

**Self Build Aboriginal Housing Using Balèwall
Construction**

CUMBERLAND HOUSE, SASKATCHEWAN

Final Report

Prepared for Homegrown Solutions

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Preface

This report was produced under the auspices of *Homegrown Solutions Maison*, a grant program funded by Canada Mortgage and Housing Corporation and administered by the Canadian Housing Renewal Association, The Canadian Housing Federation of Canada, Canadian Home Builders' Association, and Federation of Canadian Municipalities are partners in the initiative, participating in the steering and selection committees for the initiative.

Homegrown Solutions Maison was initially funded in 1995 by the federal government as a national enablement demonstration initiative with the objectives to

1. help locally based community organizations to meet housing need by identifying and harnessing new and existing resources available to their communities; and
2. demonstrate and share the ideas and approaches used to respond to local housing need

Homegrown Solutions Maison is not just about physically producing houses, it is an effort to build local capacity and enable communities to be creative in leveraging the resources that already exist to meet local needs.

This final report has been produced by the World Vision Aboriginal Council as documentation of this initiative in order to share this information with others seeking to similarly address affordable housing need in their community.

A total of 13 initiatives were selected in 1996 and each will culminate in a final report during the latter part of 1997 and 1998. A further 18 initiatives were funded in 1997 with the initiatives then being implemented in 1998/99 and reports produced as each initiative is completed.

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Executive Summary

Project Highlights

This initiative, undertaken in a remote aboriginal community in north-eastern Saskatchewan has developed an affordable housing model that can be replicated in this and other communities. It focused on testing the feasibility of balewall construction as a self-build construction technique that could be easily taught and applied. It also involves the development of a funding model in the form of a revolving loan fund.

The initiative has resulted in the creation of a home building and renovation co-operative, completion of a training program in self-building techniques and development of organizational and administrative skills. The pilot project was extended to two communities in northern Manitoba -- Sioux Valley and Lake Manitoba where two homes have been successfully constructed. Two additional homes are scheduled to start construction in Cumberland House in the spring of 1998.

Funding and Community Resources

The World Vision Canada Aboriginal Council provided leadership in community development and supervised the training program. The community formed a co-operative as the legal entity to develop and own the homes, although some may be sold to individual owners. Community members in the co-operative contribute sweat equity to the construction process, while learning the straw bale building technique.

The Village of Cumberland House donated the land for the homes while a number of professionals and building suppliers donated expertise and materials for the first homes. The donation of land, materials and expertise, in combination with free labour provided through the sweat equity process will result in the first two homes being constructed with a minimal cash outlay. The homes will either generate rental or mortgage payments which will be used to fund a revolving loan pool. For the sale option, the group is currently adapting the Habitat for Humanity mortgage model (principal repayment only plus sweat equity).

Because the homebuyer will repay the loan slowly, it will take many years to collect the full price of the home. To fund their ongoing building program, rather than selling the homes, the co-operative may simply rent them to members, and seek to borrow against the equity in the first two homes (to be created through a combination of sweat equity and donated materials). Rental revenues will then be used to repay a commercial mortgage on the properties.

The group has also approached Saskatchewan Housing to provide a capital contributions and is soliciting other cash donations to increase the size of the revolving fund. As new homes are completed and occupied, a process of repayments from subsequent homes will continually replenish the fund.

Impact on Affordable Housing Supply

The initial homes will be built with only minimal cash outlay, but will be mortgaged based on estimated values of approximately \$35,000-\$45,000. The revolving loans will charge a below market interest rate and whether sold or rented the homes will be affordable for households with low income or that are on social assistance - monthly costs are expected to be below \$350.

Lessons and Adaptability

The group notes that community development is not something to be rushed. They have moved more slowly than originally planned but feel it was necessary to work at a pace at which the community felt comfortable in taking on ownership of this process. Considerable effort was directed to developing training materials both in the construction technique and in organizational skills in the newly formed co-operative.

The balewall/strawbale construction technique was found to be very practical. It was easily taught, through a hands on process and the group feels that with this new skill the community will be able to maintain an ongoing building program to meet its housing need - gradually adding homes each year. The high insulation value is also expected to assist in reducing the high cost of heating in this northern community.

