



The major building component of the Earthship is used automobile tires. These tires are filled and compacted with earth to form a rammed earth brick encased in steel belted rubber. This method creates a nearly indestructible frame allowing the use of thermal mass to heat and cool the interior. The rear and sides of the structure is buried with earth to connect it to the deeper earth mass. Floors must be finished with stone, tile, cement, or some other material that will further enable the concept of thermal mass construction.

Interior non-structural walls use recycled bottles and cans to form their shape. They are laid like bricks to form a matrix in cement. The cans and bottles serve no structural purpose. They are simply used as a method to form concrete into walls in a low-tech way using recycled materials instead of more cement or wood. These walls can be plastered over for a clean look. Many of the bottle walls are plastered, but leave a portion of the bottles exposed to allow a stained glass effect.

During the winter months, the low angle of the sun allows passive solar heat to be collected through the south facing windows. It is absorbed into the floors and walls throughout the day. Later in the evening when the outside air cools, the stored heat is released. Residents of Earthships claim they can feel the heat being released during the coldest hours of the night. They say it feels as though someone just turned on the heater.

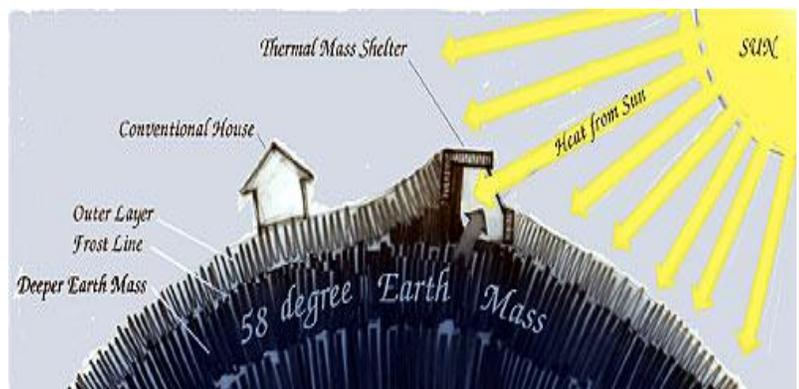


Illustration Courtesy of Earthship.org

During the hot summer months, the angle of the sun is too steep to reach the interior portions of the structure. This allows for a radiant cooling effect from the earth. In addition to the thermal cooling properties, passive ventilation systems assist in maintaining a comfortable temperature. Small windows are opened along the south side to allow air in. Skylights are then opened to draw the fresh air up through natural convection. For extremely hot climates, a cooling tube can be added. Incoming air is channeled through a tube buried in the earth. This taps into the cool earth temperature and draws cool air into the house.

Rainwater is collected for the water supply from the roof. The water is stored in cisterns buried next to the house. The water is then pumped and pressurized from the cistern through a filtration system before it is used for drinking, bathing or cleaning. Hot water is obtained through a solar hot water heater. On-demand heaters, powered by natural gas, are used as a back-up. Once used, the grey water is collected and filtered through an indoor planter called a botanical cell. The water is used for growing various edible foods, herbs and ornamental plants. Once filtered, the grey water not used by the plants is recycled for use in flushing toilets. Black water from the toilet is treated in a septic system then passed through an intermediate botanical cell outside the home before the

water reaches the septic leech field. Most often, as the landscape plants absorb most of the water, the leech field becomes unnecessary. This leech field is, however, required by building code. This system effectively uses the same water four different times.

The “Systems Package” is the name given to all the equipment needed to run an Earthship. This includes a water organizing module for filtering collected water, a pressure tank, a grey water pump panel, batteries and a power organizing module. These components are normally packed in a small room, but easily accessible for servicing. Energy is collected by the sun via solar panels and stored in the battery system.

The Earthship concept has been developed over 30 years by architect Michael Reynolds. Earthships now exist all over the world and could be an ideal candidate for affordable housing as they are inexpensive to build. The simple building methods used makes it easier for people to build the homes that they are going to live in. Once built, Earthships are highly energy efficient and have low running costs, keeping them affordable.

The Greater World subdivision is comprised of 633 acres of rolling mesa whereby 347 acres will remain as common land upon completion of the subdivision. There are 130 home sites, 42 of which are considered affordable housing. All sites range in size from five acres to slightly less than one acre. While this seems like sprawl by smart growth definition, one should consider that this subdivision is experimental. It is expected that future developments incorporating the Earthship concept can be much more dense.

