CONSERVATION VILLAGE

SITE PLAN FOR A SUSTAINABILITY-MINDED COMMUNITY IN OTTAWA

Despite the availability of research on the technical aspects of sustainable housing, such as wind and solar power, relatively few examples of the synthesis of this information into actual design have been developed. Even fewer examples of implemented, functioning sustainable communites exist. Since providing livable, functioning examples is critical to encouraging widespread interest, the underutilization of this type of development is a lost opportunity.

Given this situation, the Green Party of Eastern Ontario has sponsored research in this area. By creating a model for sustainable communites using a specific site, an indication of the form, character and function of such communities can be provided. With only a description of solar panels, for example, it is difficult to visualize or get a sense how they would impact on the community. These drawings may help people to see that sustainable living is not a sacrifice. In fact, this type of design can promote greater attention to social integration, scale and interaction with the landscape than can conventional housing developments.

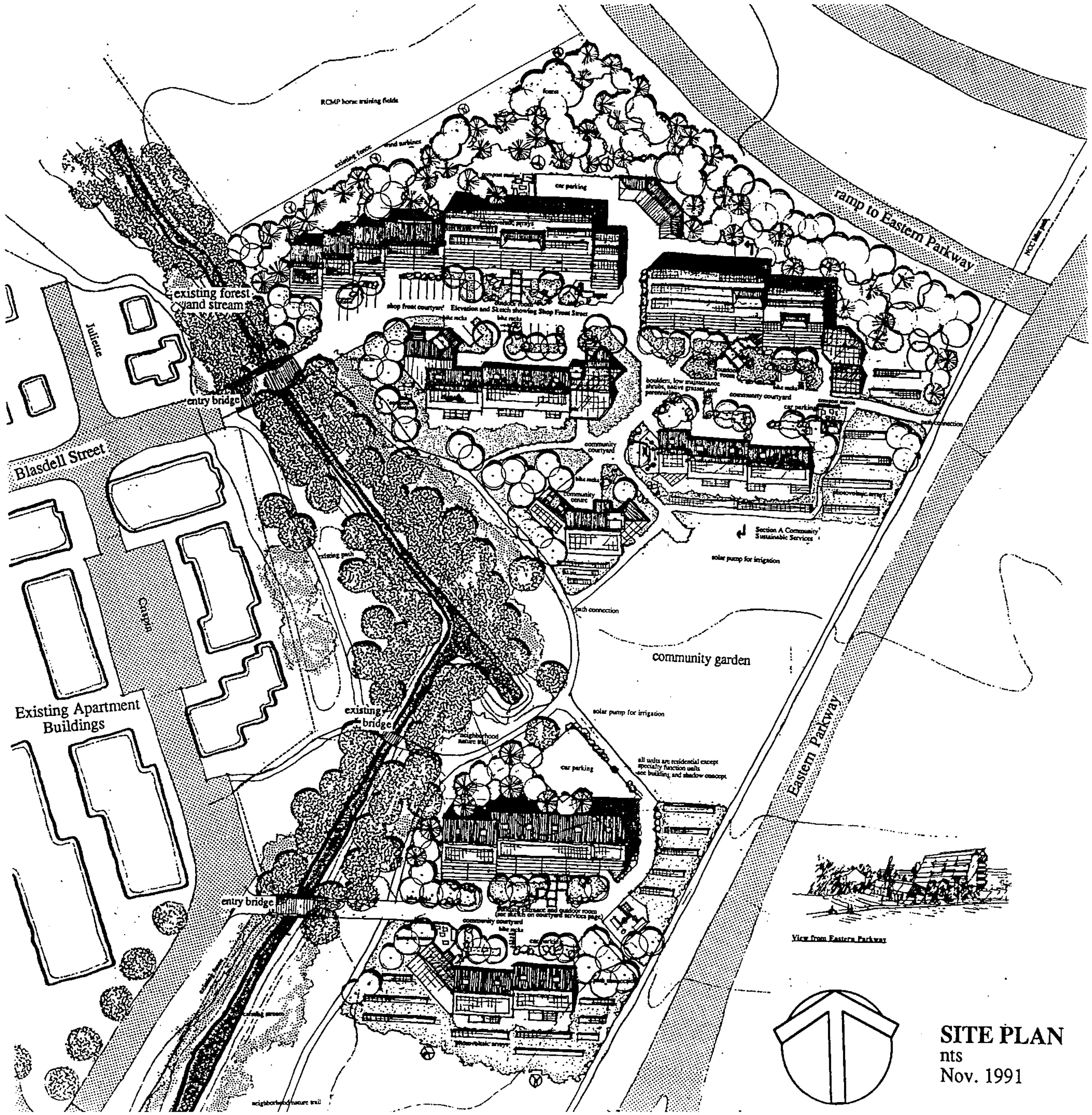
The following drawings and description are intended to provide both a model for future development and an indication of the character and lifestyle possibilities of sustainable communities. Using an existing site in Ottawa the following goals and objectives were established for the community:

GOALS:

1.-to significantly reduce non-renewable energy consumption through conservation and on-site production
2. -to significantly reduce consumption of water and subsequent water pollution through conservation and recycling
3.-to provide a livable, medium-density community in an urban setting

OBJECTIVES

1.-reduction of energy needs by 73% of conventional household use through passive solar space heating, solar water heating and high-efficiency insulation and sealing
2.-on-site production of 21% of energy needs with photovoltaic arrays and wind turbines
3.-reduction of water consumption by 55% of regular household use through provision of low flow toilets which use recycled greywater, cleansed stormwater for non-potable water use and recycling of greywater for garden and greenhouse irrigation
4.-significant reduction of blackwater sanitary sewer loads and elimination of greywater sanitary sewer loads and stormwater sewer loads
5.-waste reduction through composting of kitchen scraps and garden waste
6.-use of low or no maintenance plants and organic fertilizer provided by the composting activity
7.-provision of 50% of landscape space for food production providing significant garden space for every unit - in addition, winter food production is possible through provision of common greenhouse space
8.-provision of a variety of open spaces for interacting with other people and with the landscape in a non-disruptive manner
9.-implementation of pedestrian community concept in which streets are primarily social spaces in their own right and secondarily places where cars can drive
10.-spatial and architectural variety
11.-use of apartment and townhouse units to achieve medium-density of 17 units per acre
12.-encouragement of home businesses
13.-provision of community facilities



