

# SWEETWATER



ACTIVITY BOOK AND FIELD GUIDE

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## WELCOME!

In our desert community, it's not often that we have the chance to see the type of animals and plants that depend on open, flowing water and lush vegetation. But, that's exactly what visitors to Tucson Water's Sweetwater Wetlands can enjoy every day of the year! From desert rodents to majestic raptors, tiny waterbugs to wandering bobcats, dozens of species of animals make the Sweetwater Wetlands their full or part-time home.

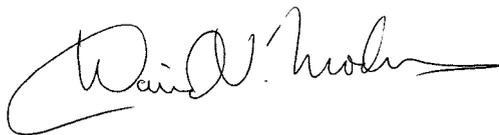
The Sweetwater Wetlands recreates one of the most endangered habitats in our desert region – a water-rich streamside riparian zone that supports a huge variety of wildlife. The Wetlands also helps treat wastewater so that it can be reused in our community to irrigate parks, schoolyards, golf courses and other landscapes. Using this reclaimed water means that we can have a “greener” community without using our drinking water to keep the grass and other plants alive.

Another important step in helping protect our environment is learning about the plants and animals that live here, so that we better understand what they need to survive. This Field Guide and Activity book is designed to enrich your experience at the Sweetwater Wetlands and help you identify the many species that inhabit this unique environment. Along the way, you'll learn about the importance of wetlands and their role in recycling a critical natural resource – water.

On behalf of Tucson Water, I want to thank all of the other people and agencies that helped contribute to this booklet. You'll find their names in the Acknowledgments on the inside back cover of this book.

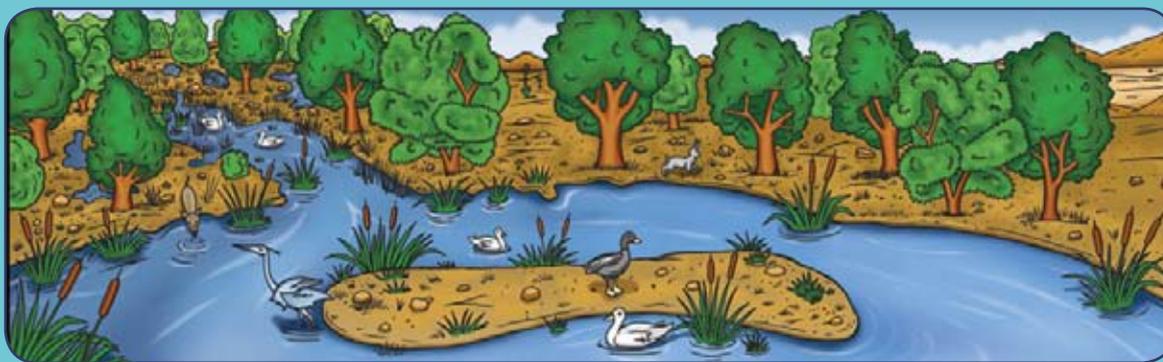
I hope that you'll find this booklet fun and informative. If you have any questions about this booklet, the Sweetwater Wetlands, or any other water issues, please give us a call!

Sincerely,

A handwritten signature in black ink that reads "David Modeer". The signature is fluid and cursive, with a long horizontal line extending to the right from the end of the name.

David Modeer, Director  
*Tucson Water*

# OUR WATER CYCLE AND SWEETWATER WETLANDS



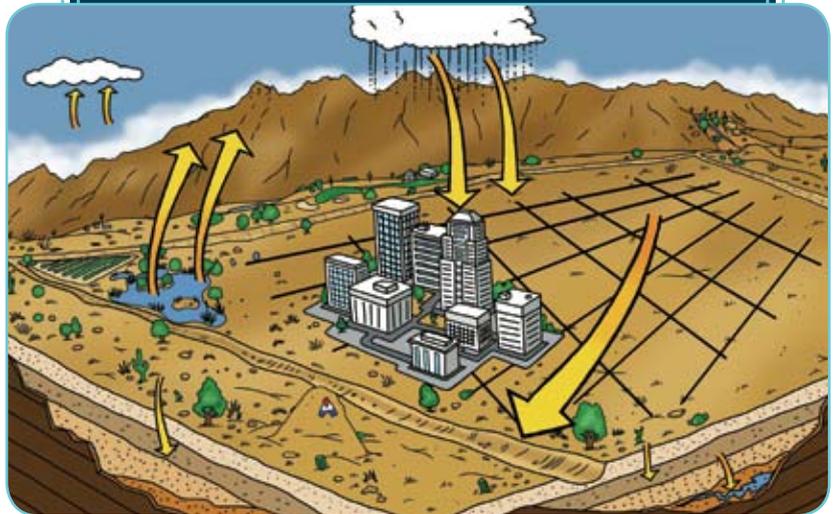
## WATER - THE MOST PRECIOUS RESOURCE ON OUR WATER PLANET

Water is a renewable but limited resource. It is renewable because water is constantly circulating through the global water cycle. It is limited because its availability and form are always changing. Water's availability in the form we most rely on—fresh liquid—varies greatly and is not evenly distributed throughout the earth.

The Earth has often been called the “water planet” because nearly three-fourths of our planet's surface is covered with water. Water is continuously changing its form but the total amount of water on Earth remains constant. Water exists in three forms: solid (ice), liquid (lakes, oceans, rain, etc.), and gas (water vapor, clouds). Ninety-seven percent of the earth's water is in our oceans and seas. The rest is in our polar icecaps and glaciers, rivers and lakes, and groundwater. A small amount is in water vapor and soil moisture. Thus, even on a water planet, only a tiny portion of our water is available for our use as fresh water at any particular time or place. Water is indeed a precious resource.

## THE WATER CYCLE

The water cycle is the continual circulation of water through its various forms, occurring in a predictable pattern. The pattern we are most familiar with includes water rising from the earth in the form of a vapor (evaporation), condensing to form clouds (condensation), raining or snowing back to the earth (precipitation) and flowing downhill over the earth due to gravity (runoff). The global water cycle is far more complex than this model but the same basic processes are constantly occurring all around the earth. Water also cycles on different time scales; it might take one year or it could take millions of years for a single water molecule to come full cycle.



## WATERSHEDS

While the water cycle is a global system, smaller cycles also occur on local levels. To better understand the movement of water on a local scale, it helps to understand our watersheds. The total land area that contributes water to a particular drainage channel (wash, arroyo, or stream) is called its watershed. For example, the rain or snowmelt from Mount Lemmon that flows south into Sabino Canyon belongs to the Sabino Creek watershed. On a larger scale, a community's watershed includes all the land area around it that contributes water to any of its water sources (including rivers, lakes or groundwater aquifers). Unless a system is established that imports water from outside a local area (e.g., Colorado River water via the Central Arizona Project), the water supply of a community comes from the immediate watershed. Because the water cycle is continual, water is constantly being added to a community's watershed and thus its water supply. In Tucson, we have long relied on water from our watershed to percolate through the earth to recharge (add to) our groundwater aquifer—currently our main source of water.

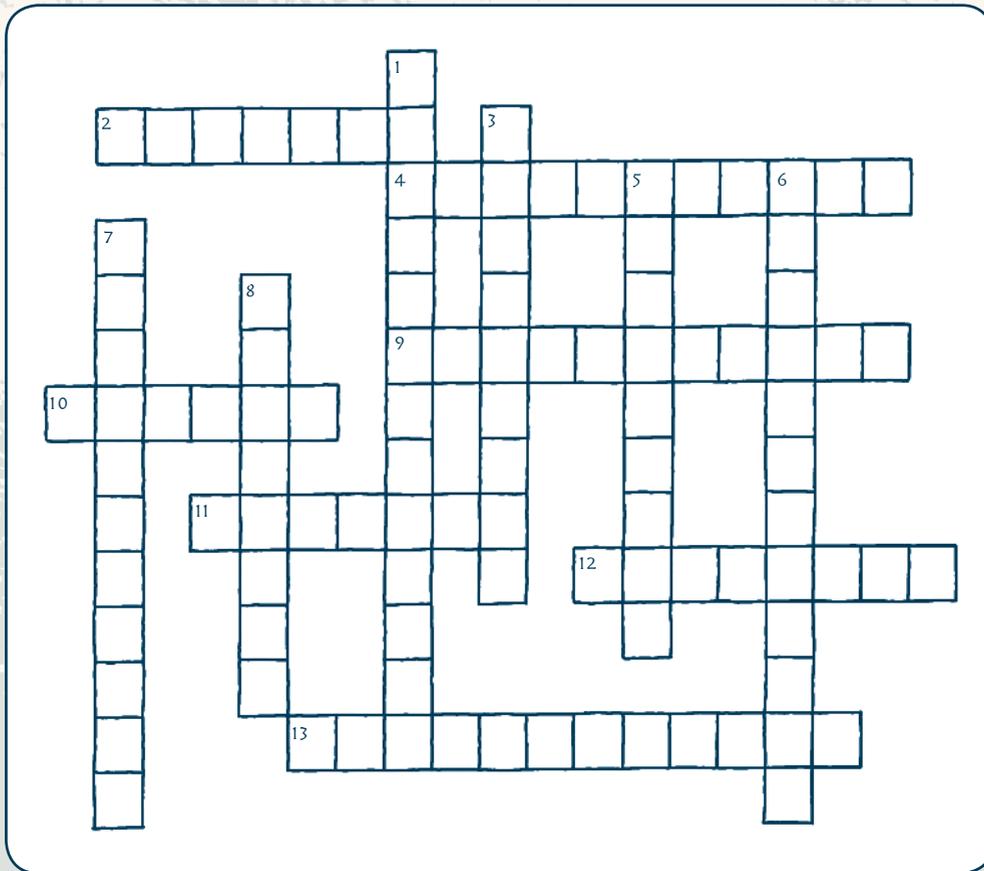


To understand a watershed, consider a particular watershed to be like a funnel. Any water that falls in the area of the funnel will be channeled into the funnel. Any water that falls beyond the edge of the funnel flows somewhere else and is outside the “watershed” of the funnel. In nature, the sides of the funnel are similar to the sides of mountains, which shed water downhill toward a particular drainage.

# WATER CYCLE WORDS CROSSWORD PUZZLE



Directions: Complete the crossword puzzle using the clues below. Refer to the text and glossary if necessary.

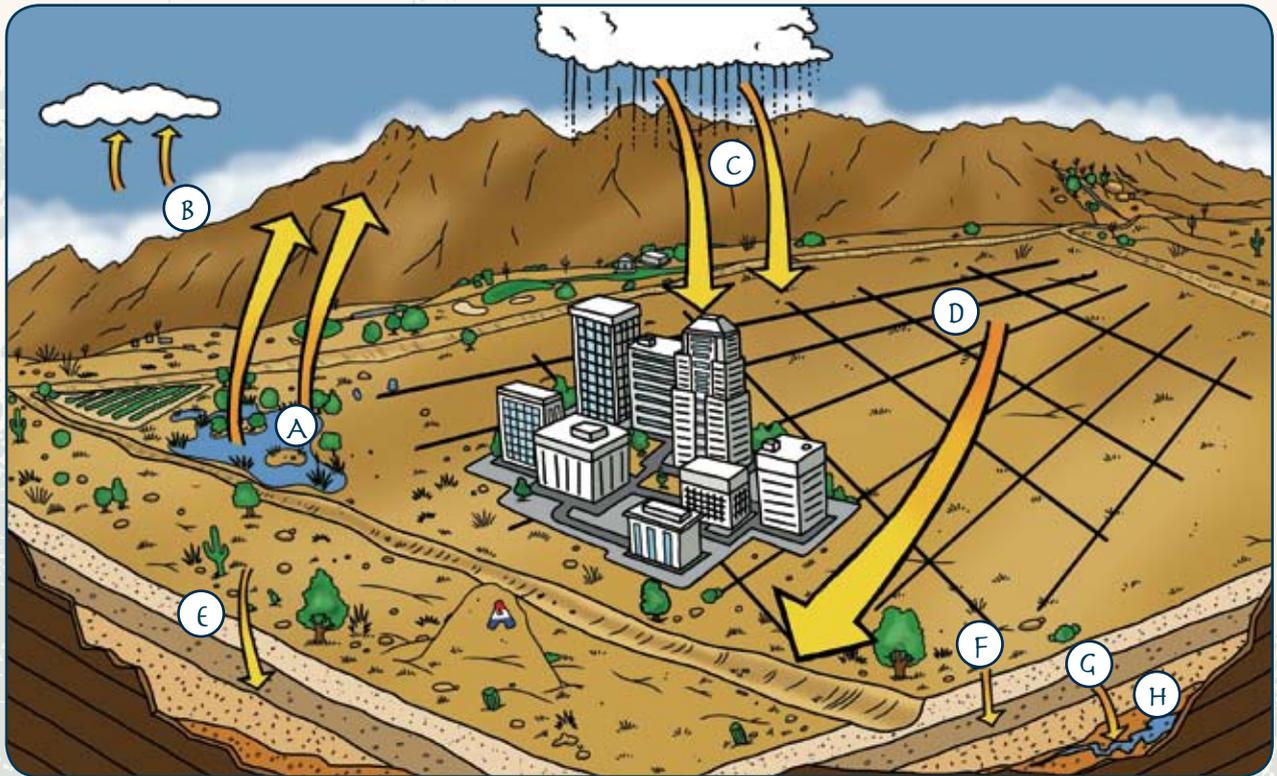


## ACROSS

2. an underground geologic formation that contains water
4. the process of a liquid changing to a vapor
9. the process of water moving down through layers of soil and rock
10. water that flows downhill over the earth's surface
11. water found on the earth's surface (as in runoff, rivers, or lakes): \_\_\_\_\_ water
12. the addition of water to an aquifer
13. the process of a vapor changing to a liquid (as when clouds form)

## DOWN

1. water that falls to the earth in such forms as rain or snow
3. the total land area that drains to a specific river, wash, or lake
5. effluent that is highly treated and can be used again: \_\_\_\_\_ water
6. the process of water moving from above to below the earth's surface
7. water found below the earth's surface
8. water that is treated and released by a sewage treatment plant



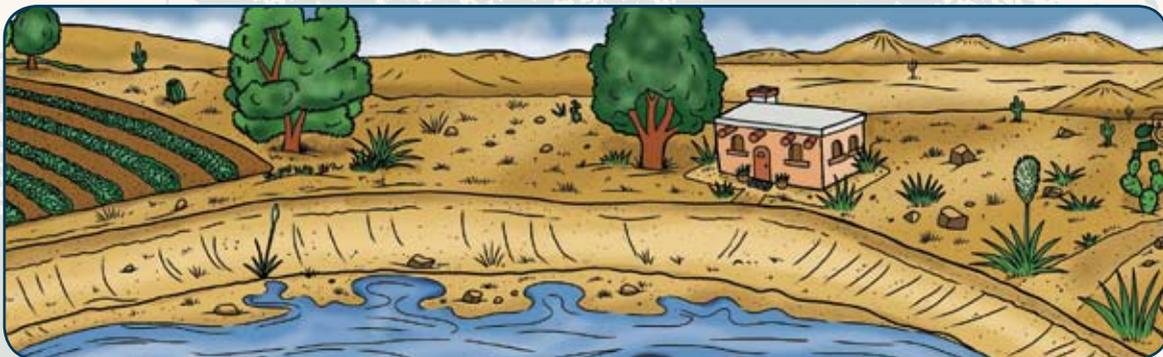
Directions: Use the clues from the crossword puzzle to find which water cycle words are needed to correctly label this water cycle diagram. Write the correct letter beside the water cycle word to indicate its location in the diagram. As an example, the first one is done for you.