Putting some effort into securing donations for this pilot project was an effective way to create equity that is now the foundation of the revolving loan fund. It will also be important to develop a process to increase the size of the fund if an ongoing project is desired. Beyond the initial pilot it is difficult to rely on donations of materials and land.

Introduction

Affordable, self-directed and managed housing continues to be a crucial need for most First Nations communities as they move toward increased self-governance and community-based project management.

The project developed and reported on herein was designed to address several levels of need which impact on the ability of the initially targeted community (Cumberland House, SK) to provide affordable housing to its citizens. Two key elements were addressed, one in a research mode and the other in both research and practical application.

While the initial target and Homegrown Solutions grant application were for Cumberland House, Saskatchewan, the alternative housing approaches being investigated sparked significant interest in several other communities. Two communities in Manitoba subsequently became involved in a demonstration housing component. (Lake Manitoba First Nation, and Sioux Valley Dakota Nation)

1. Background Context and History

Cumberland House is a Metis settlement located beside the Cumberland reserve - the oldest settlement community that is non-First Nations in Saskatchewan. Formerly the most widely used trading centre in the northwest, the local economy has eroded with little or no economic activity generated that is long-term, and which has been able to replace the traditional economies. These collapsed in large part due to the fur lobby efforts of the European Union and through the creation of large hydro-electric control structures which have flooded traditionally dry ground and re-directed water into other than traditional waterways.

Following the formation of the World Vision Canada Aboriginal Council (WVAC), the council actively began to ascertain the most effective means of determining, and then responding to, the most urgent needs of the Aboriginal communities of central Canada (Saskatchewan, Manitoba, and North-West Ontario).

Through research of written materials and interaction with the aboriginal communities it was quickly evident that one of the communities' greatest needs was housing. The Council therefore consulted with communities, began organizing formal study workshops, and engaged Devcon Community Development Consultants (Mr. Ernest Dyck, a community development specialist), to conduct further research and to determine World Vision Canada's best response to the situation. Further work was done by Urban Village Housing Consultants, Vancouver (Craig Vance housing consultant) to develop the revolving loan fund proposal.

1.1 Review of Available Programs and Literature

Devcon's mandate was to:

- Under the direction of the Manager, Aboriginal Programs, establish contact with agencies and individuals in the region that have been involved in aboriginal housing projects.
- Gather available information, including studies and plans, on aboriginal housing projects with particular attention to the use of alternative housing materials and construction methods.
- Prepare a summary of housing initiatives in aboriginal communities funded by the Government of Canada, giving attention to their objectives, priorities and philosophies.
- In consultation with the Manager, Aboriginal Programs, establish contact with aboriginal leaders of three divergent communities recognized as having serious housing deficiencies.
- Arrange a meeting with representatives of the three communities, the Manager, Aboriginal Programs, and other appropriate resource persons (e.g. engineer, community planner, construction and building materials specialist) to discuss issues and problems, leading to the development of an alternative housing strategy.
- Recommend a strategy or strategies for housing in aboriginal communities.
- Provide the information and input required to structure an eventual proposal for government and/or other funding.

The initial research resulted in the presentation of a report to the Council and World Vision. From that review it was determined that a community-based approach must be used in the project and that low-skill construction techniques are essential in a self-build project. A subsequent decision was made to ensure that construction for at least one unit was undertaken so that whatever was learned from others' experience or whatever research was produced in terms of a model could be tested and a determination made as to whether or not it was likely to work in the field.

1.2 Liaisons and Study Workshops

In an effort to determine the possibilities of working in communities representing all of the three designated areas noted in the report (serviced, remote and isolated), the Aboriginal Council organized a Focus Group on alternative housing for Canadian Aboriginal Communities. Attending the meeting in addition to various specialists, were aboriginal representatives from Attiwapiskat (and isolated community on James Bay), Cumberland House (a remote community in North-Eastern Saskatchewan) and others aboriginal communities nearer to Winnipeg. The Cumberland House representatives expressed very strong interest in the process. This led to further planning sessions and a project presentation to Homegrown Solutions on behalf of the Kikinana Mammowetowin Cooperative housing project at Cumberland House.

