PDHonline Course C710 (2 PDH)

Survival Home Strategies

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SURVIVAL HOME STRATEGIES

Ruben A. Gomez, P.E.

1.0 PREFACE

An old cliché that has endured the test of time preaches that "a man's home is his castle", however, that home would hardly be his castle if it is going to collapse at the first 100 mph wind gusts that come along, and fail on its mission to providing a safe shelter for his family, and further, also fail to provide for the essential basic elements of survival.

As the American legend Mark Twain used to comment: "everybody complains about the Weather and nobody does anything about it". Humor put aside and in practical terms, there is not a lot we can do to change the Weather, however, there is a great deal we can do to use those forces of Nature to our advantage and ultimately, to our own plan of survival.

In one of our previous course titled "Tornado Resistant Homes" we showed how to improve in our current construction methodology to make our houses resistant to the high winds generated by hurricane and tornadoes as one of the main steps towards a survival strategy that starts at home, for every year tornadoes tear down a large number of homes and unnecessarily puts in serious jeopardy the lives and welfare of thousands of families, fellow citizens and their properties.

Of course, having a tornado resistant home to live in is just the first step into the principles of survivalism we predicate. In addition to an adequate shelter, there are other basics that are also important as part of the idea of preparing a program leading to preserve our lives and those of our family members. We also need potable water, adequate food and a reliable source of energy to run a certain minimum number of appliances and amenities.

When it comes to sources of energy, it all depends of whom we have chosen to listen to, some say that we will be running out of oil within the next twenty years while others say we have enough oil to carry us for at least another fifty years of consumption. The reality is that, eventually and regardless of whomever is right of those two groups, the operating cost to extract that oil is going to be so high that we will not be able to afford the retail price anyways. Therefore and reasonably speaking, we owe it to ourselves to examine all possible sources of alternative energy in addition to whatever other available alternative ideas of what to do when all other options get exhausted.

In this course we will examine a collection of practical ideas conducive to different projects we can put to use in our own homes and geared towards self sufficiency. Most of those projects and ideas do not need any special skills to either be understood or be put into action, just our sense of anticipation, hard work, initiative and determination.

2.0 DEMAND FOR & SOURCES OF DRINKING WATER

If we go by the water needs for a regular family of four, basically a husband, wife and two children, and we take as good the predicated water consumption of 60 gallons per person per day, the amount of water needed in a year would be: Q = 4 x 60 x 365 = 87,600 gallons. If we use as a prototype the house plan shown in our course titled "Tornado Resistant Homes" with a roof projected area (overhangs included) of some 2,400 square feet (43 x 56) and at the same time take the yearly rainfall as it takes place in the area of North Florida/South Georgia in the amount of 46 inches*. The total volume of rain water that can be collected from such roof would be: (2,400 x 3.82 x 7.48) 0.93** = 63,776 gallons. This represents about 73% of the total water demand in the household. The remaining 27% would have to be supplied by either a conventional water well or from a connection to the municipal trunk lines. However, in this course we will not cover "city water" because that is the source we will first need to "liberate" ourselves from, since it is prone to collapse when the social and political establishments fail to operate as we are accustomed to.

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*We have obtained this accumulated yearly rainfall from Mr. John Gaughan, Director of the Department of Meteorology of WJXT, Channel 4 in Jacksonville, FL. Admittedly, this part of the country has an uncommonly large precipitation, especially during the period of the Summer months (June-September) when the Greater Jacksonville and its surrounding areas may sustain a rainfall totaling up to 30 inches. By the same token, in those areas of the country which are substantially drier, in order to be valid those calculations as shown herein will have to be adjusted accordingly.

**Please note that in above calculations we have allowed a 7% total loss to account for evaporation, joint leaks and surface saturation.

As we read above, the total rainfall volume of 63,776 gallons collected by the roof falls short by 23,824 gallons to equal the demand, as indicated above, the difference will need to be pumped out of a water well. In the next section we will show the specific details of what to do to accomplish such purpose.

3.0 SURVIVAL HOME BASIC SCHEME

Much is being said and a large number of books have been written by those liberals and conservationists who claim to be engaged in the task of saving this planet from its own imminent demise, however, little has been done to actually implement effective ideas towards such expressed purpose. Enclosed Figure 3.1 displays a schematic view of a residential structure with the different features that can be introduced to make it water supply and disposal efficient by combining and maximizing the natural resources available to all of us.

The figure in question describes a primary and secondary water supply system which could be used separately or combined, depending on the needs and the population in the household.

The basic idea is to utilizing a primary system derived from the rainfall collected on the roof, which half of the volume is simultaneously sent by gravity to a cistern under the house and the other half to an elevated solar heated tank over the carport as a source of hot water for domiciliary purposes. After the tank is filled to its maximum capacity, the excess water is sent down to the cistern for storage. At the same time and while all this takes place, cold water from the cistern is also solar pumped to the house on demand.

SUN HEATED WATER TANK

Figure 3.2 shows the elevated sun heated water tank as part of the primary supply system. Such tank carried by steel joists and beams, also acts as the roof cover for the carport below.

The secondary water supply system is depicted in Figure 3.3 and consisting of the traditional drilled well equipped with a jet pump and a pressure tank from where the water is sent under pressure to the house. The water well shall be located within the property boundaries in such a way that is at least 75 feet away from the drain field as shown in the Figure 3.4 at the end of this section.

DRILLED WELL

All underground water has at one time or another originated at the surface of our planet and as it is heated by the rays of the sun, it gets evaporated to form clouds that are eventually precipitated back to the ground in the form of rain or snow. Once on the ground that water either seeps into the soil or gathers together and flows into streams, ponds, rivers and eventually makes its way to the ocean. However, the water seeping into the ground accounts for the larger volume which has been calculated by geologists to be some 30 times larger than the total *fresh* water volume remaining on the surface. Consequently, when drilling a well the probability of the driller finding water at any given location is very high.

Machine-drilled wells are the most common type found today, especially when the required depths are at least fifty feet or over. Those wells can be done by using either *percussion* or *rotary* methods for the performance of such task. In the percussion method, a drilling tool is repeatedly lifted and dropped until the bore hole reaches water. In rotary drilling however, a drilling bit is driven to form the well to the necessary depth. In both cases a steel or plastic casing is introduced in the bore hole to prevent caving and preclude contamination. A well screen is attached to the bottom end of the casing to prevent entrance of sand and gravel and thus allowing a free flow of clean water into the pump.

PUMP(S)

A regular jet pump is normally used for 2 in. wells and should be sized adequately to assure continuous supply of water as needed in the house served. Pump capacities are determined in function of well depth and peak demand. As a matter of example, a 50 ft. well with a 2 in. casing and a 1.5 HP pump should be able to produce about 12 gallons per minute (720 gallons per hour), which is adequate for a modern home containing two bathrooms with a toilet, tub and sink each; a kitchen with a sink and dishwasher, a washing machine, a laundry sink and two outside faucets for outdoors use.

For the purpose of the example referred to in this course we have selected a common well jet pump manufactured in Delavan, Wisconsin 53115, with the following listed specifications:

60 cycle AC, 1½ HP, 115V, 19.2A

Since *volts times amps equal watts,* 115 x 19.2 = 2,208 watts (2.2 KW)

Such data will become necessary to size the designated power source, as we will see it later in Figure 3.5.

