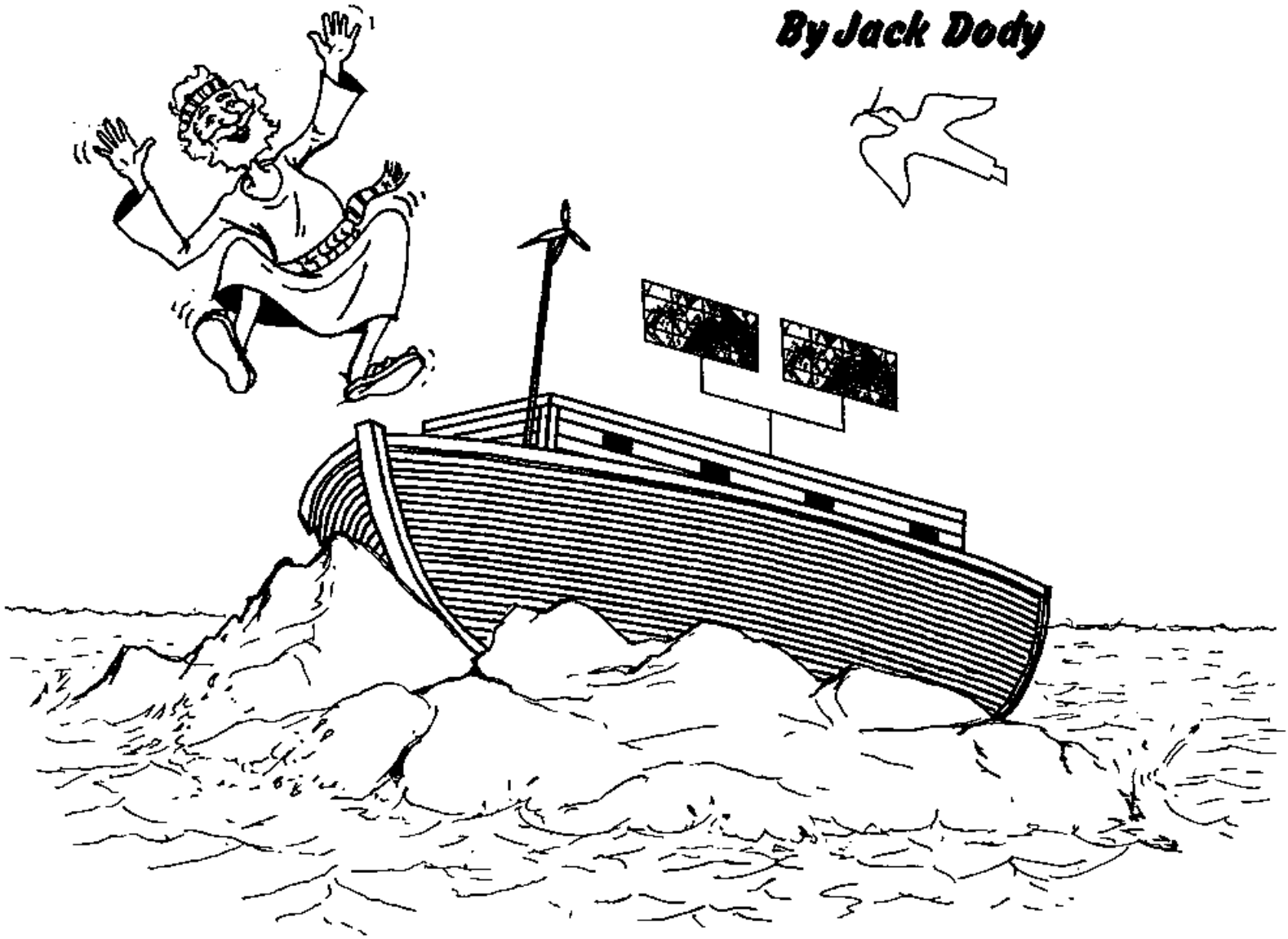
The NOAH PROJECT

By Jack Dody



A HANDBOOK OF CHRIST-CENTERED SUSTAINABLE LIVING

Thanks to . . .

My wife, Marilou – for her amazing patience and adventurous spirit

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Questions or comments about this book are welcome. If you need help designing your Solar Ark, we would be happy to consult with you. If you are visiting our part of the country, we would invite you to call ahead and make arrangements to see our ark.

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FORWARD

I assume that people laughed at Noah. It took a long time to build the ark, and no one had seen a flood. The people must have thought he was insane. Noah kept building because he cared more about what God said than what people said. The Noah Project has driven me. I am convinced that it is the call of God upon my life. I have an overwhelming sense that what I am doing is right and necessary. My study of the Scriptures urges me on, compels me, leaves me no choice.

I am also strongly motivated to share personal experiences that may help the reader avoid a trap in which I found myself. When I was the parent of young children I struggled to meet the needs of my family. The financial pressures were tremendous as we went through a depressed economy for ten years in my hometown. The relationships in my family were strained to the breaking point. I kept asking myself, "How can I work so hard and still find myself unable to provide? How can the basics be so expensive?" Some answers to those questions are in the following pages.

You should know that the ideas here are the result of much Bible study. There are no new concepts presented, just timeless biblical ideas revisited. I encourage the reader to carefully consider what is written in these pages in light of what the Scriptures say. The Bible is a guide in all things, including the most mundane aspects of sustenance and shelter. I do not see the Bible as a list of black and white rules that specifically address every daily question. The Jews tried that. They ended up with a convoluted tangle of thousands of laws that no one could possibly obey. Jesus clearly stated that such legalism was not the way to honor God. What Jesus commanded was that we become so aware of Him, so connected with Him in relationship, that every thought and deed would be a result of our love for Christ. Chuck Colson calls this "thinking Christianly."

When we think Christianly we bring every aspect of our lives under the loving control of Christ.

This book contains an extensive bibliography of the best and most recent information concerning all sorts of traditional and alternative ideas about what is called "self-sufficient" living. I don't like the term "self-sufficient" because it is disingenuous. We are not capable of self-sufficiency. We are always God-dependent, whether we know it or acknowledge it. Noah had to depend on God, even to shut the door of the ark!

Many of the people who work toward sustainability like to think of themselves as self-sufficient and independent. They don't want to rely on anyone, particularly not on God, and they don't want anyone to rely on them. But the Bible commands us to be **interdependent**. On every page we see that relationships are to be most important in our lives – our relationship with God and our relationships with others. We are to serve one another. That may mean lifting up a person who needs help or relying on others in our time of need. For the Christian, a sustainable lifestyle can never be an excuse for isolation.

From the beginning, God created a world in which the systems upon which we depend for survival are perpetual. We see cycles for the creation of clean water to drink, for the continuous production of food, and for its return to the soil to be used again. Energy necessary for our productivity and comfort flows constantly to us from the sun to be stored in various forms until we need it. The materials God has provided for shelter are only limited by our imaginations. In urbanized America, since the late 1940s, we have insulated ourselves from natural cycles and learned to depend on grocery stores, utility providers and complicated waste disposal systems. We have turned the building of our homes over to an array of bureaucrats and contractors. We now take for granted that a vast public infrastructure works well and will continue to do so. I will devote the first section of this book to show that this false assumption could have a devastating impact upon our lives.

The Bible shows us how and why we can depend upon God for all that we need. God's system to provide food, shelter, water, heat, and waste disposal works continuously without complex, man-made infrastructures and bureaucracies, and without negative consequences.

It is the planned dependence upon God for our daily needs and the service of others that is the goal of The Noah Project. However, as you study this book to learn to provide for the physical aspects of life, you may find your spiritual life soaring, as I have, by leaning on God for every need, and realizing, with gratitude, that He provides magnificently for and through his people.

SECTION ONE

God told Noah to build an ark. Noah built the ark because God told him to do so. God told him to build the ark because the people of the world, except for Noah and his family, were corrupt and violent. God had had enough and He was going to destroy those evil people.

I don't know how God decided when the people of Noah's time became so rotten that He would send the Flood and wipe them from the earth. I have no idea when He will find America's behavior so detestable that He will supernaturally intervene to chasten our country, but think about this: Even if God chooses only to allow the consequences of our corruption and violence to run their natural course, we are still in big trouble.

> *For as in the days that were before the flood they were eating and drinking, marrying and giving in marriage, until the day that Noah entered into the ark, and they knew not until the flood came, and took them all away. Matthew 24:38,39 NIV*

Here I want to make a comment about modern "prophets" of despair. I am not a prophet and I don't believe that we are without solutions to the problems we now face. That is not to say that the challenges that lie ahead are not formidable, but God is not overwhelmed, and His people need not be. We only need to turn to Him. And that is one reason I believe that a national emergency is imminent. Few people are willing to bend their knees to Christ and to sincerely ask how they might turn around. Many, including those in the Church, are happy with the status quo.

Our society's rebellion is reminiscent of the history of Israel: They rebelled, which was followed by political and economic disaster, followed by brokenness and repentance, followed by God's renewed showers of blessing, followed by another rebellion. America has been in rebellion for generations, bringing us ever closer to political and economic disaster.

It is relevant to note that throughout history most countries, whether Christian or not, have been able to maintain world dominance for only brief periods of time. Their declines came after about 200 years. As America passed its two hundredth birthday it was obviously not the moral bastion that it had once been. The violence on our streets and the corruption in our government is evidence of the downward spiral in which we find ourselves.

A problem with the prophets of gloom and doom is their tendency to oversimplify and overstate their arguments in an effort to be sensational. They tend to draw word pictures of tidal waves of catastrophe. I don't see tidal waves. I see a constant dripping. In both scenarios the water rises. The effect of being overly dramatic is that, when the big event doesn't take place as predicted, people turn back to their old business, ignoring the small, constant flow. The waters of trouble continue to rise.

To have a realistic picture of our situation, we must learn to see things as God sees them. Look at the Scriptures. History is seen in long time periods. *"With the Lord a day is like a thousand years, and a thousand years are like a day." (2 Peter 3:8 NIV)* The consequences of our present actions will be evident only in the distant future.

When we take this long view of reality, we begin to understand that it has taken America a long time to make its way to the brink of disaster. When the Pilgrims and Puritans arrived on our shores they had put their lives on the line for Christ. Even though Europe was hostile to the their radical Christianity, it took great courage to leave the security of civilization. Our forefathers were so passionate about the Scriptures that they were willing to leave all the comforts of European society behind to follow the teaching of the Bible without compromise. But that passion dissipated with time. By the end of the Revolutionary War, Samuel Adams, one of the war's key instigators, was already complaining that the moral state of Boston was wretched. (from *John Adams* by David McCullough)

By the time we reached the end of World War I, our greatest minds were tackling the problems of an urbanizing America: how to provide clean water, safe waste disposal, and adequate power for work and play. The faith of our fathers had been all but overwhelmed by the god of modernity—Science. If God's ways were remembered, they were overshadowed by modern thought. Men were not, for the most part, thinking Christianly.