2. Project Objectives

The original objectives they were to:

- i) investigate the feasibility of stack wall and/or Balewall as alternative construction

methodologies for low-cost housing as a part of low skill, sweat equity building program in a rural community (Cumberland House, SK);

- ii) document the development of a community loan fund that would provide low or no interest home loans for community member unable to secure standard financing.
- iii) Research the standards and requirements for compliance with the NHA and a comparative cost analysis with standard financing.
- iv) Determine the minimum skills requirement for effective safe construction and develop a training outline for sweat equity builds which would reflect the same.
- v) Development of a written evaluation resource and a checklist as a grid that could be used by the community to determine feasibility.
- vi) Prepare documentation outlining the appropriate set-up capital injection level, policies, procedures and operation of a Habitat for Humanity type mortgage loan fund that can be utilized to provide low cost financing of new construction.
- vii) Ensure that as a part of the above process, members of the community participate and are equipped with the required skills.

Following the literature analysis and consultation process, the use of stack wall housing was discarded in favor of balewall¹ for the initial trial period early in the planning process because:

- i) it requires considerably more time to organize effectively,
- ii) it is not as efficient a building material,
- iii) it does not provide as good insulation
- iv) it is not suitable for use by low skilled labour
- v) it was considered better to perfect one method before employing the second.

The intention, originally, was to move ahead much more rapidly. The first houses were to be built in the summer of 1996. The work of community development is, however, a slow process requiring considerable awareness raising and frequent community meetings. Local participants not only need to be trained in project development, but they need also to be allowed to progress at a pace comfortable to them after having assumed ownership of the process. While it is evident that our original projections were too optimistic, we believe the process is of sufficient importance to commit ourselves to following the same process in our work with other communities in the future.

3. Overview

The Cumberland Lake project was initiated over a period of approximately six months with members of the local community receiving assistance from Terry LeBlanc of World Vision Canada and Ernest Dyck of DevCon International. Focusing on developing both community development and construction skills the process involved practical and theoretical training. There was direct linkage between training and the application of newly-learned skills for the benefit of the community housing project. WVAC facilitated

the formation of a housing cooperative (Kikinana Mamowwetowin Inc), in the community as the vehicle through which to develop and own the homes. The co-op has representation from the various segments of the community, ie. Reserve residents, metis, and town people. The co-operative will administer the housing once it is constructed.

Since the cooperative is new, training is being provided in management and administration of a cooperative. While initially an external trainer will be brought in, once trainees have acquired sufficient knowledge, they will themselves, under continued supervision from the WVAC, train members for their respective communities. Training in conjunction with the use of the newly acquired skill in practical application will likely increase retention. Retention will also be reinforced through long-term community based follow-up and support at three levels: i) Basic training entry (the provision of sweat equity in community housing), ii) job entry level by working alongside qualified trades people, and iii) providing opportunities for self-employment.

Service to the community will be stressed as training is provided in needs assessment and contribution to community needs. As individuals gain knowledge in housing management and maintenance, and acquire the needed skills their sense of self sufficiency as well as that of the community, should grow, leading to positive changes in lifestyle. The project should therefore reduce the funds needed for both house construction and maintenance. On the one hand because a significant amount of the construction labour will be contributed through sweat equity, and on the other hand, because increased self assurance and self sufficiency will result in reduced wear and improved maintenance.

The new home construction and home renovation project will be managed by the housing cooperative. A five-year plan will be designed to capitalize the cooperative. The initial capital for the project will be raised through the construction of two units to be built by donated labour and sweat equity. Commitments have already been received for the donation of almost all of the needed materials for the two units, either in kind or in funds for the purchase of materials. Mortgage loans will be arranged based on the market value (including all donated labour and sweat equity) of the two houses. The two houses are then to be used as equity for loans from financial institutions for the establishment of a revolving mortgage loan fund .

A workshop on housing tenure was held with members of the community in Cumberland House, facilitated by Craig Vance of Urban Village Housing Consultants. The community was presented with options of being a continuing equity co-op, or a builders co-op. While the final decision has not been made by the community, it is anticipated that they will choose to be a builders co-op with final title being held by each household.

4. Revolving Loan Fund

The revolving loan fund proposal is based upon the following:

- 1) Building one or two strawbale homes capitalized largely through materials

donations, capital donations and sweat equity.