As an alternative to alternating current (AC) pumps, it should be said here that the market also offers *solar jet pumps* equipped with integral 12V, 25A DC magnet motors. The life expectancy of these pumps is shorter than the regular AC pumps and the price is somewhat higher. However, because the DC pumps have much lower starting torque requirements, their motors are ideal for use with photovoltaics (PV).

PRESSURE TANK

When the pump discharges water into the pressure tank, the air at the top of the tank compresses like a spring and remains compressed until a faucet is turned on. As the compressed air expands back, it pushes the pressurized water into the open faucet. The pump automatically starts when the pressure in the tank drops below a predetermined level and stops when the pressure is restored.

The size of the pressure tank will have an effect on the operation of the water system. The larger the tank, the more constant and steady the pressure in the system will be. A 42 gallon tank is commonly recommended for the average home.

When it comes to the material, in spite of its drawbacks related to rusting when exposed to the weather, the galvanized tank is still the most popular. However, other materials are available, such as epoxy, plastic coated, glass lined and fiberglass. Those other materials, although more expensive, are either resistant or immune to rust and corrosion.

PRESSURE SWITCH

The pressure switch is the basic operational control of the tank. It starts and stops the pump at pre-established pressures, and is the feature that gives the tank and the water system the “automatic” operational nature. A common setting is the 30/50 PSI which means that the pump starts automatically when the pressure drops to 30 pounds per square inch, and continues running until it reaches the pressure of 50 PSI. A setting of 20/40 is also used in conditions where the pump is on fairly leveled grounds and in the close proximity of the served area.

There are other secondary but necessary features which should be included as part of a pressurized tank, such as the *liquid level control,* the *low flow switch,* and the *pressure relief valve.*

WASTEWATER TREATMENT SYSTEM

The individual wastewater treatment system we will examine here is the traditional *septic system* we are all used to see in individual homes located in rural settings where collective and centralized wastewater treatment is either impractical or uneconomical.

Although there are many variations to the conventional septic system, they are all based and designed on the same principles. They consist of a *septic tank*, a distribution box and a drain field, all connected by pipes commonly known as *conveyance lines.*

The septic system should be seen as a household wastewater arrangement where the soiled water and waste are temporarily held by the tank until the heavy solids and scum separate from the water. That separation process is mostly what the sanitary engineers designate as the *primary treatment.* The solids get further digested by aerobic bacteria and the remaining waste would need to be removed a few years later by a septic tank pumper.

After the partially treated wastewater leaves the tank it flows into the *distribution box*, from where it gets distributed along the *drainfield pipes.* Pre-drilled holes in those pipes allow the wastewater to seep into the gravel trenches. Such *effluent* infiltrate into the subsurface soil as part of the designated *secondary treatment.*

When it comes to the septic system, the reader will find Figure 3.4 to be clearly self-explanatory. However, bear in mind that most incorporated urban municipalities do not approve of the septic systems; therefore their use as described herein is applicable to rural properties, which are indeed the settings where the ingenious survivalist would like to establish his home.

The size of the septic tank is a function of the number of persons in the household, as well as the number of drain outlets in the dwelling. Commonly, a three bedroom home as described elsewhere in this course uses a 950 gallon tank. On the other hand, the length of the drain field pipes (L) is a function of the tank capacity and the absorption capacity of the soil where the field is located.

BASICS ON PHOTOVOLTAICS

Since this is not a course in geophysics, geo-engineering or electrical engineering, we will only "scratch the surface" on *solar energy technology*, just enough for the sake of completeness and at the same time to trigger the curiosity for this fascinating topic in the inquisitive minds of our dedicated readers.

It is a well accepted principle that all forms of energy come either directly or indirectly from the Sun and that energy manifests itself in many different and varied ways. When it comes to the direct manifestations, of the four types of solar energy systems, PV (photovoltaics) is by far the largest and most rapidly growing market, and as the industry grows the costs are naturally coming down and reaching a competitive parity with other forms of energy offered by the general market. When solar PV first started in the 1970's the upfront price per watt capacity was in average some $20 and now in 2014 that price has dropped to around $2 and is expected to continue its fall.

At the same time the cost of production falls, the technology itself is being improved to new heights. At the beginning of the solar experience, much of the energy absorbed by the solar cells was wasted, but now the efficiency has doubled with the advent of the *thin film* PV devices.

The system we have described so far in this course has good qualities but also has some fundamental drawbacks. We have taken advantage of the natural rainfall; some of the collected volume has been directed to the cistern under the floor of the house while some other volume has been directed to an elevated tank where the water gets heated by using the sun's rays. However, the total volume so collected is not enough to supply the household with the needed water volume year around; therefore, well water was needed to supplement the deficit. In order to pump the well water out, an electricity source was needed. Additionally, a second pump was also needed to extract the water already stored in the cistern.

Obviously, the intent of the survivalist should be to free himself from the yoke of the commercially produced energy, especially if he has some environmental concerns. That is why he should pursue his solution from those offered by commonly found natural resources such as hydraulics (waterfalls), wind, geothermal and sun energies.

Of those sources of energy mentioned above, the most sensible and reachable source is the one provided directed by our supreme energy provider: the Sun. The conversion of sun's light energy into useable electrical energy is called *photovoltaic effect.* Solar cells are the basic semiconductor devices which produce such energy conversion.

When sunlight is converted to electricity, the power generated is in the form of direct current (DC). However, most homes and buildings are equipped with appliances energized by alternating current (AC). To run those appliances on energy generated by photovoltaics, an *inverter* is needed to convert DC to AC power. The major drawback of the inverters is the large power loss that occurs during the conversion process, with even additional losses taking place during the stand-by mode. Such a power loss is the reason why DC appliances are recommended since they are more compatible than AC appliances for application with photovoltaic systems.

In general, the photovoltaic system greatest power output occurs during mid-day when the sun rays are most direct, since the amount of electricity produced by a system correlates to the amount of sunlight falling on the solar panels. On the other hand, consumption of electricity tends to concentrate in the morning and evening hours when the photovoltaic system is at its low production. Consequently, for a photovoltaic system to be useful day or night, it needs to be backed up by either another form of energy source or a storage battery bank.

One more problem that has to be kept in mind is the fact that sunlight is not consistently available, neither geographically or seasonably. Both geographical location and seasonal variations affect the amount of sunlight available to power PV systems.