Even so, what the scientists and engineers created was a tremendous accomplishment and blessing. America's high standard of living became the benchmark for the world. Our excellent sanitation allowed us to prosper in good health. Our energy delivery systems allowed us to be incredibly productive. It would seem that God blessed us in spite of our deteriorating moral condition.

The designers of our present infrastructure had great intentions. And they succeeded in advancing the sanitation, comfort and productivity of Americans or any group of people who used American technology. There were, however, some unintended consequences that became apparent over time. First, because the systems devised called for centralization, personal responsibility was lessened. Eventually, we simply didn't care to know the source of our food, water and energy. We certainly didn't spend any time thinking about what happened after we flushed the toilet. Out of sight, out of mind.

Secondly, a bureaucracy developed to oversee the operation and maintenance of the infrastructure. This bureaucracy often became tied to the local, state, and federal governments. Men being men, and Christian thought being muted, greed and hubris soon became the order of the day. There were ways that the new technology could be used to make money—lots and lots of money. With money came the power to control. The people who supervised water and waste and energy had the ability to force the general public to do what the supervisors thought best. "Don't complain; don't ask questions; just pay your bill." Ideas for improvement or thoughtful criticism of "the system" were smothered in layers of bureaucracy.

There was plenty to criticize. Huge centralized systems never work well for everybody in every situation. Even if you wanted keep your personal dwelling simple and inexpensive, you couldn't do it because of mandatory codes and permits. You had to be a part of the infrastructure. Certain groups of people found that they simply couldn't afford the services offered, no matter how wonderful those services were. When greed became a part of the system, profit margins became the first priority. Huge, complicated systems are expensive to properly maintain and update, and those costs ate into the bottom line. Soon the upkeep on most systems was neglected in favor of larger profits. The neglect of maintenance and the unwillingness to implement better ways to address utility issues is leading to the destruction of our infrastructure. In the meantime, we have spent trillions on boondoggle social welfare programs, wars of questionable necessity, and on personal luxuries that have become an idol for millions. We fill the bank accounts of unscrupulous politicians and intransigent bureaucrats who refuse to address crucial survival issues. The dark waters continue to rise.

An insidious, incremental crisis that will strike at the heart of our everyday survival looms on the horizon of history, unbeknownst to most Americans. It will not be one dramatic event that can be noted on the calendar. It will be an ongoing, subtle erosion of our lifestyle that will pull us slowly downward. If we don't take steps to change our situation we will find that we don't have enough clean water to drink or nutritious food to eat. We will face shortages of the energy that we need to be comfortable and productive in our homes, and we will not have effective waste disposal systems. Let me point to information in recent news that foreshadows the coming meltdown of our basic survival systems. I have been careful to include only information that can be documented easily. There are no phony emergencies presented, backed up by "junk science." There is no need to resort to hyperbole or questionable sources; the reality of our situation is frightening enough.

Our Water and Waste Problems

Here are some facts about how we use water in America:

> In 1977, 12 percent of all water consumption was for domestic purposes, 35 percent for agriculture, 6 percent for industry and 47 percent for energy production.
>
> The top three states for per capita daily water use last year (1997) were Wyoming (14,075 gallons per day); Idaho (13,017); and Montana (10,187). In these three states combined, 94 percent of water consumption went for agriculture. Nationally, the per capita daily water consumption was 1,512 gallons.
>
> **from *The Gazette*, Colorado Springs, Colorado, Tuesday, April 21, 1998, p.1.**

Drinking water problems cover the entire country, from the smallest rural hamlets to the largest cities.

> *In 1993, 400,000 people got sick and 104 died when the Crytosporidium microbe infected Milwaukee's drinking water. The Natural Resources Defense Council says there were at least 116 outbreaks of diseases borne by drinking water in the nation between 1986 and 1994. More than 25,000 water systems serving 92 million Americans were out of compliance with Safe Drinking Water standards of 1993-94.*
>
> **"A Guide to Clean Water" by Tom Arrandal, *Governing*, December 1995, p.60.**

Dozens of big cities with aging water systems reported that bacteria found their way into water taps. Among them: the 6.5 million-customer New York City Aqueduct System, plagued by chronic bacterial contamination; the Washington, D.C. water supply system, with sewage contamination; Louisville, Kentucky; Tulsa, Oklahoma; Jersey City, N.J.; Dayton, Ohio; Seattle, and parts of Philadelphia.

from a 1996 story for the Knight-Ridder Newspapers, Washington bureau

Fertilizer and feed-lot waste run-off (in the form of nitrates and nitrites) and pesticide run-off are finding their way into drinking water. In Dayton, Ohio, environmental manager Douglas "Dusty" Hall says, "If you live in a community with a history of industry [or farming or mining] expect your water to be imperfect. You will discover more problems."

In a study of 145 of the largest public water systems serving 24.5 million Americans, the following contaminates were found:

Lead found in 50 systems (34.4 percent)
Nitrates/nitrites found in 25 systems (17.2 percent)
Heavy metals other than lead, 19 systems (13.1 percent)
Arsenic, 10 systems (6.9 percent)
Other contaminants, including dioxin, hydrocarbons, pesticides, radium/radon and cyanide, were found in 31 systems

"How Safe is Your Water?" by John F. Wasik Consumers Digest, May-June 1996

The Atomic Energy Commission (now the NRC) is allowing radioactive materials to be dumped into America's sewers. Commenting on a case in Ohio in which sewerage works and sewage residuals were allegedly contaminated by a NRC licensee, the NRC's Chairman publicly stated the Commission's position that the party in possession of the radioactive material is fully responsible for the costs of mediation, which means that in most cases the local sewerage agency is stuck with these costs.

from Dr. Lue-Hing, Director of Research and Development for Metropolitan Water Reclamation District of Greater Chicago

The United States federal government is the biggest producer of hazardous waste in the country. It is estimated that it [would] cost almost $400 billion to clean up its waste sites, but the amount goes beyond that if the real score of the government's damage is considered. The government, which refuses to pay its environmental liabilities, assumes that it does not have to follow the environmental rules it promulgates.

Source: An abstract of "America's Worst Polluter," Journal of Commerce and Commercial, March 25, 1997, v.411, p 6A

Our Food Supply Problems

The farmers of America have done a remarkable job feeding not only the citizens of our country, but those of the entire world, increasing food production by 20% since 1969. Our farmers are proud of their accomplishments, and rightly so, but there are issues that need to be addressed. Some of the concerns have to do with the farmers, and others are beyond their control. For example:

1. Agricultural chemicals from fertilizers and pesticides are making their way into our water supply, as previously stated. In 1992 the EPA analyzed ". . . more than a half million miles of rivers (about one third of the national total) [and] found nearly 50 percent of the river miles too polluted to support their intended uses for recreation, drinking water, or fisheries. About 60 percent of the impairment was traced to agricultural run-off." (1993 Environmental Quality Index - by the National Wildlife Federation, Feb-Mar 1993, National Wildlife Magazine)

2. Irrigation is lowering the levels of our aquifers. To use agricultural water at the current rate is not sustainable.

3. Urban sprawl is taking some of our best farm land out of production.

4. The positive response of crops to fertilizers and pesticides may be declining. (See *USA Today,* June 1996, v.124, p.16, "World Faces Challenge of Rebuilding Grain Stocks")

5. Many foods are processed in such a way that taste and nutrition are compromised. All of us have purchased flavorless tomatoes that

closely resembled billiard balls! Fruits and vegetables are picked early so they can be shipped long distances. Certain minerals may be missing from foods because those minerals have been depleted from over-worked soils.

6. The costs of fertilizers and pesticides, farm equipment and diesel fuel, transportation, packaging and marketing all combine to inflate our grocery bills. For example, the farmer gets only three cents on the dollar for each loaf of bread he produces. The other 97 cents goes to middlemen. (*National Catholic Reporter,* Nov. 1, 1996, v.33, p.13, "Food: Lack of Access, Not Supply")

   (Do you remember the oil embargo of the 70s? Oil will certainly become more expensive and the higher costs will be reflected in the food you purchase.)

7. The United States government is strangling our farmers with regulations and red tape, encroaching on property rights, saving vermin from extinction while assuring the financial demise of many farmers. In a speech entitled "Property Rights and the Food Supply," Richard McQuire makes a strong case that " . . . agricultural productivity is inextricably linked to private property. It is disturbing to note how individual property rights are steadily being eroded by increasingly burdensome environmental laws." (*Vital Speeches,* August 15, 1995, v.61, p.657)

8. "After decreasing for three consecutive years, world carryover stocks of grain in 1996 dropped to 48 days of consumption, the lowest level on record." (*USA Today,* June 1996, v.124, p.16, "World Faces Challenge of Rebuilding Grain Stocks")

(Proverbs 21:20 says: "In the house of the wise are stores of choice food and oil, but a foolish man devours all he has." NIV)

9. There is a trend in agriculture that could be more troublesome to the consumer than any problem yet discussed. Only 2-3% of America's workers are farmers. As small farms are sold to huge conglomerates, the number of farmers continues to dwindle. At the same time, only ten corporations dominate the world food trade. (*National Catholic Reporter,* Nov. 1, 1996, v.33, p.13)

   It is easy to imagine price setting and other monopolistic practices concerning food in the future. Who could stop these businesses from setting prices as high as they pleased, since they would have control of the best negotiating tool of all--FOOD!

   Revelation 6:6: "Then I heard what sounded like a voice among the four living creatures say, "A quart of wheat for a day's wages, and three quarts of barley for a day's wages...." (NIV)

Our Shelter Problems

My father-in-law used to say that anyone who owned their own home deserved it! After decades of fighting to pay the bank, insurance and utility providers, and maintenance men, I began to understand what he was talking about.

Home-building has evolved into a complicated, multi-faceted, money-eating machine. The consumption doesn't end when the structure is completed. The costs go on and on and on. The idea that we work all of our lives to support our houses is a relatively new phenomenon, and it is not what God intended.