CROSSWORD CLUE	WATER CYCLE WORD	LETTER LOCATION IN DIAGRAM
6 DOWN	<u>infiltration</u>	<u>e</u>
9 ACROSS	_____	_____
4 ACROSS	_____	_____
13 ACROSS	_____	_____
1 DOWN	_____	_____
12 ACROSS	_____	_____
7 DOWN	_____	_____
10 ACROSS	_____	_____

## TUCSON'S WATER CYCLE

In our local water cycle, precipitation delivers water to our watershed. The runoff infiltrates (moves through) the surface of the soil. Once in the soil, it slowly percolates down to recharge our groundwater aquifer (water occurring below the surface of the earth).

Tucson's water supply was originally surface water (water on the earth's surface) flowing primarily in the Santa Cruz River. There was enough runoff that, coupled with the level of our groundwater, the Santa Cruz River kept flowing pretty much year-round.



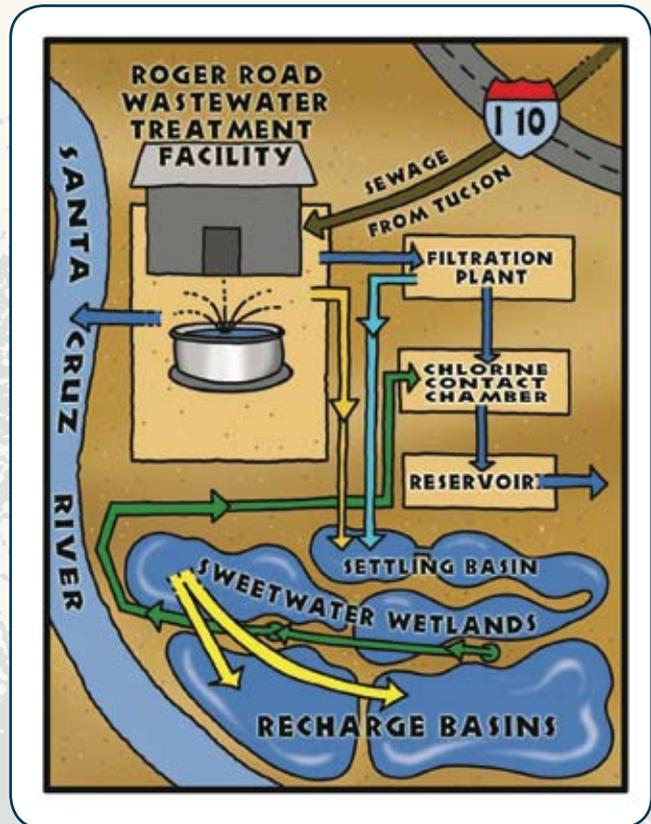
Extensive human use caused surface water in our valley to largely disappear. Our water supply changed from surface water to groundwater, which we pump up with wells. Continued use has caused our groundwater table to drop to such a level that we have started importing water from the Colorado River using the Central Arizona Project (CAP) canal to minimize the impacts of excessive use of groundwater.

Tucson's water is always cycling. The mountain ranges surrounding our city continue to funnel water into our watershed. Some of this water percolates down to recharge the aquifer. However, we use more water than is being recharged into our groundwater aquifer. Additionally, we live in a desert. Limited precipitation and high evaporation rates naturally result in water scarcity. Hydrologists are constantly seeking ways to conserve and, more recently, reuse water. Sweetwater Wetlands plays a role in Tucson's water cycle by helping us reuse valuable water.

## RECLAIMED WATER

The water that we use in our homes and businesses throughout Tucson is primarily a mix of groundwater and CAP water. After we use this water, the resulting "wastewater" (also called primary effluent) flows to the county sewage treatment plant where it is treated mechanically, biologically and chemically. When it reaches the level of quality set by state and federal environmental standards, it is called secondary effluent. Some of this water is released into the Santa Cruz riverbed. Some is recharged through special basins. And some of this effluent is further treated through a system of filtration and chlorination at Tucson Water's reclaimed water treatment plant. Here, it is cleansed to an even higher level of quality and becomes "reclaimed" water.

A small portion of the secondary effluent is sometimes piped directly to Sweetwater Wetlands for natural filtration. However, Sweetwater Wetlands gets most of its water from the backwash of Tucson Water's reclaimed water treatment plant. (Backwash water is produced when the silica/carbon filters at the plant are cleaned.) Sweetwater Wetlands serves to naturally cleanse and filter this effluent. From the wetlands, it is delivered to the recharge basins, where it filters through 140 feet of soil to the aquifer. The water stored in the ground beneath the recharge basins is pumped up, chlorinated and mixed with the other reclaimed water to be used on city parks, golf courses, street medians and school playgrounds.



### WHAT'S SO SPECIAL ABOUT RECLAIMED WATER AND SWEETWATER WETLANDS?

As our population grows, more water is used, leaving less groundwater available for future use. However, there is more "wastewater." Because water is such a vital resource, it makes sense that we should find ways to recycle and reuse this water.

Reclaimed water is recycled water, but it is cycled on a time scale for immediate human use. Our reclaimed water has its own system of pipes for delivery throughout Tucson. Most is used to water golf courses, school playgrounds, and parks. Using reclaimed water for irrigation and other activities saves groundwater and CAP water for other needs such as drinking and bathing.

Sweetwater Wetland's role in cleaning up our wastewater is small but extremely important. It takes a lot of resources and time to filter effluent through Tucson Water's water treatment plant. Sweetwater Wetlands accomplishes much of the same results but through the natural water cleansing processes that occur in wetlands. At the same time, a habitat is created which supports a diversity of plants and animals that were once common along the Santa Cruz River.

## HISTORY OF THE SANTA CRUZ RIVER AND SWEETWATER WETLANDS

Sweetwater Wetlands is located on the banks of the Santa Cruz River. Although it is a dry riverbed today, the Santa Cruz once flowed year-round. Construction of the wetlands has restored some of the native habitat that occurred along the Santa Cruz before the 1900's. Although it is a constructed wetlands, the plants and animals found at Sweetwater Wetlands are typical of the species that were once common along the Santa Cruz River.



*Directions: The scenes to the right shows changes along the Santa Cruz River over time. Can you put the pictures in order? Use the images and descriptions below for clues! Write the correct date by each picture. When you are done, answer the questions at the bottom of this page.*

**1500'S** Long ago, the Santa Cruz River flowed year-round in our area. The water table was close to the surface. Beautiful riparian and wetland habitats were found along the river! Many birds and other animals lived in these lush habitats.

**1700'S** - The river served as a reliable water source. This drew Native Americans and then other people. These early settlers did not use very much water. The water they did use was replaced by the water cycle. The water table stayed close to the surface.

**1900-1940'S** - More people moved to Tucson. They used river water and dug wells. A turning point came near the middle of this century. People began using more groundwater than was replaced by rainfall. The water table fell. The river stopped flowing regularly. Riparian and wetland habitats shrunk.

**1950-1990'S** - Tucson grew into a larger and larger city. Because more water was needed for the growing city, people drilled many deep wells. Over time, the water table dropped 200 feet in some areas. The riparian and wetland areas were almost all gone. The beautiful river had become a dry, barren channel. Many plants and animals were lost.

**EARLY 2000'S** - A few years ago, Tucson began using Colorado River water. Also, many parks, golf courses, and school grounds started using reclaimed water. This means that less groundwater is needed. Some wells have been turned off. The water table is rising! Sweetwater Wetlands was built on the banks of the Santa Cruz River. This constructed wetland purifies treated sewage water and provides wildlife habitat.

### ANSWER THESE QUESTIONS:

1. Describe two differences and two similarities between the scene from the 1500's and the scene from the 2000's.

Differences: .....

Similarities: .....

2. Why is there very little difference between the first two scenes?

.....

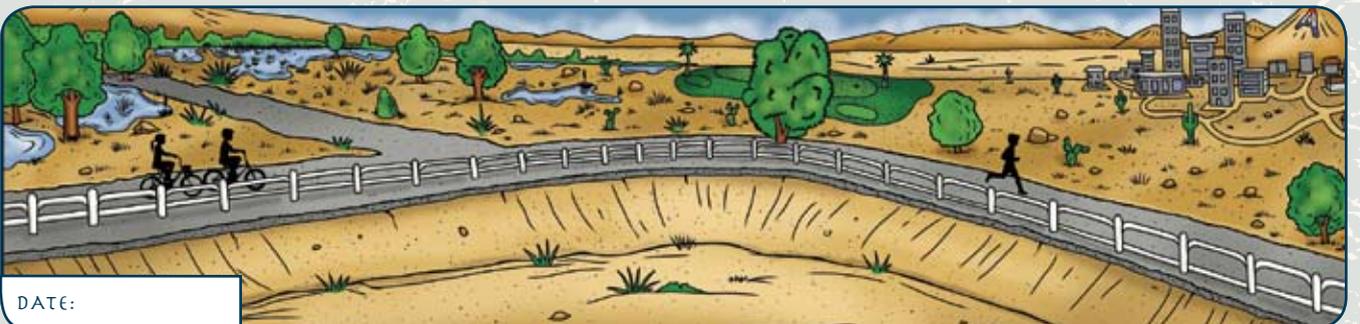
3. Which illustration shows the most drastic change from the scene before it? Why do you think the change is so drastic?

.....

4. Describe how the scene might look in 50 years from now and explain why it might look like this.

.....

.....