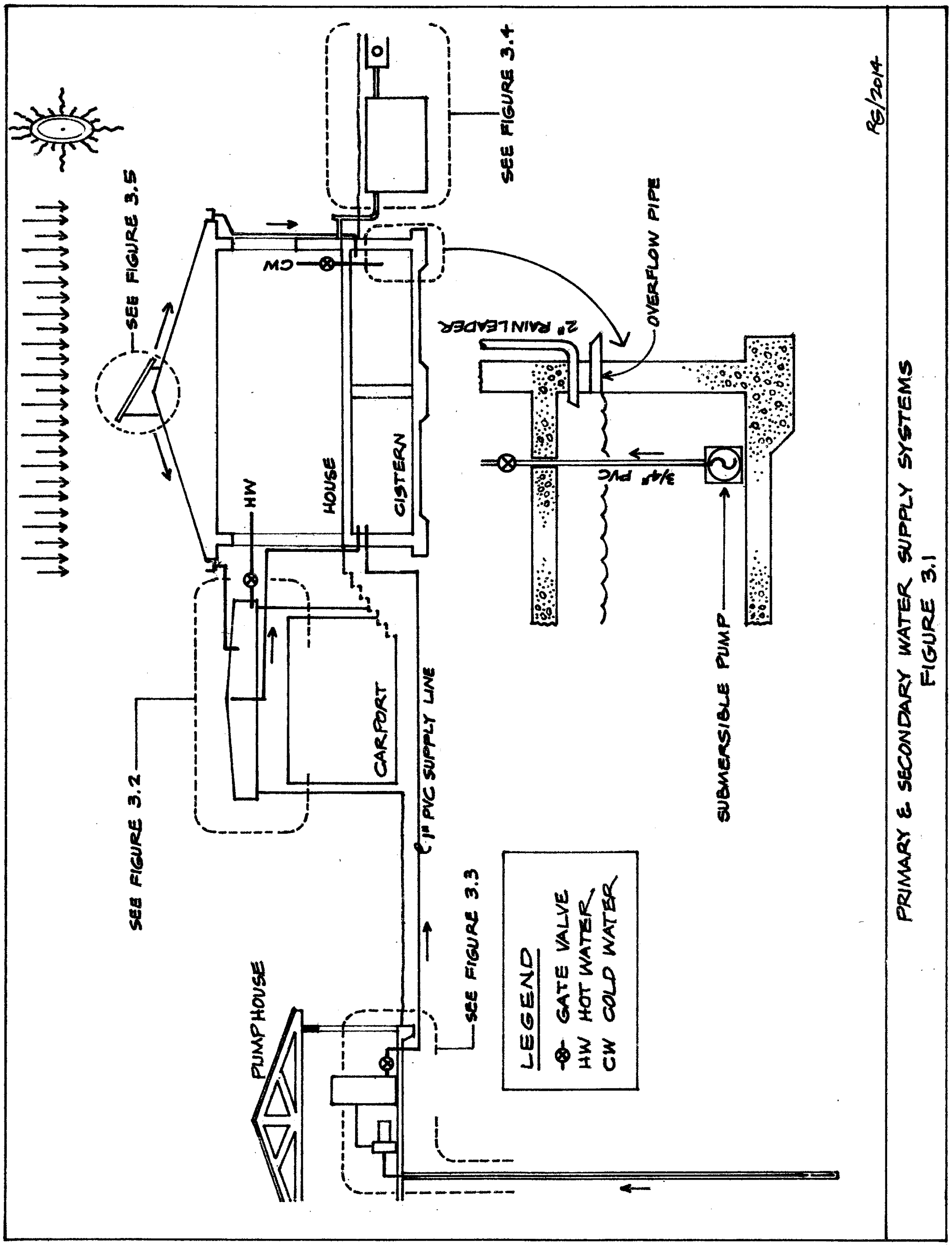
The following Table 3.1.1 provides a limited listing of random chosen locations within the United States and their *annually averaged* peak hours per day for different regions:

TABLE 3.1.1
Average Sun Light Peak Hours

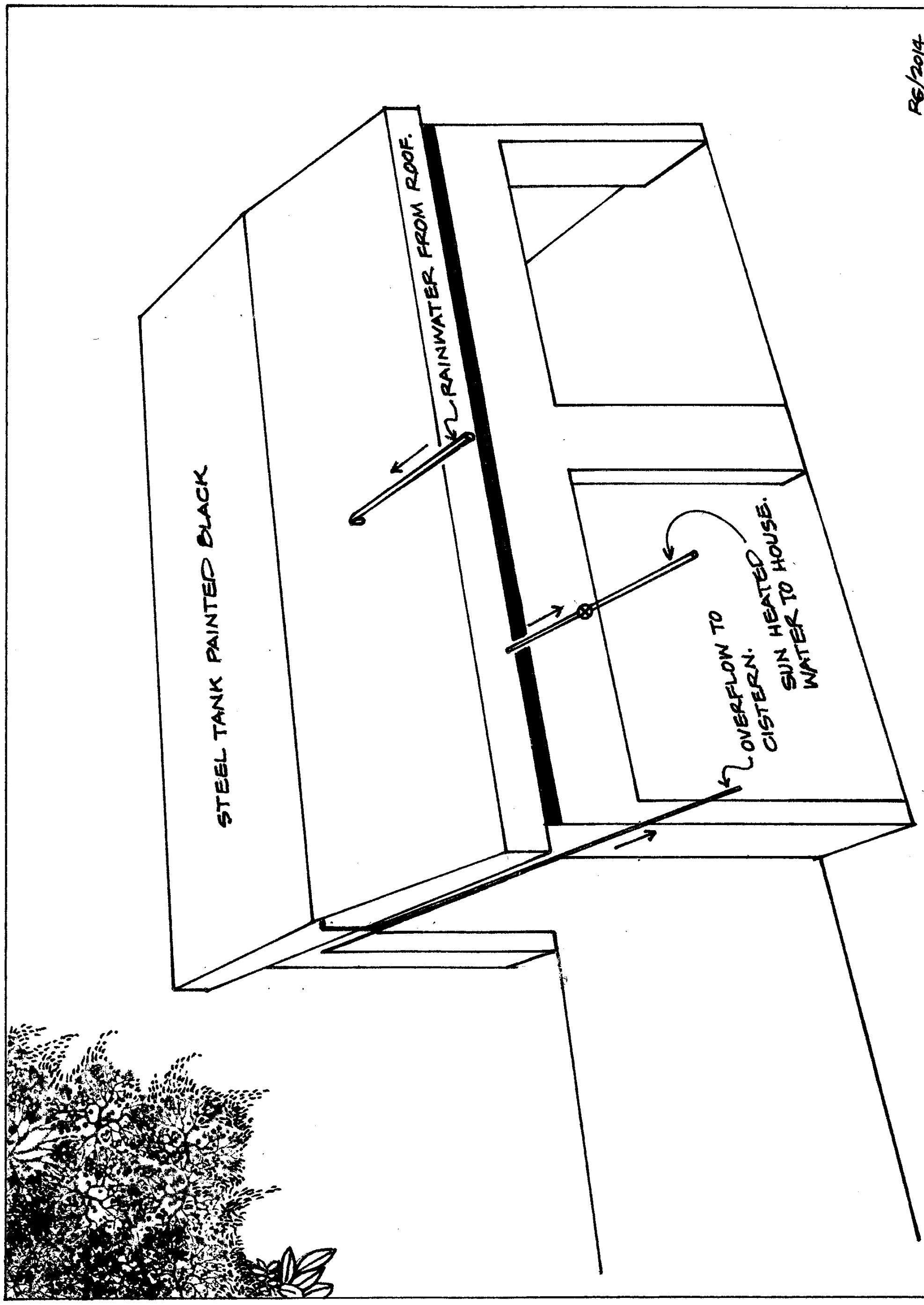
STATE	CITY	DAILY PEAK SUN HOURS
Alabama	Birmingham	4.5
Alaska	Anchorage	3.0
Arizona	Phoenix	6.0
Arkansas	Little Rock	4.5
California	Sacramento	5.0
Colorado	Denver	5.0
Connecticut	Hartford	4.0
Delaware	Dover	4.0
Florida	Orlando	4.7
Georgia	Valdosta	4.5
Idaho	Boise	5.0
Illinois	Peoria	4.5
Indiana	Indianapolis	4.5
Iowa	Des Moines	4.6
Kansas	Topeka	4.7
Kentucky	Lexington	4.6
Louisiana	Monroe	4.5
Maine	Bangor	3.7
Maryland	Baltimore	4.0
Massachusetts	Worcester	3.7
Michigan	Flint	4.2
Minnesota	Minneapolis	4.3
Mississippi	Jackson	4.5
Missouri	Springfield	4.6
Montana	Billings	5.0
Nebraska	Lincoln	4.7
Nevada	Las Vegas	6.0
New Hampshire	Manchester	3.8
New Jersey	Trenton	4.0
New Mexico	Albuquerque	6.2
New York	Albany	4.0
North Carolina	Raleigh	4.5
North Dakota	Bismarck	4.5
Ohio	Columbus	4.5
Oklahoma	Oklahoma City	5.0