> The lambs are for thy clothing, and the goats are the price of the field. And thou shalt have goats' milk enough for thy food, for the food of thy household, and for the maintenance for thy maidens." Proverbs 27:26 (NIV)

In other words, throughout history a man's homestead provided basic necessities and "worked" for the owner. Today, a man works to support his homestead. Think of a home as an organism. Does it require life support or does it support life? All of the wires and pipes and vehicles that run to and from a typical home are indicative of a home on life support. The housing situation that we see today did not develop until after World War II. Prior to that, house and home, for most Americans, was tied directly to the farm. Even city dwellers maintained many of their country habits of living close to the land with a garden and some livestock.

Houses were considerably simpler in their design, with limited electricity and, in many cases, no indoor plumbing. The smaller size of most homes was also a major factor in their lower cost. People would often begin by building small structures that would grow with time, necessity and availability of funds. Mortgages were small or non-existent. As house designs grew in size and complexity, and utilities were tied into a great infrastructure, the Uniform Building

Code and its attending bureaucrats evolved into a monstrous army with special divisions like OSHA and the EPA.

Let's make this clear. The Uniform Building Code may have been started to protect consumers from poor building practices; OSHA may have been designed to protect workers, and the EPA may protect the environment, but what exists today is nothing less than licensed extortion by government pencil pushers. Only the mortgage lender is protected, at giant expense to the homeowner. The resulting inflexible bureaucracy has made it nearly impossible to effect needed changes in the provision of shelter and utilities. Let me give an example of this bureaucratic insanity:

In Florissant, Colorado, a rural mountainous area, land was subdivided during the fifties and sixties. Lots as small as one-half acre were sold. Local codes called for septic systems consisting of septic tanks and leaching fields. Since there were few public water systems, each landowner was expected to have his own well. As a result, in some areas we now have a well and a septic tank on every half-acre! By the 80s, as the population grew, human feces began to contaminate the Florissant water table. Remember, government-sponsored engineers and bureaucrats had not only designed this faulty system, they had mandated it and forced the homeowners to pay for the disaster!

To add insult to injury, the powers that be, to this day, force landowners to build exactly the same non-functional systems. They will not consider composting systems or gray water systems that have been proven safe and effective. All the expense to solve the problems that they created are borne by the landowner. Code departments accept no fiscal responsibility. A common argument for building codes is that we need to be protected. I do need protection, but it is from the building code enforcement departments.

The story of Florissant is not unusual. Most people who have to deal regularly with code enforcement will attest to the stupidity that exists today in modern

homebuilding. In most areas, reasonably priced housing is simply not available. The size and complexity of even the most modest shelter, built to meet code and a myriad of local covenants, drives the purchaser of a home into the avaricious clutch of the mortgage lender.

CODES AND PERMITS

Officials, wary of unofficial dam-building, sent a cease-and-desist notice to a landowner on Spring Pond after being notified of unofficial dams on his property.

> STANTON, Michigan -- "It has come to the attention of the Department of Environmental Quality that there has been recent unauthorized activity on the above referenced piece of property," read a notice the DEQ sent to the landowner. "A permit must be issued prior to the start of this type of activity."

Apparently, they were unaware the unauthorized dams were built by beavers living in the pond. The property owner responded with a letter denying responsibility:

> "A couple of beavers are in the process of constructing and maintaining two wood 'debris' dams across the outlet of my Spring Pond.... As to your dam request the beavers first must fill out a dam permit prior to the start of this type of dam activity, my first dam question to you is: Are you trying to discriminate against my Spring Pond beavers or do you require all dam beavers throughout this state to conform to said dam request?"

The case, prompted by a complaint from a neighbor about flooding caused by the dams, was dropped after investigators discovered beavers were to blame, said DEQ spokesman Ken Sifven.

from *The Gazette*, Colorado Springs, CO
April 4, 1998

Our Energy Supply Problems

For the sake of simplicity, our energy problems will be divided into two categories: electricity and oil-based fuels. (I realize that electricity is often generated with oil.) Our electricity supply problems provide an excellent example of the collision of politics, bureaucracies and individual consumers. The resulting tangle has resulted in brownouts and blackouts across the country, and the situation is worsening. The demand for electricity keeps growing, but red tape and radical environmentalists have made it impractical to get new power stations on-line. We lack real leaders who will spend tax dollars on power plant maintenance and expansion. Politicians would rather spend your tax dollars on entitlement programs that encourage voters to become more dependent upon government, assuring their own re-election. The following quotes will help the reader understand what is happening in the electricity business:

> *We might have shortages in our electricity supply by the end of [this] decade--simply because we won't have enough power plants to make enough power. The principle reason for this is that economic regulations of electric utilities has become so perverse that [utility providers] are discouraged, indeed they are penalized, for making investments that are in the long-term best interest of their customers and the nation at large....*
>
> **"Electricity Shortage?" by Peter L. Spencer, *Consumers' Research Magazine,* December, 1992, v.75, p.38**

Power companies are plagued by aging plants and transmission networks at a time when Americans' love of gadgets is putting more of a strain on the system. There already was one scare during a heat wave last month, when utilities saw their electric reserves depleted and storms knocked out some service. Now, at least one major power provider is proposing paying big business to turn off electricity in the next crunch.

From *The Gazette*, Colorado Springs, Colorado, July 11, 1998, p. A9.

The municipal utility in Key West, Florida imposed [temporary blackouts] for 26 days in the summer of 1978 while repairing rundown equipment . . . Angry citizens protested the inconvenience by hurling spoiled meat and other foods through the tiny utility's plate-glass window.

"Get Ready for Power Brownouts," by Peter Nulty, *Fortune*, June 5, 1989, v.119, p. 116

Nearly a third of [Maine's] population, more than 400,000 people, were left without electricity [during the storm of the century]. That often meant the absence not only of light, but of heat, water, cooking facilities and communication with the outside world....

***The Economist*, January 31, 1998, v.346, p.33**

On the night of July 13, 1977, 3,777 people were arrested for looting when the power failed in New York City. Looting was most prevalent in the city's poorest neighborhoods. The largest theft was 50 new cars from a car dealership.

"Blackout Terror," New York, April 19, 1993, v.26, p.156

A series of blackouts that stretched across 15 western states cut power to as many as two million homes and businesses, causing commuter havoc, stopping air conditioners and disrupting airports and railways. The electrical outages spread from Southern California to Texas and north to British Columbia, which was slightly affected. Officials said the cause was a short circuit on one power line between Wyoming and Idaho.

"In the Dark," *MacClean's*, July 15, 1996, v.109, p.37

[In the Silicon Valley] manufacturers who suffered shutdowns during [a] massive blackout in nine western states were assessing their vulnerability in its aftermath. "Is this an indication of what is going to happen in the future?" The cascading power failure . . . started when a 500,000 volt line arced into a tree in Oregon....

Ed Pope, San Jose Mercury News, 1996

America is a superpower, but it's got the grid of a Third World nation. If we don't work together and fix the problem, we'll all end up sitting in the dark.

U.S. Secretary of Energy Bill Richardson, *The Grid and the Village*, p. X, Stephen Doheny-Farina, 2001.

Perhaps you're thinking that all of our electricity needs will be met by nuclear power plants. Think again. Even if the Greenies and the EPA would allow these power plants to get on-line, the problems with nuclear waste make the whole idea impractical. The costs of building the plants and handling the resulting waste would unacceptably raise the cost of the electricity produced.

The question of what to do with nuclear waste provides an example of the unmerited arrogance of man. On a recent tour of the United States, I spent a few months in Idaho. One of the most important industries there has to do with nuclear waste disposal. I was able to speak to many engineers working on the problem. As I pressed each of these highly educated individuals, every one of them finally admitted that they didn't really have a clue about reaching a solution. The laws of physics that we presently understand would have to be altered, and that's not happening, short of some supernatural intervention. Yet every engineer that I interviewed defended the use of nuclear energy and assured me that they would find a solution! Something doesn't compute here, but the government pushes ahead, spending astronomical amounts of money on crazy, half-baked schemes for disposal.

An illustration of one of these very expensive pipedreams is the plutonium graveyard twenty-six miles east of Carlsbad, New Mexico. Consider the costs of this operation. (The following statistics and quotes are from "Nuclear Weapons Waste? Right This Way" by Michael Dolan, *Outside Magazine*, May, 1998, pp. 32-34.) Waste will be transported to the Carlsbad site in almost-safe containers that cost $267,000 each. "According to the Department of Energy's own data, . . . 37,000 tractor-trailer sorties [will be] needed to transport . . . 850,000 drums of transuranic waste, [resulting] in about 50 accidents." Think about how much the resulting litigations will cost! Underground caverns have been built at a cost of $2.2 billion, so far. The total building costs are estimated at $7 billion.

"What the Energy Department is loath to mention, however, is that [all that has been done at such great expense] is a very tiny step. The waste isolation pilot plant has been sold to U.S. taxpayers with the argument that it will hold the 2.5 million cubic feet of transuranic waste now accounted for and the 3.7 million cubic feet expected to result from bomb plant decommissioning over the next forty years. That may sound impressive, but it's less than 2 percent of the radioactive military residue stocked and buried around the country. In other

words, the waste isolation pilot plant will take care of only a speck of America's nuclear waste stockpile."

Let's assume that the figures provided are accurate. We would need to build about 50 more storage facilities. If this awesome project would somehow come in at today's prices (we know that it wouldn't), the total costs to consumers/taxpayers--**us**--would be $350 billion. We must also add the costs of thousands of transport containers at $267,000 each, and the cost of fuel and drivers to move the wastes. Let's be fantastically conservative and project that we would only add ten thousand more containers, costing a total of $2,670,000,000, and that we only had to move the waste a total of one million miles at $1.50 per mile. Our total expense for storing only the nuclear waste that exists today, with nothing added, would be:

$ 7,000,000,000	for completed storage facilities
350,000,000,000	for 50 more such facilities
2,670,000,000	for almost-safe transport containers
1,500,000	for fuel and drivers
$ 359,671,500,000	TOTAL

If we spent the same dollars purchasing photovoltaic panels at today's price of $4 per watt, we could buy 89,917,875,000 watts of clean, long lasting power. How long lasting? Some of the photovoltaic panels sent into space in the 60's are still operational! 89,917,875,000 watts of power would provide a small power system for 250 million individual Americans. You tell me. Does the building of nuclear-generating plants, with all of the expensive disposal problems, make sense?

Our Problems with Oil-Based Fuel

Many of us remember waiting in line at the gas pumps and the skyrocketing costs of heating our homes during the oil embargo. Common sense tells me that the cultural animosity between Americans and Middle Easterners, or just plain greed, will soon lead to other embargos. It is simply a matter of time.