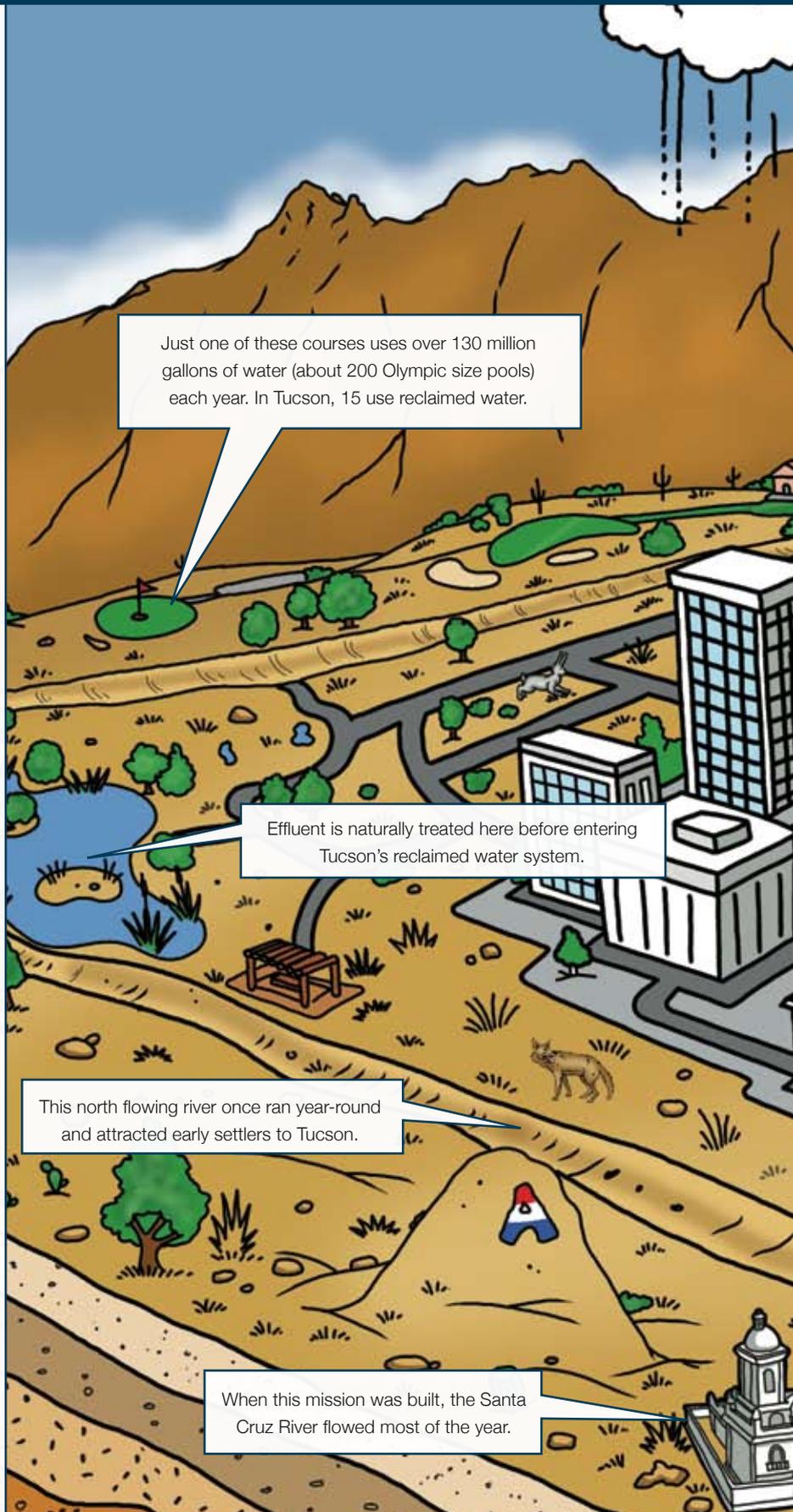


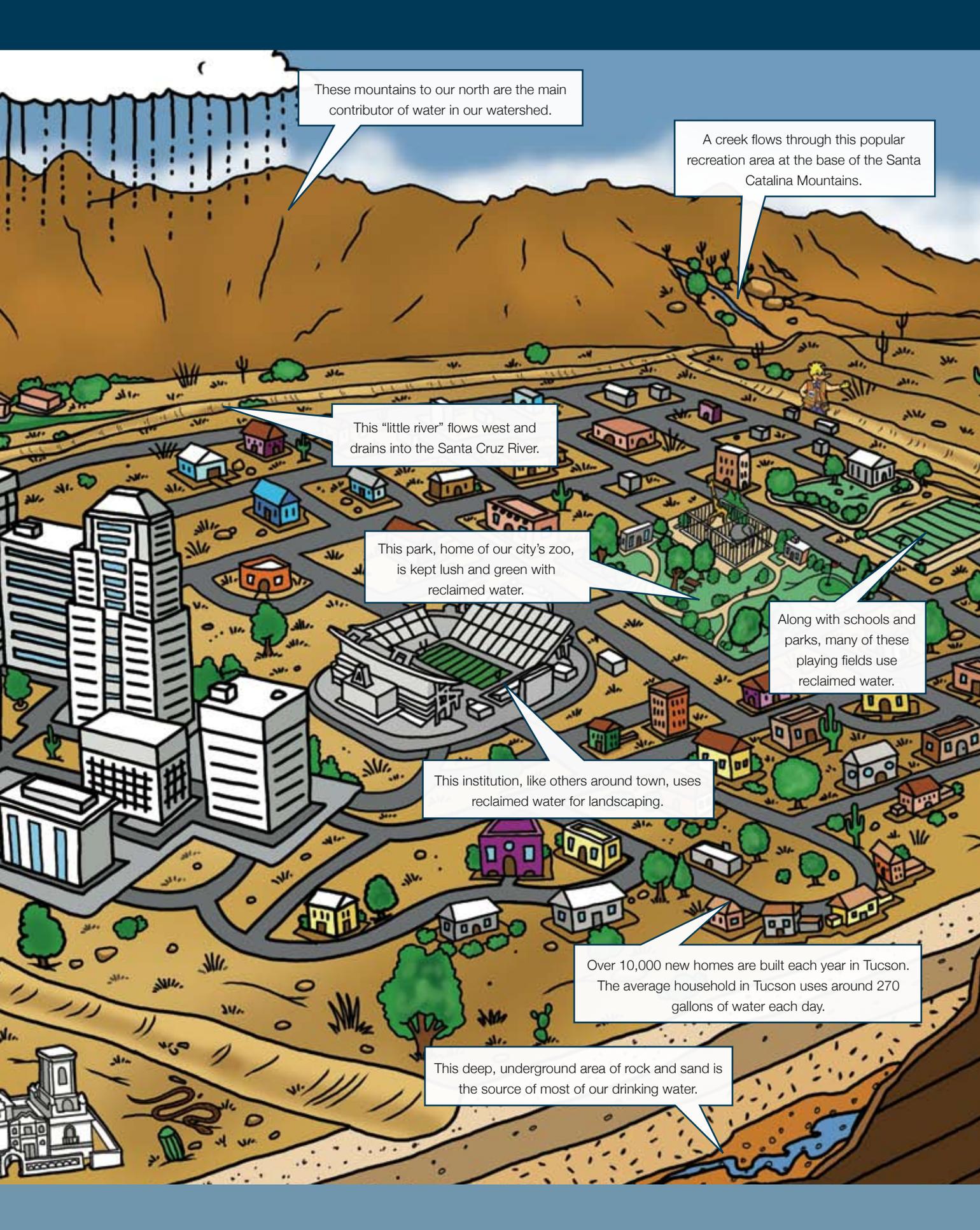
## TUCSON BASIN DIAGRAM: FINDING WATER IN THE DESERT



*Directions: It looks like a desert but water is actually everywhere in Tucson. Can you find the following items in this diagram of the Tucson basin?*

- SANTA CATALINA MOUNTAINS
- SANTA CRUZ RIVER
- SABINO CANYON
- SWEETWATER WETLANDS
- U OF A
- JACKRABBIT
- GOLF COURSE
- RILLITO RIVER
- SAN XAVIER MISSION
- PETE THE BEAK
- REID PARK
- SOCCER FIELD
- HOUSING DEVELOPMENT
- SAGUARO CACTUS
- SNAKE
- FINGER ROCK
- GROUNDWATER AQUIFER
- COYOTE





These mountains to our north are the main contributor of water in our watershed.

A creek flows through this popular recreation area at the base of the Santa Catalina Mountains.

This "little river" flows west and drains into the Santa Cruz River.

This park, home of our city's zoo, is kept lush and green with reclaimed water.

Along with schools and parks, many of these playing fields use reclaimed water.

This institution, like others around town, uses reclaimed water for landscaping.

Over 10,000 new homes are built each year in Tucson. The average household in Tucson uses around 270 gallons of water each day.

This deep, underground area of rock and sand is the source of most of our drinking water.

# INTRODUCTION TO WETLANDS



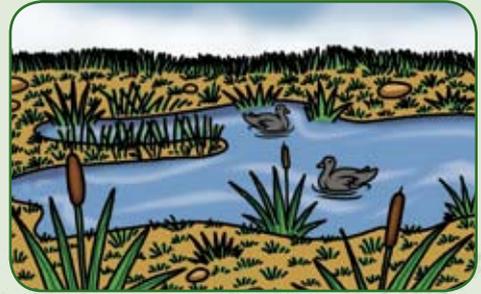
## WHAT ARE WETLANDS?

Living in the desert, it is difficult to imagine a wetland. Unlike our hard, dry desert soils, a wetland is a place with soggy ground, pungent, moist smells and lush, green plants. A wetland is very different from the desert! In the desert, natural wetlands are rare but they do occur. A small backwater beside a desert stream, a seasonal pond or spring and a marshy cienega are all types of wetlands that might occur within the desert environment.

While there are many different kinds of wetlands worldwide, all have three identifiable characteristics: the soils are saturated, there are hydrophytic (water-loving) plants present, and water occurs there. These conditions do not need to be year-round or constant. Some wetlands change dramatically through the seasons or even (in the case of intertidal marshes) through the day. There may be periodic flooding or drying-up. Some places are considered seasonal wetlands and only exhibit wetland conditions during certain times of the year. Sometimes water is very obvious with a large pond full of fish and ducks. Sometimes the water is just below the surface of the soil and not obvious at all. As the name implies, however, it is the presence of water that makes a wetland what it is.

## TYPES OF WETLANDS

Many types of wetlands occur all around the world. There are coastal wetlands associated with marine estuaries and coastlines. These are mainly salt water wetlands. There are also freshwater, inland wetlands associated with rivers, lakes and ponds. Pond wetlands include bogs and seeps. All these wetlands occur naturally and are influenced by such things as topography, climate and geography.



## WETLAND FUNCTIONS

Wetlands serve several very important roles which scientists call “wetland functions.” Wetland functions contribute to the physical, chemical, or biological health of the environment. Wetlands also have an economic value to humans.



## WETLANDS SERVE IMPORTANT PHYSICAL FUNCTIONS IN THE WATER CYCLE

- They naturally help slow and control flooding.
- They contribute to groundwater recharge.
- They trap sediments which might otherwise impede the water cycle.

## CHEMICAL FUNCTIONS REFER TO A WETLAND’S ABILITY TO CLEAN-UP WATER

- Wetland plants filter pollutants out of the water.
- Wetland plants help settle toxic residue into the wetland soil where they may become chemically neutralized over time.
- Some pollutants are processed by the bacteria living in wetlands.

## WETLANDS ARE VERY PRODUCTIVE HABITATS THAT PERFORM SEVERAL BIOLOGICAL FUNCTIONS

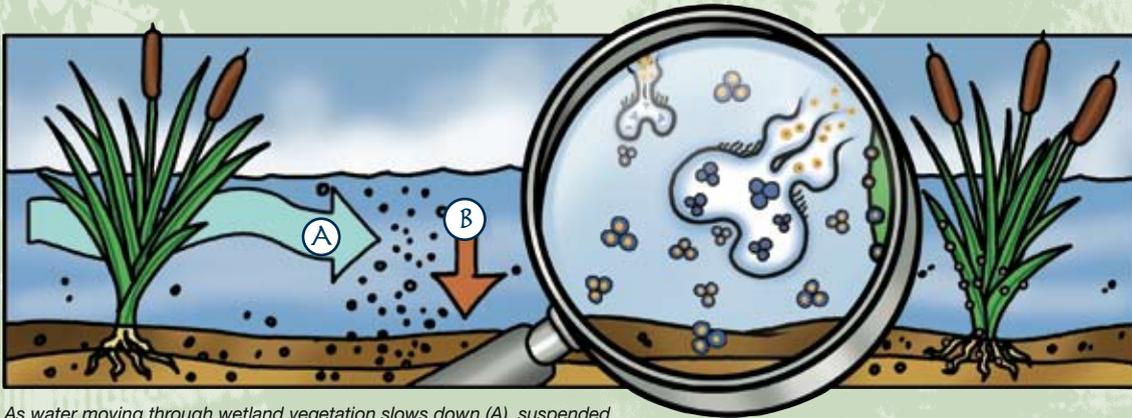
- Wetlands provide resources and nutrients that support a diversity of abundant life in wetlands and the surrounding uplands.
- Wetlands provide important value as habitat – both as nurseries for abundant productivity and as home to a myriad of species, including many that are endangered.

Humans also rely on the economic function of wetlands. Foods such as rice and cranberries are grown in wetlands. In some countries, wetland plants such as peat, reeds and trees are harvested for fuel, fiber or timber. People value wetlands as places for recreational activities such as bird watching, canoeing, or fishing. It is important to remember that humans benefit from all functions of wetlands: physical, chemical, biological, and economic.

## HOW WETLANDS CLEAN UP WATER

As mentioned, a very important function of wetlands is their natural ability to filter and clean water. Water entering a wetland slows down as it moves through vegetation. As the water slows, particles that were suspended begin to fall out of the water and either settle into the soil at the bottom of a wetland or become trapped among the vegetation. These solids might be any type of debris including soil or effluent particles. Frequently, various chemical pollutants—e.g., fertilizers, pesticides, heavy metals and other harmful compounds—are attached to these solids.

Besides slowing the flow of water, wetland plants are able to take up waste water pollutants into their cells. They also create the perfect environment for other processes that cleanse water. The dead plants at the bottom of a wetland pond help trap solids and provide conditions for the growth of important microbes. Microbes also attach themselves to the stems of living plants. Through various processes such as decomposition, predation and neutralization, these microbes are able to transform contaminants into less harmful forms. Microbes also convert various nitrogen compounds into nutrients that help plants grow. The microbes that thrive in the wetland environment literally gobble up pollutants.



*As water moving through wetland vegetation slows down (A), suspended solids fall out of the water (B) and settle to the bottom. Wetlands microbes transform contaminants into less harmful forms.*

## CONSTRUCTED WETLANDS

It is well known that natural wetlands improve water quality and provide important wildlife habitat. For those reasons, wetlands are often built by humans. These “constructed wetlands” are primarily built to clean up wastewater and create wildlife habitat. Constructed wetlands naturally filter and treat wastewater and are often less expensive than traditional treatment plants. Constructed wetlands are also more appealing than other treatment plants because of the habitat they create and because of their ability to reduce odors. In an urban environment where land is scarce, a traditional treatment plant may produce more reclaimed water per acre, but a wetland has numerous additional benefits.

Sweetwater Wetlands is a constructed wetland, built to treat water that is backwashed from the filters at Tucson Water’s Reclaimed Water Treatment Plant. It provides valuable wildlife habitat, supporting numerous species of birds, mammals, amphibians and reptiles. These wetlands also serve as a recreational and educational site for area visitors and residents.

## ACTIVITY: WETLAND WORDS



Directions: Find the wetlands words in this word search puzzle. Be sure to look forward, backward, up, down and diagonally in all directions.

P	B	E	Z	U	R	C	A	T	N	A	S	T	W	M
D	R	A	X	H	T	N	C	P	E	J	I	N	R	I
E	E	E	C	O	N	S	T	R	U	C	T	E	D	N
N	T	C	L	K	L	I	A	T	T	A	C	G	C	V
R	A	C	O	O	W	C	D	N	R	L	T	R	R	A
R	W	E	Y	M	Y	A	E	E	A	S	F	E	H	S
T	T	M	S	C	P	U	S	I	L	E	V	M	W	I
Y	E	E	W	L	L	O	M	H	I	B	B	B	W	V
S	E	R	N	F	W	E	S	V	Z	O	E	U	G	E
S	W	G	F	B	D	Z	W	I	A	R	W	S	D	N
W	S	E	N	W	G	X	Q	S	T	C	D	I	X	G
J	E	N	A	K	C	C	J	W	I	I	O	V	V	U
W	A	T	E	R	S	H	E	D	O	M	O	A	J	M
G	E	C	I	B	O	R	E	A	N	A	F	N	Q	K
R	U	N	O	F	F	Y	O	V	T	M	O	H	I	D

ANAEROBIC

BACKWASH

CATTAIL

CONSTRUCTED

CYCLE

DECOMPOSITION

EFFLUENT

EMERGENT

FOODWEB

INVASIVE

MICROBES

NEUTRALIZATION

RECLAIMEDWATER

RUNOFF

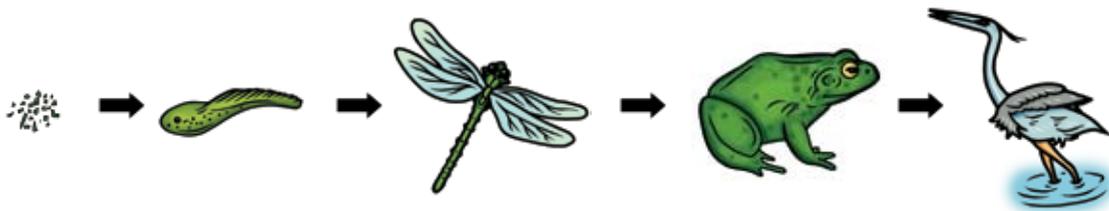
SANTACRUZ

SUBMERGENT

SWEETWATER

WATERSHED

# WETLAND ECOLOGY



A simple wetland food chain.

## WEBS OF LIFE IN THE WETLANDS

There is an abundance of water and nutrients in wetlands. With plenty of sunshine (the ultimate source of energy), plants thrive in this environment. As plants grow, die and decompose, they become the basis of the wetland food chain. Bacteria, fungi and other tiny organisms feed on these decomposing plants (also called detritus). In turn, these microorganisms feed small invertebrates such as insect larvae, snails and worms. Animals such as frogs, small fish and birds consume these invertebrates. The small animals become food for larger animals such as raccoons, foxes, herons and hawks.

Energy travels through food chains and food webs. The sheer productivity of energy at the primary level makes wetlands unique. The constant growth of plants, which are the primary level of the food chain, leads to an abundance of energy all the way up the food chain. Wetlands are literally teeming with life.