SITE PLAN
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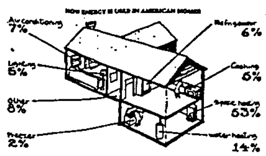
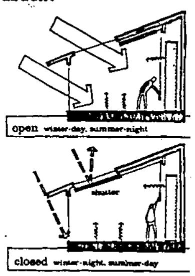
Passive Solar Heating

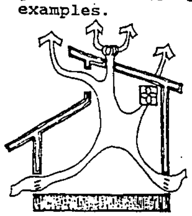


The average household of four in the Ottawa region consumes 32 kw hours per day of electricity. Since approximately 53% of this is for space heating this area presents great potential for energy conservation. One of the most important criteria of the site plan is the arrangement of the buildings to maximize passive solar gain. This is achieved by elongating the buildings on an east/west axis thereby maximizing surface area on the south side. Also, windows on the north, east and west sides are minimized while those on the south side are maximized.

Another important criterion in the site plan is a study of the shadow lengths during the winter when the sun is low in the sky. Shadow length coefficients were applied to ensure that shadows cast from buildings did not obstruct the sun from reaching all south facing windows. The Shadow Length concept diagram indicates the length of shadows at 9:00 am and 3:00 pm on December 21, the shortest day of the year. On this day, shadows are 3.89 x longer than the height of the object casting it. This diagram illustrates why the 6-7 storey apartment buildings are placed on the north side and why the court yards are as wide as they are. Since a winter shadow does not adversely affect the garden, a 6-storey apartment building is located on the south side of the garden.

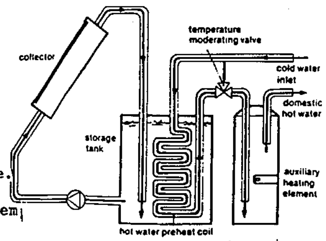


Sun penetration into the house during the winter should be maximized. During the summer when the sun is at its highest angle, sun penetration should be minimized. The concept diagram shown here and the Townhouse Detail illustrate how this can be achieved with flexibility. Skylights and clerestory windows increase sun penetration into the north side of the residence. The sun should also penetrate storage mechanisms or thermal mass during the day so the heat can be released at night. Examples of thermal mass include the following; stone walls, tile floors, water tanks and water filled culverts. Water has the greatest heat storing capacity of these examples.



Closing the house to the sun with insulated roll-down blankets and shutters as shown in the Townhouse Detail drawings helps to prevent heat from entering the house in the summer. This diagram illustrates how the natural ventilation system lets warm air, which tends to rise, leave the building. Also, deciduous trees in full leaf located in front of the south window or deciduous vines overhanging this window will reduce the sun penetration without preventing the winter sun from heating the house.

Solar Water Heating

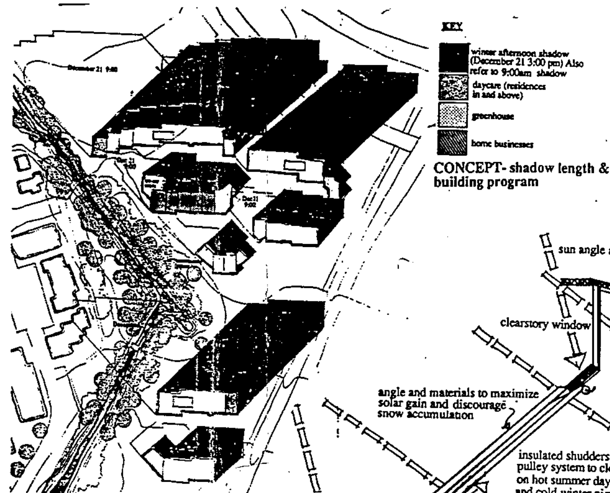


Water heating represents approximately 17% of regular household needs. Like passive solar heating, solar water heating can simply and efficiently harness heat from the sun to heat water. This diagram demonstrates the process for a pumped system. The collectors can be oriented on the south facing roof roughly at a 60° angle. Although some electricity will be required for pumping and a backup system the solar water heating should meet 60% of annual household need. With water heater and pipe insulation and simple hot water saving devices regular consumption of hot water can be reduced by 30%.

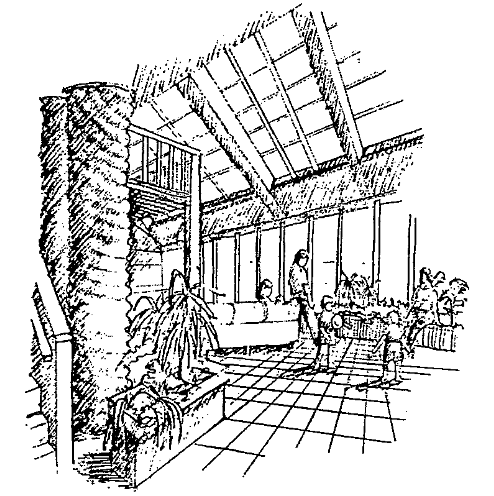
Insulation and Sealing

The efficiency of the passive solar heating is also dependant on the degree of heat transfer to the outside. R30 insulation in the exterior walls and roofs as well as triple pane Argon windows will greatly reduce the amount of heat lost. The shared walls of the townhouse and apartment units will reduce the amount of surface area exposed to the outside. Reducing the amount of infiltration points in the house construction will also increase efficiency. Finally the angle and material of the north peak of the townhouse and flat apartment roofs will encourage snow accumulation which also acts as an insulation. Reducing heat loss through the building envelope can cut home energy demand by one third or more.