It is also a matter of time before we run out of domestic fossil fuels. We know that our fossil fuel supply is finite. As the supply decreases, the price will increase. Obviously, preparation would serve well the man or woman responsible for meeting the energy needs of his or her family.

Common Elements in our Problems with Food, Shelter, Energy, Water and Waste Disposal

All of our basic needs are related to one another in the real world. Individual supply and delivery systems are like separate threads in a woven cloth. All of the threads become related and dependent upon one another. As energy costs rise, so do all other costs. If we spend more for food, we have less to spend on housing. If we spend trillions on the disposal of nuclear waste, fewer resources are available for solar energy.

If we are to provide adequately for our families, there are two great problems we must overcome: 1. The staggering costs of maintaining our present, technically advanced supply and delivery systems; 2. The lack of political will to deal with the maintenance and development of adequate supply and delivery systems.

Consider the following statements:

> The U.S. EPA figures that it will cost America's communities $137 billion in the next two decades to build new sewage plants, repair decaying pipes, install storm water collectors, keep rainstorms from flushing raw sewage downstream and deal with polluted water running off farmlands and suburban parking lots.
>
> **"A Guide to Clean Water," by Tom Arrandale, *Governing*, December 1995, v.9, p.57**

> The United States federal government is the biggest producer of hazardous waste in the country. It is estimated that it [would] cost almost $400 billion to clean up its waste sites, but the amount goes beyond that if a real score of the government's damage is considered.
>
> **Abstract of "America's Worst Polluter," *Journal of Commerce and Commercial*, March 25, 1997, v.411, p.6A**

I challenge the reader to find any politician or government agency that is seriously addressing the stated issues with food, shelter, energy, water, and waste disposal, successfully procuring budgets that will allow solutions to these problems. **Perhaps it is time to create a new way to provide utilities.**

Is There Hope?

Is there any hope of dealing with the problems we face? Absolutely! We are children of the God who created the universe, a universe that He designed to gloriously provide all of our needs. He has control of all things. We only need to return to living in ways that are clearly outlined in God's Word. First, we need to accept responsibility for our part in the existing mess. The agencies that control food, housing, waste and water could not have evolved to their present state without the support, implied or tacit, of Christians.

God calls upon us to resist evil and to use our ability to reason. Resisting things that are wrong or that just don't make any sense takes lots of energy. It's frustrating and time-consuming to be at odds with the people who make or enforce the rules that control homebuilding, food and energy production, water distribution, and waste disposal. Politicians and bureaucrats will resist change in an effort to continue in their careers, regardless of the catastrophic effect on our nation. For decades many Christians heard from the pulpit that it was their role to remain silent and suffer the consequences. People who either didn't know Christ, or who did not think Christianly, were given free reign to make the rules that govern so many aspects of our lives. They were given time to entrench themselves in institutions that today wield tremendous power. By remaining silent, Christians have allowed a monstrous intrusion on personal liberty.

God cares about freedom and order and reason. These are things that are worth defending with our time and energy. As bold believers, we need to be on the citizen boards that are often part of governing water plants, sewage facilities and power generating stations. We need to bring biblical perspectives to the management of these facilities. Christian farmers need to strive for excellence while working to make government farm programs more sensible.

When we build our homes or help others meet their needs for shelter, we need to challenge the Uniform Building Code and the EPA. Christian lawyers should work to change unreasonable regulations for building, energy use, or water use. Christian engineers and scientists, and all workers, should be about the business of improving everyday life for themselves and others. We need to be open to new ideas that will make our homesteads more efficient and more comfortable. We also should make what we learn available to others.

The Church must make its presence felt in politics. We should be voting in blocks whenever this is practical. Politicians who choose to "bring home the bacon" for their constituents without thinking of "the greatest good for the greatest number," should hear loudly and clearly at election time that such selfishness will not be tolerated.

Finally, Christians should show the world that materialism is not their god. God blessed us with things to make our lives more interesting and comfortable. We are to share our blessings with others, thus sharing the love of Christ. We cannot continue to consume with no concern for others.

Christians must act NOW! We do not have time to wait for someone else, particularly the government, to solve our problems. Does the government typically provide simple, inexpensive solutions to problems? Expensive, complicated, high-tech solutions are not required. God has made the sun to shine on everyone. His rain falls on the just and the unjust, and His world is resplendent with great things to eat. While it is true that we have created an ecological mess because of our greed and arrogance, it is also true that we can turn back to God, and He promises to provide for all those who love, obey, and depend upon Him.

It is the Church that should be creating a God-dependent, sustainable standard of living. We have an opportunity to display the true relevance of God's word in our day. How exciting it will be when God's people lead the world in creating

communities that demonstrate His power to provide the necessities of clean water, good food, and comfortable shelter! These things are available through Him without creating ecological problems or unbearable financial pressures that tear families apart.

God's ability to provide is undeniable. The question we must answer is this: Are we willing to follow God's principles about sustainable, interdependent living and will we change the way we live so that we honor Him?

As in the flood of Noah, the waters are rising. A storm of trouble may soon overwhelm America, but we can prepare, just as Noah did.

SECTION TWO

It's time to build a new ark. Because modern housing has evolved into a complicated, expensive, deteriorating system, we need a different way of sheltering ourselves. One key component for change is a structure I call a Solar Ark.

The Solar Ark is a living structure, a "land vessel". It is easy to build using simple tools and materials that are readily available. Once completed, it is maintained with reasonable effort. Here are the characteristics that make the Solar Ark unique:

1. **It produces and conserves energy.**

2. **It supplies drinking water and conserves all water used.**

3. **It provides space for year-round food production.**

4. **It recycles wastes.**

In the remaining pages we will go from the theoretical to the practical. I will talk about how my wife and I built our Solar Ark, sharing what we have done that worked well, and more importantly, what we would do differently to make construction or daily operation more effective.

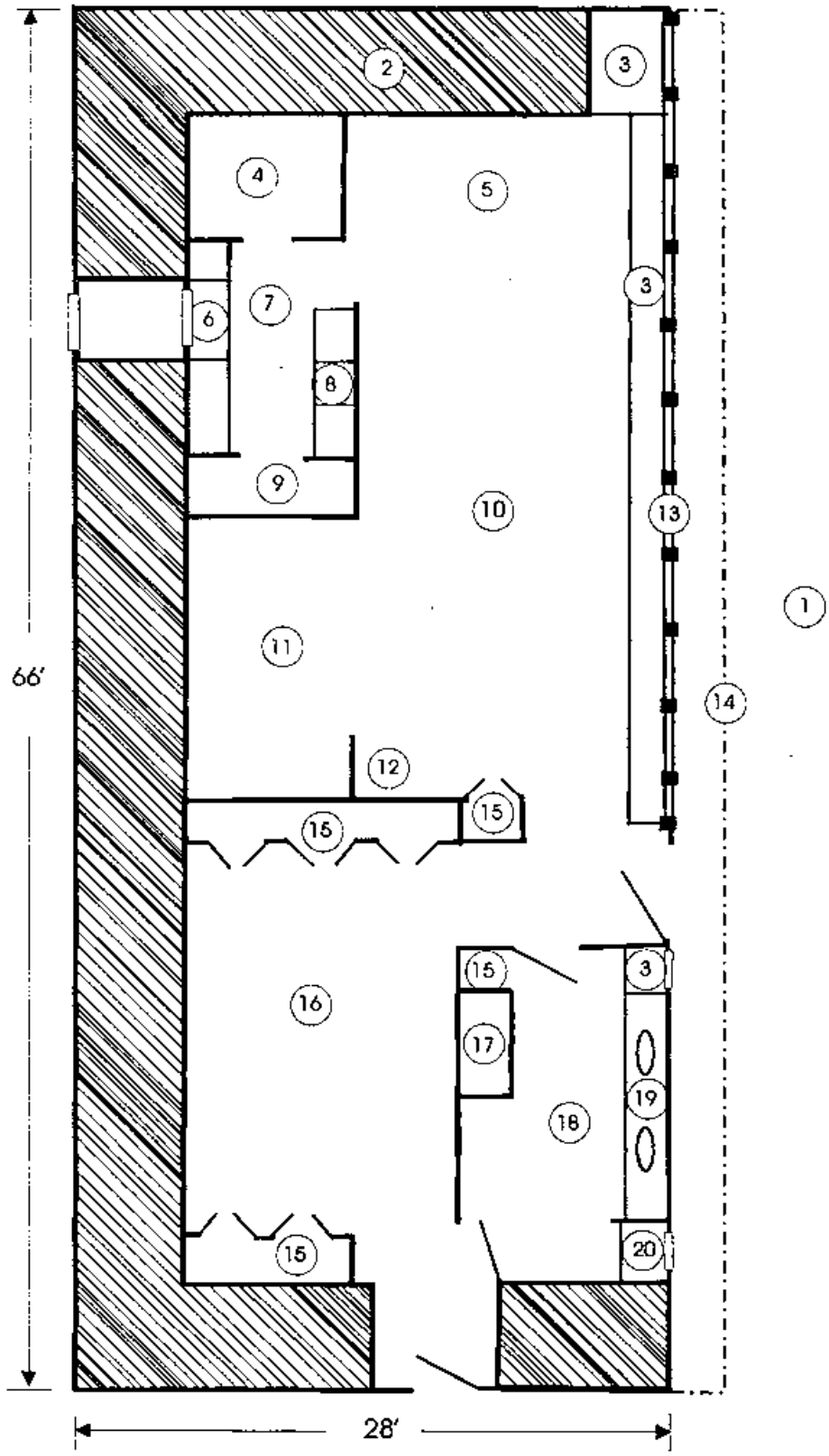
Our way of solving our shelter problems was realistic for us. Your way may be considerably different. As long as your structure has the characteristics of a Solar Ark it will work for you. I encourage you to look at all the resources that are available to you and to begin immediately to create your Solar Ark.

On any ship designed for long distance travel all the basics for survival must be stored or manufactured. You would make sure that you could meet your family's

needs before beginning a journey on such a vessel. It took Noah many years to build the ark and to prepare for the anticipated needs of his family. It has taken years to develop the Noah Project and much work remains. I pray that you will begin as soon as possible and that God will mercifully allow time for preparation for the coming torrent of trouble.