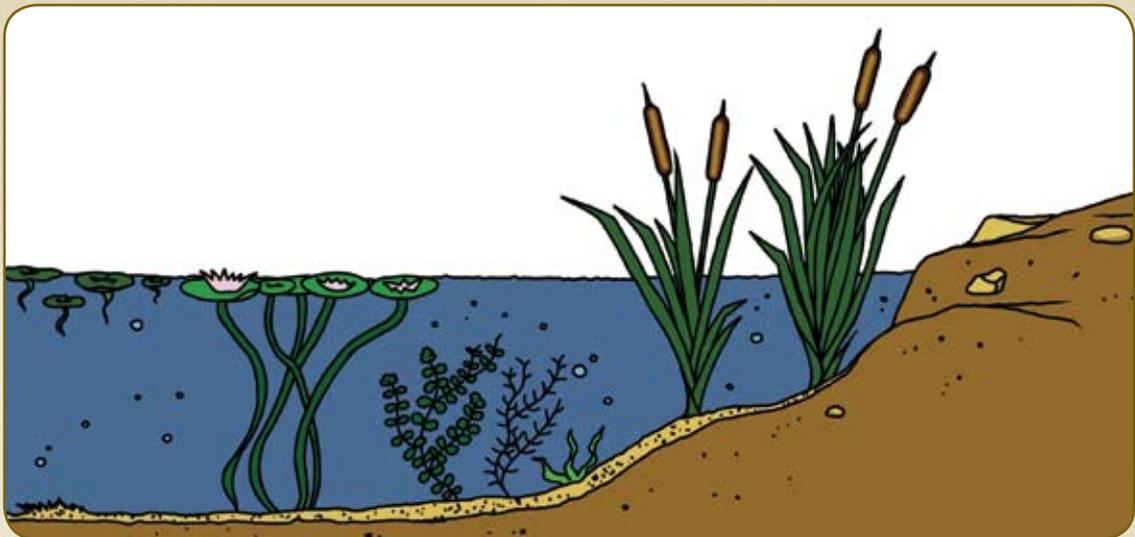
A cattail stem provides a good example of an emergent wetland plant using air spaces (called aerenchymas) for moving oxygen to its roots. In cattails, these spaces not only transport oxygen, they provide a strong yet light-weight structure, an adaptation which helps the plant support itself as it grows in the water and as it emerges above the water.

## ADAPTATIONS TO LIFE IN THE WETLANDS

Even with its abundance of water and nutrients, the wetland environment is a challenging place to live. Survival in the wetlands means adapting to periods of both flooding and drought. It means dealing with reduced oxygen in both the soil and water. Organisms must often contend with accumulated salts or other pollutants. The day to day tasks of finding food and shelter as well as mating must also be accomplished to ensure a species' survival. Wetland plants and animals have developed a variety of physical and behavioral adaptations to deal with the particular set of challenges presented by life in the wetlands.

One of the biggest challenges organisms face in the wetlands is surviving in an oxygen-deprived environment. Sediment and soil in a wetland are often anaerobic – that is, there is very little available oxygen. This is a big challenge for wetland plants that need oxygen for respiration and nutrient exchange. Wetland plants have developed several strategies to deal with this condition. Many have developed air spaces throughout their structures to move oxygen from the emergent parts of the plant (the part above water) to the roots. Other plants have developed above-ground roots and other structures which enable them to literally “come up for air.”

Wetland bacteria have a unique way of dealing with anaerobic conditions. Rather than using oxygen for respiration, they use sulfate. The by-product of their respiration is hydrogen sulfide, which is what causes the rotten-egg smell in the muck of many wetlands.



Wetland plants generally fall into three categories. Emergent plants are those that are rooted in the soil but extend above the water's surface. Submergent plants are those that live completely underwater. Floating plants are just that – they float on the water's surface and may or may not have their roots in the soil.

## WETLAND HABITATS

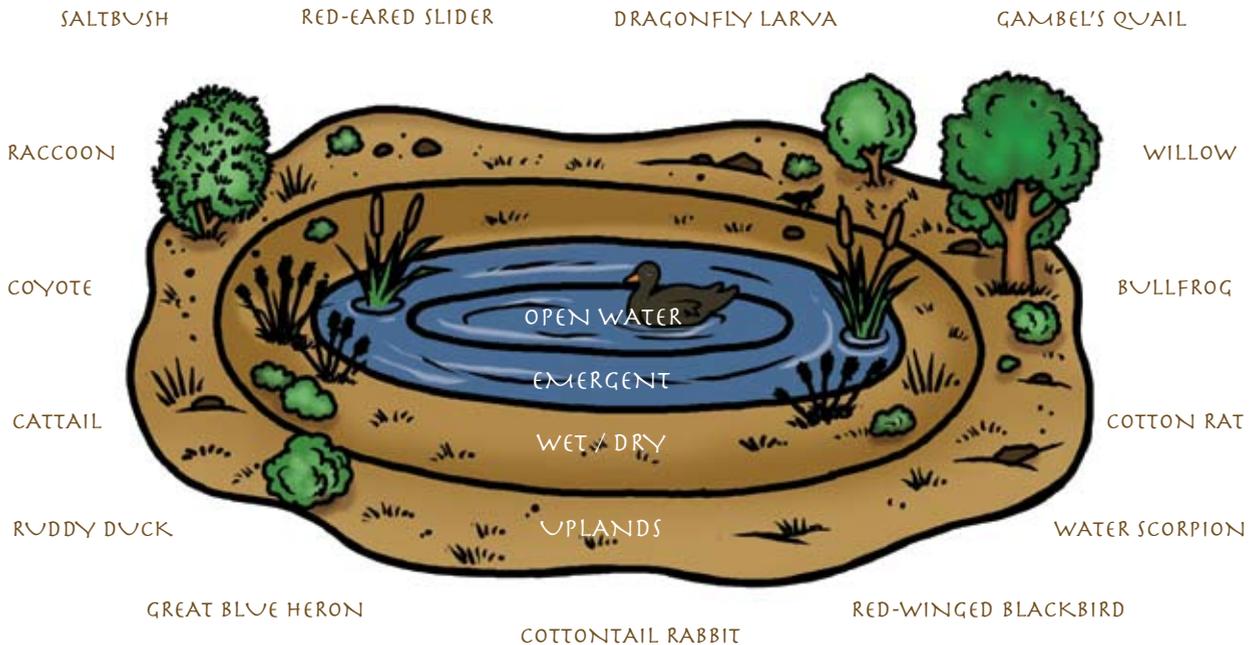
A habitat is a place where an organism finds the food, water, shelter and space that it needs to survive. In other words a habitat is a home for plants and animals. Wetlands are home to a diversity of plants and animals specifically adapted to wetland conditions, as well as a variety of “microhabitats” which offer very specific conditions for animals and plants. A microhabitat is an area within the habitat that presents a different set of living conditions from the area right next to it.

In wetlands, some specific microhabitats include the open water zone, the emergent zone, the zone where the soil is sometimes wet and sometimes dry and the dry uplands. There are plants and animals that are perhaps abundant in one of these areas but could not survive in an adjacent zone. For example, cattails are found in shallow water at the edge of the wetlands but cannot survive either in deeper water or on dry land. Floating plants need open water. Most ducks can be found both in open water and along the shore of wetlands but they rarely range to the dry uplands. Wetland plants and animals are uniquely adapted to life in one or more particular microhabitat.

### ACTIVITY: HOME IN THE HABITATS



*Directions: Note the habitat zones in the picture below. Use the Plants and Animals of Sweetwater Wetlands section of this book to find out the preferred habitats of the plants and animals listed. Draw a line from each plant or animal to the habitat zone in which it would be found. Some organisms may be found in more than one zone.*



## ACTIVITY: WETLAND WEBS

Sweetwater Wetlands supports a thriving community of wetland plants and animals. Plants such as cottonwoods, cattails and bulrush produce energy through photosynthesis. They are the primary producers of energy in the community. Animals such as northern shovelers, coots, cotton rats and round-tailed ground squirrels eat the plant material found at Sweetwater. They are the primary consumers. The variety of carnivores that inhabit the wetlands are the secondary consumers. These include raccoons, rattlesnakes, Harris's hawks and even bobcats! Within the wetlands and the surrounding desert habitat there is an abundance of food for the variety of wildlife that occur there.

 *Directions: In the illustrations below, draw arrows to show who eats whom in the Sweetwater Wetlands food web. The arrows should point in the direction the energy flows. For example, energy flows from the tadpole to the dragonfly. You can find out what these animals eat in the Plants and Animals of Sweetwater Wetlands.*



# WETLAND CONSERVATION



## LOSS OF WETLANDS

Wetlands historically comprised vast amounts of land area in the United States. According to the U.S. Environmental Protection Agency (EPA), there were over 200 million acres of wetlands in the continental United States prior to the American Revolution. By the end of the 20th century, there was less than half that. There was a time in the not-too-distant past that we were losing over 50 thousand acres of wetlands each year.

## HOW DO YOU "LOSE" WETLANDS?

Natural wetlands are typically lost due to human activities. They may be drained for agricultural or industrial purposes. They may be lost when dams block their water source. Wetland losses also occur from dredging, filling, diking, logging, mining, and construction. We also lose wetlands to habitat degradation. Although wetlands have a natural ability to clean water, they can only take so much pollution. Excessive runoff, air and water pollution, and toxic chemicals can all harm a wetland to the point that it loses its ability to function as a healthy ecosystem. Wetland habitats can also be degraded by overgrazing of domestic animals and by the invasion of non-native plant and animal species.

Compared to the rest of the country, very little of Arizona's landscape today has wetlands. However, historical records indicate that Arizona once had approximately 30% more wetlands than today. Fortunately, because of our growing awareness of the value of wetlands, we have reduced wetland losses both in Arizona and across the country. Despite laws protecting wetlands, however, they are still threatened. Understanding wetlands will help aid their conservation.

## ACTIVITY: SPY THE INVADERS



**Directions:** Review the natural history information about the invasive species at Sweetwater Wetlands. In the diagram below, find the invaders. Circle each invasive species and note where it is in the scene. On your visit to Sweetwater Wetlands, see if you can find this scene and spy the invaders in real life!

In Tucson and the surrounding Sonoran Desert, several invasive species have taken hold. Some of these plants and animals can be seen at Sweetwater Wetlands. The managers of the wetlands work hard to keep these species from taking over and negatively affecting the native species. Several invasive species that occur at Sweetwater Wetlands are described below.



**BULLFROG** (*Rana catesbeiana*) – Although they occur throughout the United States, bullfrogs are not native to Arizona. They were introduced as a game animal and are now abundant statewide. Bullfrogs are so ravenous and produce so many young, that they can wipe out entire populations of native small animals. Since showing up at Sweetwater Wetlands, bullfrogs have reduced the populations of other amphibians.



**TAMARISK** (*Tamarix ramosissima*) – Tamarisk trees originally came from Asia. Tamarisks are known to invade riparian areas where they take up space and water and otherwise “out-compete” native riparian species such as willow and cottonwood. Tamarisk trees often sprout up on the islands at Sweetwater Wetlands. Although some have grown to tree size, most new sprouts are immediately removed.



**BUFFELGRASS** (*Pennisetum ciliare*) – Originally from Africa, buffelgrass is now widespread in the Sonoran Desert. Originally introduced as a pasture grass for cattle to graze, it has now taken over many stretches of desert, changing the habitat into a grassland. Buffelgrass can be found in neighborhoods throughout most of Tucson. When found at Sweetwater Wetlands, it is removed immediately.



**YELLOW STARHISTLE** (*Centaurea solstitialis*) – The starthistle, a small herb native to Europe and Asia, has become a successful weed in many areas of the United States. It out-competes other plants for space and water and will degrade a habitat if left to spread. It produces small, yellow, thistle-like flowers in the late spring. At Sweetwater Wetlands, yellow starthistle plants are removed as soon as they are detected.



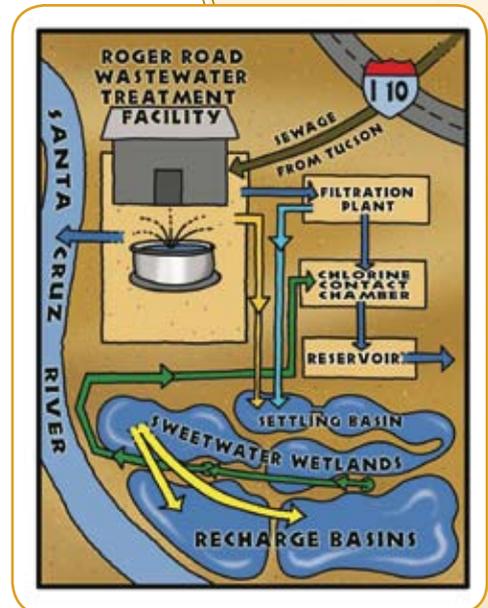
# ABOUT SWEETWATER WETLANDS

## HOW SWEETWATER WORKS: AN AMAZING DESIGN

Sweetwater Wetlands is designed to clean the backwash water from Tucson Water's Reclaimed Water Treatment Plant. The backwash water from the plant's filters is first piped to the settling basins at Sweetwater Wetlands. In the settling basins, suspended solids drop out of the water and settle onto the basin floor. These solids contain bacteria, viruses and metals. The large majority of these contaminants drop out early in the settling process. The solids are trapped in the soil and wetland plants in the basins.

The water next flows gradually downhill through a small channel to the wetland ponds for further "polishing", or cleaning. The water enters the ponds from the east side and slowly filters through the vegetation and around the islands toward the west side of the ponds. The water's movement through the ponds may take several weeks. During this time, more solids settle out and microbial transformations occur which clean the water of a variety of contaminants including pathogens and heavy metals. This water is recharged into the groundwater through the recharge basins. The flow of the water from the settling basins to the recharge basins is entirely directed by gravity: the water simply moves slowly downhill. After it filters through the recharge basins, it is pumped back to the reclaimed water plant where it is chlorinated and delivered to many parks, schools and golf courses.

The flow of water through the system – including the pumping of water to the wetlands, pumping water up from the ground, and delivery of the reclaimed water – is remotely controlled by Reclaimed Water Treatment Plant operators using computer commands. The amount of water that moves into and out of the wetlands is controlled by special gates called "weirs" that are operated manually. Reclaimed Water Treatment Plant operators must have complete knowledge of the entire system and the computers. Even the amount of water that is delivered to parks and golf courses all the way across the Tucson Basin is monitored and controlled by a plant operator at a computer.



## MANAGING SWEETWATER WETLANDS

The design of Sweetwater Wetlands includes areas of deeper open water, shallow water, shorelines, and uplands. Each of these areas serves a particular purpose and provides specific habitat like that of a natural wetland system. Because Sweetwater Wetlands' primary purpose is to clean up water, it must be managed and maintained for that purpose. The wetlands cannot become overgrown with vegetation and the settling basins must occasionally be cleaned of the built-up sludge. Also, each spring the managers at the wetlands conduct a controlled burn to remove some of the bulrush and cattails that have grown thick during the past year. This not only keeps the vegetation from overgrowing at the wetlands, it reduces mosquito habitat and allows improved application of chemicals to control mosquitoes.

