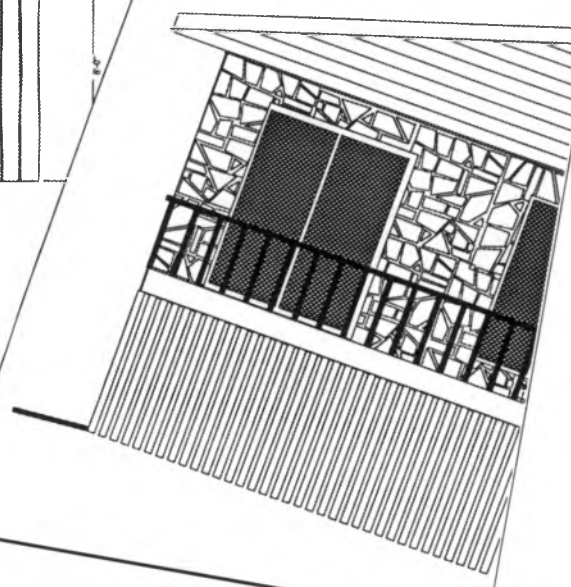
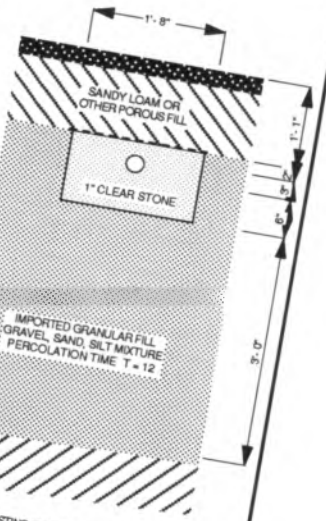


DOCK PLAN







TYPICAL ABSORPTION TRENCH

SCALE 3/4" = 1'-0"

SERVICES

RECREATION

DOCKS

BOAT RAMPS

DECKS

COTTAGES

SMALL WATER SYSTEMS

SEPTIC SYSTEMS

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SCHEDULE "A"

Terms Of Reference

SCHEDULE A -- TERMS OF REFERENCE

NO CHANGES TO THIS SECTION AND THE FOLLOWING UNLESS WRITTEN PERMISSION OF THE CORPORATION IS GIVEN.

1. PROJECT MANAGEMENT:

Principal Investigator:

Mr. R. Donn Milligan

CMHC Project Officer:

Mr. Christopher Ives
Research Division

2. STATEMENT OF WORK:

2.1 INTRODUCTION

The Whitesands First Nation is proposing to construct an Elders Housing project on their territory near Armstrong, Ontario. The architects have prepared preliminary drawings which indicate that electric heating will be used. The community is remote, off the Hydro grid and presently being service with electricity from diesel powered generators. Heating with electricity is expected to be extremely expensive.

In order to reduce the O&M costs for the project, CMHC is investigating the viability of providing a small cogeneration facility which will provide both electrical energy and energy for space heat and domestic hot water.

2.2 SCOPE OF WORK

The accurate determination of the heat loss and energy requirements for space heat, ventilation and domestic hot water will give some guidance in recommendations concerning energy efficiency and form the basis for determining the design loads for the cogeneration project. This work will be undertaken in the following manner.

Phase 1 - Preliminary Report

The preliminary report will analyse the building units as they are currently being proposed by the Architect. The report will show:

- Heat Loss calculations performed on the CANMET Hot 2000 computer program.

- List assumptions regarding building plans, occupancy, domestic hot water consumption and base electrical loads for appliances, etc.
- Show location and weather data.
- Air tightness type of building construction.

The preliminary report will also show a "what if" scenario should various components of the building be altered to show how some improvements in energy efficiency can be made.

Phase 2 - Recommendations regarding changes to Building Envelope

The final design of the building complex will be the decision of the Owner and his Architect, however, suggestions will be made for the owner to consider when reviewing the energy officiency of the Elder's Units and incorporating a heating system which will be compatible to the hot water delivered by the cogeneration facility. These suggestions will consider:

- Ceiling insulation
- Exterior wall construction and insulation
- Floor and foundation
- Preferred hydronic heating systems

3. SCHEDULE OF TASKS AND ALLOCATION OF STAFF BY PHASES:

Phase 1: (Preliminary Calculation) - by 10 April 1995

Phase 2: (Final Report) - by 15 April 1995