The rest of this book gives answers that grow out of the Bible and reflect a Christ-centered perspective. The following section is designed to challenge the reader to examine what may be radical, but by no means exclusive, solutions. The principles put forth by the Noah Project will make any building situation better, whether it be a bombed-out neighborhood in some war-torn land, a development south of the border, or your personal homestead. I urge you to begin now to create a comfortable, sustainable living environment.

Our Solar Ark
Floor Plan



Our Solar Ark

We built our home so that approximately 75% of the heat needed comes from the sun. The other 25% is provided by a wood stove. The house is super-insulated so that the heat gained in the day is not lost too quickly at night. In the summer, the house remains cool. As I describe the house, you will see that its structural design is integrated with water and waste, energy and heating systems. **All systems in a Solar Ark work together.**

Originally, the basic building material for my walls was to be tire bales. These are bales of tires that are compressed and held together with stainless steel wire. Each bale consists of about 100 tires and weighs 1000-1200 pounds. They are almost five feet long, four feet wide, and 30 inches high. The tire bales are absolutely impervious to weather, insects and sunlight. When covered with stucco they make a very attractive wall that is so massive that the structure itself moderates interior temperatures.

When I started construction I tried to make arrangements to have the tire bales delivered and set up on my site. Each bale was about $25. When trucking and a forklift to set the bales were added, the total for my 1150 square foot home was to be about $4,000.

One of the keys to saving money when you build your home is to use indigenous materials whenever it is practical. As I began checking around, I found that I could have 4' x 4' x 8' straw bales delivered and set up on my site for $1,000. The farmer who owned the bales lived only a few miles away and had the truck and tractor with which to set the bales. Hooray for indigenous materials!

I had a local excavator level and compact my home site. Then I placed two layers of six mil, black polyethylene under the bales so that moisture from the earth could not be absorbed by the bales. The bales were already a year old and

very dry. It only took four hours for the bales to be delivered and set in place on the north, east, and west perimeter.

A concrete floor was then poured within the walls that the bales created. A planter was created on the south wall and a cistern was built. The floor plan is a modified Earthship design. Notice how the windows are placed so that the sun can heat the concrete floor. The kitchen and bedroom are cooler because they are not "seen" by the sun. Studying Michael Reynolds' *Earthship* books will help you understand the basics of designing a workable, passive solar home. Another great resource is *The Passive Solar Energy Book* by Edward Mazria. It contains many examples and explanations of existing passive solar homes.

I placed the bales so that I could build a window on the north and east side and a door on the west. The north window is not a good idea as far as solar design goes, but it was a good idea because my wife said it was. You don't have to be such a purist that you make yourself crazy when designing your home, but it is important not to ignore too many rules of passive solar design if you want your house to heat and cool properly. The south wall would be framed, with windows from floor-to-ceiling and a glass door, all covering 37 feet.

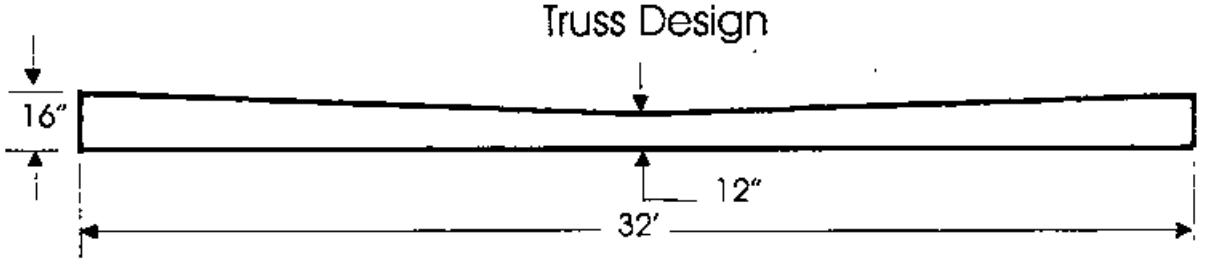
The bales were not going to be used to support the roof, so I needed to build a frame around them that would support the roof. Also, at this time, I looked into the cost of stuccoing the bales inside and out. This is a job that I could have done, but it would have taken more energy than I had for the project. The cost of stucco and application would have been more than $10,000. That was not in my budget. I decided to build a framed wall to completely surround the bales. This was much less costly because I could provide the labor and buy used lumber for the framing.

A concrete footer was poured on the outside perimeter of the bales as a foundation for the outside wall. It cost me about $5,000 to build the walls

enveloping the bales and have them drywalled inside. On the outside I used 4' x 8' sheets of hardboard siding.

The walls are about five feet thick. Fiberglass insulation was used at the top of the interior walls to create a dead air space. There is practically no heat loss or gain through the north, east, and west walls.

The next design consideration was the roof. I wanted to catch the water on the roof for our cistern, so I designed an almost flat roof. It is actually slightly concave, directing all water to the drain near the center of the roof. I built what Michael Reynolds calls an idiot truss. (see pp. 15-17, *Earthship III).* The truss design was modified to meet my needs.



The height of the trusses allows plenty of room for insulation. I placed them on 16" centers. They were hurricane-clipped into place, each truss held with four clips. A hurricane clip is a piece of metal designed to anchor trusses and hold them even in hurricane winds. A clip is usually used to secure the truss at each end. Knowing the windy conditions here on the prairie, I added two more clips where the trusses passed over interior walls. I'm glad I went to the extra trouble. When a rough storm blew through here last year it took my neighbor's roof with it. We were snug.

The roof trusses provide a 30" overhang on the south side of the house. The overhang was supposed to keep the high summer sun from overheating our home, but we had to install venetian blinds. It does let the winter sun shine in.

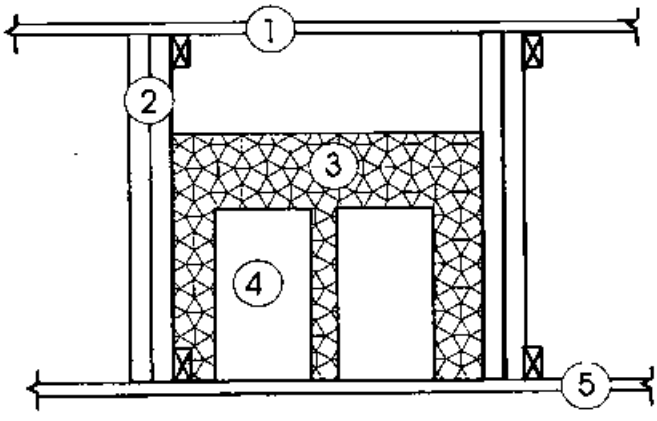
The roof membrane is EPDM, or 60 mil rubber. It is a pricey roof to install but it will probably last 35 to 50 years. In the long run, the cost per square foot is comparable to other roofs.

The roof is insulated with at least 12" of insulating material. When I was buying bricks for my fireplace, I noticed thousands of styrofoam blocks in a great pile. They were about 5" x 8" x 8". The yard manager for the brick company noticed me looking at the styrofoam. She asked if I wanted them, free of charge. The government had purchased them and then decided they were not necessary. I loaded up all the blocks, not knowing exactly how I would use them.

When I got them to my building site, I saw that I could use them in my ceiling. Here's how I did it. The outside sheathing and roofing was in place. I hung one row of ceiling sheetrock and then slid the styrofoam into place on top of the sheetrock.

The blocks fit in rather loosely and would let cold in between the gaps. I was also concerned about fire, since styrofoam burns readily. To solve these problems I blew cellulose insulation over the styrofoam blocks. It filled the gaps and created a fire barrier.

Roof Insulation Plan

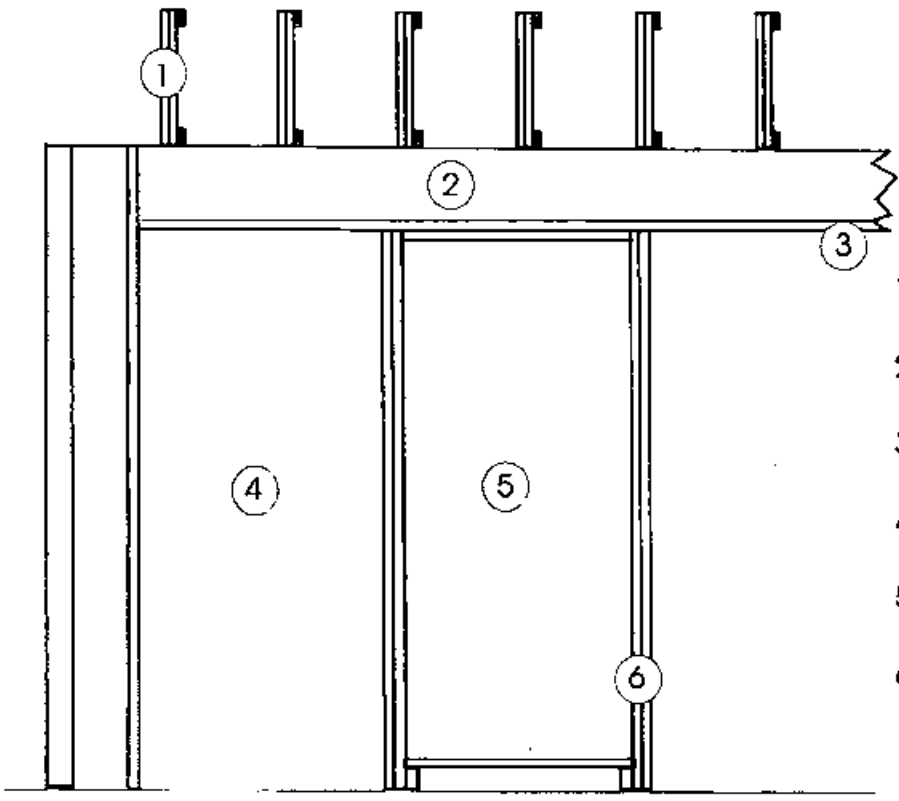


1. Roof sheathing
2. Truss
3. Cellulose insulation
4. Styrofoam block
5. Ceiling sheet rock

The roof is rated at about R-40. To provide a comparison, a wall made of 2x6's and insulated with fiberglass is rated at R-19. Most homes use only about 4 to 6 inches of insulation, giving them a R-rating of only 13 to 19.

Now my Solar Ark was ready for windows and doors. The design had been built around used windows, which I purchased before framing. Used windows saved 50% or more as compared to new windows. The south wall of my home is almost all glass. I purchased tempered glass that had been discarded from broken sliding doors. When one sheet of glass is broken in a sliding door, the other piece is usually discarded and can be purchased at a building surplus business for about $10 to $15 a sheet. Tempered glass cannot be cut, so you must build your frame around the glass.