## MOSQUITO CONTROL

Mosquitoes breed in wetlands and Sweetwater Wetlands is no exception. The still waters amid the bulrush offer prime habitat for mosquitoes—especially the species *Culex tarsalis*, known to be a vector (or carrier) of encephalitis, a disease which inflames the brain. Due to this health risk, mosquito control at Sweetwater Wetlands is very important!



Because mosquito larvae live and develop in water, the managers at the wetlands have a very rigorous program for controlling these aquatic larvae. The “mosquito abatement program” includes weekly mosquito counts, annual vegetation removal, and weekly applications of a larvicide from March through November. This larvicide kills only the mosquito larvae in the water and is non-toxic to other organisms such as beneficial insects, reptiles, birds, and mammals. However, no pesticide can manage to kill all larvae. If large numbers of surviving larvae become adults, a company is hired to chemically fog the area with a low-toxicity pesticide. This pesticide is approved by the Environmental Protection Agency for use in aquatic environments.

This aggressive mosquito abatement program has greatly reduced mosquito populations at the wetlands. However, managers are constantly working to find new and improved ways for controlling the mosquitoes.

## WHAT YOU CAN DO TO AVOID MOSQUITOES:

- It is important to understand that *Culex tarsalis* mosquitoes are nocturnal. During the day they are hiding out among the bulrush and cattails. Avoid going out at night near any mosquito breeding habitat.
- If you must go out at night, wear mosquito repellent.
- Wear long pants and long sleeves at night.
- When visiting Sweetwater Wetlands in the summer, stay away from the shoreline vegetation. This is where mosquitoes hide during the day because of the cooler temperatures and higher humidity.

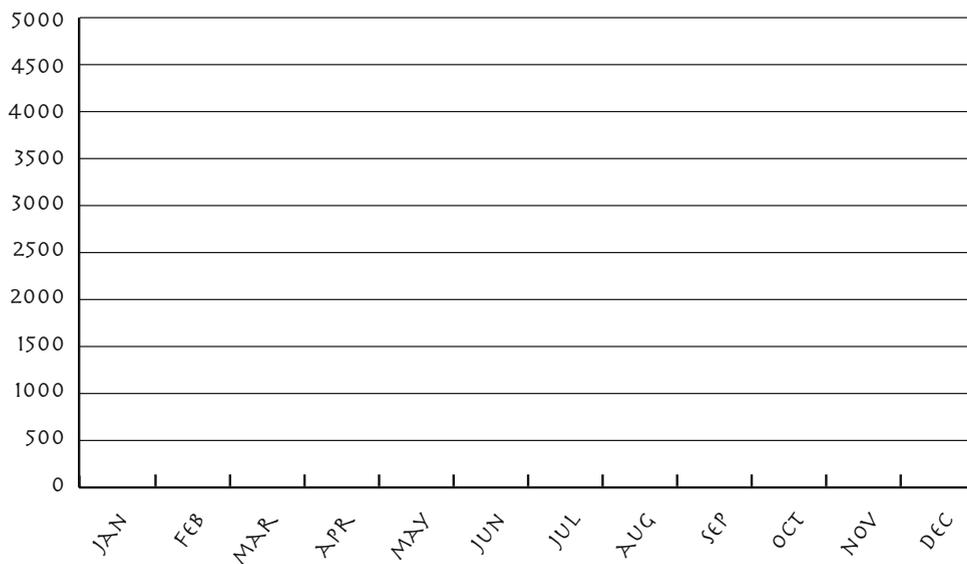
## ACTIVITY: THEY'RE DROPPING LIKE FLIES (MOSQUITOES THAT IS)



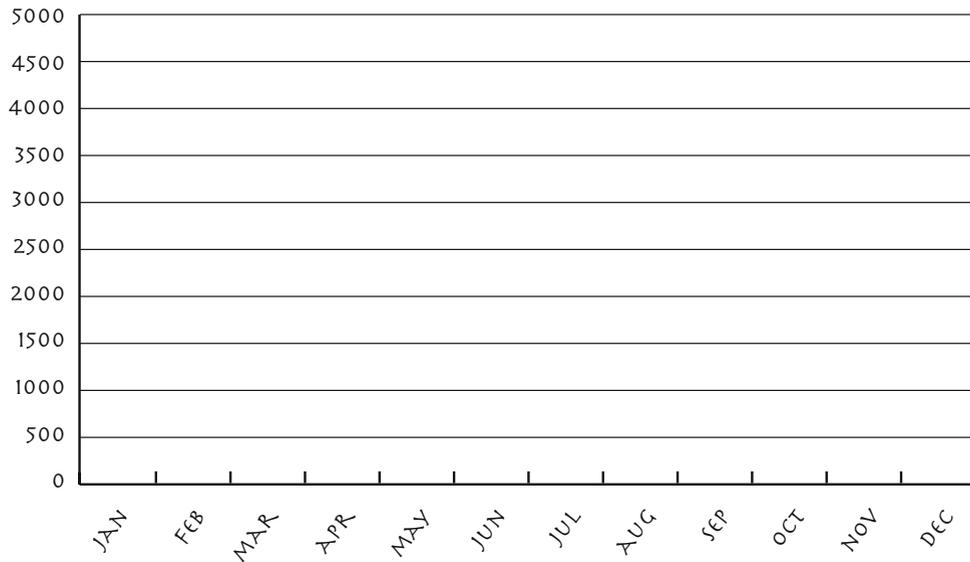
Directions: Adult mosquitoes are trapped year-round at Sweetwater Wetlands. This table shows the average number of mosquitoes trapped per trap night, each month. Use the data in the table to complete the bar graphs, below. Compare your completed graphs then answer the questions at the bottom of the page.

MONTH	BEFORE PROGRAM AVERAGE MOSQUITOES PER TRAP NIGHT 1998-1999 (AVG.)	AFTER PROGRAM AVERAGE MOSQUITOES PER TRAP NIGHT 2004-2005 (AVG.)
JANUARY	—	6
FEBRUARY	13	4
MARCH	868	61
APRIL	823	150
MAY	3415	720
JUNE	4655	585
JULY	623	401
AUGUST	280	454
SEPTEMBER	501	963
OCTOBER	1075	309
NOVEMBER	292	18
DECEMBER	—	—

BEFORE MOSQUITO ABATEMENT PROGRAM  
1998-1999 (AVG.)



AFTER MOSQUITO ABATEMENT PROGRAM  
2004-2005 (AVG.)



1. The mosquito control program began in 1999. What has happened to the mosquito population since that year?

.....  
.....

2. Does the mosquito control program appear to be working? Why or why not?

.....  
.....

3. During which months are mosquitoes most prevalent?

.....  
.....

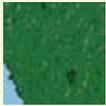
# SWEETWATER WETLANDS TRAIL MAP



DESERT UPLANDS



DIRT TRAIL



EMERGENT ZONE



ISLAND



OBSERVATION DECK



OPEN WATER



PAVED TRAIL



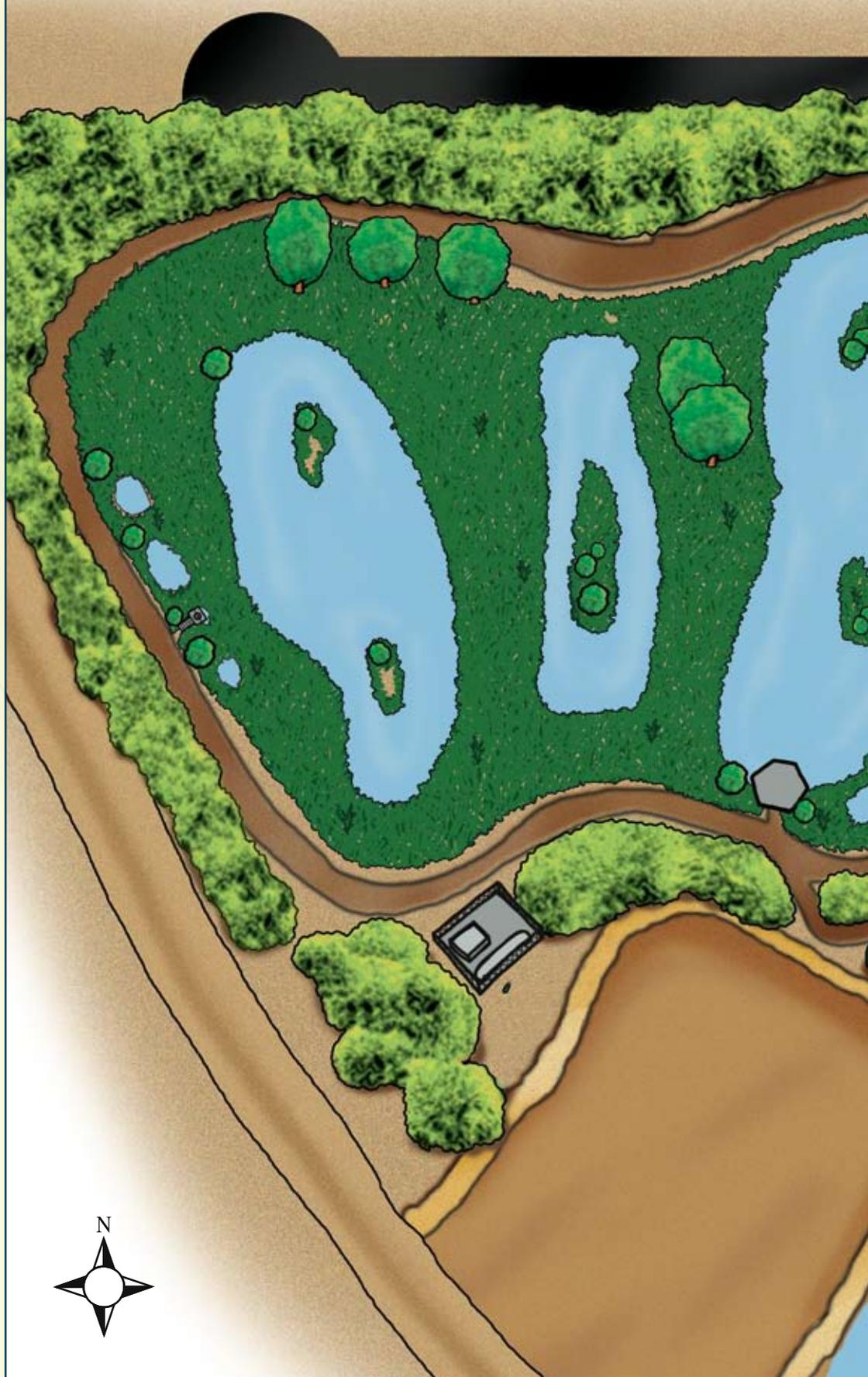
INTERPRETIVE SIGNS



WEIR



RESTROOMS





RECHARGE

BASINS

# VIEWING WILDLIFE AT SWEETWATER WETLANDS

Our presence in the outdoor environment is very obvious to the local animals. We may not see them, but they are quite aware of us. Our movement, behavior, and even our smell influence how animals react to our presence. When visiting Sweetwater Wetlands and other outdoor sites there are some very simple things we can do to be more successful in observing nature.



**USING YOUR SENSES.** Most humans rely on their sense of sight to gather information about their environment. Try adjusting the way you look at things. Instead of looking for specific shapes, relax your eyes a bit and try to detect motion. Can you spot a well-camouflaged animal hiding in the vegetation? Anything under water? When it comes to detecting wildlife, we can be more successful if we use some of our other senses as well. Some animals can be detected by smell. Also, listen carefully. Many birds at the wetlands hide among the cattails and bulrush. However, these birds can be very vocal! Listen carefully

for the metallic call of the red-winged blackbird or the chatterly trill of the marsh wren. You might hear the wings of a dove as it flies overhead or the splash of a turtle slipping into the water. Or you may hear a bird or small mammal rustling in the dry leaves under a shrub. Remember, your own silence will help you better detect the sounds in nature.

**BE AN ANIMAL.** Imagine what you would be doing if you were an animal at this location. Where would you hide? What would you eat? What kinds of things would frighten you? If you think like an animal, chances are you will be more sensitive to where to look to see one. You might also realize that your own human presence is potentially frightening: how can you be more considerate of the animals? Remember: you are now in their habitat!

**SLOW AND STEALTHY.** In nature, animals primarily run to escape danger or chase prey. When they detect another creature moving quickly, it's only natural that they would run away or try to hide. Move slowly and be conscious of how you step. Do you tromp along or can you be stealthy? When approaching a pond or going around a blind corner, slow down and approach quietly. Remember, stay calm and quiet and you could see some amazing wildlife behavior.

**WHAT ARE THEY DOING?** When you do see wildlife, take your time to observe its behavior. It's one thing to see a coot swim by but it's quite another to watch as it drags a piece of cattail all the way across a pond to build its nest. Animals exhibit all kinds of nesting, courtship, territorial and feeding behavior. They do all these incredible things right in front of our eyes! But we must be still and observe and see not only the animal but also what it is doing.





### ACTIVITY: SENSING WILDLIFE

Search for signs. Sometimes wildlife remains quiet and hidden. But we know they're there. Looking for signs of wildlife is fun and challenging. Each species has its own distinct tracks and scat (feces). You can learn these and identify wildlife by its signs! Look for other signs like grasses matted down that might show where an animal rested. Chewed prickly pear is often sign of javelina or pack rats. How many different animals can you detect by their signs alone?



*Directions: Can you match the animals with the signs they leave? Draw a line from each animal to its tracks and / or scat. (Note: Only mammal scat is included.) Look for these signs at Sweetwater Wetlands!*



COYOTE



GREAT BLUE HERON



DUCK



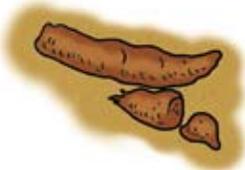
GAMBEL'S QUAIL



BOBCAT



RACCOON



## SWEETWATER THROUGH THE SEASONS

Sweetwater Wetlands, like anywhere, changes through the seasons. What you might or might not see during your visit depends on the time of year you go. Below are just some of the things to look for during the different seasons of the year.

### SPRING

- catkins on cottonwoods and willows
- birds building nests
- courtship displays
- blooming plants
- insect activity
- migrating birds

### SUMMER

- trees fully leafed out
- young coots
- dragonflies
- baby rabbits
- mosquitoes
- quail in pairs with young
- breeding frogs and turtles
- aquatic insect activity
- snakes
- lush vegetation
- red-winged blackbirds
- lizards
- lots of insects



### FALL

- eclipse (drab) plumage in ducks
- quail in coveys
- leaves falling from trees
- lots of dragonflies
- insect behavior
- lots of bullfrogs
- migrating birds

### WINTER

- small wintering birds
- yellow-headed blackbirds
- cattail going to seed
- sunning turtles
- leafless trees
- saltbush gone to seed
- brown and downed rushes
- lots of northern shoveler ducks



## MY VISIT TO SWEETWATER WETLANDS

Are you ready to visit Sweetwater Wetlands? One way to prepare for any field trip, is to study the plants and animals you might see there. This will help you know what to look for and where in the habitat to look for it. Use field guides such as the *Plants and Animals of Sweetwater Wetlands*. Develop a mental image of that plant or animal and you just might recognize it when you see it, even if you have never seen it before!