- 2) Initial residents who are members of the co-operative pay market rent on the two units. (nb: "market rent" in this instance is consistent with that paid on assistance programs for a family of four).
- 3) The first two units are mortgaged to the maximum amount that can be obtained with the homes pledged as security to secure the mortgage.
- 4) The proceeds of the mortgage and rental income capitalize the construction of the next two units which in turn are mortgaged by the Co-operative while residents pay market rent.
- 5) At conclusion of the project (target 10 units) the members of the Co-operative take title to their homes and the total indebtedness of the Co-op is divided by the number of units. The amount of the mortgage on each unit would not exceed the ability of each household to make the payments at the rates provided through social assistance, which would ease lenders concern about lending in a remote community.

There is the possibility of a capital grant from Saskatchewan Housing. If this grant is forthcoming the combination of sweat equity, materials donations, and rental income will result in homes well under a threshold of \$40 - \$50,000 per unit. This is the point at which the homes are affordable to low income people (ie: mortgage payments in the \$350 per month range at 7% mortgage rates) and well below the approximately \$100,000 per house cost to build houses in Cumberland House under recent RNH programs.

5. Modified Habitat Mortgage Model

The mortgage structure of Habitat for Humanity is a principle only mortgage to the homeowner, often secured additionally by a "sleeping second" mortgage. Habitat has a scale linked to the poverty line in a given area for a maximum mortgage payment for differing family sizes. The "sleeping second" mortgage is designed to protect the value of the "sweat equity" contributed to the project in a resale situation. No payment is required under the second mortgage, except in the event of a resale.

In the Cumberland House application, it is planned that the principle-only (i.e. interest free) mortgage will be based upon the actual hard costs of the project. The sleeping second would be for the difference between the value of the first mortgage and the market value of the home, to the degree that the market value in a remote community can be determined. The "sleeping second" would be forgiven over a period of time.

Elements of the Habitat Model will be used and adapted to the requirements of the project as it develops.

6. The Target Client Group

The people to be targeted will be rural, reserve and village residents (initially of the Cumberland House area) who:

- Do not qualify for mortgages from existing financial institutions.
- Are unable to obtain adequate housing through existing federal and/or provincial programs.
- Are willing to try a new venture and enter into a community labour pool
- Are able to repay a mortgage loan at reduced interest rates.
- For the home repair program (being developed in parallel), are owners of homes in need of renovation or retrofitting, but are unable to personally make the repairs or to pay for the same.

7. Need Identification

Devcon's study indicated that government programs do not appear to be successful in delivering affordable, adequate and suitable housing according to the standards defined in the excising program delivery agreements. In remote areas 65% of Rural and Northern Housing Program (RNH) clients face high shelter/income ratios and/or inadequate housing conditions.

Although affordability accounted for only 14% of rural aboriginal housing needs, 44% of these households have been identified as being in core need. That is, rural aboriginal households are more likely to occupy housing in need of major repairs or needing to be replaced than to occupy sound housing they are unable to afford.

The federal government programs were more successful in meeting general rural housing needs than in targeting assistance to aboriginal households in core need. The target of 50% aboriginal beneficiaries hasn't been met. Only 30% of RNH Regular units are occupied by households with at least one member belonging to the aboriginal community. For units delivered between 1985 and 1989 this percentage increased to 48%.

The RNH Demonstration Program's self-help approach to building and operating housing in rural areas yields the most housing services for the least amount of materials, labour and land. The potential for self-help was not fully realized due to the short-term nature of the programs. Learned skills would have produced better results over an extended period of time. Even the Demonstration Program which stressed local involvement more than any other RNH development program did not allow for any significant local involvement in housing design, although where this did occur, involvement in the design and construction of one's own house and household responsibility for repairs were found to have a positive effect on house conditions.

There is therefore need to develop longer term training and construction programs in which the client group is provided with the needed training and assumes responsibility for

the program from its inception. The housing focus group meeting held in Winnipeg in January 1996 provided the needed impetus, and the Cumberland House Community, among others, has picked up the challenge and, while initial plans were to complete construction of the first house in 1997, will begin construction in spring of 1998.

8. Alternative Housing Materials: Strawbale and Stackwall

Two alternative construction systems were explored in the original proposal: stackwall and balewall. Both systems feature a building method which is easily used by inexperienced homebuilders and with readily available materials.

"Stackwall" is a building system which uses pieces of common firewood stacked on top of each other in a mortar matrix to form the wall system. The butt-end of the firewood is usually left exposed, which creates an aesthetically attractive pattern.