Oregon	Portland	4.0
Pennsylvania	Scranton	4.0
Rhode Island	Providence	3.7
South Carolina	Columbia	4.6
South Dakota	Pierre	4.5
Tennessee	Nashville	4.5
Texas	Lubbock	5.0
Utah	Cedar City	6.0
Vermont	Burlington	3.7
Virginia	Richmond	4.5
Washington	Spokane	4.0
West Virginia	Charleston	4.5
Wisconsin	Madison	4.5
Wyoming	Cheyenne	5.1

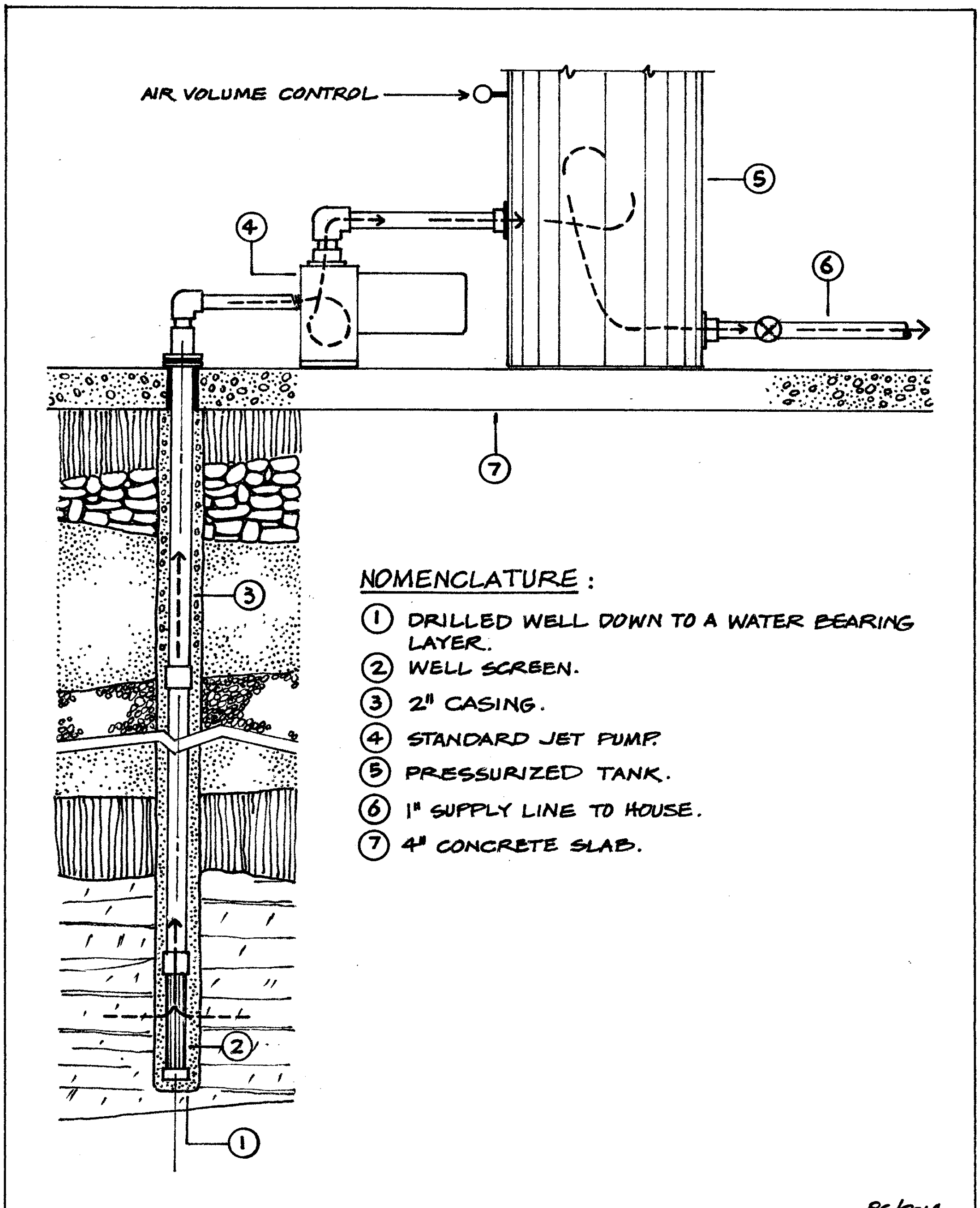
Figure 3.5 depicts a possible PV scheme with a roof mounted PV array provided with certain level of adjustment so to optimize capturing the most efficient amount of solar energy for which purpose there is a controller included to adjust the inclination angle. The generated DC electricity is sent through a disconnect for the DC appliances in the household. However, if AC appliances are selected instead, then, an inverter must be provided to convert the DC current into AC. A battery bank is also shown to assist the system when solar energy supply drops below minimum volume standards.



