Creating That Special Place

Pond Tour U.S.A.

Nebraska

Carol & Terry Hunter, Papillion

Famous last words of my husband, Terry:

"Well, when we move to the lake, at least

I won't have to help you dig a pond."

My love for water has been with me since I was a small child. Growing up in southern California, water was always close by and a part of my life. Once in Nebraska, I began to create landscapes which included water as a way to nourish my own spirit. When we made the decision to move to a home on a small lake, it was easy for Terry to believe a pond would not be a part of the gardens surrounding our home. The current pond, however, fulfills more than my need for having water close to me. It provides a special place where I connect with Nature and get to know the fish, frogs, and plants as friends. I experience these friends and their changing lives and thus feel a greater connection to the Universe.

Having had two other ponds with a connecting stream at my earlier home, I was eager to try something new. The biggest change came not from external design but from geography. Our move was from extreme shade to total sun. This dramatically changed my experience of water gardening. I was a beginner all over again.

Our yard is terraced down to the lake with two seawalls. The first separates the small sandy beach from the water. The second separates the lawn and garden from the sandy beach. Each level is about three feet higher than the other. I chose to site the pond on the corner of the yard, overlooking the lake and beach. The site is also directly beneath the cedar deck which runs the length of the house. This means we can step outside any door, look over and have a perfect view of the pond. Often, we, as well as our guests, run to the deck rail to inspect the pond, momentarily forgetting the inviting view of the lake and the mighty Platte River just beyond the lake. My wish to have water around me has indeed been granted.

The pond design is a figure eight with a small arched redwood bridge crossing the middle of the eight. The pond is approximately 10 x 19 feet, shelved with two tiers, and at its deepest is four feet. A small rock waterfall flows into the east end and a spitting frog fountain flows into the west end. The forty goldfish plus frogs stay out all winter long with the help of a small, floating heater. For a couple of months during the winter, most of the pond freezes over except for the small circle of water left by the heater. At times, the windchill can be minus 30 degrees, but the fish do quite well.

Summer-blooming Black-eyed Susans accent the blooming lilies and lotus within the pond. *Photo by Carol Hunter.*

Pond Specifics

- 2400 gallons
- 2 Supreme Pondmaster 250 pump/filter units
- filtration primarily submerged and floating plants
- liner of 60 mil UltiLiner, 15 mil geotextile material bonded to 45 mil rubber

Carol's pond, viewed from the deck above, is tucked above the sandy beach leading to the lake. *Photo by Carol Hunter.*

For three summers I enjoyed the beauty of tropical lilies, 'Tina' and 'Evelyn Randig.' Both thrived and bloomed continuously. However, I finally tired of hauling them out in the fall and fretting about their questionable survival in the basement from October through April. Now I rely on hardy lilies and find they meet my need for both beauty and ease. Three water lilies mean something is always in bloom from May through early October. I have 'Arc-en-ciel,' 'James Brydon' and 'Perry's Fire Opal.' The small lotus 'Chawan Basu' also delights us with multiple blossoms from late June through September. I fertilize all my blooming aquatic plants regularly with Pondtabs.

This past summer I added a novelty, the pygmy water lily, 'Helvola.' It was exciting to see the tiny perfect yellow flowers about the size of a quarter.

In addition to the lilies, the pond is overflowing with miniature cattails, variegated sweetflag, pickerel rush, *Equisetum hyemale*, *Sagittaria*, umbrella palm, water parsley, parrot's feather, water lettuce, water hyacinth and thick anacharis and *Cabomba.* I've learned the trick of making a corral for the water hyacinth and have had lots more daily lavender flowers. I thin the floating plants every month, but they multiply rapidly.

What fun it has been to see my grandson, Colton, become old enough to peek over the edge and eagerly feed the fish. One of his first words was, of course, 'fish.' The pond is a private sanctuary for me, a special place to be alone as well as to share with others.

Nebraska

Phyllis Meyer, Bellevue

Phyllis Meyer is a person well-known in Bellevue, Nebraska, and in surrounding Sarpy County as a woman who gets things done. Few people who know her in her active civic and business life have visited her secret garden. Yet, even here in her water garden, she gets things done, actively designing, creating, and building with each passing season.

Each autumn, Phyllis says, "Now, that's about enough." But during the cold, snowy winter months, she begins to dream again. By early spring, she has sketches and is buying supplies. Phyllis does most of the work herself.

The pond has been a seven-year project. She says it is "an evolution in the making." In 1991, Phyllis took a garden hose out onto the back lawn and laid out a design. The final hole was an L-shaped lagoon with one side of the "L" being 7 feet x 13 feet and the other side being 7 feet x 6 feet. The completed pond holds about 2100 gallons. Phyllis hauled in over 4 tons of Colorado moss rock to create natural pond edges, two waterfalls, and a terrace. She used the excavated dirt to create a large berm which skirts the backside of the pond.

The berm is planted with a variety of perennials which thrive in our Nebraska weather. Now seven years later, many of them are up to five feet high. *Ligularia, Penstemon, Bergenia, Cimicifuga,* and *Aconitum* stand behind *Hosta, Astilbe,* honeysuckle, candy lilies, bleeding heart, and *Ajuga.*

The pond itself is alive with the wonderful energy of 25 Koi and golden orfe. Some Koi are as large as 16 inches. About 3 years ago, Phyllis accepted a small group of Koi from a begging friend. She now claims these newcomers are the worst behaved Koi she has seen. The active, mischievous fish have provided new opportunities for Phyllis' creativity. In order to save her water lilies and 15-20 other varieties of water plants, Phyllis brought in small pre-formed ponds and put them directly into the larger pond. Mounted on bricks and filled with water, they became a stable and safe sanctuary for the plants: hardy water lilies, spider lilies, umbrella plant, dwarf papyrus, ribbon grass, horsetail grass, pickerel rush, water hyacinths, and others.