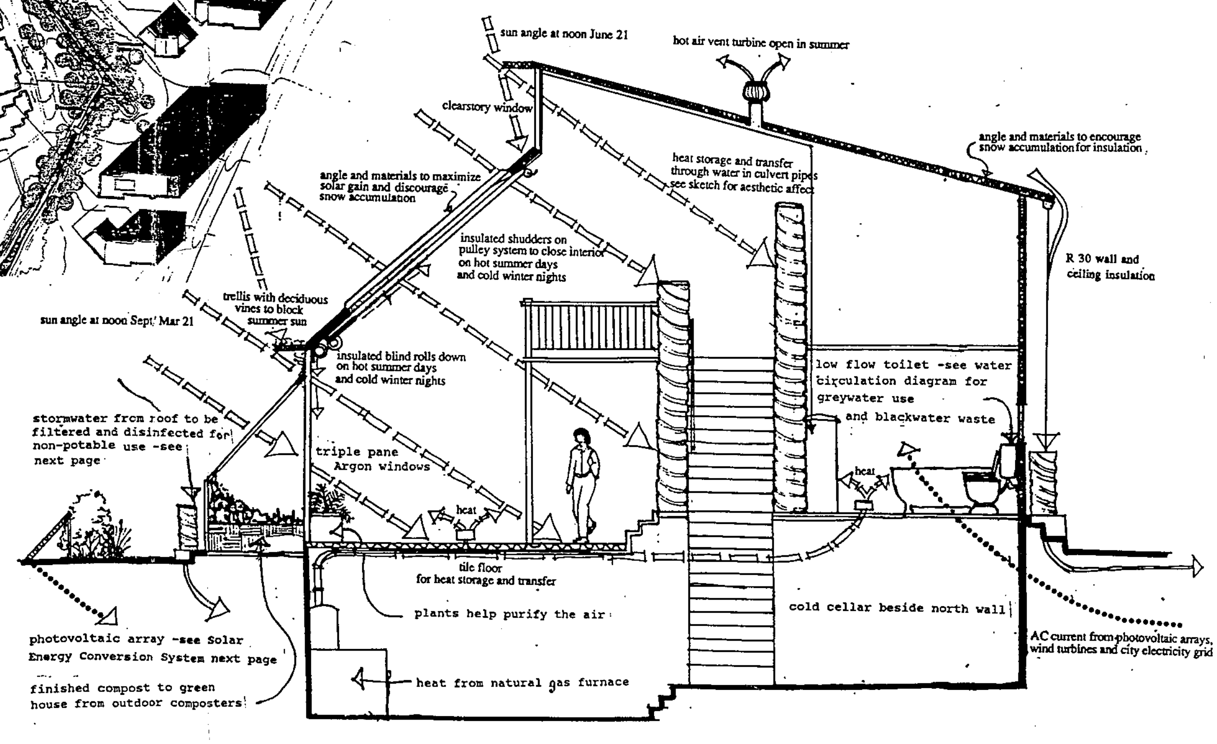
One unfortunate consequence of totally sealing a house is sick air syndrome. This can cause not only medical problems for residents but rapid building deterioration. Through the use of plants as purifiers and filters as well as an air exchanger, this can be alleviated. Examples of useful species are: Boston Fern, English Ivy and Peace Lily. However, this technique has not been perfected. Much research is still necessary to make this a more viable solution.



CONCEPT- shadow length & building program



Interior showing Heat Storage Culverts



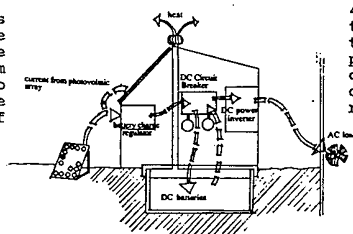
Although the possibility of using ground source heat pumps was examined, they are not used in this design. Firstly, CFCs circulating is the system can leak. Secondly they require electricity. Since one-third of the electricity produced in Ontario is fossil fuel and one-third is nuclear, electricity consumption should be discouraged. If the rational for not using natural gas is to discourage non-renewable energy consumption, the same is true with electricity consumption. Natural gas is relatively non-polluting compared to other fuels. As a result it is used in this design as a back-up heat source.

Many other energy saving means can be achieved depending on the commitment of the residents to conservation. These measures are difficult to build into the design and are thus only recommendations for the users: using compact florescent light bulbs, avoiding vacuum cleaners and broadloom (which restrict the thermal mass exposure of tile floors), and hanging clothes to dry. With these saving measures including passive solar heating, water heating , insulation and sealing, these units should consume only 27% of the energy requirement of conventional households. The difference is 32 kw/h per day compared to 8.7 kw/h per day.

2. On-site Energy Production

<u>Solar Energy</u>

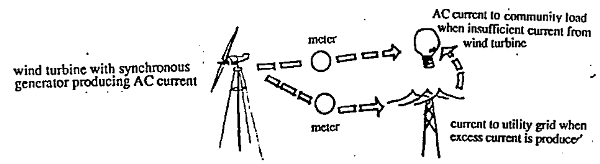
Harnessing on-site, renewable, non-polluting energy sources can contribute significantly to the energy provided for this community. A mechanism for harnessing sunlight and converting it directly into electricity is the photovoltaic cell. In Canada, photovoltaic arrays (groups of cells) are most commonly used in remote locations where the cost of a system does not exceed that of extending the utility grid. However, they can be used with a utility grid to significantly reduce the energy drain on the grid with limited aesthetic impact or space problems. This community's photovoltaic system will provide 16.8% of the energy needs of the whole community. This diagram illustrates how the conversion to electricity works. (Refer to the <u>Site Plan</u> for the location of photovoltaic arrays.)