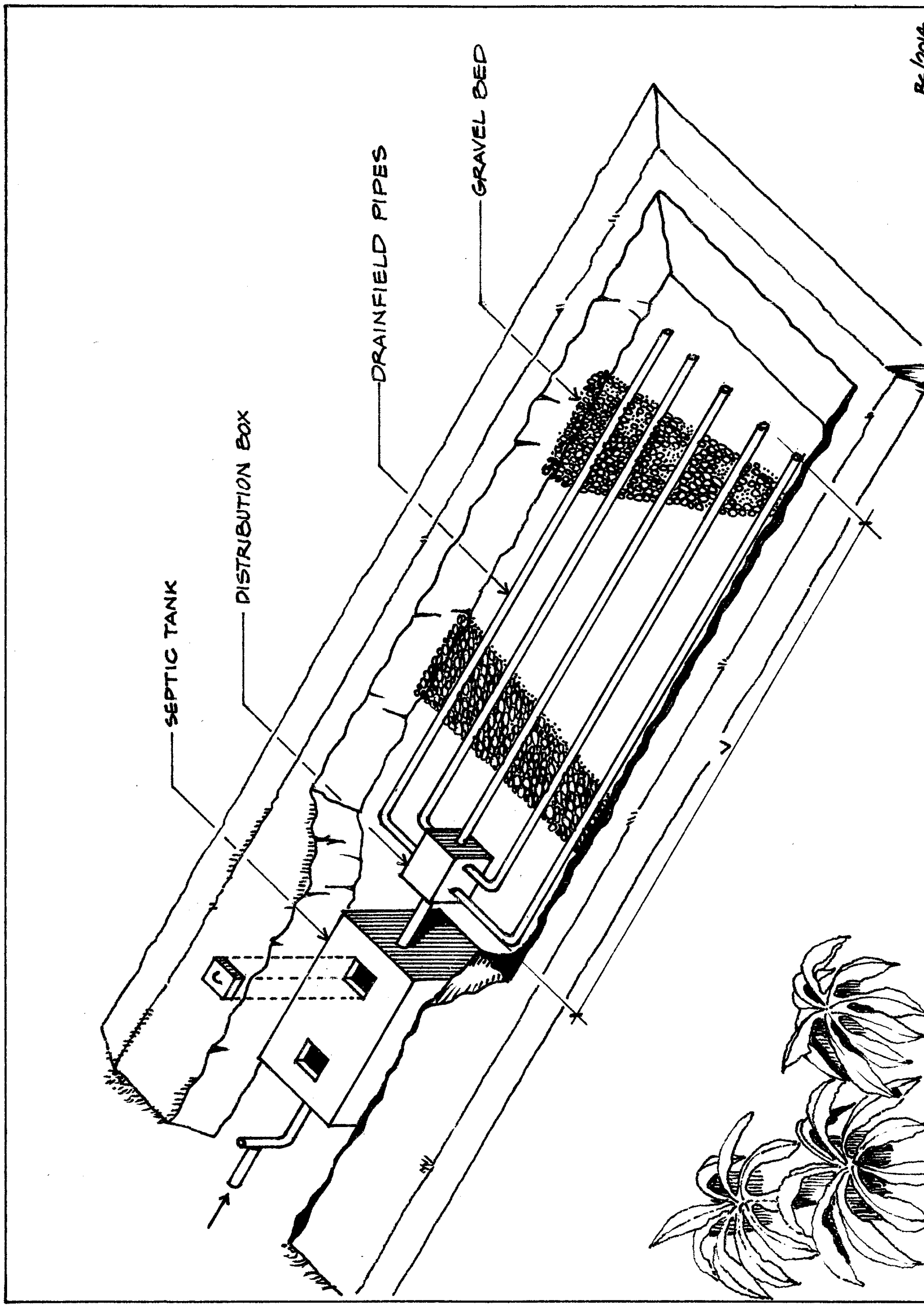
PRIMARY & SECONDARY WATER SUPPLY SYSTEMS
FIGURE 3.1



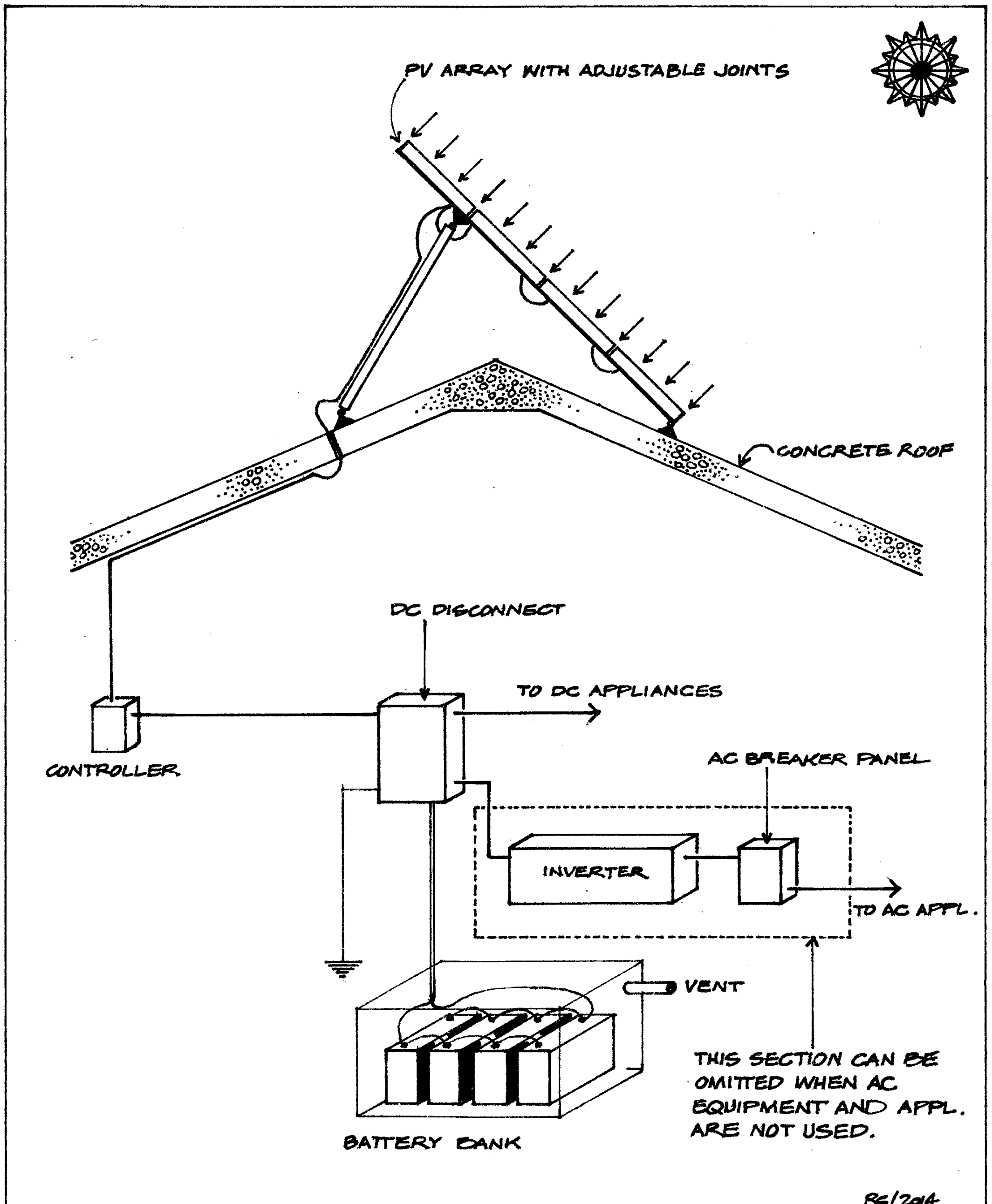
ELEVATED STORAGE TANK
FIGURE 3.2



AUXILIARY WATER SUPPLY SYSTEM
FIGURE 3.3



CONVENTIONAL SEPTIC SYSTEM
FIGURE 3.4



PHOTOVOLTAIC SYSTEM
FIGURE 3.5

4.0 ABBREVIATED METHOD TO SIZE PV ARRAYS

In order to adequately size a PV system you must first determine what the electrical energy needs are. To do so, you need to list all loads feeding from the power source you are designing, such as lighting, televisions, radios, computers, ceiling fans, hair dryers, pumps, etc., which are of common use in the average household. The actual *wattage* consumption of every appliance can be found in the rear or the bottom of the unit by means of a permanent plate with such information as provided by the manufacturer. In some instances you may find that the plate does not show the wattage but the number of amperes, in such case you may determine the wattage by multiplying the amperes by the voltage. The person in charge of the design procedure must also know the frequency those fixtures and appliances are used.