The Gravel Pit Reclamation area of this community is an example of higher density possibilities. In this project area, home sites are much closer together than in other areas of the subdivision. 24 units will be built upon completion and each site is less than one acre. While still not as dense as a typical suburban community, it does set aside more common space than a traditional suburb. Further, the community considers the Gravel Pit area as reclamation of damaged land through positive-impact construction. Since its inception, the Gravel Pit project area has experienced a slow return of natural vegetation along with planted gardens.

Part of the agreement for building in the Greater World Community is that no wells will be drilled. Rainwater is expected to be the only method of water collection. This presents a problem for the community because the average annual rainfall is barely eight inches. To supplement the occasional drought seasons, one community well has been drilled in the subdivision. This well is not piped to individual homes; therefore collection must be by hand.

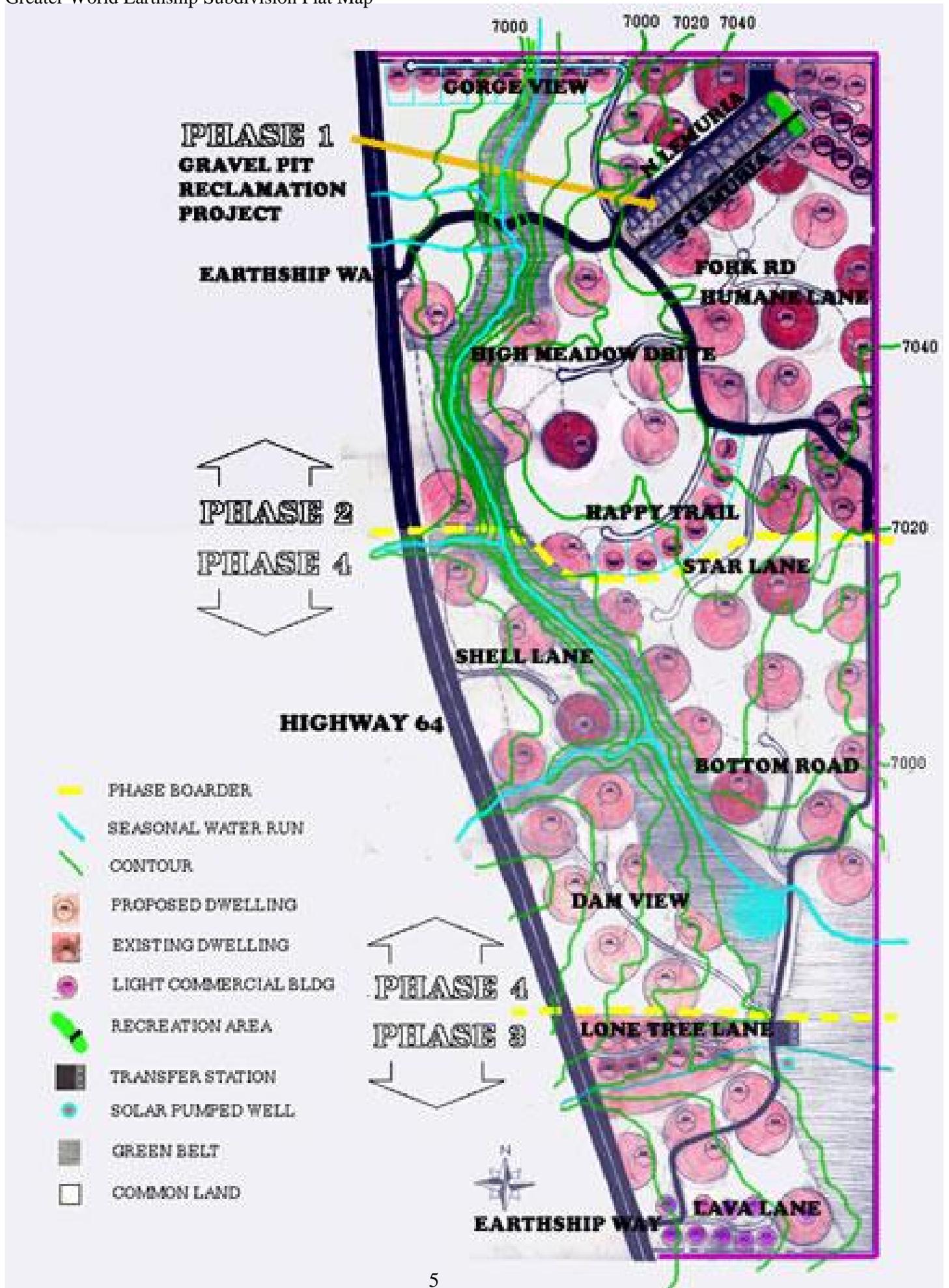
There is one area of the subdivision set aside for light commercial buildings. This area is located at the southern most end of the property on the beginning of Earthship Way and on Lava Lane (see plat map on page five). This area is intended to encourage cottage industry and office studio spaces. The buildings must be Earthships and adhere to all rules placed upon community members.