<u>Solar Energy Conversion System</u>

<u>Wind Power</u>

Like the photovoltaic arrays, wind turbines turn a renewable, non-polluting on-site resource into usable energy. Generally wind turbines allow wind caught in a wheel configuration to turn a rotary system so that mechanical motion can be used directly or converted into another form of energy like electricity. The fluctuating flow of wind is made constant by a synchronous generator which simultaneously converts the kinetic energy into AC current. This can be metered to determine the flow into the household load. When there is an excess of current it can be sent to the utility grid and the meter runs backwards. When the load receives insufficient current from the turbine it pulls electricity from the utility grid. The number of turbines possible in the site plan is limited by the distance required between turbines (3-5 rotary widths) and the availability of unobstructed wind. The site analysis indicates that the north west edge of the



site adjacent to the horse training field is the best location, given the prevailing wind pattern. (Refer to the <u>Site Plan</u> for turbine locations.)

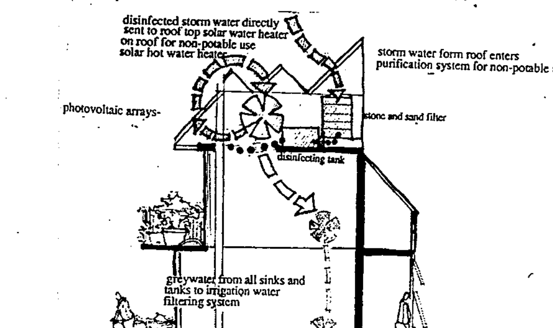
The percentage of electricity provided by the wind turbines is 4.3%. Therefore, the total on-site electricity production is 21% of the communities needs. Normally calculations would involve sizing the system to fit the energy requirement, however, wind and solar power are regarded as energy supplements only. Given the other objectives of the project, such as medium-density and garden space, on-site electricity production was limited to this supplementary role.

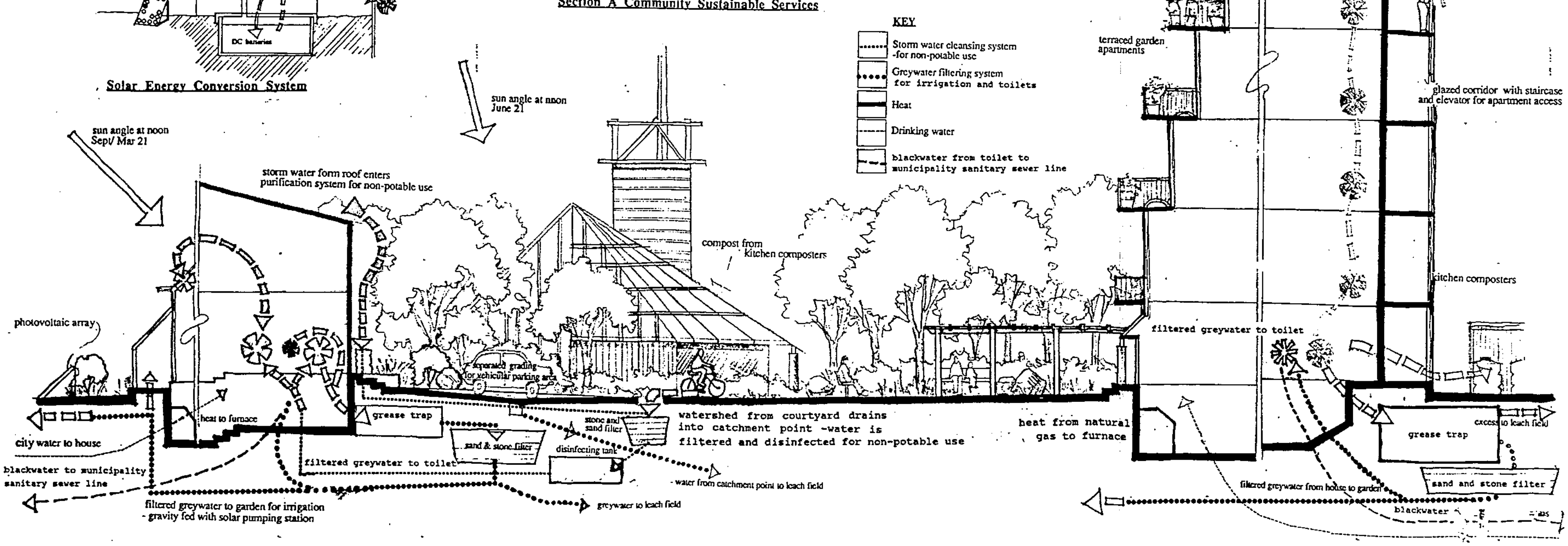
3. Water Conservation

<u>Cleansed Stormwater for Non-potable Water Use</u>

Another water conservation measure is the directing of stormwater through a simple collecting and cleansing process for non-potable household use. The water sheds include all roof and courtyard areas, but exclude areas for car parking. Since water from parking areas will introduce toxins into the system they have a separate drainage system which directs water to a leach field. The <u>Section'A'-Courtyard Sustainable Services</u> drawing shows this system. Rain water is directed to a catchment point where it is filtered through layers of sand, stones, wood chips and pea gravel before entering a final treatment or disinfecting process. It is then pumped to the bathroom sinks, tubs and clothes washers.
The total area for all watersheds is 10 500 sq.m. With an average annual water depth of .6629m, the average annual water accumulation is 6960 cu.m or 6960000 litres. The coefficient of runoff (.775) takes the surface material and slope factors into account to calculate the total storm water volume collected. This is 5 394 335 litres per year or 14 779 litres per day. If the volume of collected stormwater is 30.8 litres/ day/ person, this process provides 24.4% of water needs for the community. This will result in a 54.7% reduction of conventional household water use.