Phyllis' pond before she enclosed it. *Photo by Carol Hunter.*

Underwater lights are strategically placed to illuminate the pond at night. Notice the frog sitting amongst the duckweed.
Photo by Carol Hunter.

The water in the pond is crystal clear. Every move made by the Koi and golden orfe is visible from the water's edge. Phyllis read about biological filters, then designed and built her own. Water flows through an aeration tower, back through three different levels and sizes of gravel and returns to the pond via a small waterfall. At the center of the pond, a larger double-tiered waterfall spills water into the pond.

Pond Specifics

- 2100 gallons, lagoon shape
- 2 Little Giant 1200 GPH submersible pumps biological filter designed by Phyllis
- 45 mil rubber pond liner cedar-framed, self-standing sun room, 1024 square feet

The top deck of the large waterfall is filled with water hyacinth adding to the water clarity. Eight underwater halogen lights illuminate activity at night.

An on-going challenge has been dealing with the leaves of the many trees in the neighborhood. Over the years, many sizes and styles of nets have been draped over the huge pond. Netting has been mounted on wooden poles or laced to metal poles with a canvas roof. Because of the size of the pond, it was difficult to keep the netting out of the pond. Finally, last year Phyllis came up with a plan: build an enclosure for the pond.

Today, a 32 x 32 foot cedar-framed structure protects the pond. The roof allows sun and light to keep the pond thriving. The roof is twin-walled verolite polycarbonate clear sheeting. Sliding transparent walls on three different tracks slide behind one another for most of the spring, summer and fall. In early spring and late fall, the walls can be slid closed and Phyllis and the pond gain additional weeks of warmth and shelter in our Zone 5 weather.

The pond is a wonderful expression of Phyllis. It represents her entrepreneurial sprit. Someone once said that most people look at what they have accomplished and say, 'Look how much we've done.' But an entrepreneur says, 'Look how much more is left for us to create.' This is Phyllis and that attitude makes her water gardens a wonderful, on-going work in progress. ❧

Phyllis built an enclosure for her pond that allows in sunlight but prevents leaves from making work for her within the pond.
Photo by Phyllis Meyer.

New York

Upper Brookville

The Pond:

Sited at the edge of a woodland setting.

8000 gallon + filter = 600 gallons and 2 bogs of 600 gallons

Designed by Bob Bon Giorno and built by Suburban Water Gardens, spring 1995

48 inch depth with 2 four-inch bottom drains feeding a vortex quad module with 750 super quad filter system.

80 watt UV light and 5400 GPH waterfall with underwater return with venturis; 2 skimmers

20 Koi (14 to 20 inches) including Shiro Utsuri, Kohaku, Yamabuki, Ogon, Sanke, Showa, Gin rin showa, Zha Goi, most are Japanese

Problems Solved:

The original concrete pond had no filter or bottom drain and consistently measured a high pH. We added the vortex filter system, bottom drains and a special thermo polymer coating to the inside of the pond. The pH now measures a constant 7.2, and the pond no longer tests for ammonia. We now enjoy healthy Koi.

Maintenance:

10 to 15% water change weekly; purge vortex twice to weekly; fertilize the bogs about every three weeks during the season.

Pondowners' Advice:

The quality of water is the key to healthy Koi. Before you build a pond, first talk to other avid

A low waterfall appears to emerge from a woodland stream at the back of the pond.

pond owners. Don't build a pond without a bottom drain; don't put your pump in your pond, read all of Helen Nash's pond books; make it bigger!

We Most Enjoy:

Our pond is the most peaceful and relaxing place in the garden. Family and friends always seem to gather at the pond first. Most folks can't believe how our Koi have grown or how they come and take food from our hands.

(top) A dry creek bed fashioned of shingled, black stone creates the illusion of water.
(above) A Japanese lantern is sited so that its light will shine on the dry creekbed.
(opposite page) Pocket bogs created around the edge of the Koi pond protect the plants from dam

New York

Massapequa Park,

The Pond:

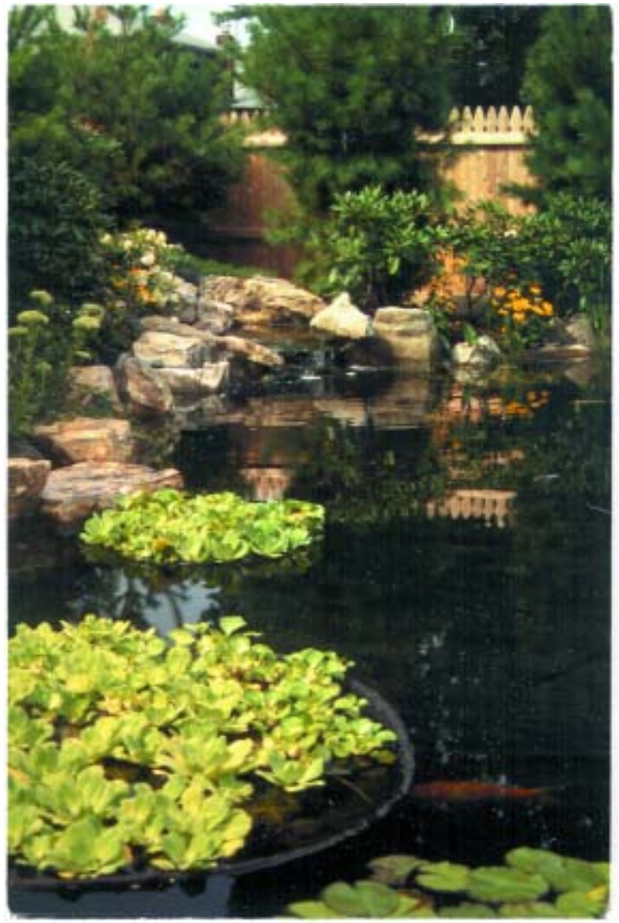
The pond is 19 x 16 and 3 fi feet deep, containing 8,000 gallons. It was designed and built by Bob Bon Giorno of Suburban Water Gardens and Greenhouses, Dix Hills, New York

The pond is edged with ten tons of hand-picked Pennsylvania moss rock which include three bogs and a two-tier cedar wood deck overhanging the pond. The rocks were strategically placed to avoid a necklace appearance around the pond. Bog plants include lotus, hardy lilies, tropical lilies, cattails, iris, and taro.