Because of their high power demand, some of the regular household appliances, such as water heaters, stoves, washing machines, clothes dryers, furnaces and refrigerators are better served by using natural gas sources.

To determine the total energy consumption of every item, multiply the wattage of the appliance by the number of hours it will be used every day. After adding the wattage consumption you may determine the total power output necessary for the PV system. Table 4.1.1 below shows how to organize the calculations in a way that minimizes errors and increases comprehension.

TABLE 4.1.1
Example of Energy Calculations

Load	**Wattage**	**Daily Use (hours)**	**Total Consumption (watt-hrs)**
Television	60 watts	5.0	300
Radio	25	2.0	50
Fluorescent Lighting (3)	60	4.0	240
Toaster	800	0.25	200
Microwave	900	0.5	450
Ceiling Fan	100	8.0	800
Computer	75	2.0	150
Printer/Copier/Scanner	80	0.5	40
Solar Pump	300	6.0	1800

Total Daily Energy Consumption: 4,030 watt-hours

As already seen in Table 3.1.1 above, different regions of the country receive varying amounts of daily sunlight, and since sunlight is the source of power for PV systems, we must determine the daily amount of sunlight for the region of our interest.

Commercial PV systems are generally rated by *peak-watts,* which is the amount of power produced when the module receives 1,000 watts (1 KW) per square meter of *insolation* (exposure to the sun).

In the case shown on the table above, if we were going to apply it to a location such as Albuquerque, New Mexico as shown above in Table 3.1.1 as producing a daily average of 6.2 peak hours, we need to divide the total daily energy consumption of 4,030 watt hours by 6.2, resulting in 650 peak units. In order to account for the 20% inefficiency caused by the battery bank, we must divide the above result by 0.80 and multiply it by 1.20 to account for leaks, system resistance and human error.

Thus,

$$650 \text{ x } (1/0.80) \text{ x } 1.20 = 975 \text{ peak watts}$$

If we decide to use solar modules rated at 100 watts, to complete the system we will need an array of 10 modules. Solar modules are commercially available almost anywhere within the continental Unites States with unit prices ranging, as of April 2014, from $1.30 to $3.00 per square foot.

The design engineer must also be aware of the fact that solar panels need to have the same ruggedness of roof shingles, as they are subject to the same rigors of the weather (sun, rain, wind, and hail storms) and in most cases the purchase price is not necessarily a reflection of quality. They must be examined for both quality of material and manufacturing details such as mounting methods, wire gage, soldering accuracy, protection against corrosion as well as structural adequacy, which will affect not only performance but durability as well.

One more item before closing this topic, there are commercially available computer software that can be used to calculate the solar panels and components needed, some are based on sophisticated programs that take into consideration many desired variables and design conditions.

5.0 HOUSEHOLD WATER RECYCLING METHOD

Together with the idea of energy savings comes the concept of recycling water as an enhancement to energy efficiency. Under technical support publication #LAR-12134 the National Aeronautics and Space Administration (NASA) described their idea of how to recycle *gray water* from showers, tubs, sinks and laundry drains, and use it to flush toilets and also provide a dependable irrigation source.

Instead of letting the used water from those fixtures to run down the drain pipes and go to waste, NASA technicians figured that if collected in a tank, chlorinated and filtered, that water could be pumped back to the toilets and/or to the outside lawn. Some of the proponents have estimated that such system could save water consumption of up to 50% for the traditional family of four.

With the basic idea shown on NASA's publication in mind, we have applied those same principles to a regular ranch house with most of the living spaces on the first floor and a basement underneath. The one-hundred gallon polyethylene collection tank has been placed in the basement. For the sake of economy such tank could be replaced by two 55 gallon tanks connected back to back, if so desired.

Figure 5.1 depicts how the drains of the washing machine, sinks and tub are connected to a 2" PVC gravity line that takes the gray water from those fixtures to the collection tank [1]. At the discharge end of the 2" line we show a filter [2] for the purpose of trapping all lint, suds and debris from the line. The collection tank is also provided with a 2" overflow line into the septic tank, that same line has an extended arm going upwards to be used as a vent or connected to the vent system of the plumbing lines.

From the collection tank we extended a ¾" PVC line into a pump [3] that injects pressure into the line feeding the toilets of the house. It is important to observe the standard requirement indicating that the lines of the water recycling system must be kept totally separate from the potable water lines of the dwelling, with no cross-connections at all.

It is also important to notice that the recycling system as described by the figure will be at all times in one of three operating modes:

a. The collection tank could be receiving too much gray water, thus causing the excess water to flow into the septic system,

b. The collection tank could have sufficient water to operate as intended but not enough to overflow, and

c. The tank could reach the condition of empty which will cause the pump to suck air and likely burn itself out.

To prevent the system from burning out, it is necessary to add a *ball-cock valve* (similar to those used in toilets) that would allow make-up clean water to flow into the tank when necessary.

BALL COCK VALVE [4]

Since most engineers know how this type of valve works. The following explanation is only for those who do not.

The valve itself could be made of either plastic or brass; we recommend the latter because it is mechanically stronger and more dependable in the long run. It consists of a valve with on and off positions, a water input and output port, a lever arm connecting to the valve on one end and on the other end accepting a threaded ¼" steel rod with a plastic float. A good quality part is normally double coated with silicone to prevent corrosion, to seal the float and assure a reasonably durable life.

When the tank is full and the arm is in its highest position, the valve shuts off the flow of clean water into the tank. As the water level drops, the float and lever arm relax their pressure on the valve and it starts to open up allowing water in and the flows continues until the water reaches up to the full position once more.

In normal operating conditions the water flow from the upstairs fixtures will maintain enough water in the tank to sustain an adequate volume; therefore, the ball-cock valve will open in rare occasions.

AN ECONOMICAL CHLORINATOR

There are effective (but pricy) chlorinators in the market that will do the job, however, for those who are handy, we have included a design which can be added to the water recycling system for a cost of just a few dollars in easily obtained materials.

Figure 5.2 is a very self-explanatory picture of an economical slow-drip chlorinator consisting of an inverted plastic bottle of commercial chlorine or supermarket bleach. Two holes need to be drilled, one through the bottom of the bottle to be used as a vacuum breaker and another one through the plastic cap to accommodate a brass compression adapter and a nut on the inside. The discharge tubing is pinched by using an electrical box connector and its screw tightened enough to allow just a slow drip of chlorine.

A suitable piece of wood is passed snug by the handle and used to hang the bottle in place and allow its future replacement as needed. Galvanized metal clips or notches in the wood strap are suggested to saddle on the edges of the collector tank.