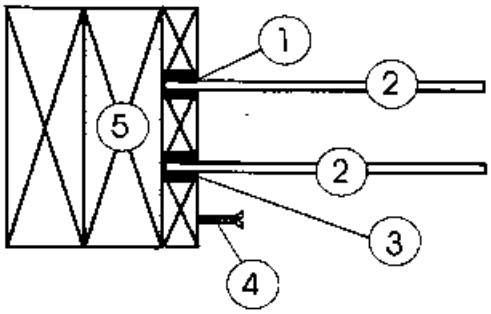
South Wall Framing Diagram



1. Truss
2. Support Beam
3. Plate
4. Space for door
5. Space for window
6. Studs (2x6's)

I made a frame between the studs, ran a bead of caulking, and pressed each exterior piece of glass into place.

Window Blow-up (Birds Eye View)



1. Caulking
2. Glass
3. Foam weather stripping
4. Brass screw
5. 2x6's

The outside glass is caulked permanently into place. The inside glass is pressed against foam weather stripping. The interior glass can be removed for cleaning if moisture builds between the two panes. Here in arid Colorado I have not had to remove the inside glass because moisture build-up has not been a problem.

Each of these windows cost about $50 - $75 to build, as opposed to $300 - $600 for a new window. There are eleven windows and a glass door on the south wall. The planter is right under all those windows. For ventilation there are openable windows in various locations. All my doors were purchased at a salvage yard. My kitchen and bathroom cabinets were used, purchased directly from the previous owners.

I realize that this is a very brief sketch of my home. More details will be given in the remaining pages. The reader should know that this is the most comfortable home my wife and I have ever lived in. It is warm in the winter with very little effort. I am writing this on January 9. The outside temperature is 15 degrees. I can smell the beautiful flowers that grow in my planter. This evening I will pick some lettuce and spinach and a tomato for my dinner salad from the indoor garden. We really enjoy this house.

Our Energy System

We make electricity on our homestead. We are completely "off the grid," which means that we have no power coming to our property from outside. We do have a phone line, but that is all.

Our electric system consists of five photovoltaic panels and a 400-watt wind generator, ten 6-volt, deep-cell golf cart batteries, a controller to keep the batteries from over-charging, and an inverter to change 12 volt direct current to 110 volt alternating current. There are various fuses and breakers to provide safety.

This would be considered a very basic energy system. We have enough energy to run our television and computer, lights and fan, toaster and microwave, and a curling iron for my wife. At this time we don't have a washing machine. We could enlarge the entire electric system or use a generator on washdays. We have a propane refrigerator that we bought at a place that sells used RV parts. It costs $850 and it works great. We cook with propane. On rare occasions, we have had to moderate our use of the TV or the computer because our batteries were low. We could always add more solar panels or another wind generator and more batteries, but we would rather conserve energy than spend more money.

Here is a list of the components in our system:

5 each	Photovoltaic Panels	
	3 each 75 watt panels	$1,200
	2 each 100 watt panels	800
1 each	400 Watt Wind Generator	
	with a 47 foot tower	1,600

10 each	6 Volt, Deep-Cell Golf Cart Batteries $65 each	650
1 each	Voltage Controller	100
1 each	Inverter, 1500 watt	1,000
	Miscellaneous Fuses, Meters, Breakers, etc.	250
	TOTAL	$5,600

I did not list brand names or get very specific in my parts list because I would rather not get into a detailed discussion of this particular system. There are many good options out there and these energy systems can be pretty complex. You need to find a reputable business that sells and services the components in your system. There are lots of here-today-gone-tomorrow, flaky people out there selling things that they do not understand. It is important to find a business that has been around for a while, with a reputation for service and honesty. I found a lady who actually lives off the grid. She uses the products she sells and has practical, working knowledge. Her service after the sale has been a blessing.

Living With Your Own Energy System

Making your own power does require some trial and error (hopefully, not too much error!), some study and a little bit of time. You learn to be more aware of your energy use. For instance, a sunny/windy day when your batteries are full is a great time to run the vacuum cleaner or use the microwave.

Maintaining the battery bank is the most time consuming chore related to energy system upkeep, but it is not difficult. The batteries I have are the type that most people use because of their reasonable price. They are deep-cell, lead acid batteries often used in golf carts. The batteries are contained in a vented box made from ¾" plywood. The box must be built sturdily because the batteries are very heavy. The vent, which is made of 2" PVC pipe, allows the escape of explosive hydrogen gas created when the batteries are charging or discharging. Because of the hydrogen gas it is a good idea not to work on the battery bank when it is being charged or discharged. Be very careful with metal tools so that sparks aren't created.

Once a month I check each cell with a hydrometer, a tool costing about $10 that tests the specific gravity of the liquid inside the batteries. The individual cells should have about the same specific gravity. If not, the whole battery bank needs to be equalized. To equalize the battery bank there is a switch on my battery voltage controller that allows the voltage to rise above normal levels, up to about 15.5 volts. I leave the batteries in this high state of charge for 3 or 4 hours. Equalizing removes lead sulfate from the plates in the battery. It's a good idea to equalize the batteries monthly. I learned a trick from the man who has been selling batteries to me for years. He suggested that I put one teaspoon of Epson salts in each cell. This also keeps sulfate from destroying the batteries.

After using the hydrometer I check the fluid level in each cell and add **distilled** water if necessary. While the cover is removed from the battery enclosure I

check all the connections to see if they are loose or corroded, cleaning and tightening if necessary. Occasionally I check the connections on the solar panels. For more information about maintaining your energy system, there is an excellent article in issue 56 of *Back Home* magazine, on page 14.

I check the voltage of the battery bank daily by looking at my voltmeter. It is our goal not to go below 80% of full charge or 12.46 volts. The batteries last much longer if only the top 20% is used.

% of Charge	Voltage	Specific Gravity
100	12.70	1.265
90	12.58	1.249
80	**12.46**	**1.233**
70	12.36	1.218
60	12.28	1.204
50	12.20	1.190
40	12.12	1.176
30	12.04	1.162
20	11.98	1.148
10	11.94	1.134
0	11.90	1.120

These readings are correct at 75 degrees Fahrenheit.
***Back Home Magazine,* Issue 56, p. 14.**

That is about all there is to maintaining the power system. Once you get the hang of it, it requires only a few moments a day. The system is very reliable. In fact, we have electricity on days when our neighbors are sitting in the dark.

Many people say, "Gee, it must be great not to have utility bills!" The truth is, there is no free lunch ... or power. While I do not receive a bill from a utility company, I must put some money aside to cover the expenses of maintaining the power system. My batteries tend to last from five to seven years. The inverter usually lasts many years, but not forever. If I have a problem, I have a problem. I cannot call the utility company and have them fix things. So, I save about $25 to $30 a month to cover maintenance expenses. Also, I spend about $25 to $30 a month on propane for the refrigerator, cooking, and hot water.

Improvements On Our Energy System

While we are very happy with the performance of our system, there are a few things that could be done differently.

First, setting up a wind charger is a big job that is potentially dangerous and probably best left to professionals. I found this out the hard way. While raising our tower the first time, I had neglected to put the components of the tower together tightly enough. As we raised the tower, it snapped in two, sending the windcharger smashing to the ground. Two weeks later, after replacing the broken blades on the charger and tightening the tower parts, we successfully raised the tower. Four months later, we were lowering the tower again because the wind generator was not working properly. I could not tell it from the ground, but that wind generator was trashed. It looked like someone had beaten it with a hammer, and it had been on fire. The gusty, 80-mile per hour winds on the plains were just too much for the model I had chosen.

Fortunately, the unit had been purchased from a great company, Southwest Windpower. They were very helpful when I was having problems and they gave me a brand new unit, a different model than the one we had first raised. The unit I have now is the type used on oil derricks in the North Sea. It is a marvel of engineering and works very well. Moral of the story: You may want to consider having professionals raise your windcharger or invest the dollars in solar panels instead. It would be a tough choice for me because the wind and sun work well together in our location; when the sun is not shining, it is often windy.

The second change I would make in our power system would be the addition of a gasoline-powered generator. On a few occasions, I have carelessly allowed my battery bank to be drained to a level that is too low. When this occurs, the only practical solution is to charge the batteries with a battery charger plugged into a

generator. My inverter has a battery charger built in for this purpose. A generator is something that complements any type of off-the-grid electric system.

If you use a generator every now and then, your electrical system can be much smaller and less expensive. If the sun does not shine or the wind does not blow for a few days or weeks, you can keep your batteries charged. Also, a generator is necessary in most owner-built electric systems when heavy tools and equipment are used. If I wanted to use an arc welder or any equipment that has a large electric motor, I would need a very large, very expensive system. The answer is a generator.

Buying the right generator requires careful study. Like Goldilocks, you have to find the one that is "just right." A generator that is not well-suited to your purposes will not perform well and will not last. You will have wasted your money. Answering the following questions will guide you to the right generator.

Will the unit be your primary source of power? Will it be used instead of photovoltaic panels or wind chargers? If the answers are yes, you should be looking diesel generators. Because they run at lower rpms, use much less fuel, and last for a long time, they are the only choice for the homeowner who plans to run the whole household on a generator. There are many articles written that will give very good information about diesels. Here are two of them:

"The Sunless, Windless, Waterless, Alternative Energy System," Skip Thomsen, *Backwoods Home Magazine*, November/December 1991.

"Diesel Generator Power Is a Sensible Choice," Skip Thomsen, *Backwoods Home Magazine*, January/February 1997.

Will the unit be used intermittently? By intermittent, we mean for only a few hours at a time, not a few days at a time. Gasoline generators work well for

intermittent use. Gas-powered units are much less expensive, but will wear out more quickly than diesels. However, if cared for properly, and used intermittently, gas units can give years of service.

Am I going to be using a generator so seldom that renting makes sense? If renting is convenient, i.e. you don't have to drive a hundred miles one-way to get your generator, paying someone else to keep the generator in top shape may be a reasonable option. Check the cost of renting and do the math.

What size generator should I use? The most important aspect of purchasing a generator is getting the right electrical output for your job. If you get a generator that is too large, the unit will not work at capacity and will not last. If you get a generator that is too small, every time you turn on an electric appliance the unit will shut down, or the engine will labor and wear out prematurely. The problem is that sometimes you'll need a large generator and sometimes a small one will do. Here is a suggestion. If you need a small generator most of the time, then buy a small generator and rent a large one when you must. Don't buy a unit that is big enough for big jobs, and then use it for small loads. The large generator will not last; it must operate close to full capacity for longevity.