The pond's residents include a mix of Japanese, Korean, Israeli, and domestic Koi.

Some of the fish were from my first pond which was 550 gallons. I outgrew that pond the first year and wished I had built it bigger and better. With my not knowing much about fish and only knowing indoor aquarium fish, Bob suggested I join the Mid-Atlantic Koi club. There is a saying in the MAKC: "Build your last pond first."

There was so much that I did not know — bottom drains, skimmers, winter draw, winter returns, vortex filters, and UV lights. I bought one UV light from a local nursery. The nursery built this light *without* a quartz sleeve and UL approval. I later learned the fish could have been electrocuted with this type of light!



Floating plants are protected from the Koi by enclosing the plants within floating net rings.

The pond is equipped with two bottom drains, one on the bottom and one at mid-level. The reason for the two-levels is the lower bottom drain is shut in the winter months so that the pond is drained only by the upper drain. The pond is filtered year round with a suburban 750 quad vortex series set up 45 feet away from the pond (hidden around the corner of the house). The first filter is the empty vortex where the debris settles to the bottom and enters the second, third and fourth vortex. Inside these vortexes are Japanese matting, foam matting, and Springflo (bio-ribbon) media. The water then passes through Suburban's UV-1 ultra light back to the pond via a waterfall and stream.

An overhanging deck provides ready access to feed and enjoy the Koi.

Problems Solved:

Massapequa Park is located in the south shore of Nassau County, Long Island, which is surrounded by water. I also live near a running stream that empties into a large lake. When the bobcat dug down two feet, water was discovered. The rest of the digging had to be done by hand. The pond was also bermed up to achieve more depth.

Pondowner's Advice:

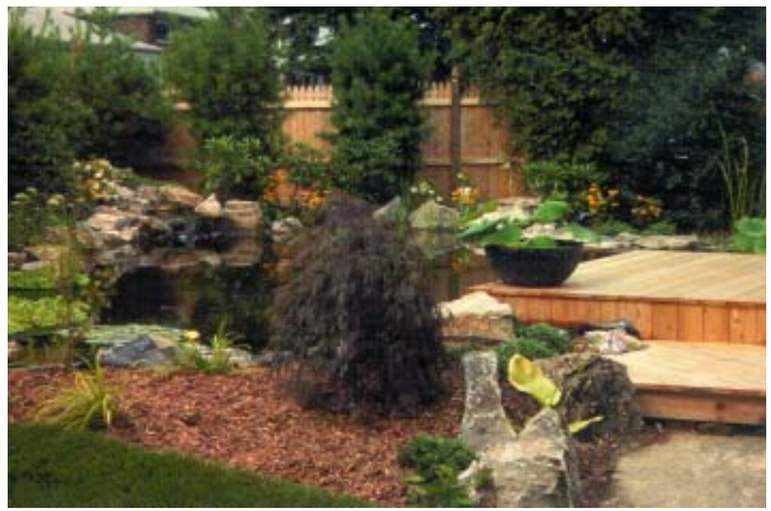
For the first-time builders, join a club and attend pond tours. A club is also helpful later for help and advice. Avoid nurseries that just want to sell you and don't know what they are talking about. Know about ponds and Koi *before* you build the pond. Find a Bob Bon Giorno in your neighborhood who will sit and explain step #1 through the completion of the pond. Enjoy the pond year-round by building it as close to the house as possible. Know the exact water capacity of the pond, including the filters, for adding salt or other medication.

Maintenance :

Weekly vortex purging and partial water changes.

I Most Enjoy:

Having a water feature in my garden: it is like dying and going to heaven.



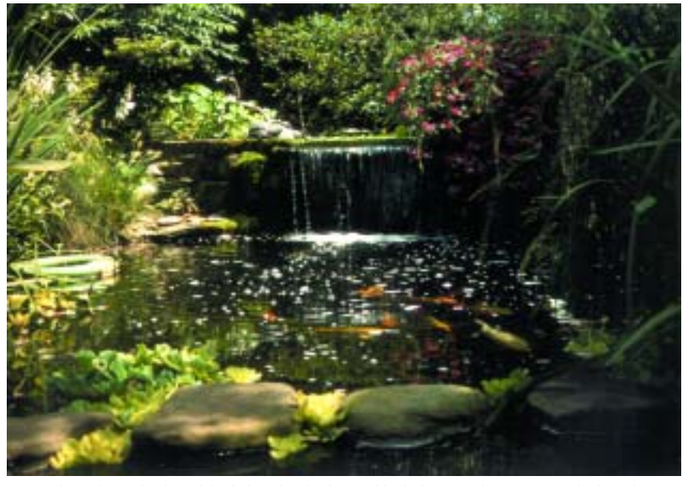
The surrounding edges of the pond are designed for low-maintenance.

New York

Dix Hills

The Pond:

Now holding 9000 gallons, the pond was originally designed by Atlantic Nursery in 1988, with a waterfall added by Rockwater later in 1988, and doubled to its present size by Suburban Water Gardens in 1993.



Now enlarged to twice its original size, the shady pond includes stepping stones and a broad, cascading waterfall.

The depth furthest from the waterfall is 3 fi feet, the area closer to the waterfall is 5 feet. It has a heavy vinyl liner with a glued seam from the addition. The pond is in front of the house, but it is hidden from the street by heavy foliage. The edging is river rock, concrete blocks, and bogs. The pond is home to more than fifty Koi, the largest being 30 inches long and weighing about 15 pounds. The water is kept clean and safe with a biological filter system of 4 gravity flow vortex tanks, 2 bottom drains, and a UV light.