"Balewall" or *"strawbale"* uses common strawbales stacked one upon the other much like bricks as the wall system. Window and door opening are framed in using a structural window buck to transfer the weight of the roof around the openings to the foundation. The bales are pinned and pre-compressed and then covered with stucco on the outside and plaster on the inside. This method of using bearing strawbale walls is known as the "nebraska method" and is being used on all three World Vision Projects. The other method is post and beam construction with strawbale infill.

8.1. Stackwall Housing

Considerable research has been carried out on this by the Northern Housing Committee of the University of Manitoba. Construction by this method appears to be considerably more complicated than with Straw Bales. No matter how dry the wood is prior to construction, the fact that it absorbs some of the moisture from the fresh mortar causes it to contract following completion. If the mortar is not redone after about three years of use the house becomes drafty. A further problem is seasonal shifting causing cracks to form in the walls. Those involved in the studies suggest that improving the foundation "should remedy this problem". Problems with this type of construction are invariably raised, usual with comments like the one above, suggesting that solutions should be available. If further research is successful this construction method should be suitable for any area producing trees five centimeters or more in diameter.

8.2. Balewall Construction

Enterprising pioneers began building "Balewall" homes in Nebraska in the mid 1800's. Many older balewall homes are still in use today. Balewall homes use strawbales much like oversized Lego, pinned and reinforced with rebar and coated with stucco inside and out. The homes referred to in this report use bearing strawbale walls ("Nebraska Style") as opposed to post and beam with balewall infill which is the other form of balewall

construction commonly in use.

Tests reveal that the balewall method results in a wall that is R-40-55 (standard walls in Canada are R-20). The walls are thick and allow for deep window seats or for one to carve out a wall niche with a chainsaw before stuccoing. If you build it yourself, costs of \$50 per buildable square foot and lower are achievable or less are achievable. This is borne out by the Lake Manitoba project which has a project cost to complete of \$43 per square foot (compared to \$70 and up for conventional construction. There are reports of extremely spartan balewall structures built for as low as \$7.50 per square foot with recycled materials and earth plasters and even as low as \$1.50 per square foot for a project in Mexico). It can also have high aesthetic value for those who use the design possibilities inherent in the material.

Stucco covered balewall is extremely fire resistant, far more so than a conventional stick-built home. Balewall owners have no more rodent or insect pest problems than anyone else and a recent CMHC study in Nova Scotia indicates that the "breathing" strawbale walls (no vapour barrier) are standing up to moisture in an area of heavy wind-driven rain.¹

9. Straw Bale Evaluation:

From the first house in Lake Manitoba, Strawbale construction appears to live up to expectations.

9.1 Affordability

The house was completed to lock-up stage before winter, with drywall work proceeding in February, 1998. The cost to date for that house is \$29, 000 with the projected cost to complete being \$45,000 for a projected construction cost of \$43.00 per square foot. This compares with. Compared with a \$70 per square foot cost for a conventional single family house with modest finishings, this house represents a saving of approximately \$27 per square foot. Strawbale is imminently suited to self-build housing and these savings are primarily from donated labour, and in part from donations for materials (Donations are detailed in section 10 below and include: strawbales; roof trusses and electrical supplies and installation).

The project should have no difficulty in keeping the mortgage on a finished unit below \$50,000. At that level a conventional mortgage can be carried at less than \$350.00 per

¹ For more information on balewall/strawbale, start with the "Surfin' Strawbale" website. (<http://www.pcisys.net/~moxvox/surfin.html>) or The Straw Bale House book by Athena and Bill Steen and David Bainbridge.

month, which is a threshold level for a mortgage to equal social service rates for a family of four in Saskatchewan.

9.2 Construction Training

Representatives from the three communities participated in three training events in partnership with World Vision Canada. Two events were held in Alberta, visiting balewall homes built there and discussing balewall with the architect/engineer involved in those houses. The third event was with the Navajo First Nation in Arizona. This involved participating in building a balewall home and was the most useful of the training events.

The project manager is of the opinion that there is now aboriginal expertise developed from the Lake Manitoba project. World Vision may use some of those people as consultants in future projects.

9.3 Community Acceptance

There seems to be enthusiasm and acceptance of strawbale construction within the three communities, as can be seen from the 60 people in Cumberland House who have shown interest in joining the Co-operative.