<u>Section A Community Sustainable Services</u>





Low Flow Toilet

The average daily water consumption per person in the Ottawa area is 210 litres. As much as 40% of that rate is consumed in the flush toilet. By reducing the amount of water used in the process of human waste management, water pollution through conventional, sanitary treatment systems is reduced. Most toilets use five gallons per flush. A simple device inserted into conventional toilets can reduce this by over 50%.

Recycled Greywater for Irrigation and Toilet

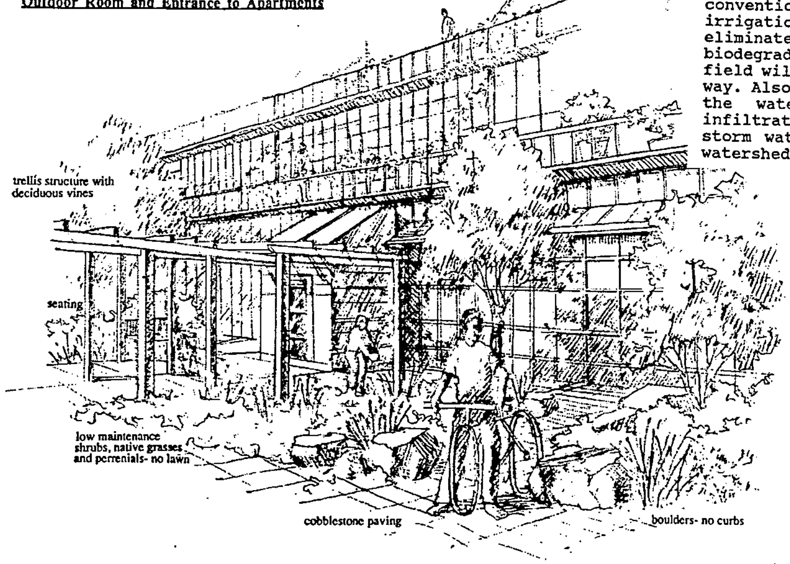
Water from tubs, sinks and clothes washers is sent to a grease-trap tank. After this it is filtered through layers of sands, stones, wood chips and pea gravel and sent to the garden and greenhouses for irrigation. The filtered greywater is also sent to the toilets. After use in the toilet the blackwater is sent to the municipality sanitary sewer lines. Greywater that is not used for either purpose is sent to the leach fields where it recharges the ground water. the irrigation water will also recharge the ground water supply.All other surhface drainage should also infiltrate directly into the ground to recharge the water table.

All potable water and water that cannot be supplied by the stormwater cleansing system will come from the city utility. The possibility of implementing a well water system was studied on this site, however the level of cleanliness from the city water treatment process is more reliable than any on-site purification process that could be provided. Also, the method of collecting, treating and distributing drinking water in this city has relatively little adverse impact on the environment. As a result, an on-site well water system is not used.

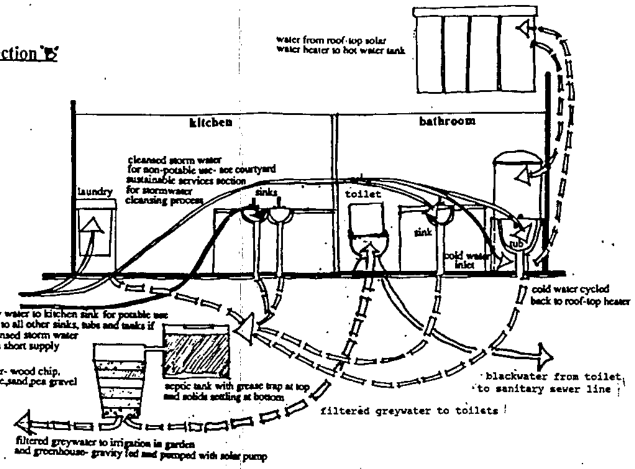
Elimination of Lawn Areas

The conventional daily water consumption figure does not take into account the use of water in the landscape and production garden. However, half to three-quarters of all municipally treated water is sprayed on lawns in the warm months. Water conservation through use of low or no maintenance perennial, shrubs and native grasses is important since conventional lawns consume a significant amount of water.

Outdoor Room and Entrance to Apartments



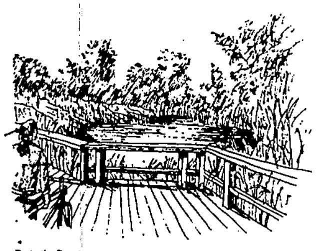
Section 'B'