Once you decide what size generator you need, you'll need to choose the options you wish to have. The price of the generator will increase dramatically if you add lots of bells and whistles, like electric starting and super-quiet operation. The options that are a must are an "industrial" engine package and pressure oiling. The "industrial" engine is usually a bit more durable than a standard unit. The pressure oiling system, as opposed to the standard "flipper" type, will greatly increase the life of the generator. Finally, I would recommend using super-slick synthetic oil in the generator engine, again, lengthening the life of the unit.

Generators do have drawbacks. They are loud; they stink; they require more maintenance than solar panels, and they need gas, diesel fuel or propane.

The noise can be a problem if you have neighbors nearby. You can baffle the sound and reduce the noise with some effort. Skip Thomsen wrote an excellent article called, "How to Construct a Soundproof Generator Shed," in the 1991 March/April issue of *Backwoods Home Magazine.*

If you keep your generator well maintained, odors can be lessened.

Recommended Reading

Earthships I, II, III

The Evolution of an Independent Home, Paul Jeffrey Fowler. Fowler Enterprises, 264 Bashan Hill Road, P.O. Box 253, Worthington, MA 01098-0253. This book shows how you can start small and build over time. The advice is real and practical.

Backwoods Home Magazine
BackHome Magazine
Countryside Magazine

These three publications will provide many examples of working energy systems. Most of the systems are owner-built.

Our Water System

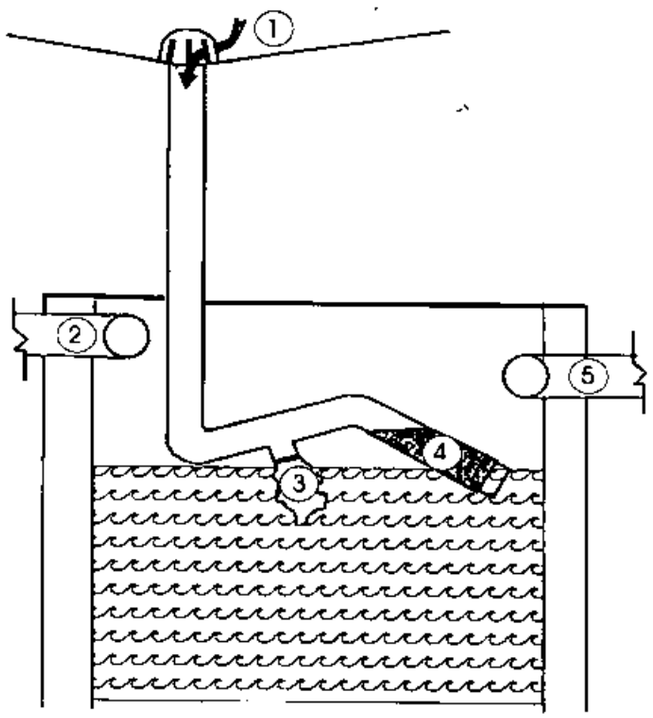
On the plains of eastern Colorado we receive about 10 to 13 inches of rainfall annually. There is a joke here that 10 to 13 inches of rain is not really very much, but it seemed like a lot on the one day it rained. Like most jokes, there is a grain of truth here. The rainy season is very short, so a large cistern is needed to see us through the dry times. Our cistern holds about four thousand gallons. It is 5½ feet deep, 13 feet long, and 8 feet wide. So far, we have had plenty of water. Another reason for such a large cistern is fire protection. If you live in the country, a long distance from your local fire station, it is a good idea to have some water on your site for fire fighting. I also have a gasoline powered pump and enough hose to get water to all parts of my house.

We catch our water on our roof. The roof is actually concave so that all water flows to the middle where there is a three-inch roof drain.

The roof drain goes directly to the cistern. I put some filters made from old nylon stockings on the cistern end of the drainpipe to filter out dirt and insects that might land on the roof.

There is a debris trap on the end of the line that allows sediment to be captured. I can visually inspect the filters and change them as needed. A simple swimming pool test kit allows me to test the water for bacteria. The water is clear and relatively clean. Because it is in complete darkness, no algae or bacterial growth is encouraged. If the bacteria level goes up, I use chlorine bleach to purify it.

Cistern / Filter Diagram



1. Roof drain
2. Ground level fill pipe
3. Filter - made from old nylon
4. Sediment trap
5. Overflow pipe - to planter

My cistern proved to be one of my biggest building problems. Because I needed such a large capacity, I chose to build the tank with concrete block and then line the tank with EPDM rubber, the same membrane that I used on my roof. A professional roofing man probably could have done this easily and quickly, but pros are expensive. I thought I would save some bucks by doing it myself. Wrong! The cistern leaked and I had to do the job three times. It never would hold water until I created a liner out of one sheet of 6 mil polyethylene. Also, because the cistern is beneath the floor of my bedroom, it created problems for my 12-volt water pump. The pump had to bring the water up from the bottom and it could not hold a prime. I solved the problem with a $25 check valve on the inlet pipe.

The next problem I faced was the constant cycling of my water pump. This will burn out a pump quickly. After four or five calls to the Shurflo pump technicians to diagnose the problem, I added a small pressure tank costing $70 to the system.

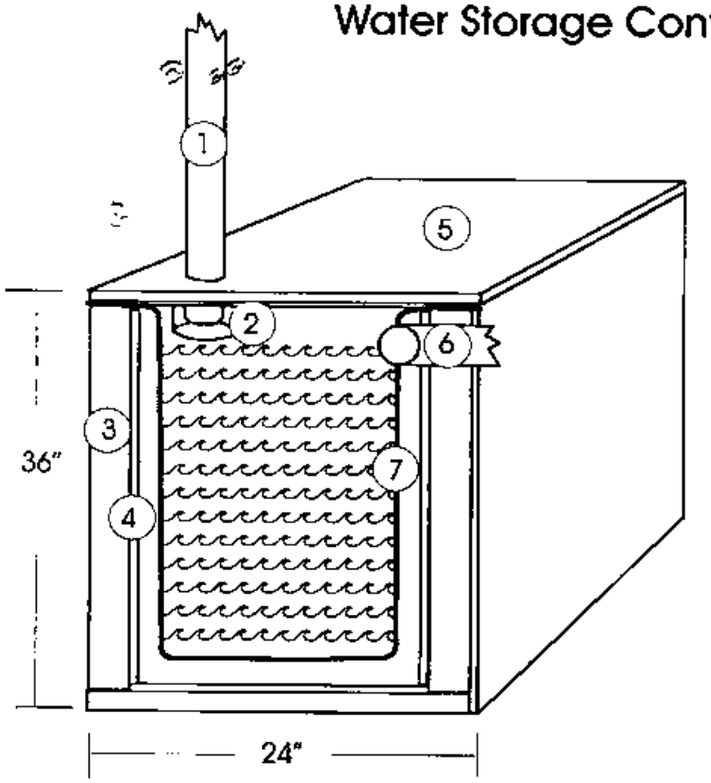
Now the system works well. I have clean, clear water for bathing and other cleaning. We do not waste any water and we do not have enough for large livestock, but we have had enough water so far. We irrigate our landscaping with gray water. If there is not enough rain, I can fill the tank by hauling water from my neighbor's well. This will be costly in terms of time and money, so I am hopeful that it will be a rare occurrence. We do not drink our cistern water because it is easier for us to carry in our drinking water. However, it would be easy to take water from our cistern and purify it for drinking. Several methods of purification could be used: chlorination, distillation, ozonation or filtration.

For $125, we bought a used, six-gallon propane hot water heater from a place that sells used RV parts. When my wife wants a luxurious bath, I put a dark colored five-gallon water container in the sun. When it is added to the hot water from the small hot water heater, it makes a luxurious hot bath. We hope to add a solar hot water heater in the future.

Improvements to Our Water System

If I were building a water system today, I would do a few things differently. First, I would build a pitched roof with shingles. A flat roof can be leaky and I like the look of a pitched roof. Second, I would not place the cistern in the ground. Accessing and maintaining it when it is that low is a hassle. Also, the benefit of the stored water to help moderate living space temperatures is lost. For this reason, I would build the water storage area above ground in the living space. The basic water container would be a structure built of wood and double layers of black, 6 mil polyethylene. Black is used because it is less affected by ultraviolet rays. The polyethylene is also known as visqueen and can be purchased as a drop cloth or landscaping barrier just about anywhere. It is inexpensive and easy to work with. We are using it in our planter to hold gray water at the present time. To build a container that would hold water, which weighs eight pounds per gallon, I would have to do some experimenting.

Water Storage Container



1. Fill pipe
2. Filter
3. 2x4 Frame
4. 7/16 OSB board
5. Lid
6. Overflow
7. 6 mil poly liner (doubled)

This box would be the size of a standard kitchen cabinet base and would provide a work surface and an acceptable looking fixture around the perimeter of living areas or along interior walls. The size is practical because a piece of polyethylene ten feet wide would make a one-piece liner. Before using the poly liner, lay it on a smooth surface to make sure it is without holes, which sometimes occur in manufacturing. To be sure there are no leaks, at least two layers are used. Watch carefully for leaks as the container fills for the first time.

Recommended Reading

Cottage Water Systems, Max Burns. Cottage Life Books, 1993

The Home Water Supply, Stu Campbell. Garden Way Publications, 1983

Making the Best of Basics, James Talmage Stevens. Gold Leaf Press, 1997.

Handmade Hot Water Systems, Art Sussman and Richard Frazier. Garcia River Press, P.O. Box 527, Point Arena, CA 95468, 1998

Mother Earth News, "The Secrets of Low Tech Plumbing," John Vivian. June/July, 1995, p. 34.

"Rainwater Harvesting" Texas Water Development Board, P. O. Box 13231, 1700 N. Congress Avenue, Austin, TX 78711-3231. (512) 463-7847, Fax (512) 478-2053.

Build Your Own Solar Water Heater, Stu Campbell. Garden Way Publishing, 1978.