*Directions: In the space below, make a list of ten organisms (plants and/or animals) that you expect to see during your visit to Sweetwater Wetlands. Refer to the *Plants and Animals of Sweetwater Wetlands* at the end of this book and the lists in *Sweetwater Through the Seasons* (previous page), to help you with your list. Be sure to consider the time of year of your visit. Beside each plant or animal, list where in the habitat you expect it might be found.*

NAME OF ORGANISM:

PREFERRED HABITAT:

1

\_\_\_\_\_

\_\_\_\_\_

2

\_\_\_\_\_

\_\_\_\_\_

3

\_\_\_\_\_

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4

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10

\_\_\_\_\_

\_\_\_\_\_

## ACTIVITY – GUIDED JOURNALING



*Directions: Choose one of the organisms you see Sweetwater Wetlands. Take time to observe that organism and use this space to describe and draw that organism in more detail. (Note: If you are not planning a visit to the wetlands, choose an organism that you could see there and answer the questions.)*

Name of your organism:

.....

Where exactly did you see your organism:

.....

In which wetland zone(s) is your organism typically found:

.....

Describe adaptations your organisms has to help it survive in its habitat:

.....

If your organism is an animal, what was it doing when you saw it? (Describe its behavior.):

.....

Draw your organism. Include features such as distinctive characteristics, colors and markings.





## PERSONAL REFLECTIONS

This may include poems, drawings, leaf rubbings..... Use your Imagination!



# MAMMALS OF SWEETWATER WETLANDS



Photo : Paul Berquist

## COYOTE – *Canis latrans*

Range – United States and into Canada and Mexico.

Habitat – Found in just about every habitat type, including suburban areas of cities. Prefer open desert plains, grasslands, high mesas and open forests but are known to adapt to open, natural space in urban settings.

Food – Coyotes hunt both day and night. They are important predators of rabbits and rodents but will feed on larger mammals such as young deer. They will also eat small reptiles, insects and carrion. In early summer, they feed heavily on saguaro fruit, mesquite beans, and other vegetable matter.

Other – Coyotes may live alone, in pairs, or in small, territorial packs. Their dog-like tracks can be seen along the paths at Sweetwater Wetlands.

## BOBCAT – *Felis rufus*

Range – North America from mountains to deserts.

Habitat – Found in all kinds of habitats but prefer rocky hillsides with lots of vegetation.

Food – Bobcats are solitary predators. They eat small mammals including mice and other rodents, rabbits, bats, ground squirrels and even newborn deer. They also eat birds such as doves and quail. They have been known to take domestic animals such as poultry and newborn livestock.

Other – Bobcats have been seen and even photographed at Sweetwater Wetlands.



Photo : Young Cage

## RACCOON – *Procyon lotor*

Range – Fairly common throughout Arizona and across North America.

Habitat – Prefers brushy areas, almost exclusively near some type of water source. Also found in urban areas.

Food – They eat just about anything including crayfish, fish, insects, frogs and the eggs of any animal they can find.

Other – Raccoons are nocturnal and usually solitary. At Sweetwater Wetlands, look for their distinct, hand-like tracks in the mud near the water's edge.



Photo : Paul Berquist

## BLACK-TAILED JACKRABBIT – *Lepus californicus*

Range – Western United States.

Habitat – Deserts, prairies, pastures and brushy areas.

Food – Jackrabbits eat a variety of plant matter including grasses, herbs, forbs and small bushes. They will eat woody material and dried plants during droughts and in winter.

Other – They are eaten by hawks, coyotes, bobcats, and owls. Because they have so many predators they are very wary. They produce several litters each year. The black-tailed jackrabbit has distinctive long ears tipped with black and a prominent black stripe that runs from its rump to the top of its tail.



Photo : Earle Robinson



Photo : Paul Berquist

#### ROUND-TAILED GROUND SQUIRREL – *Spermophilus tereticaudus*

Range – Common inhabitants of the Sonoran Desert and throughout desert areas of the southwestern U.S. into Mexico.

Habitat – Found in desert flatlands where the soil is good for digging burrows.

Food – These squirrels feed on plant parts, including seeds. They are known to eat insects and even roadkill.

Other – They build underground burrows, tunneling into the desert soil. There may be several small openings to their burrows. Look for their burrows in the upland, desert areas around the wetlands at Sweetwater. They have many predators including hawks, snakes, bobcats and coyotes.

#### JAVELINA – *Tayassu tajacu*

Range – Desert scrub areas throughout central Arizona, east to Texas, and south to South America.

Habitat – Brushy habitat along creeks, stream beds and canyons within desert mountains.

Food – Javelina are opportunistic feeders. They feed on flowers, roots, grasses, forbs, tubers, fruits, mesquite pods, and most succulent plants. They eat a lot of cacti, especially prickly pear.

Other – Javelinas live in herds and mark their territories with their scent and droppings. Mountain lions and bobcats are the most common predators of javelina although coyotes, golden eagles and even foxes are known to prey on young javelina.



Photo : Paul Berquist



Photo : Paul Berquist

#### ARIZONA COTTON RAT – *Sigmodon arizonae*

Range – Central and southern Arizona.

Habitat – Desert areas primarily along canals and stream banks thick with weeds, grasses and brush. They are strongly associated with the drainages and waterways of the southwest.

Food – Cotton rats mostly eat green plants and grasses and are known to occasionally eat insects. Unlike some rodents, they do not store their food.

Other – They are active both day and night throughout the year. At Sweetwater Wetlands, they can be seen scurrying between patches of cattail and bulrushes. They can have up to twelve young in a litter with numerous litters per year. They are important prey species for many predators including coyotes, foxes, hawks and owls.

#### MEXICAN FREE-TAILED BAT – *Tadarida brasiliensis*

Range – Most free-tailed bats live in the western U.S. and Mexico.

Habitat – Occur in a variety of habitats from low-elevation deserts to pine-oak forests at 9,000' elevation. They live in colonies in caves, large, hollow trees, abandoned mines, tunnels, under bridges and in buildings. They will also use bat houses.

Food – They eat a variety of insects, especially moths. Free-tailed bats play an important role in reducing agricultural pests such as cotton boll moths and cut worm moths.

Other – Females give birth to one or two young per year. Their colonies can reach numbers in the millions.



Photo : AZ Game and Fish Department



Photo : Earle Robinson

#### DESERT COTTONTAIL RABBIT – *Sylvilagus audubonii*

Range – Deserts and plains throughout the western United States.

Habitat – Deserts, grasslands and woodlands in areas with lots of brushy vegetation and hiding holes.

Food – They primarily eat grass but will eat other vegetation.

Other – Desert cottontails are an important prey species for many predators including hawks, foxes, owls, bobcats, snakes and coyotes. They line their burrows with grasses and fur as bedding for their young. Cottontails are smaller than jackrabbits.

# BIRDS OF SWEETWATER WETLANDS



Photo : Paul Berquist

## GAMBEL'S QUAIL – *Callipepla gambelii*

Range – Throughout the southwest deserts in Arizona, New Mexico and Texas. Also in desert habitats of southern Nevada and Utah.

Habitat – Desert grassland and desert scrub.

Food – These quail feed on seeds, grains, some insects, berries and succulent green vegetation. Gambel's quail also feed on the buds of mesquite flowers.

Other – In fall and winter, Gambel's quail can be seen in large coveys (groups) of up to 40 birds. In spring, the birds break up into pairs for courtship and nesting. They are ground-nesting birds, preyed upon by snakes, birds of prey, and coyotes.

## ABERT'S TOWHEE – *Pipilo aberti*

Range – Southern and western Arizona north to southern Nevada.

Habitat – Brushy areas and thickets in desert scrub, riparian areas and woodlands. Often near water.

Food – Abert's towhees forage on the ground by raking at underbrush to uncover seeds and insects.

Other – A shy, somewhat secretive bird that is usually detected by its call which is a high pitched “peek”. They are usually alone or in pairs.



Photo : Earle Robinson



Photo : Greg Clark

## CACTUS WREN – *Campylorhynchus brunneicapillus*

Range – Southwestern U.S. to central and northeastern Mexico, including Baja California.

Habitat – Desert flatlands and foothills where large cacti are found. They also occur in urban areas within their range.

Food – They feed on insects and other arthropods, fruits and seeds.

Other – Cactus wrens are very busy and inquisitive birds. They usually build their spherical nests among the spiny stems of cholla cacti but may use palo verde, acacia, or saguaro. They are known to build “decoy” nests, which may distract predators from the real nest with the young.

## RED-WINGED BLACKBIRD – *Agelaius phoeniceus*

Range – Across the entire U.S. through Canada and into western Mexico.

Habitat – Among the vegetation in wetlands, riparian areas and fields near water.

Food – These blackbirds eat seeds, grains and some fruits. They also eat insects and spiders.

Other – Red-winged blackbirds can be seen in large flocks, year-round among the cattails and bulrush at Sweetwater Wetlands. Their calls are very distinctive, sounding gurgling and metallic. The black males have prominent, red wing patch



Photo : Paul Berquist

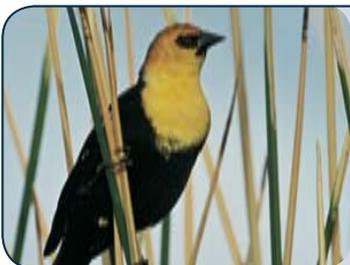


Photo : Paul Berquist

## YELLOW-HEADED BLACKBIRD – *Xanthocephalus xanthocephalus*

Range – Breeds in the mid-western U.S. into Canada. Winters in the southwestern U.S. and Mexico.

Habitat – Wetlands, ponds and lakes with lots of reeds, and agricultural fields.

Food – They eat seeds, grains, insects and some snails.

Other – Yellow-headed blackbirds hang out in large flocks. They are mainly a spring, fall and winter visitor to Sweetwater Wetlands and can be seen on emergent vegetation.



Photo : Earle Robinson

#### GREAT-TAILED GRACKLE – *Quiscalus mexicanus*

Range – Southwestern U.S. from California to Louisiana. North to Nebraska and south through Mexico.

Habitat – Fields, farms, riparian areas, wetlands and urban parks. Common around neighborhoods and parking lots.

Food – Grackles are opportunistic feeders, eating insects, small birds, a variety of invertebrates and even small fish and frogs. They also eat seeds and berries.

Other – These large, black birds have an iridescent purple sheen to their feathers. Males have a long tails that they fold length-wise like a keel. Grackles often form large flocks. Their loud calls are almost always heard at Sweetwater Wetlands.

#### GREATER ROADRUNNER – *Geococcyx californianus*

Range – Southwestern U.S. from north-central California to east Texas. South to Mexico and Baja California.

Habitat – Desert scrub, chaparral, brushy areas, and some oak woodlands.

Food – Roadrunners are predators. They eat a variety of prey including snakes, lizards, mice and insects. They typically chase down their prey. They will eat some seeds and cactus fruit.

Other – Roadrunners seldom fly. When surprised or startled, they usually run away. Roadrunner tracks are easy to identify. They have two toes facing forward and two backward, which helps them run fast. They build their nest of twigs in small trees or sometimes in cholla cactus.



Photo : Paul Berquist



Photo : Paul Berquist

#### GILA WOODPECKER – *Melanerpes uropygialis*

Range – Southern Arizona to Nevada and south into western Mexico and Baja California.

Habitat – Desert scrub mainly in habitats that include saguaro cactus. Also around riparian woodland and urban areas.

Food – Gila woodpeckers are primarily insect eaters, searching for prey on a variety of desert trees.

Other – Gila woodpeckers are cavity nesters. They use their strong, pointy bills to make holes primarily in saguaro cactus. They are the most common woodpecker in the desert and can be seen year-around.

#### BLACK PHOEBE – *Sayornis nigricans*

Range – From northern California across the southwestern U.S. to west Texas. South to into Mexico and Baja California.

Habitat – Streams, rivers, lakes, wetlands and urban ponds. Often seen perched on branches by the water's edge.

Food – Black phoebes mainly eat flying, aquatic insects. They have keen eyesight and catch the insects in the air.

Other – Black phoebes are year-round residents at Sweetwater and are often seen near "Hidden Pond." Their nests are made of mud attached to a rock face near water. Their song is a repetitious "fee-bee".



Photo : Earle Robinson



Photo : Earle Robinson

#### HARRIS'S HAWK – *Parabuteo unicinctus*

Range – In the U.S., found only in southern Arizona and south-western Texas. South into mainland Mexico and Baja California.

Habitat – Desert scrub, cactus and mesquite forests, brushy fields and open woodlands.

Food – These birds of prey eat small mammals, birds and reptiles. They are known to hunt cooperatively, taking turns to chase down prey until the kill is made.

Other – Harris's hawks are frequently seen at Sweetwater Wetlands. They often perch on the tallest trees in the area and sometimes nest nearby.



Photo : Paul Berquist

#### AMERICAN KESTREL – *Falco sparverius*

Range – Throughout most of North America, through Mexico and into South America.

Habitat – Open country, farm fields, roadsides, and urban parks.

Food – Kestrels eat small rodents, reptiles, birds and large insects. They are also known to eat frogs and bats.

Other – These small falcons can be seen perched on fence posts and wires. They will bob their tails while perched. They often hover while hunting. Kestrels are cavity nesters (they nest in holes) and will use large nest boxes. They can be seen year-round at Sweetwater Wetlands

#### PEREGRINE FALCON – *Falco peregrinus*

Range – Nearly world-wide but only in suitable habitat.

Habitat – Open country with nearby cliffs, rocky canyons, cities with tall buildings, and cliff faces along seashores.

Food – Peregrines primarily eat other birds, which they catch on the wing. They prefer ducks, quail, pigeons, doves and other medium to large birds.

Other – Peregrines are known to reach speeds of up to 175 mph in a dive. They can be seen hunting around Sweetwater Wetlands during migration and in the winter.



Photo : AZ Game and Fish Department



Photo : Paul Berquist

#### GREAT BLUE HERON – *Ardea herodias*

Range – World-wide in suitable habitat of temperate and tropical regions.

Habitat – Along the shorelines of most bodies of water including wetlands, seashores, lakes, and rivers.

Food – Great blue herons stand very still while hunting for fish, frogs and large invertebrates. They jab their long bills suddenly into the water to catch their prey.

Other – These large herons are seen only occasionally at Sweetwater Wetlands.