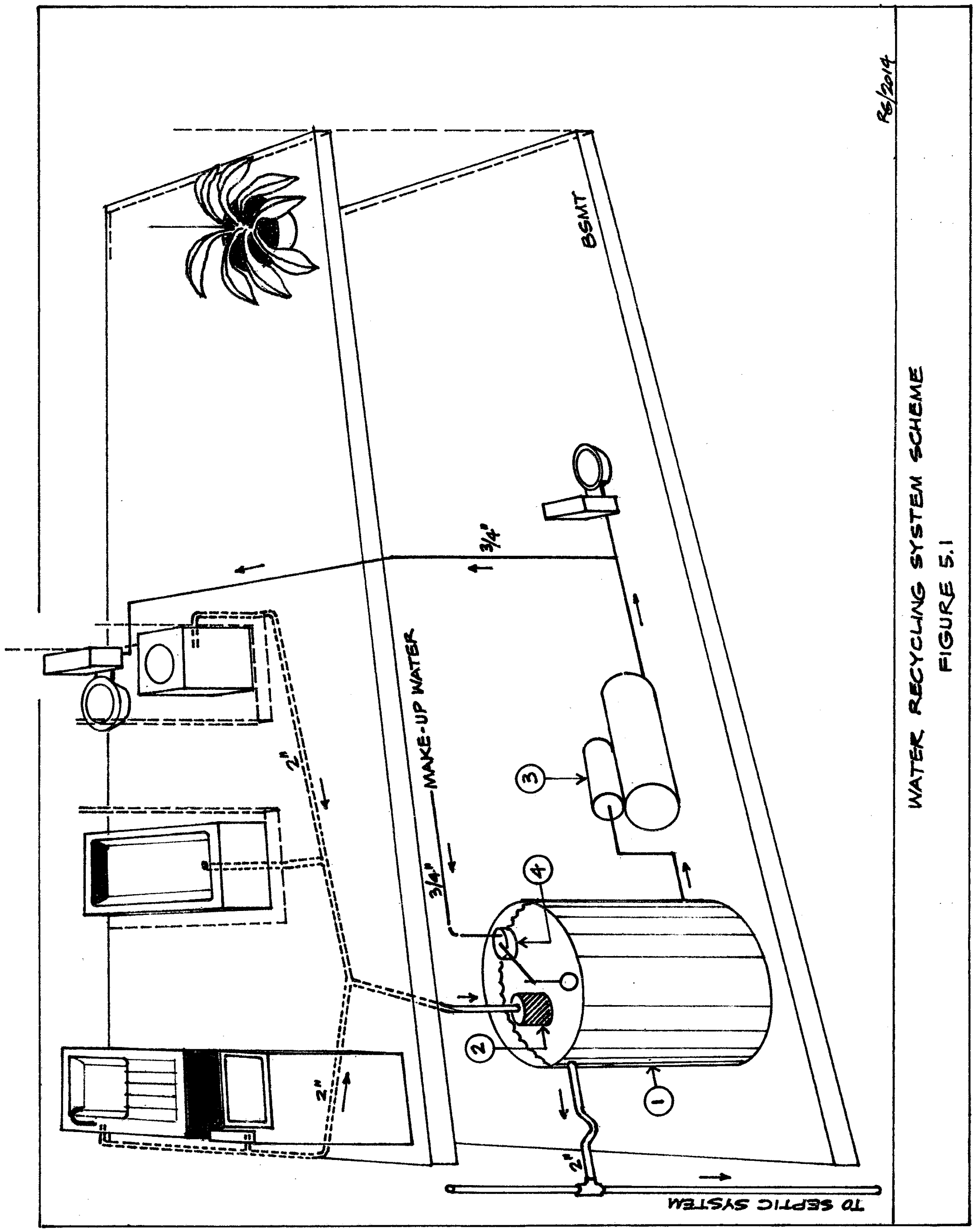
SYSTEM PERFORMANCE

Reports coming from long time users of this water recycling system indicate that they are well satisfied with the idea for more than one reason:

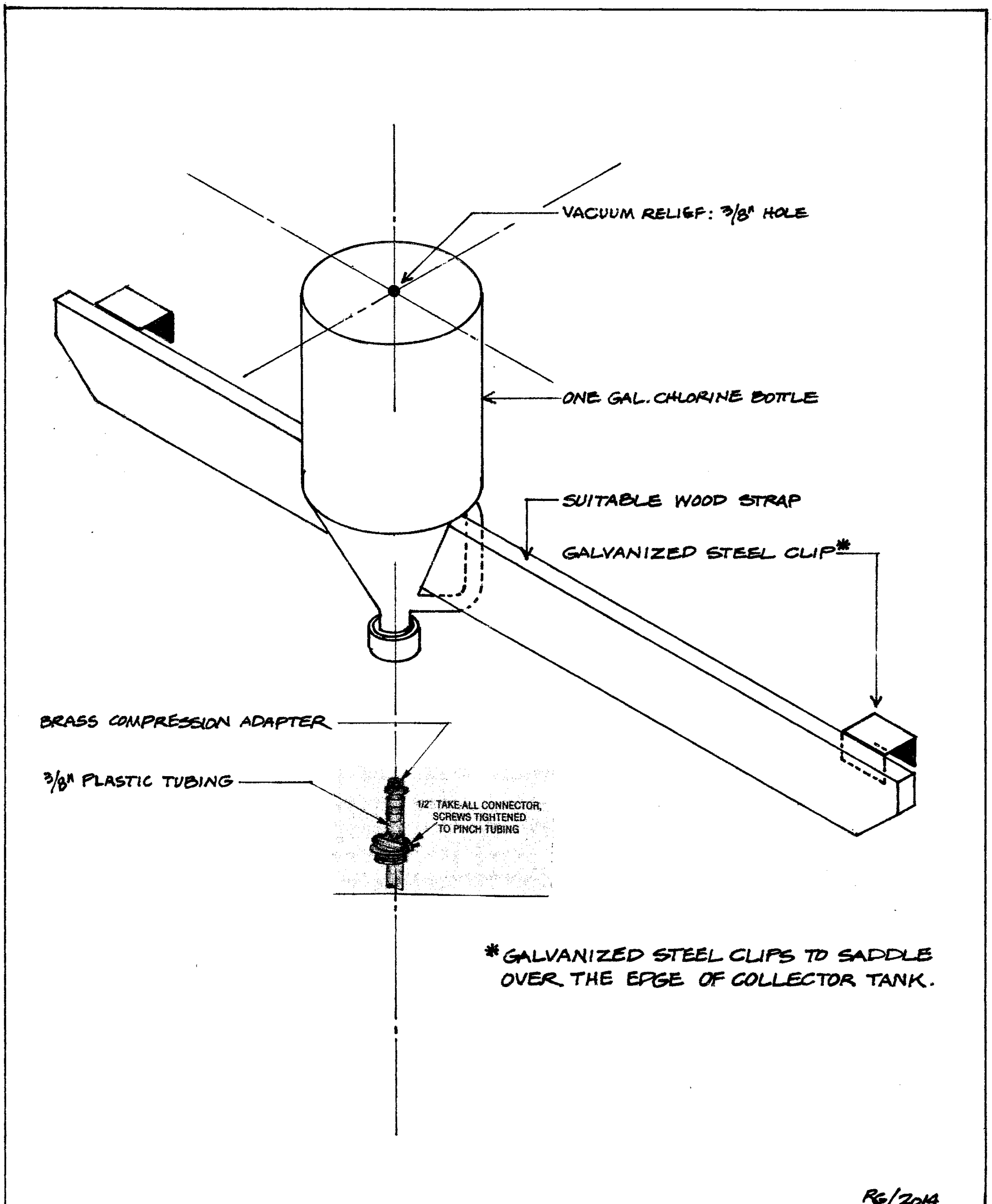
a. they reduce water consumption,

b. they feel to be contributing to save our planet resources, and

c. since some of the soaps and detergents may escape the filtering process, they would help to maintain the toilets free from the usual scum build up in the bowl.