Our Gray Water System

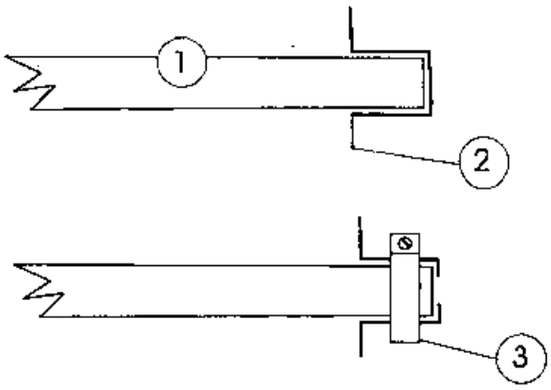
Gray water is the water used in a home that is not contaminated by feces, urine or harsh chemicals. Such water can be reused to sustain plants. The water from our bathtub, shower, and bathroom sinks goes into our planter, which is located under our 34 feet of windows on the south wall. The planter is two feet wide and 32 inches deep. It is lined with two layers of six mil, black polyethylene. There is an overflow at the end farthest from the gray water source, which allows excess water to escape to a dry well outside.

Three pipes allow water into the planter at the end closest to the bathroom: one from the tub, one from the bathroom sinks, and one from the overflow of the cistern.

The planter was built of concrete blocks. The back wall and the floor of the planter were poured when the rest of house's concrete was poured. Because the concrete was rough, I lined the planter with a piece of old carpet before I put the two sheets of polyethylene in place. Because the carpet gets wet it is important to choose a piece of carpet that is made from synthetic materials. Each sheet of poly was large enough to provide a seamless liner. To protect the poly liner from being punctured, I lined the planter again with old carpet. The liner was sandwiched between two layers of soft carpet. I carefully cut holes through the poly to allow the pipes through which would bring gray water into the planter. Then I went to the opposite end of the planter and prepared the drain. The drain is a 3-inch schedule 40 PVC pipe that protrudes from the south wall. I carefully gathered the poly liners and forced them over and around the 3-inch pipe.

After getting the poly around the pipe, I placed a stainless steel clamp around the pipe and poly. Then I cut the liner out of the center of the pipe, which allows the water into the pipe to the dry well. Because any opening made in the liner is above normal water levels, the planter does not leak [see illustration–next page].

Drain



1. Pipe.
2. Poly liner.
3. Stainless steel clamp.

The dry well [see illustration - p. 60] is designed to temporarily contain any water that overflows from the planter, which holds over 200 gallons. The water in the dry well seeps into the ground.

After completing the drain, I was ready to fill the planter. I realized at this point that I had made a big mistake. All the literature indicates that planters used like ours for a gray water system should not be more than 15 or 16 inches deep so that the roots of the plants in the planter will be in the gray water, using the water for growth and purifying the water at the same time, much like a wetland. My planter was 32 inches deep. So I had a problem. Here is what I did. I placed clean five-gallon plastic buckets upside down in the bottom of the planter. They had been drilled with ¾ inch holes on top, bottom, and sides to allow the water to flow freely. I left room at both ends of the planter for the water to collect. These collection areas were covered carefully so that odors do not become a problem. Gray water can smell bad. Then I covered the five-gallon buckets with a layer of old carpet so that the sand placed on top would not fill in all the spaces and slow down or stop the water's movement. At each end of the planter, I used concrete blocks to create a wall that would hold the sand in place. Eventually, I will add a small 12-volt pump in the far end of the planter so that it is easy to use that water for the plants in the planter. At this time, I use a large pump to draw the water out for my trees.

Because we have a cat that was looking at all that sand with great lust and a twitching bladder, we placed small river rock over the sand. We use poly landscaping containers that are placed in the sand for our plants. By using a second container set in the planted container, it is easy to remove a plant when it needs attention or replacement.

assures such temperatures. I do not turn or stir my compost, letting time be the most important factor in creating safe humus for the garden or trees.

A person must be very careful if they use their compost in the garden. After the mulch has had six months to a year to sit, it can be put on the garden and then covered with 6 to 8 inches of soil. Seeds are planted in the covering soil. I would not plant root crops in compost.

When watering, it is important to be careful not to splash gray water onto what will be eaten. A drip system solves this problem and saves water, too. All fruits and vegetables must be washed carefully before consumption.

6. Some plants do not do well indoors. I have not been able to determine why. Perhaps it has to do with soil temperature, light, or with the particular variety of seed that has been used.

7. Less water is needed to maintain plants indoors because there is less evaporation.

8. Problems with severe weather are eliminated. Wind and hail may destroy the vegetation outside, but my indoor garden keeps going.

9. My indoor garden works best in the winter when the sun is low in the sky and hits my plants directly. In the summer the plants are too much shaded by the roof overhang. I move the pots outside as soon as the weather is warm enough and back inside if the weather gets too rough.

While there is much to learn that will help me increase food production, just having an indoor garden is a great asset to the beauty and comfort of our Solar Ark.

Recommended Reading

Square Foot Gardening, Mel Bartholomew. Rodale Press, 1981.

AFTERWORD

Noah gave a wonderful gift to his sons. Because he was obedient to God, his sons were able to have another chance at life. They were able to build a new society.

All of us, dear readers, have that same opportunity if we are the sons or daughters of God through Christ. What a gift we have been given! We also have the written word of God which was not available to Noah's family. Gifted as we are, we have the great obligation to make this world a place that is pleasing to God: a world in which even the poorest people can enjoy comfortable shelter that is warm in the winter and cool in the summer, a home in which there is clean water to drink and good food to eat, a homestead that recycles most of its waste rather than sending it away for someone else to handle. The Solar Ark makes it possible to achieve all of these things.

Like the sons of Noah, we have a huge problem – sin. Although we are saved by God's grace, we must always be aware of our sin nature. It is natural for us to be selfish and greedy, to house ourselves in luxury while those around us live in deplorable conditions. It is easy for us to say, "That's their problem; if they weren't so foolish, or evil, or simply born in the wrong country, they could have what we have. It's their own fault!"

You can use what you have read in the previous pages to share God's love with those around you, particularly those in need. To do anything less is to ignore God's clearly stated command to feed the poor, to shelter the needy, and to share cheerfully what we are so freely given.

Once you have decided what God would have you do concerning all of these things, after a careful study of the Word, and upon your submission to His will,

you will still have some interesting obstacles if you choose to build your own Solar Ark and help others build theirs.

You will be confronted by rules in most localities in the United States that will make it difficult or impossible to build a Solar Ark. We solved this problem by finding one of the few places in our state of Colorado that was not governed by the Uniform Building Code. However, shortly after we began building, the politicians went to work and changed that situation. Our Solar Ark is legal because we finished it before the new regulations took effect.

In your locale, you will have to find out how you can create your sustainable shelter while obeying or changing existing codes or covenants. I challenge you to work to change rules and regulations that keep families from building decent, affordable, sustainable shelter. Fighting the homebuilding bureaucracy will be a huge undertaking, but the importance of revising outdated or harmful restrictions cannot be overstated. We need to have places set aside in every community where people can build affordable housing without being harassed by the government. The Uniform Building Code has its place in public buildings where safety must be guaranteed, but private individuals must be given the freedom to house themselves without being driven to financial ruin or bondage.

May God bless you and give you courage, and may you begin soon to build your own Solar Ark and to share the ideas found in these pages with others.

Castles in the Air

When I was a young boy I spent a lot of time with my grandparents. My grandmother often chided me for building "castles in the air", her term for my endless daydreaming. With God's help I've been able to make some of those "castles" real, like the Solar Ark in which I am now living.

I'm still daydreaming. I imagine groups of Christians pooling their resources, much as they did in the early church, and building communities of Solar Arks. They could be built in the country, where agriculture might be a source of income, or rural communities could provide a labor pool for industry.

The ideas used in Solar Arks would make life better in urban settings, too. A complex of aging condos or apartments could become an oasis in a busy city, with many of the grassy areas converted into food producing gardens enriched by compost from a self-contained waste disposal system. Solar hot water heaters could supplement space and water heating. Photovoltaic panels could reduce dependence on local utilities.

Ministries devoted to helping people achieve financial and emotional independence could be augmented by assisting those people as they built, for themselves, a village of Solar Arks. It's HABITAT FOR HUMANITY taken to new heights.

The Bible would inspire not only the building of each ark, but how the people governed themselves within those arks. The relevance of the Scriptures would be shown to the world.

As the Church works with building bureaucracies, new regulations could be hammered out that would allow more freedoms for those who wish to build their

own homes. Universities exploring new construction methods are often allowed to bend rules. A church that could show itself to be thoughtful and serious about building a sustainable community could also be accommodated.

The benefits of sustainable Christian communities would be many. Time and money spent acquiring and maintaining a typical home could be devoted instead to relationships. Families could have more time with Dad. Moms could stay at home to enjoy and nurture their babies. Singles would have more time to serve others.

Like the Pilgrims and Puritans of old, people living in Christ-centered, sustainable communities could create "cities on a hill" for the world to see.

Appendix

Staying Healthy While Building Your House

Building a house is hard, physical work. If you are not careful, you could be very sore as a result of your work, even causing lasting joint problems. Here are tips to help you maximize your efforts and minimize your risks of physical harm.

There are two factors that make house building potentially painful: weight and repetition. Dirt is heavy. Bricks are heavy. Even wood is heavy. The repetition of carpentry work can take its toll. To avoid physical discomfort, there are two things that can be done—stretching and strengthening.

I am over fifty years old as I write this book and build my house. I am in good physical condition, but no one would be mistake me for Arnold Schwartzeneggar. I stretch at least every other day. (I should stretch every day.) I basically stretch every part of my body. There numerous books, or your chiropractor could help you with a stretching program. I do less with strengthening. The building project itself will show you what areas need special work. Again, many books will give you ideas for strengthening exercises.

As you begin your building project, don't over-do it physically. If you work at a desk, start by working just a few hours a day on your house. Let your aches and pains be a guide. If you keep pushing past the pain, you will hurt yourself. You must give your body time to recuperate after you've worked for several days on your project. If you wake up feeling tired and aching, you need more rest and more stretching. The point is be gentle with yourself. Do not put yourself on an impossible timetable. You will only hurt your body and make yourself crazy. A house is a work of art that will evolve most beautifully if you let it grow at a comfortable pace. The project will be there tomorrow.

It is important to stretch your muscles and protect your joints. There are two factors in house building that present a danger to the joints: repetition and impact. Some repetition cannot be avoided unless you hire lots of help. Not a bad idea if you have the money!

The problems caused by impact to the joints can be lessened greatly by knowledge of how to properly use tools. Let the tool take the blow, not your body. Make a point of watching professionals at their labor. Watch someone who uses a pick and shovel. Watch a carpenter swing his hammer. Notice how they use economy of motion and leverage to maximize the ratio of energy used to work accomplished. Look at the size and shape of the tools being used.

Take your time, eat well, drink plenty of water, get lots of rest, stretch carefully, and you can enjoy building your own house.