Problem Solved:

We had a problem with aeromonus after a long winter and found that the goldfish carried the disease and passed it to Koi. We gave away all of the goldfish in 93. We cover the pond with a heated greenhouse in the winter so the fish can grow healthily 12 months a year.

Tucked within the dense foliage shielding the pond from the street is a 'scrap-metal' sculpture of a giraffe that watches over the pond.

Maintenance:

Purge filters two times week, clean skimmers daily and remove floating debris. Check fish for any signs of disease.

Pondowners' Advice:

A good filter system and keeping the pond clean is time-saving in long run. Try to put pond away from large trees to prevent debris. We didn't do this! Seek help from professionals and friends or acquaintances who have ponds. Clean water, good filtration, and healthy fish are not as easy as it looks.

We Most Enjoy:

The sound of the waterfall and the interactions of birds and local wildlife that are non-threatening to our fish. The flowers and foliage are different each month, and the fish are always relaxing to watch.

New Jersey

Marty Wilk Jr.

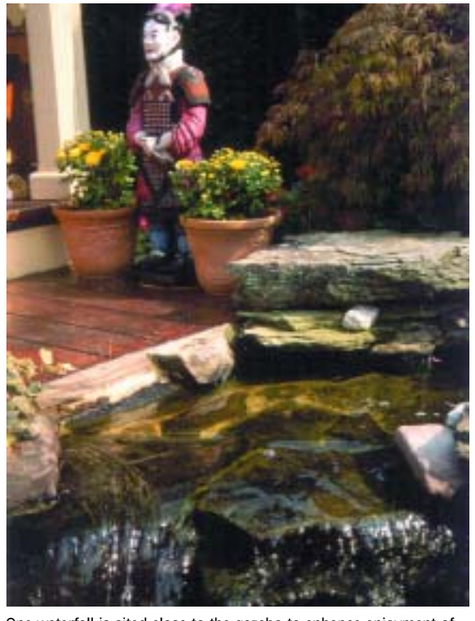
The Pond:

Holding 1,000 gallons and 39 inches deep, it was designed and built by Marty in 1994.

Lined with rubber, it is shaped as an hour glass about 16 feet long and 9 feet wide with a handmade bridge at its center. Pennsylvania wall stone surrounds the pond. Marty also made a gazebo to overlook the pond where he can watch and feed his 13 Koi. The water is circulated with a Dolphin 36 pump through a settling chamber and pad media. Water is taken 50% from the bottom and 50% from the skimmer. A 40-inch Emperor UV light keeps the water clear.

Problems Solved:

A UV light and salt additions did away with green water.



One waterfall is sited close to the gazebo to enhance enjoyment of its relaxing sound.

Maintenance:

Remove any floating debris and clean out the filter every 7-10 days with water pumped from the pond.

Pondowner's Advice:

Regular maintenance, cleaning, and water changes keep the pond from getting the upper hand.

For the first-time ponder: talk to your local gardening/pond center. Also, join a Koi club and talk to people who have a pond. Experience is the best teacher

I Most Enjoy:

watching the fish.

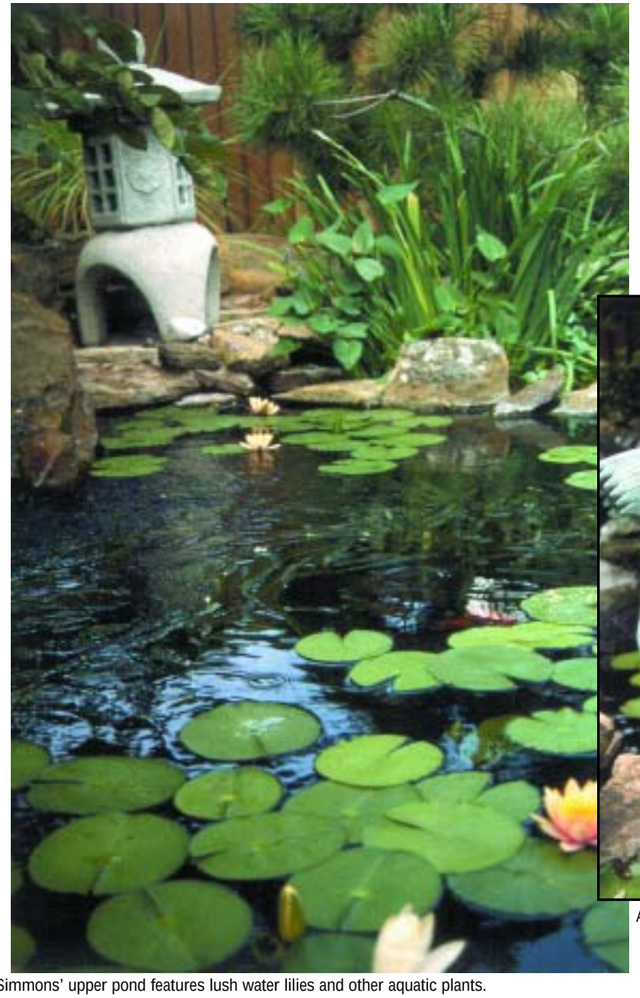
Fully constructed by Marty, his Koi pond includes a charming bridge and a gazebo.