10. Committed Partners

The following organizations and groups committed to partnering with the three communities building homes by making contributions to the project:

The Kikinana Mamowwetowin Housing Cooperative currently has about 60 members, each member has committed some funds and stands ready to participate fully in planning and implementing the initiative. This group will be the primary supplier of sweat equity. They will be responsible for project management and administration.

Cumberland House LCA -Village will provide lots and servicing to frontage.

World Vision Canada Aboriginal Council will provide staff time for community development training and overall supervision of the project and the training process. They will assist in the identification of and supervision of training personnel, and be the intermediary in the establishment of the bulk purchasing arrangement for building materials.

Habitat for Humanity, an internationally recognized provider of housing to low income people, has agreed to share its outline for planning and executing "sweat equity builds", its mortgage pool management system, and its financial and administrative structure.

We will be looking to New Careers to provide educational equipment, training tools, and other training materials.

Homegrown Solutions grant in support of this innovative project.

The possibility of obtaining a capital pool from Saskatchewan Housing for new construction will be explored, with expectations that these funds will be available for the second year, if not the first.

The Business Community, particularly a major supplier of construction materials, has indicated interest in assisting in the establishment of a bulk purchasing cooperative resulting in significant savings on construction materials. Commitments as listed below, have already been received from:

Agency	Resource
Urban Village Housing Consultants, Inc.	Co-op development consulting, report writing, research on financial models
DevCon International Ltd	planning and management, and assistance in community development.
Northcote Development Corporation	a Metis organization will provide some of the training equipment as well as the physical facilities for training
Schweitzer-Mauduit	Straw Bales and transportation
Newton Enterprises	Windows & Doors
Manufab Building Components	Roof Trusses
Yashe Boge, Boge & Boge Contracting	technical assistance, drawing and structural assessment
Mississauga Electrical	electrical supply/installation (two units)
Delta Blueprinting	blueprints, adaptation of plans

It is not reasonable to project the same level of support in the long term with the exception of the already expressed commitment by World Vision and DevCon. While sweat equity labour will continue to be central to the project, building materials will need to be purchased. With less donated materials the value of the equity in subsequent houses will likely be less, and will limit the growth of the revolving loan fund. Grant funding (to capitalize the loan pool) will be critical to the success of this project if it is to meet the objective of providing low interest housing loans to people that do not qualify for housing loans through financial institutions.

11. Project Outputs

Both tangible and intangible output will result from this project. Both should increase with each succeeding year of project implementation.

11.1 Tangible Outputs - Short Term

Two high- energy efficient houses will be constructed in Cumberland House (plus additional houses in two other communities) during the first year at no monetary cost to the co-operative.

Energy efficiency and training in building maintenance will reduce operating costs.

The equity generated by the construction of the first two houses will provide leverage for additional funds resulting in a sustainable revolving fund for house construction and renovation.

The development of indigenous structures and operating systems evidenced by functioning community based cooperative managed by local people.

Increased participation of residents in community projects & skills related to same.

11.2 Tangible Outputs - Long Term

A revolving loan fund ably managed by qualified local people.

Annual construction of a minimum of 3 balewall and/or Stack wall housing units.

Capitalization of the loan fund through Saskatchewan Housing Corporation's remote housing program over a five year period (not yet confirmed).

11.3 Intangible Outputs- Long Term

With experience in designing their own plans and proposals, members of the community will develop their planning and proposal preparation skills.

Working together in unprecedented ways will increase skills in organizing and executing joint community projects.

Skills development will increase individual and corporate self-confidence and self reliance.

Increased enthusiasm for taking ownership of and resolving problems and/or unsatisfactory conditions.

12. Summary of Recommendations

Though not an exhaustive list, the following form some of the key recommendations of the project thus far:

That emphasis be put on community-designed, rather than externally-designed, housing programs.

That the program maintain a community development focus.

Decisions and plans will result from frequent community meetings allowing the community to take ownership of the program.

Housing solutions (outputs) will be the result of cooperation within the community.

Although discarded for the first year, the benefits of Stack wall housing should be revisited in future years.

The rate of housing unit construction and repairs should be doubled every two to three years as management capacity is developed until the potential for the community has been attained.

That private and commercial capital be sought in order to continue capitalization, and that

funds be managed so as to provide reduced rates of interest to members of the cooperative.

¹ The stackwall and Balewall techniques are described in more detail later in this report.