Waste management has been carefully thought out by members of the community. Their intent is to demonstrate the reuse of by-products of our society. The buildings themselves demonstrate the reuse of several by-products. Aluminum cans and glass bottles can be used as bricks for minor planter walls and partitions. Hard plastic containers are ground up and mixed with pumice in the waste water treatment systems. These materials will be collected for reuse at two transfer stations located at opposite ends of the property. One transfer station will be at the northern end of the property and one is already in use at the southern end. These transfer stations provide “earth-bermed bins” for aluminum cans, steel cans, plastics, glass bottles and jars, and tires. Compost is used by each home owner on their sites to help enrich the desert terrain. A leased dumpster from a local waste management company is currently provided at the south station for the remaining solid waste.

The community plan for transportation is to keep the impact of roadways to a minimum. The objective is to preserve the beauty of the natural terrain as much as possible. There is one major road servicing many small low impact roads ending in cul-de-sacs. The main through road of the Greater World Community is called Earthship Way and is an easily accessible dirt road. It begins at the southern end of the property and exits near the northern boundary. Both of these highway access points existed prior to the subdivision. One was for ranching and one was for the existing gravel pit. All minor roads in the community are also dirt. Final build out of all roads is expected to take twenty years from inception in 1998. Roads will occur as development requires.

There are many questions I have after investigating the Greater World Earthship Community. There is no doubt that the Earthship exceeds the general expectation of a sustainable building, but the greater world community does not meet the criteria described as smart growth. Dwellings are arranged too far apart. Individually owned cars are still the main source of transportation. Currently, the nearest retail center is twelve miles away. Residents of this community must either telecommute for work, or drive to places of employment. How could this community be modified to increase densities without compromising the way an Earthship works? If a subdivision like this could be modified, would it be suitable for California’s central valley? If so, would anyone buy them? Further, would a developer take on the task of the labor intensive rammed earth tire?

Since the inception of the Greater World Community, Michael Reynolds has attempted to address some of these questions. In his newest book, Earthships volume III, Michael Reynolds introduces his idea of the “Urban Earthship – City Application.” While I have not fully investigated the concepts, he presents drawings and explanations for designing entire cities that don’t need municipal water or power services. Perhaps it’s a crazy concept, but we have done crazier things. I hope to continue evaluating this possibility and gather opinions from local building officials, developers, planners and zoning administrators. If one Earthship could be constructed in the greater Sacramento area for the purposes of evaluating its viability, it should be considered a successful venture into creating the ultimate sustainable housing.



**Sources:**

Reynolds, Michael. *Earthship Volume I: How to Build Your Own*. New Mexico: Solar Survival Press, 1990

Reynolds, Michael. *Earthship Volume II: Systems and Components*. New Mexico: Solar Survival Press, 1990

Reynolds, Michael. *Earthship Volume III: Evolution beyond Economics*. New Mexico: Solar Survival Press, 1993

Reynolds, Michael. *Comfort in any Climate*. New Mexico: Solar Survival Press, 2000

Reynolds, Michael. *Earthship Weekend Seminars: Hands-on Experience*. Earthship World Headquarters, New Mexico. September 22-24, 2006

**Internet Resources:**

*Earthship Biotecture* - <http://www.earthship.org/>

Learn everything there is to know about Earthships. Rent an Earthship for the night, schedule a seminar with the architect, buy books, and view photos of Earthships in the image gallery.

*Kirst's Earthship Adventures*- <http://www.pinkhammer.blogspot.com/>

View the experiences of one young woman who has successfully built her own Earthship. Kirsten Jacobsen also works at the visitors center in the Greater World Earthship Community. She is credited as an excellent advocate of the Earthship concept and has contributed numerous photos to the Earthship Biotecture Website.

*The Official Website of Denis Weaver* -

<http://www.dennisweaver.com/earthshipforsale.htm>

The late actor, Dennis Weaver created a video of him and his wife building a large Earthship in the mountains of Colorado. This video is for sale on the earthship.org website. Currently, Dennis Weaver's Earthship is for sale.

*Low Carbon Network* - <http://www.lowcarbon.co.uk>

The Low Carbon Network is a UK based non profit company. They are working towards making the Earthship a viable option for community housing in the UK. They currently have an Earthship visitor's center in Brighton, England and are working to promote development within Brighton and Hove City.