Texas

Ross & Onie Simmons, Dallas,

The Pond:

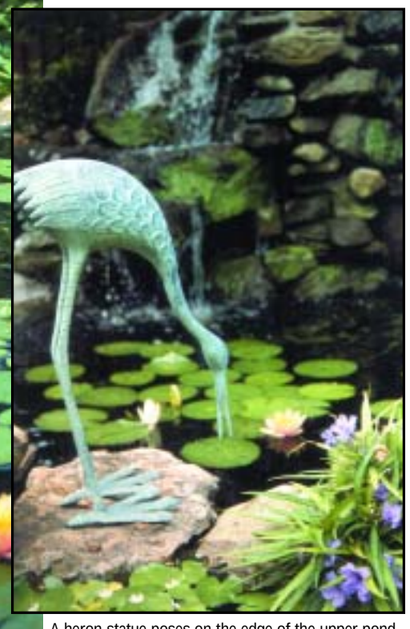
Designed and built by Beau Roye in 1994, the upper lily and goldfish pond holds 2500 gallons and is 24 to 30 inches deep. The lower Koi pond also holds 2500 gallons but is 40 to 46 inches deep. Both are lined with an EPDM liner and finished with extensive rock work around them. each pond. There are two water falls: the upper water fall cascades approximately 4 feet into the upper pond, and an 18-inch waterfall links the upper and lower ponds. (See www.flash.net/rems for complete description.) The upper pond is home to 20 to 30 fancy goldfish and comets. The lower pond is home to 6 to 12 Koi. Filtration is provided by a Cyprio 6000 and two Cyprio 4000, UV lights, two pea gravel bogs, and a settling tank.



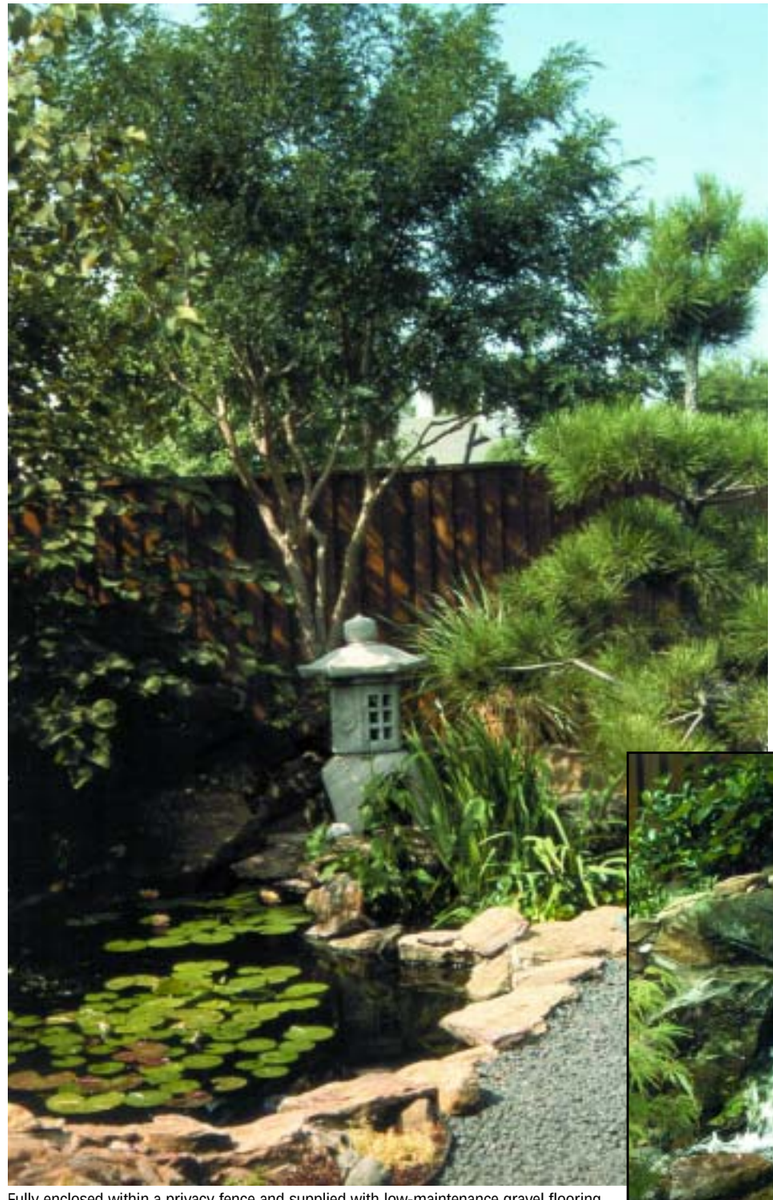
The Simmons' upper pond features lush water lilies and other aquatic plants.

Problem Solved:

We solved the spring algae bloom with a UV light.



A heron statue poses on the edge of the upper pond.



Fully enclosed within a privacy fence and supplied with low-maintenance gravel flooring, the Simmons' ponds are the focal point of their outdoor room.

The waterfall actually splits to cycle water into both the upper and lower ponds.

Texas

Jim and Barb Quast, Rowlett

The Ponds:

1. The Koi Pond

Holding 12,000 gallons, it was designed by Jim and Barb and built by Suburban Water Gardens in 1996. Constructed of CIM over gunnite with flagstone coping, the Koi pond is 4.5 feet deep. A new 15 x 8 x 4 ft waterfall has been added. A gazebo overlooks the pond that is surrounded with tropical landscaping and plants tucked within the waterfall. The pond is home to 75 Japanese Koi, 3 to 18 inches long. Clear water is provided by Suburban Water Garden's 750 vortex system, a bubble bead filter, and a UV 20 light.

2. 1,000 gallon Pond

A 30-foot stream leads to the pond equipped with a fountain and plants. A bridge crosses the stream. 15 goldfish, 4- to 6-inches live in the pond. A low boy box filter keeps the water safe.

3. 100 gallon Pond

A small waterfall graces the 'nursery' pond, home to 4 2-inch Japanese Koi and plants. A low boy box filter tends the water.