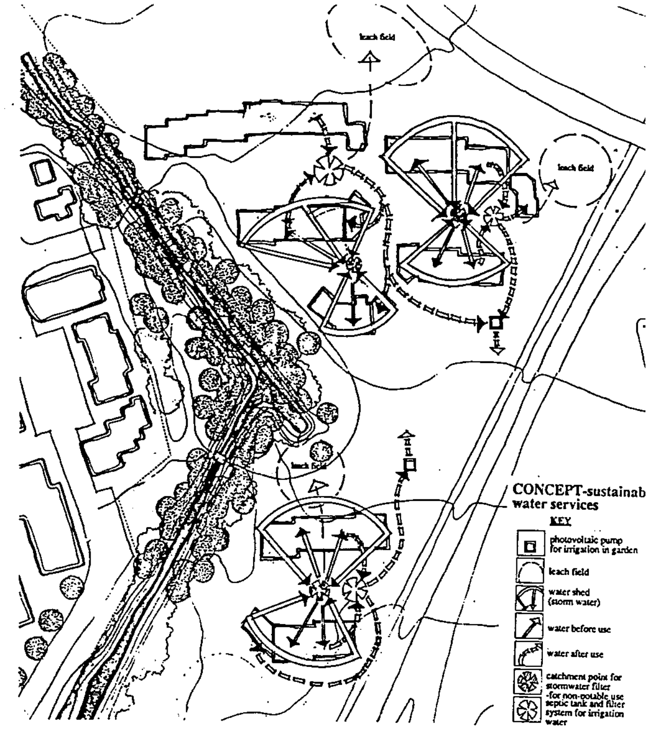
4. Reducing Sewer Loads

Despite the level of sanitary and storm water treatment in the region, the water that is returned to the rivers, streams and ground water sources has greater levels of toxins and organic matter than when it originally left the river. For example, oil from roads is washed into the storm sewer system and eventually into the natural water system. Also fertilizers from lawns and human waste from toilets adversely affect the natural water systems. Thus the purpose of water conservation in a province where water is abundant is not to avoid water shortage but to alleviate the decline of water quality.

The blackwater load to sanitary sewers will be the only sanitary sewer load. Even this will be significantly reduced from conventional blackwater loads due to the low flow toilet. The irrigation system, leach fields and recycling of greywater will eliminate the greywater load to sanitary sewers. If residents use biodegradable soaps and non-toxic cleaners, the load in the leach field will recharge the water table in a relatively pollution-free way. Also, the ground itself will filter water, thereby recharging the water table with relative cleanliness. Finally, the infiltration of water into areas outside the courtyards as well as storm water collection methods outlined for courtyard and roof watershed areas will eliminate storm sewer load.



Protective Boardwalk



5. Waste Reduction

At various locations indicated on the Site Plan, composting stations will handle garden waste and kitchen scraps. Although the possibility of using waterless composting toilets was examined, problems of odours and flies seemed to outweigh the benefits, particularly in a medium density application.

6. Low Maintenance, Chemical-free Landscapes

The on-site waste management process is an important factor in the landscape concept. Organic fertilizer eliminates the need for harmful chemicals which leach into the water table or enter streams through surface runoff. Also, the replacement of lawns with low or no-maintenance shrubs, perennial and native grasses reduces the need for chemical fertilizers. Residents will be encouraged to implement sustainable gardening techniques. The proposed forest on the north and east sides of the site is also a low maintenance landscape. This forest could be generated from seed using regenerative techniques which accelerate the natural process of forest growth.

7. Food Production

Approximately 50% of the landscape is occupied by the production garden. This provides 32 sq.m garden plots for each household. Also 6.25 sq.m of common greenhouse space will be provided for each household in addition to the private greenhouses on the south side of the townhouse units. This will be particularly useful in the winter months. Together these should provide a large portion of the household vegetable and fruit needs. The tree species selection for the courtyards could include Macintosh Apple trees or varieties of pear.

8. Social and Natural Open Spaces

Social Interaction

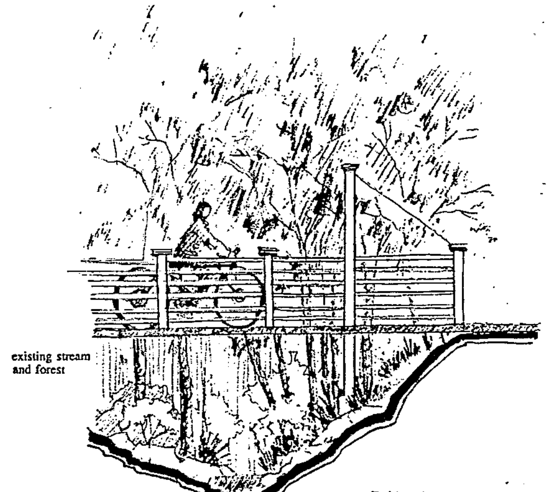
The garden space is an important part of the open space concept: to provide a variety of open spaces for social interaction and interaction with the landscape in a non-disruptive manner. Gardening will encourage social interaction and the community spirit of working together. Similarly, the arrangement of buildings around common courtyards with seating opportunities and community facilities will encourage interaction. The social integrity of these courtyards should not be affected by cars for reascns indicated in the section below on Pedestrian Communities.

Interaction with the Landscape

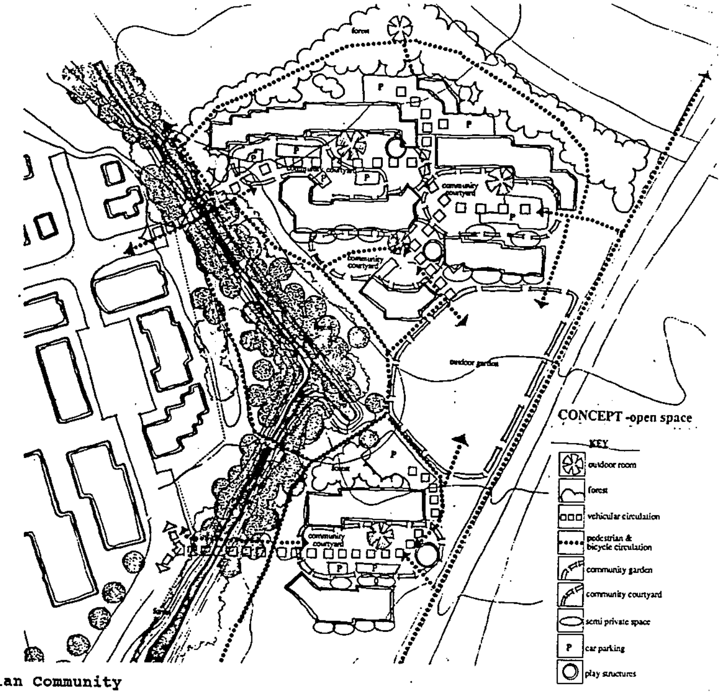
For quiet recreation, a nature trail by the stream is provided. This leads to an existing pond with a protective boardwalk. These trails take advantage of existing blazed paths and two existing bridges as well as the natural recreation features of the site. Connections to the NCC bike path link the community with landscape experiences such as the nearby Ottawa River. The proposed forest on the north and east edges provide both a visual screen to the off ramp and the Eastern Parkway as well as another landscape option. Since the river cannot be seen at ground level, this forest does not prevent a view opportunity. Instead it screens an undesirable view.