WATER RECYCLING SYSTEM SCHEME
FIGURE 5.1



SLOW DRIP CHLORINATOR
FIGURE 5.2

6.0 CONCLUSION

There are plenty of theories and varied speculations regarding the oil based energy availability and the duration of such availability. Some of the scientists, as well as the "prophets of gloom and doom" have even ventured into predicting the dated end of petroleum, and as all predictions of this nature they are all prone to fail and make the predictors look like fools in the end. However, there is a path that is becoming clear and clearer as the time passes, oil exploration and its extraction from the ground are becoming more involved and difficult, and certainly that difficulty is being reflected in the price of oil products we all pay for.

That such a progression indicates that as the cost of getting the oil out of the ground increases, so will be the wholesale and retail prices, and as they continue to increase out of control, our affordability will decrease proportionally until it will become nil and oil will disappear from the horizon of realistic solutions and expectations. Consequently, our strategy must be one directed to anticipate such a calamitous dead-end and seek for all those other energy sources which are presently available to the common individual.

It is unlikely that we will find a panacea, as it was oil, to solve all of our energy woes. But likely is the possibility that we will have to use all energy sources combined to solve our common consumption problem that is clearly under way. That is, that we will have to ponder, explore, examine and apply wind, solar power, biodiesel, geothermal energy, nuclear, natural gas and coal combined so to prevent the extreme point of disastrous and irreparable consequences to our industrial and scientific further development.

Undoubtedly, we certainly have some major challenges ahead. We have to re-program our thinking and the assumption that everyone is taking for granted that our economy will expand without limits, that the population will grow unchecked and that we will always have endless supply of crude oil. The reality is that such thought is in total error, the end of cheap oil is near, however, there is a bright side, for the dimmer the hope for plentiful fossil fuel is, the better the future for alternative energy will be.

The true moral of this story is that in every crisis, no matter how ugly and dismal it may look, it contains within itself the formula for its own solution and oil is no different than all the problems that mankind has faced before and in spite of all the odds, it has managed to survive and emerge triumphant.

APPENDIX

We have referred herein a few times to our prior course titled "Tornado Resistant Homes" where we show as an example a concrete shell house with a hip roof. One of our readers has sent a query asking if such structure would also be earthquake resistant. Although that particular structural scheme was not prepared with seismic forces in mind, we feel that considering its geometry and the presence of by-directional shear walls, that house would do well under seismic conditions. However, due to the large inertial forces developed by concrete structures under extreme seismic conditions, we would be inclined to recommend for such case a combination of reinforced concrete and structural steel as a way to introduce a larger ductility into the "picture" and thus a much better chance of survival.

Referring back to energy efficiency, we have reproduced below a collection of energy related bit and pieces that most of readers will find instructing at best and interesting at least.

TYPICAL HEAT VALUES OF FINISHED FUELS (BTU/GALLON)

Fuel Oil #6	150,000*
Fuel Oil #2	139,000*
Compressed Natural Gas	138,700*
Diesel Motor Fuel	138,700*
Distillate Fuel	138,700*
Jet Fuel	135,000*
Diesel #2	129,500**
Biodiesel Blend B20	127,200**
Automotive Gasoline	125,000*
Aviation Gasoline	120,200*
Biodiesel B100	118,300**
Propane Gas	91,600**

Sources: *University of California at Berkeley, Department of Geo-engineering.
**Author's own files.

ENERGY UNIT EQUIVALENCES*

1 barrel of oil = 5,800,000 Btu's
1 Btu = 252 calories

1 Kwh (kilowatt-hour) = 3,412 Btu's

*Source: American Physical Society.

COMPARISON OF U.S. PASSENGER TRANSPORTATION MODES*

Transport Mode	Average Passengers	Efficiency per Passenger (btu/mile)	(mpg)
Motorcycles	1.2	2,049	56
Commuter Train	33.4	2,571	44
Intercity Train	17.2	2,935	39
Cars	1.6	3,549	32
Airplanes	90.4	3,587	32
Pick-up Trucks	1.7	4,008	28
Intercity Buses	8.7	4,160	27

*Source: Oakridge National Laboratory/Center for Transportation Analysis.

COMPARISON OF U.S. FREIGHT TRANSPORTATION MODES*

Transport Mode	Fuel Consumption (btu/ton/mile)
Class 1 Train	344
Domestic Freightboats	417
Truck Trailers	3,357
Air Freight	9,600

*Source: Oakridge National Laboratory/Center for Transportation Analysis.

U.S. DEPENDENCE ON OIL

Here is a snapshot to the statistics (2010):

Country's Population: 330 million (about 4.5% of the world population)

Total Oil Consumption: 20.9 mbpd (about 25% of world consumption)

Total Crude Oil Production: 5.2 mbpd (million barrels per day)

Total Oil Products Imports: 14 mbpd (67% of total consumption)

If being dependent on foreign oil sources for over two-thirds of our total domestic oil consumption is not bad enough, then take a look at the next tid-bit and you will find out who those suppliers are.

TOP TEN OIL EXPORTERS TO THE UNITED STATES

Name of Exporter Country	Imported Oil (mbpd)	% of Total
Canada	2.4	17
Mexico	1.7	12
Saudi Arabia	1.5	11
Venezuela*	1.4	10
Nigeria*	1.1	8
Algeria	0.7	5
Iraq*	0.5	4
Angola*	0.5	4
Russia*	0.6	4
Other smaller exporters	3.6	25
Total Oil Imports:	14.0	100

*Countries followed by an asterisk are either clearly hostile to the U.S. or seemingly have "an axe to grind".

Further, of all those above named oil sources, the following countries are now experiencing declining production:

Saudi Arabia, Mexico, Venezuela and Nigeria.

TOP WORLD OIL PRODUCERS (2010)
(With production of 1.0 mbpd or larger)

Country	Yearly Production (mbpd)
Saudi Arabia	10.9
Russia*	9.9

United States	6.9
Iran*	4.3
Mexico	3.6
China*	3.6
Canada	3.2
United Arab Emirates	3.0
Venezuela*	2.8
Norway	2.7
Kuwait	2.7
Nigeria*	2.3
Algeria	2.0
Iraq*	2.0
Libya*	1.8
Brazil	1.8
United Kingdom	1.6
Kazakhstan	1.4
Angola*	1.4
Qatar	1.2
Indonesia	1.0

*Countries which have demonstrated hostility towards the United States.