#### MOURNING DOVE – *Zenaida macroura*

Range – Throughout the U.S. into central Canada and south through Central America.

Habitat – In a variety of habitats including desert scrub, grasslands, farms, cities, parks, and open woodlands.

Food – These doves eat a variety of seeds.

Other – Mourning doves are year-round residents at Sweetwater Wetlands. Their mournful "coo coo coo" is frequently heard.



Photo : Paul Berquist



Photo : Paul Berquist

#### WHITE-WINGED DOVE – *Zenaida asiatica*

Range – In the extreme southern portions of the U.S. and throughout Mexico to Central America.

Habitat – Saguaro forests, mesquite forests, fields, urban areas and riparian woodlands.

Food – White-winged doves mainly eat seeds. They also eat berries and cactus fruit.

Other – These large doves are only seen at Sweetwater Wetlands during the warmer months as they fly south for the winter.



Photo : Doug Backlund

#### SONG SPARROW – *Melospiza melodia*

Range – Across the U.S., through Canada and into southern Alaska.

Habitat – Riparian scrub, thickets, woodland edges, and brushy areas.

Food – Song sparrows eat a variety of insects, seeds, berries, and grains.

Other – Song sparrows are commonly seen and heard at Sweetwater Wetlands. They forage around the base of bushes and sometimes hop into the open on a higher perch to belt out their melodious tunes. Their distinct song starts with two or three clear whistles followed by a loud trill.

#### EUROPEAN STARLING – *Sternus vulgaris*

Range – Across the U.S. north into Canada and south through Mexico. Also in Europe and Asia.

Habitat – Urban settings, fields, woodlands, grasslands and farms.

Food – Starlings eat a variety of insects, fruits and seeds.

Other – Starlings were introduced into the U.S. from Eurasia. They have now spread across the country and are considered an invasive species. They are a cavity nester and will take nest holes that would otherwise be used by native species.



Photo : Earle Robinson



Photo : Paul Berquist

#### KILLDEER – *Charadrius vociferus*

Range – From Canada, throughout the U.S. and south into Mexico.

Habitat – Open fields, mudflats, airports, golf courses, grassy lawns and flat, rocky shores.

Food – Killdeer primarily eat insects.

Other – They are named for their call which sounds like a loud “killdeer, killdeer.” They will pretend to have a broken wing in order to lure intruders away from their nests. Killdeer are common at Sweetwater Wetland’s recharge basins.

#### CINNAMON TEAL – *Anas cyanoptera*

Range – From southwestern Canada, through the western U.S. and into Mexico.

Habitat – Ponds, small lakes and wetlands.

Food – Cinnamon teal eat a variety of aquatic plants and insects. They also eat snails and other aquatic invertebrates and some grains. They skim the water with their bills and also dip below the water to reach food items.

Other – The males of these striking ducks are easy to identify with their dark chestnut plumage. The females are a mottled brown color. Males go through an “eclipse plumage” stage in late summer during which they resemble the females. They are seen at Sweetwater Wetlands mostly during migration and through the winter.



Photo : Paul Berquist



Photo : Paul Berquist

#### AMERICAN WIGEON – *Anas americana*

Range – Breeds in Alaska, Canada and the northern United States. Winters in the southern U.S. and into Mexico.

Habitat – Ponds, lakes, wetlands, bays and shorelines.

Food – These dabbling ducks mainly eat plant material but will occasionally eat aquatic invertebrates.

Other – Male wigeons go through their “eclipse plumage” stage during late summer and early fall. Wigeons are seen mostly during the winter at Sweetwater Wetlands.



Photo : Paul Berquist

#### NORTHERN SHOVELER – *Anas clypeata*

Range – Throughout western North America. Winters in the southern states across the U.S. and into Mexico.

Habitat – Ponds, lakes and wetlands. Sometimes winter in saltwater bays.

Food – Shovelers use their large bills to strain the water for plant matter and aquatic insects.

Other – Their large, shovel-like bills are distinct on both sexes. Males go through an “eclipse plumage” stage in late summer during which they resemble the females. During the winter, these ducks can be seen all over Sweetwater’s ponds as well as resting on the islands.

#### MALLARD – *Anas platyrhynchos*

Range – Throughout most of North America south into Mexico. Also in Africa and India.

Habitat – Ponds, lakes, rivers and wetlands. Common in ponds of city parks.

Food – Mallards eat plant material and some aquatic insects.

Other – These very common ducks are seen year-round at Sweetwater Wetlands. Males resemble females in the late summer during their “eclipse plumage” stage.



Photo : Paul Berquist



Photo : Paul Berquist

#### RUDDY DUCK – *Oxyura jamaicensis*

Range – Breeds in the western U. S. and Canada. Winters in the southern U.S. into Mexico. Some populations occur in South America.

Habitat – Lakes, ponds and wetlands.

Food – Ruddy ducks are diving ducks, diving underwater to find their food. They eat aquatic invertebrates and plant material.

Other – These ducks have a distinct, perky tail. In breeding plumage during the spring and summer, the bills of the males are bright blue. Ruddy ducks are seen year-round at Sweetwater Wetlands.

#### AMERICAN COOT – *Fulica americana*

Range – Throughout North and South America except in the coldest regions.

Habitat – Ponds, lakes, wetlands and urban parks with water.

Food – Coots mainly eat aquatic vegetation. They can be seen with their tails in the air as they forage in the water. They also dive deeper for aquatic invertebrates and some fish and amphibians.

Other – Coots are not ducks but are in the rail family. Instead of webbed feet, their toes are separated. They are year-round residents at Sweetwater Wetlands. They nest in the tall bulrush and cattails. Young coots with their red-orange heads can be seen in the spring.



Photo : Paul Berquist



Photo : Paul Berquist

#### COMMON MOORHEN – *Gallinula chloropus*

Range – Locally in southern Arizona and New Mexico, and along the coast of California. Also in southern Gulf states of Texas, Louisiana and Florida. South to South America.

Habitat – Freshwater wetlands and marshes, ponds and lakes usually with emergent vegetation.

Food – Moorhens primarily eat aquatic vegetation. They also eat a variety of invertebrates including insects and snails.

Other – Moorhens, like coots, are rails, not ducks. They can be seen year-round walking over fallen emergent vegetation and swimming in the ponds at Sweetwater Wetlands.

# INSECTS OF SWEETWATER WETLANDS

## DRAGONFLY – Order: *Odonata*, Suborder: *Anisoptera* (dragonflies)

Habitat – Larvae are purely aquatic, living in ponds, lakes, wetlands, and slower moving streams. The adults occur both near water and around fields and grassy areas, including urban parks.

Food – As larvae, they eat tadpoles, tiny fish, and the larvae of smaller insects. They grab prey with an extendible jaw. The adults feed on other flying insects, including mosquitoes.

Life Cycle – There are many species of dragonflies. Most deposit their eggs on the surface of water or wet mud. The larvae that hatch are aquatic, living underwater and breathing with gills. After completing all their growth stages, the larvae leave the water (usually by crawling up a reed). The adult emerges from the larval skin and flies away with newly formed wings. Adults leave the water and return only to mate and deposit eggs to continue the cycle.



Photo : Dennis Caldwell



Photo : Steve Prchal - SASI

## PREDACEOUS DIVING BEETLE – Order: *Coleoptera* (beetles), Family: *Dytiscidae*

Habitat – Ponds, wetlands and slow moving water.

Food – Both the adults and larvae are voracious predators. They feed on other aquatic insects (including mosquito larvae), small fish, tadpoles and even adult frogs. They inject a digestive fluid into their prey and suck out the juices.

Life Cycle – Eggs are laid in water, usually attached to an aquatic plant. The larvae, called water tigers, spend their entire lives in the water until digging into mud at the water's edge to pupate into adults. Adults primarily live in the water but can emerge and fly to other ponds. Adults capture an air bubble behind their wings as their underwater air supply.

## DAMSELFLY – Order: *Odonata*, Suborder: *Zygoptera* (damselflies)

Habitat – Ponds, wetlands, lakes and streams.

Food – Damselflies are predaceous in both adult and larval stages. Like dragonflies, they catch prey with an extendible jaw. They eat other insect larvae, tadpoles and small fish.

Life Cycle – Eggs are deposited in the water on aquatic plants. The larvae are aquatic, going through several growth stages before emerging from the water to molt into adults. Adults may fly away or stay near the water to mate.



Photo : Steve Prchal - SASI



Photo : Steve Prchal - SASI

## GIANT WATER BUG – Order: *Hemiptera* (true bugs), Family: *Belostomatidae*

Habitat - Slow moving streams or standing water habitats such as wetlands and ponds.

Food – The larvae eat mainly other aquatic insect larvae. The adults eat insects, small fish, tadpoles and snails. Adults wait at the water's surface for their prey which they ambush and then subdue with a toxin.

Life Cycle – Eggs are laid by the females directly onto a male's back. He will carry and care for these until they hatch. Larvae breathe air through a small snorkel-like device on their backs. Larvae go through several molts until they become adults. Adults are also aquatic but breathe air which they capture as a bubble under their wings.

**WATER SCORPION** – Order: *Hemiptera (true bugs)*, Family: *Nepidae*

Habitat – Among vegetation in slow moving water such as wetlands and ponds. Some are found under rocks in slowing moving streams.

Food – These are ambush predators, capturing their prey with their forelegs. They eat insect larvae, worms and other invertebrates.

Life Cycle – Eggs are laid on aquatic vegetation and floating objects. Larvae molt through several stages before becoming adults. Adults tend to stay near the water's surface attached to some vegetation. They will breathe using a snorkel-like siphon and trapped air bubble. They are poor swimmers and instead tend to crawl around on aquatic vegetation.



Photo : Steve Prchal - SASI



Photo : Steve Prchal - SASI

**BACKSWIMMERS** – Order: *Hemiptera (true bugs)*, Family: *Notonectidae*

Habitat – Ponds, wetlands and other aquatic habitats, usually in slow moving water.

Food – They prey on other aquatic invertebrates including and the larvae of mosquitoes and other insects.

Life Cycle – Eggs are laid on the stems of aquatic vegetation. They go through several stages before becoming adults. As their name suggests, they swim upside-down. As air breathers, they capture a bubble as an underwater air supply.

## PLANTS OF SWEETWATER WETLANDS

**FREMONT COTTONWOOD** – *Populus fremontii*

Range – Riparian areas of Arizona and throughout the southwestern states from Texas to California.

Habitat – Found near water primarily in desert, woodland and prairie riparian habitats. Often occur with willow trees.

Characteristics – These large, broad trees can grow to 60 feet high. Their seeds are covered with a soft "cotton" and are wind-carried. During the late spring at Sweetwater Wetlands, look for the cottony seeds flying through the air.

Other – Cottonwood trees need lots of water for their survival and reproduction. They have extensive roots for obtaining water. They provide important habitat for birds, insects, lizards, snakes, and small mammals. They lose their leaves in the fall.



Photo : Greg Clark



Photo : Bruce Prior

**GOODING WILLOW** – *Salix gooddingii*

Range – From Texas to California north to Utah and south into Mexico.

Habitat – Found near water in desert, grassland and woodland riparian habitats. Often occur with cottonwood trees.

Characteristics – These fast growing trees grow to around 50 feet high. Like cottonwoods, these willows have a "cottony" seed that becomes airborne in the spring.

Other – They are also deciduous, losing their leaves in the fall. Along with cottonwoods, these trees line the banks of Sweetwater Wetlands.



Photo : Bruce Prior

#### SALTBUSH – *Atriplex* spp.

Range – Depending on the species, saltbush may range west to California, east to Kansas, north to Washington and south into Mexico.

Habitat – Desert shrub to juniper shrub habitats. Some species thrive in salt flats and coastal plains.

Characteristics – There are four species of saltbush at Sweetwater Wetlands. All are medium to large bushes. They are called saltbush because they can tolerate “salty” soils and because they exude salt onto their leaves, making them salty.

Other – Saltbush provides great habitat and forage for birds and other wildlife.

#### AMERICAN THREE-SQUARE BULRUSH – *Scirpus americanus*

Range – Across most of the U.S. except the extreme north central states. North into Canada and south into Mexico.

Habitat – The edges of ponds, lakes and wetlands. Grows mostly in the water but can tolerate some dry spells.

Characteristics – Bulrush is an emergent plant. It is rooted in the soil at the water's edge and grows up through water with its leaves and seeds “emerging” above the water. This bulrush is called three square because its stems are triangular in cross section.

Other – Bulrush are an important part of the wetland food chain. Their underwater stems (both when alive and when decomposing) provide important food and habitat for aquatic organisms. Many wetland birds eat the seeds of the bulrush.



Photo : Bruce Prior



Photo : Bruce Prior

#### SOFT STEM BULRUSH – *Scirpus validus*

Range – Widespread across the U.S. and into Canada and Mexico.

Habitat – The edges of ponds, lakes, wetlands and ditches. Grows in shallow water and wet soils.

Characteristics – Soft stem bulrush can reach 8 feet high and tend to droop with the weight of their brownish flowers and seeds.

Other – Their seeds are important food for many wetland birds.

#### GIANT BULRUSH – *Scirpus californicus*

Range – Across all the southern states as far north as Kansas.

Habitat – Grows in shallow water along wetlands and marshes and shorelines of waterways.

Characteristics – This is the tallest bulrush at Sweetwater Wetlands, reaching 10 feet in height.

Other – These tall, emergent plants provide important habitat and forage for a variety of wetland wildlife.



Photo : Bruce Prior



Photo : Bruce Prior

#### CATTAIL – *Typha* spp.

Range – Throughout the U.S. into Canada and Mexico.

Habitat – Standing water and wet soil of wetlands, marshes, ponds and ditches.

Characteristics – There are several species of these tall, wetland grasses. They are named for their long, brown seed heads (resembling a cat's tail) which mature through the summer. In winter, they begin to release the individual seeds in cottony clusters that become windborne.

Other – Cattails are important food and shelter for many wetlands animals. Humans also use them as a food source. Like many emergent plants, cattails cannot grow in water more than three feet deep so are found at the water's edge.

### VELVET MESQUITE – *Prosopis velutina*

Range – Through Arizona, into New Mexico and south into Mexico.

Habitat – Although mainly a desert and grasslands dweller, mesquites also live in moist areas just up from the water edge, forming thick forests called “bosques.”

Characteristics – These trees can grow to 30 feet. They have tiny, feather-like leaves. Mesquites also have very long “tap” roots which grow very deep into the soil to reach water.

Other – Mesquites provide food and shelter for a variety of animals. They bloom in the spring, attracting numerous species of insects. By summer, the pollinated blossoms produce the protein-rich, yellowish bean pods which are eaten by many animals. During the winter and times of drought, the mesquite will drop its leaves.