For both ecological and practical reasons no lawn space is provided. Since there is a large public playing field with baseball and soccer facilities located 3 minutes walking distance on London Street, it would be impractical to provide one here.

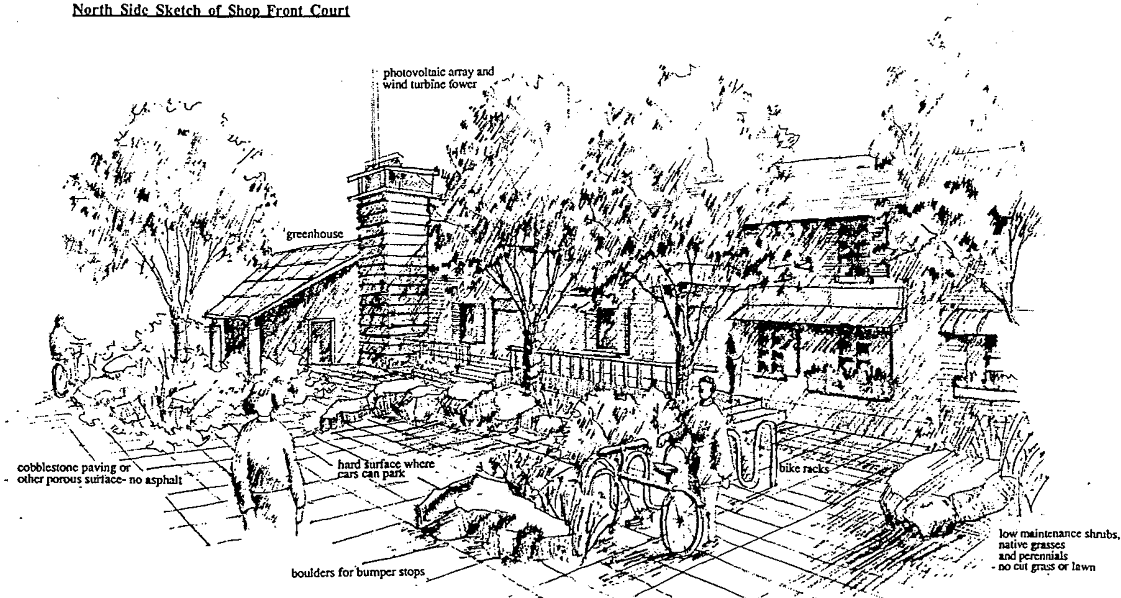
In addition to common open spaces, private and semi-private spaces are provided. All apartment units include a south facing terrace which is 15 sq.m. All townhouses have a south facing semi-private space and another in the courtyard.



Bridge from Blasdell Street



North Side Sketch of Shop Front Court



9. Pedestrian Community

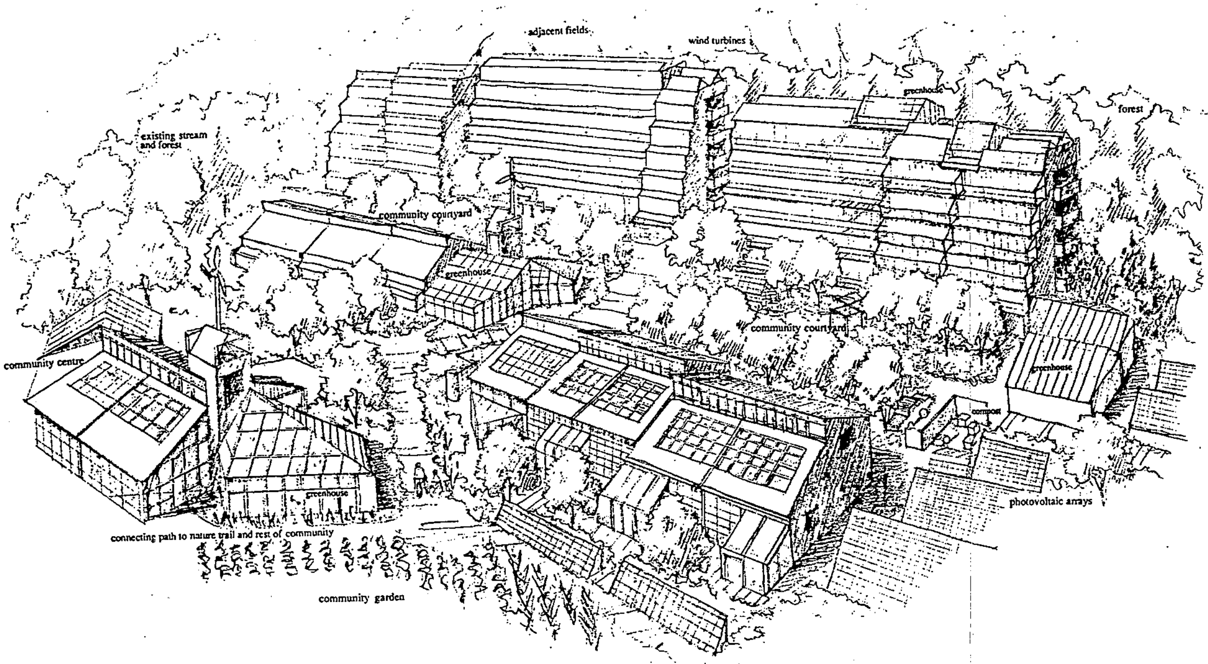
In conventional housing developments, the road greatly influences the spatial arrangement of buildings. The separation of housing units by roads which are designed strictly for motorized vehicles eliminates the potential of that space for social interaction. In pre-industrial urban design, the space in front of housing units arranged in rows was central to the social fabric of the community. One reason that these courtyards or social streets provided interactive opportunities is that no barriers separate the space. Linear vehicular roads impose a social dead-zone and affect the interactive integrity of this important space.