Problems Solved:

Improved filtration system in the large Koi pond by adding vortex system to gain clearer water

The Quasts' gazebo allows close enjoyment of their Koi and new waterfall. *Photo by Jim and Barb Quast*

Maintenance:

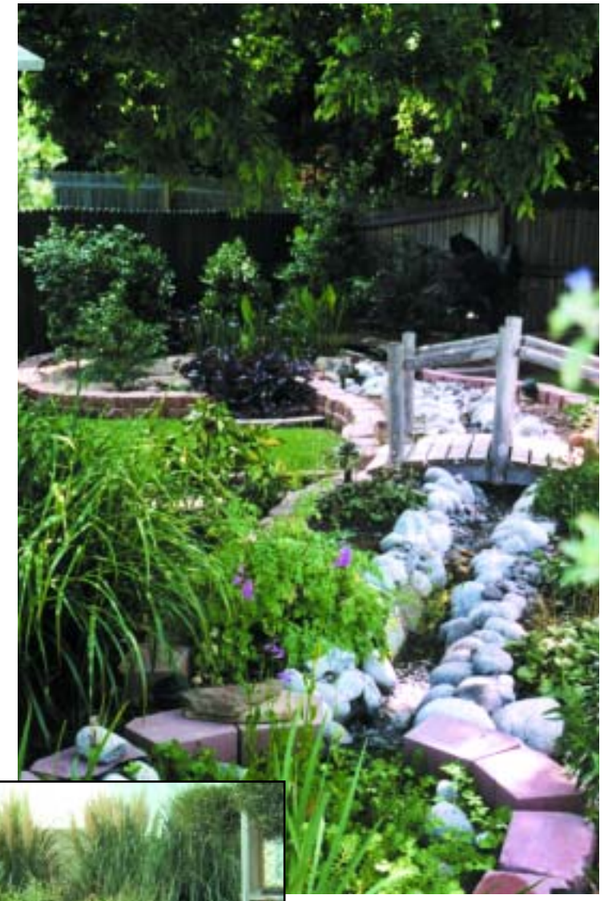
For the large Koi pond, we clean the filter pads 15 minutes every other night. In the other two ponds, we clean the box filters once a week.

Pondowners' Advice:

Talk to pond society and clubs for advice. It's helpful to become members. We use an irrigation system with the waterfall to water all surrounding plants

We Most Enjoy:

Creating a backyard 'oasis' with the unbelievable sound of the new waterfall and the tropical plants; feeding the fish — they eat out of our hands; the sound of the 'babbling brook' and the wildlife attracted to our yard. ❧



In another section of the garden, a stream connects two small water gardens. *Photo by Jim and Barb Quast*

Part of the Quasts' enjoyment of their garden lies in attracting wildlife, encouraged by feeding stations for birds and butterflies.
Photo by Jim and Barb Quast

Umbrella palm is grown within the Koi pond.

Privacy screening around the back patio provides the backdrop for an above-ground pond that is enjoyed year-round from the family room inside.
Photo by H. Nash

Missouri

Debbie Robbins and Jim Cushing, Springfield

I saw my first backyard water garden twelve years ago. I knew then I had to have one and got started right away. I knew nothing and made plenty of mistakes along the way. With three ponds under my belt before moving to Springfield in September of 1993, I thought I knew something about water gardening...wrong! The first pond we put in after moving here is now the bio-filter for the 300-gallon above-ground pond set outside the patio doors.

The patio pond is a 300-gallon RubberMaid stock tank sitting in the corner of the fenced patio. We lined it with 45-mil rubber pond liner when the tank cracked. (I guess it couldn't take all those rocks sitting around the edge!) The rocks, along with plants in containers, help hide the tank. The bio-filter (our 'first' pond) is behind the fence with a connecting tube coming through the fence so that the water returns in a little waterfall. A 1200 GPH Diamond pump powers the volume to the waterfall. A small Little Giant pump runs the water through the filter system. The bio-filter uses lava rock for the medium, along with water celery and water hyacinth for vegetable filtration. Spadderdock (*Nuphar*), watercress, a water lily, water lettuce, horsetail, rush, yellow snowflake, stargrass, and water mint grow in the pond, along with a dozen or so goldfish, most born and raised in there.

A second small in-ground pond sits just off the patio. It has been redone several times, getting larger each time. Its biofilter is a 35-gallon container with the same ingredients as the other one. Two little pumps work here, one to the filter system and another for a little bit more water flow. The water doesn't make a big splash, but gently flows down a few rocks. Watercress, pennywort, thalia, mini bamboo, taro, celery, yellow flag iris, marsh marigolds, and a yellow 'Mexicana' water lily, along with seven split-tail, calico goldfish and a few babies all live here.

But I wanted some Koi. That meant more water. Three years ago, Jim and I started digging again. Did I say digging? It was more like pick and pry, the shovel used only to scoop up the rock we broke loose with the pick. Jim said that $15.00 pick was worth a million. All the rocks in and around the pond came from the hole — that includes all the ones around the flower bed, too! I was a bit worried about how all those ugly rocks were going to look, but as plants starting growing, they covered and softened those rocks. It goes to show you can work with whatever is available.

A 3900 GPH pump goes to the 300 gallon biofilter that is mostly hidden by plants inside and out. That water falls into another little pool of water with water celery taking most of the room and then down to the pond. We figure there is about 1500 gallons of water here, maybe a little more. There are 12 to 13 water lilies in the pond. Most are hardy, but there are a few tropical lilies, 'Green Smoke,' a day bloomer and 'Red Flare,' a night bloomer. A pink lotus was given to us by a fellow Springfield Watergarden Society member, Reba Claspill. Working part-time at O'Quinn's Orchids and Water Gardens introduced us to the great variety of marginal aquatics set in the pond shallows. The pond's collection of Japanese and domestic Koi, along with two butterfly Koi, are named, of course.

A RubberMaid tank, tucked among plantings, performs both biological and vegetable filtration.

Lush plantings around the large pond lends a lush atmosphere as they camouflage the basic stonework.

Since Helen Nash visited our ponds a couple years ago, she and I have been trying to convince Jim there is room for yet another large Koi pond. Reluctant to grab that pick-ax again, he is *beginning* to consider the project....but don't tell him we know.

Pond Chemistry

Taking the Mystery Out of Pond pH

by Helen Nash

Understanding water pH is critical

to understanding your pond's chemistry.

As soon as you include living creatures within your pond, water quality is important. This involves far more than maintaining clear water in which to see and enjoy your aquatic pets. Suddenly, you need to know a little bit about water chemistry — the unseen world of your pets' watery habitat. Think of it in human terms. Cities issue smog alerts and pollen reports to warn us of possible respiratory problems. Well water must be tested to determine if unsafe bacteria are present that might make imbibers ill. And we all know the carbon monoxide danger of remaining inside a garage in which a car motor is left running. Our environment affects our health....and our very lives. So, too, does the water in our ponds affect our amphibious pets.

As much as we like to think that our backyard ponds are recreating nature, we can only *imitate* nature in their construction and operation. Those sparkling waters of lakes, rivers, ponds and streams that we find in vacation get-a-ways or on weekend hikes are 'open' systems — provided by Nature with natural ways of cleansing and replenishment. A food chain keeps the numbers of fish within a proper range, and the fish enjoy immensely more surface area and water volume than we can possibly hope to supply in an artificial backyard pond. Consider your garden pond an outdoor aquarium and so seek to maintain its water quality for the health of your finned pets.

Water Chemistry Basics

We take water for granted. In setting up a garden pond, we likewise take it for granted that plants adapted to growing in water and animals like fish who naturally live within water will thrive. If water were just water and nothing more, we would never have to worry about the quality of water. 'Just' water, or pure water, is composed of millions of molecules, each made up of two atoms of hydrogen and one atom of oxygen. (H2O)

Remember the old saying that 'opposites attract'? I still recall a science experiment when my grade school teacher passed out very small magnets, each having a positive and a negative charge. When we put two magnets together, positive to negative ends, they snapped together. When we put them together with positive to positive or negative to negative ends, they pushed away from each other. We can use that simple analogy to understand water. Every element, like hydrogen or oxygen, bears a natural charge, positive or negative, just like the ends of those little magnets. Hydrogen is negatively charged, so when a free hydrogen atom exists by itself in the water, we call it a hydrogen *ion*, ion being the term to describe a negatively charged free atom. The oxygen atom, of course, has a positive charge. These charges make for fascinating snappings together and pushings away within our ponds. Often the negatively charged hydrogen atom is in the thick of the action.

Scientists have their own vocabulary to describe the snappings together and pushings away of these positively and negatively charged atoms. When two atoms snap together, they call it *binding*. Two atoms that have snapped together are called *bound*. They have *bonded* together to make a new whole. That whole, the binding of two or more atoms, creates a unit or a molecule. *They have created a home*. But just as two atoms bind together, they can be broken apart. An opposite charge can literally grab its 'soulmate' from the molecule and elope. Similarly, a fish or a plant or aerobic bacteria can use the oxygen from a water molecule and leave the two hydrogen atoms free... or homeless. These homeless hydrogen ions wander around until an oppositely charged atom or molecule snaps together with them to create a new whole and give them a home.

As we explore the invisible world of water chemistry in our ponds, keep these basic images in mind — the snappings together of opposite charges and the pushings away of like charges; the 'orphans' or homeless free atoms in search of homes; the creation of new units or homes when homeless free atoms or whole units (molecules) are accepted by, and bound to, an oppositely charged atom or molecule; and the capacity of whole units or molecules being broken apart by these same actions of snapping together or pushing apart.

pH

pH is perhaps one of the most complicated and difficult of water chemistry topics to understand. It is usually defined as being the measurement of free hydrogen ions in water as measured on a logarithmic scale of 1 to 14 with 7 considered 'neutral.' For the moment, picture a bunch of homeless hydrogen atoms, called 'ions' because of their negative charge. *pH readings are simply a way of indicating how many of these orphans are running loose in your water.* A high pH reading indicates that more of the homeless hydrogen ions have found a 'home' and are part of a molecule, primarily water molecules. Low pH readings indicate more orphans are free in the water. Neutral is that magic point where the number of free hydrogens balances against the numbers bound within molecules. Healthy water for your fish requires ample whole water molecules with oxygen, as well as a reasonable amount of free hydrogen to bind with oxygen at the water's surface and at aeration points such as waterfalls and venturi systems within the pond. This most healthful state of the water is reflected in pH readings in the range between 5.5 and 8.5, with the neutral range of 7.0 to 7.4 considered ideal.

pH is really all about water. Higher pH readings indicate more hydrogens have homes within water molecules and so reflect the degree of water molecules in the pond. There is oxygen available in each molecule, oxygen to supply the needs of plants, fish, and aerobic bacteria. Low pH readings indicate a greater degree of loose hydrogen atoms or ions. (And less oxygen available for plants, fish, and aerobic bacteria!) Think of these free hydrogen ions as being in quest of a home.

The degree of presence of free hydrogens that have found homes within molecules is not a constant. The water's pH is in a constant state of fluctuation as oxygen is removed from water molecules, freeing hydrogen, and as hydrogen finds homes.

Oxygen is removed from water molecules in several ways. Fish remove oxygen in their 'breathing' through their gills. At night, plants respire, taking in oxygen and producing carbon dioxide, the opposite activity of their daytime hours of photosynthesis. Aerobic bacteria, ever present and the facilitators of the

nitrogen cycle, use oxygen to convert ammonia into nitrite and then nitrite into nitrate. Other aerobic bacteria process organic wastes, known as oxidation, using oxygen to fuel that activity. *In all of these actions, oxygen is removed from water molecules...and hydrogen is set free or left homeless.* More free hydrogen is reflected in a pH measure as a lowered pH reading. It is all relative, hence, the logarithmic scale. The more loose hydrogen ions, the lower the pH reading. The less free hydrogen, the higher the pH reading. This can be confusing unless you think in terms of "less is more and more is less".