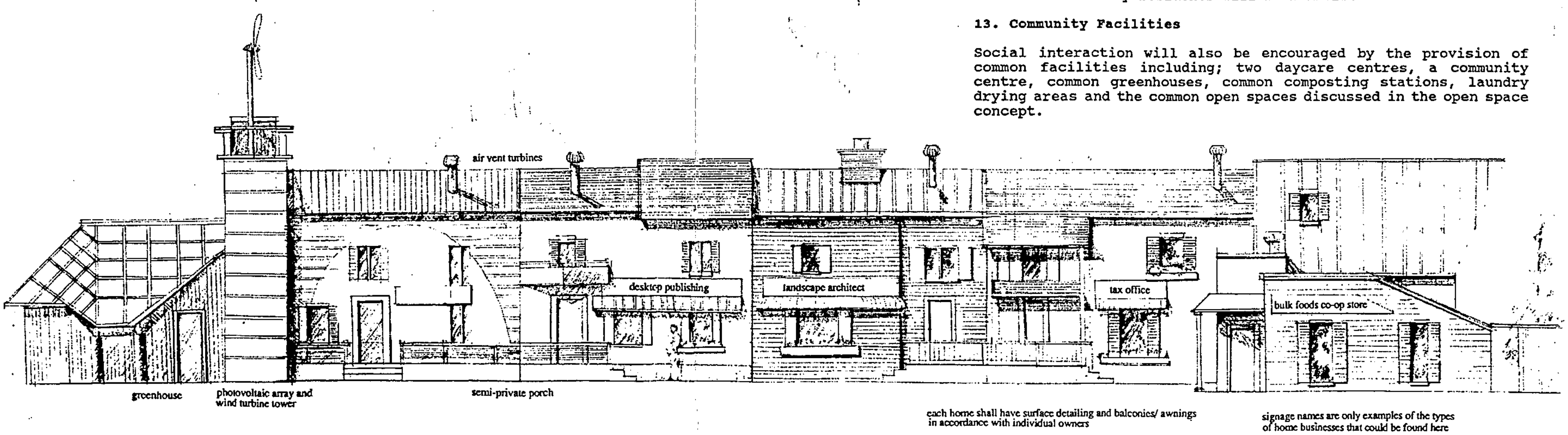
The social street concept does not prohibit cars. People can share the street with cars as long as cars are moving slowly and at a low frequency. This will happen if the paving material is rough, if the streets are not through-streets and if the driving area is narrow and not rigidly defined. By eliminating curbs and asphalt, this path will be perceived as part of the total social space of the courtyard. This process does not produce roads, but places where cars can drive and where people feel comfortable talking or playing.

LAND USE ALLOCATION IN STANDARD DEVELOPMENT

Land Use Type	Standard Development Percent Total
Backyard	22
Front yard	19
Street (including parking bays)	18
Houses	15
Side yards	11
Garages and carports	5
Sidewalks and bikeways	5
Driveways	5
Agricultural area	0
Common area	0

In conventional housing developments, almost 30% of the total land area is occupied by roads and parking, including garages and driveways. In this community only 3% of the land area is occupied with parking. The 75 spaces are located mostly on the shadow side of the apartment buildings or function also as part of the social space of the courtyard.
Although no residence has an individual garage, a community garage space is provided on the shadow side of the apartment buildings.





North Side Elevation of Shop Front Court

10. Spatial and Architectural Variety

When identical houses are arranged equidistantly along a road neither a sense of spatial or architectural variety is promoted. The townhouse units provide a basic structure which can be individualized by the surface detailing of each owner. (Refer to the Shop Front Street page for possible variations.)

Both the Site Plan and Aerial Perspective indicate a variety of enclosed and open spaces. For example, the forest or the trellis area in the courtyard are intimate, enclosed spaces unlike the garden or the centre of the courtyard which are more open.

11. Medium Density

Two basic building types are used; the apartment and the townhouse. Although the townhouse has more efficient passive solar heating capability, the 6 and 7 story buildings allow greater density to be achieved. If all the units had been apartments the shadow lengths would have prevented the passive solar heating concept. Thus, a best-fit balance was achieved with these two housing types. The 17 units per acre allowed a balance between density, livability and sustainability.

From a cost perspective, density is important. For environmental reason, increasing density allows human dwellings and other activities to be closer together. This means that people do not need to rely on cars to transport them longer distances. Walking and cycling become more feasible options.

12. Home Businesses

Another means of promoting non-vehicular transportation is the mixed use concept. Places where people live, work, play, shop and enjoy other daily activities are more accessible without cars if they are integrated into the community fabric. The separation of these places encourages people to drive cars. Unfortunately the site context does not include enough local shopping or employment opportunities to encourage residents to walk or cycle. It is not a mixed use area. As a result, shopping and employment opportunities will be provided on-site through encouragement of home businesses. Although any resident can open up a home business, a shop front courtyard is provided for those who wish to be part of a concentrated "commercial area". This area would include more parking spaces since people from outside the community will visit. One business which is certain to do well is a bulk food co-op store to which community residents will be members.

13. Community Facilities

Social interaction will also be encouraged by the provision of common facilities including; two daycare centres, a community centre, common greenhouses, common composting stations, laundry drying areas and the common open spaces discussed in the open space concept.