When the water's pH measures below 7.0, the neutral point, it is considered acidic. When it measures over 7.0, it is considered alkaline. Alkaline water is considered more chemically stable than acidic water since it contains more 'whole' molecules with fewer stray hydrogen ions running loose in search of a home. Acidic water, possessing so many more free hydrogen ions, is more likely to form chemical bonds and alter the water's chemistry quickly.

However, *alkaline water is not safe from pH fluctuations*. When plants, fish, or aerobic bacteria use oxygen in the water, their oxygen comes from the very molecules of water that are made up of two hydrogen atoms bound to one atom of oxygen. Their removal of oxygen leaves behind 'homeless' hydrogen atoms, this being reflected by a drop in the pH measurement. This explains why water gardens with plants measure a lower pH first thing in the morning as the plants have removed oxygen from the water molecules in the nighttime respiration process. Too great a removal of oxygen from the water can result in a sudden drop in the pH measurement, or a sudden increase in the number of free or orphan hydrogen atoms — this being known as a 'pH crash.' Sudden changes in pH of more than even two tenths of a point can stress fish. In a pH crash, the number of free hydrogen ions increases so rapidly that the pH reading reflects whole integers of change. For fish, this is a deadly situation that can result in perfectly healthy fish floating belly up the next morning.

pH crashes are more likely to happen when the water is warm and is less able to hold oxygen — the oxygen evaporating into the air and leaving behind free hydrogen ions. pH crashes are also possible when great quantities of fish, plants, and aerobic bacteria are removing oxygen from the water, leaving behind free hydrogen ions. Maintaining aeration in the pond water is helpful in preventing such pH fluctuations since you then supply oxygen to bind with the free hydrogen and create more whole units of water. However, simple aeration is not enough to bind great amounts of free hydrogen and thereby bring the pH back within a desirable and stable range for your pond's life. *You can stabilize the water's chemistry or prevent extreme fluctuations of the number of free hydrogen ions by providing a chemical buffering agent.*

A buffer is just that — a protective shield or a means to ease a shock. A 'buffer' provides a shelter or a place to go for the loose hydrogen ion. In giving the homeless hydrogen a place to go, the water's pH cannot swing wildly. Think of your pond water's buffering capacity as being the extent to which orphan hydrogen ions can be given homes within molecules. You can increase the water's capability to do this by adding bicarbonate to the water. Bicarbonates are like homeless shelters, providing a ready acceptance of orphan hydrogen ions. This capacity of the water to bind free hydrogen ions from the water, or the degree of presence of bicarbonates that perform buffering, is referred to as alkalinity. Remember, water that tests low in pH, having more free hydrogen is considered 'acidic.' Water containing more *whole* water molecules with relatively fewer orphan hydrogens running around is considered 'alkaline.' Acidic water is usually thought to require more buffering to control the number of free hydrogen ions. Yet the removal of oxygen by plants, fish, and bacteria from 'alkaline' water creates a need for setting up homeless shelters, too.

If your pond water shows signs of fluctuations of more than a few tenths of a point when measured *at the same time each day*, you need to supply buffering to the water. Note that some fluctuation will naturally occur during the course of any twenty-four hour period, especially in the times between day and night and night and day when plants shift their activities from oxygen-producing photosynthesis to oxygen-using respiration and vice-versa. Small changes are normal and are tolerated by your fish. If the fluctuation swings widely over several measuring points, you risk stressing your fish. While goldfish and Koi prefer alkaline water, they can tolerate acidic water as long as the water is not turning acid in a brief period of time. Except in the extreme ranges of the pH measure (below five and above nine), the key to your fish's tolerance of a pH level is the relative stability of that level.

If the water's pH is lower than 5.5, your fish can experience *acidosis* with symptoms of anorexia, production of excess slime, isolation, and resting on the pond bottom. Untreated, their fins streak with severe stress and they die. The condition is reversed by bringing the pH back into a tolerable range.

If the water's pH measures 8.5 or higher, your fish can experience *alkalosis* with symptoms of excess slime coat production and gasping at the water's surface. The condition is hard to reverse and can be fatal. Alkalosis is usually encountered in concrete ponds or in heavily planted ponds where plants use up oxygen and leave more free hydrogen to raise the water's pH.

While you can change pH levels with additives such as a careful use of vinegar to lower it or baking soda to raise it, the best solution is to maintain a consistent, reasonable range of pH through the use of bicarbonates that buffer the water. Use crushed oyster shell, crushed limestone, or SeaChem (R) Neutral Regulator. In an emergency of a pH crash, add 1 teaspoon of baking soda per 5-10 gallons of water. Check the pH an hour later to be sure the pH has risen.

Because so many factors can affect your pond water's pH, you should include testing it as part of your weekly water testing. pH, after all, is really a measure of how much 'water' (H2O) is in your water! By all means, if a fish appears troubled, include pH monitoring with your tests for ammonia and nitrite since pH also impacts the toxicity of these chemicals in the pond water. (We'll talk about that in the next issue of *P & G*!)

If your pond contains a heavy bio-load — including fish, plants, decomposing organic matter, and aerobic bacterial action in a bio-filter, even alkaline water benefits from buffering. The key, after all, to preventing fluctuations in the number of free hydrogen ions (and reflecting pH measurements) is providing potential homes for the orphan ions. Those potential homes may be chemically present with buffering agents that readily accept free hydrogen ions or, to a lesser degree, with the availability of oxygen to bind into water molecules. Whatever your pond water's pH measurement, assist in preventing sudden drops of pH by providing ample aeration and, to a smaller degree, enough exposed surface area of your pond water for oxygen exchanges. After all, two orphan hydrogen ions can combine with one atom of oxygen to create a whole molecule, or a 'home.'

Knowing your pond's pH levels is critical to understanding the water in your pond. pH *is* the water in your pond....and that water is the home of your plants and fish. You want that home to be as safe and healthy as possible for your finned pets.