Photo : Bruce Prior



Photo : Bruce Prior

### WOLFBERRY – *Lycium berlandieri*

Range – Southern Arizona east to Texas and south into Mexico.

Habitat – Desert scrub, rocky desert slopes and desert plains.

Characteristics – A large, thorny shrub reaching over four feet in height. Wolfberry blooms sporadically and produces red berry-like fruits.

Other – Wolfberry produces its leaves in response to rain. It may be leafless during times of drought. A variety of desert birds and other animals eat its fruits.

## REPTILES OF SWEETWATER WETLANDS

### WESTERN DIAMOND-BACKED RATTLESNAKE – *Crotalus atrox*

Range – Across the warm southern states from Arkansas west to California.

Habitat - Prefer deserts, rocky canyons and foothills but found in a variety of habitats from the plains to the mountains.

Food - They feed mainly on small mammals such as rats, mice and even small rabbits. They will also eat small birds such as quail. They feed mostly at night. They have potent venom which they use to help subdue prey.

Other – Western diamond-backed rattlesnakes average 3 to 5 feet in length and are the largest rattlesnakes in the west. Like most rattlesnakes, they will lay in the sun to warm up their bodies and seek shade under rock crevices when they get too warm.



Photo : Earle Robinson



Photo : Paul Berquist

### SONORAN DESERT TOAD – *Bufo alvarius*

Range – Mostly occur in the Sonoran Desert but range west to California, and into central Arizona.

Habitat – Deserts and grasslands near a water source.

Food – These predators will eat just about anything they can catch including large insects and other frogs and toads.

Other – They spend winter underground and dig to the surface to become active throughout the summer. Sonoran Desert Toads lay their eggs in water, with the first weeks of their lives spent as tadpoles. The glands on their backs contain a toxin that can be harmful to animals (including humans). They are the largest native toad in the United States.



Photo : Dennis Caldwell

#### TREE LIZARD - *Urosaurus ornatus*

Range - From Arizona east to Texas, north to Wyoming and south into Mexico.

Habitat - Lives on trees and rocks in riparian, woodland, semi-desert and urban areas.

Food - These small carnivores feed primarily on insects and spiders.

Other - Look for tree lizards doing "push-ups" on tree branches at Sweetwater Wetlands.

#### RED-EARED SLIDER TURTLE - *Trachemys scripta elegans*

Range - From Georgia to New Mexico north to Illinois and Indiana. Not native to Arizona and those at Sweetwater Wetlands were introduced.

Habitat - Lives in fresh water ponds, lakes and slow moving streams. Prefers muddy bottoms.

Food - They eat aquatic vegetation, invertebrates and small fish. They also eat decaying vegetation.

Other - These turtles love to bask in the sun and are commonly seen on logs and on the banks of Sweetwater Wetlands.



Photo : Paul Berquist



Photo : Paul Berquist

#### RED-SPOTTED TOAD - *Bufo punctatus*

Range - East to Central Texas and Kansas and west to California. Also occurs south into Mexico.

Habitat - Prefers riparian areas (near streams and small water courses) in otherwise arid habitats. Likes to hide among streamside rocks.

Food - They primarily eat insects.

Other - The cricket-like call of the males can be heard in desert riparian areas during the summer rainy season. They are prey to a variety of predators.

#### SONORAN GOPHER SNAKE - *Pituophis catenifer affinis*

Range - Gopher snakes occur across North America into Canada and Mexico. The Sonoran subspecies occurs in the Sonoran Desert.

Habitat - Found in a variety of habitats from deserts to forests. Also found in cultivated fields and urban, open space. Prefers grassy and brushy areas.

Food - These predators kill their prey by constriction (squeezing). They eat small mammals, birds, lizards and even other snakes.

Other - Gopher snakes are eaten by a variety of predators including hawks, coyotes and foxes. They resemble rattlesnakes and even mimic rattlesnake behavior by coiling and shaking their tails.



Photo : Paul Berquist



Photo : Dennis Caldwell

#### BULLFROG - *Rana catesbeiana*

Range - Native to the eastern and central states but now occurs throughout most of the United States.

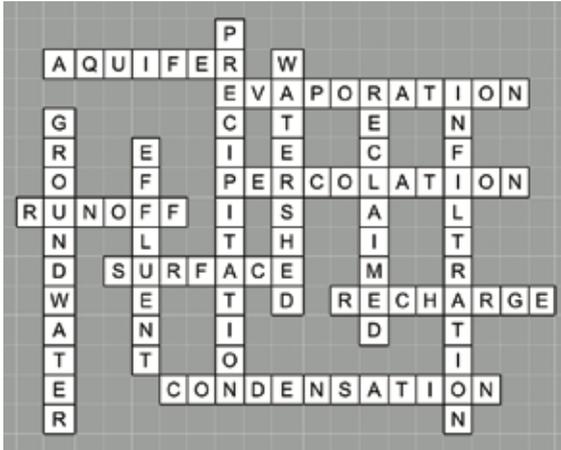
Habitat - Warm ponds, lakes, wetlands and watercourses. The bullfrog is purely an aquatic species.

Food - These voracious predators eat other amphibians, reptiles, fish, insects and almost anything they can catch.

Other - This frog has been introduced in numerous states as a food source. It is hunted for its leg meat. It has become an invasive species, killing off native species through predation and competition.

# ANSWER PAGE

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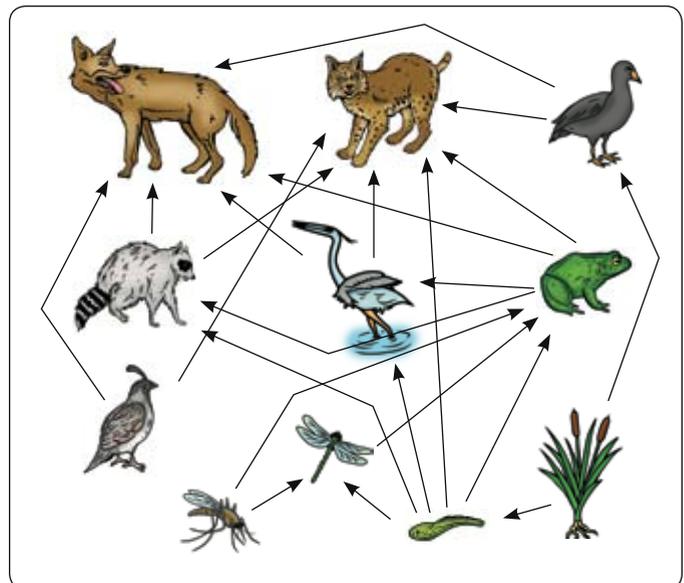
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- 1st Picture 1950-1990
- 2nd Picture 1500's
- 3rd Picture 1900- 1940
- 4th Picture Early 2000's
- 5th Picture 1700's

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- Saltbush – upland
- Cotton rat – upland, wet/dry
- Gooding willow – upland, wet/dry
- Gambel's quail – upland
- Bulrush – wet/dry, emergent
- Dragonfly larva – emergent, open water
- Bullfrog – wet/dry, emergent, open water
- Water scorpion – emergent, open water
- Red-eared slider – wet/dry, emergent, open water
- Red-winged blackbird – upland, wet/dry, emergent
- Cattail – wet/dry, emergent
- Cottontail rabbit – upland
- Coypte – upland
- Great bule heron – upland, wet/dry, emergent
- Ruddy duck – wet/dry, emergent, open water
- Raccoon – upland, wet/dry

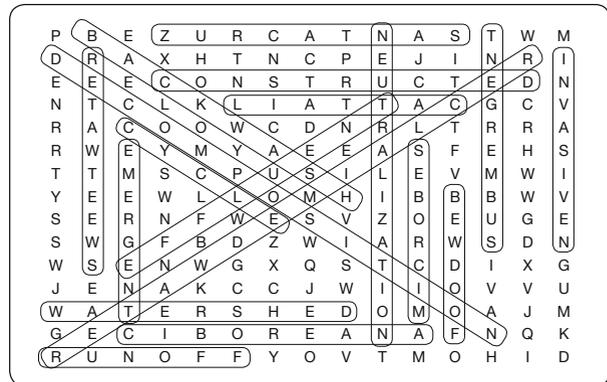
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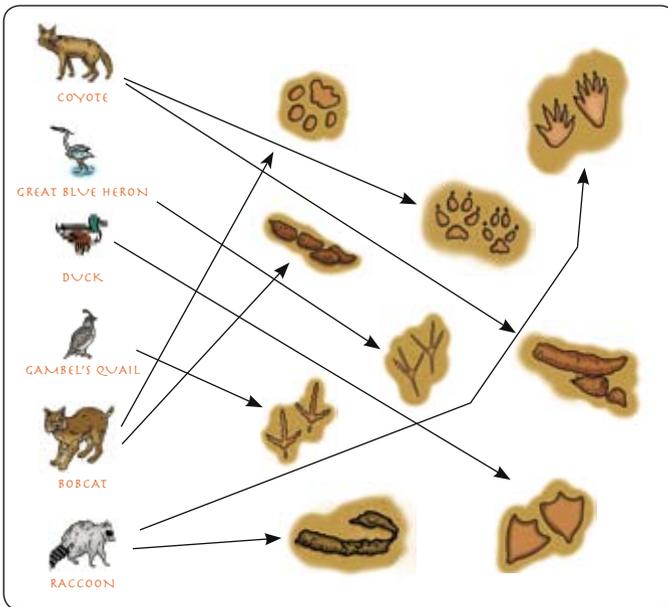
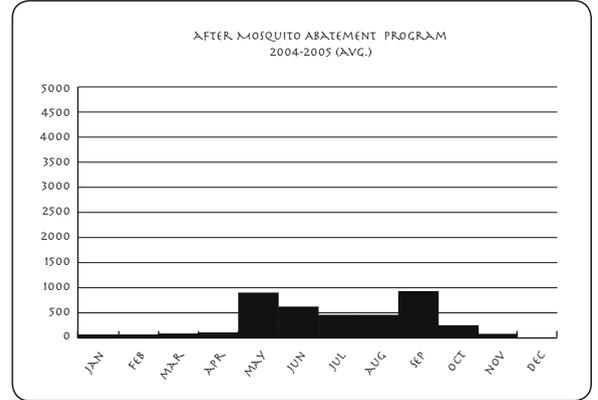
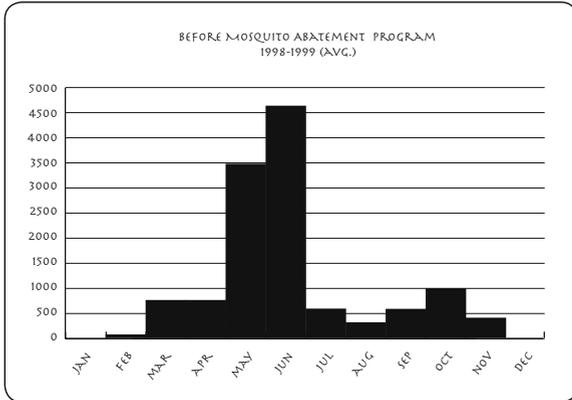


Page 8

crossword clue	water cycle word	letter location in diagram
6 down	infiltration	e
9 across	percolation	f
4 across	evaporation	a
13 across	condensation	b
1 down	precipitation	c
12 across	recharge	g
7 down	groundwater	h
10 across	runoff	d

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## GLOSSARY

**Aquifer** - An underground geologic formation that contains water.

**Condensation** - The process of a vapor changing to a liquid (as when clouds form).

**Effluent** - Water that is treated and released by a sewage treatment plant.

**Evaporation** - The process of a liquid changing to a vapor.

**Groundwater** - Water found below the earth's surface.

**Infiltration** - The process of water moving from above to below the earth's surface.

**Percolation** - The process of water moving down through layers of soil and rock.

**Precipitation** - Water that falls to the earth in such forms as rain or snow.

**Recharge** - The addition of water to an aquifer.

**Reclaimed water** - Effluent that is highly treated and can be used again.

**Riparian** - On or relating to the land just beside a river, stream, or wash.

**Riparian habitat** - The typically lush area next to a river or stream that is home to a variety of plants and wildlife.

**Runoff** - Water that flows downhill over the earth's surface.

**Surface water** - Water found on the earth's surface (as in runoff, rivers, or lakes).

**Water table** - The highest level of groundwater.

**Watershed** - The total land area that drains to a specific river, wash, or lake.

**Wetland** - Land that is covered with water for at least part of the year; only plants adapted to very wet soils can live in wetland habitats.

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***This booklet is the product of many individuals and organizations:***

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Hugh Armstrong

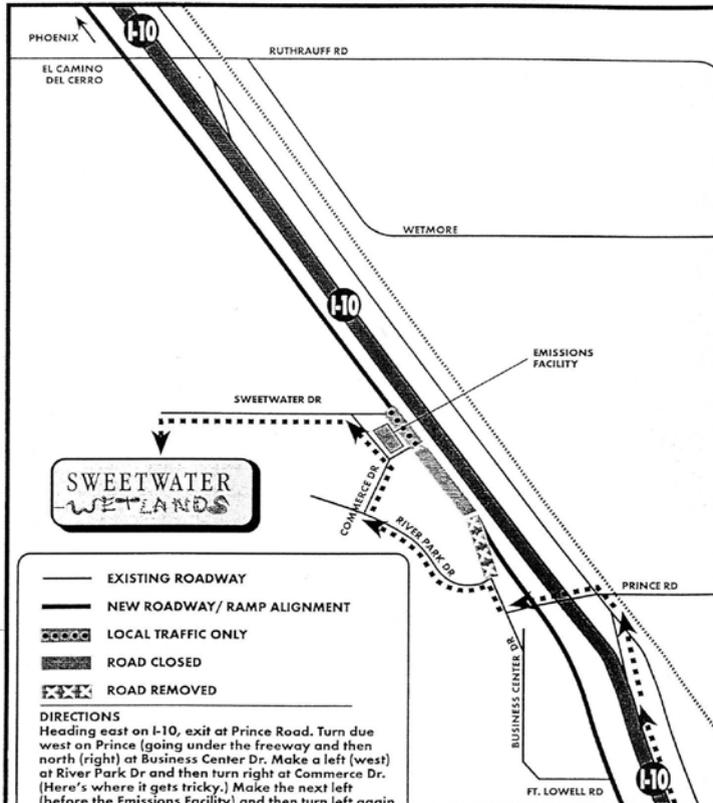
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Bruce Prior  
Earle Robinson



# MAP TO THE SWEETWATER WETLANDS

A PROJECT OF THE CITY OF TUCSON WATER DEPARTMENT



**SWEETWATER WETLANDS**

- EXISTING ROADWAY
- NEW ROADWAY/ RAMP ALIGNMENT
- LOCAL TRAFFIC ONLY
- ROAD CLOSED
- ROAD REMOVED

**DIRECTIONS**  
 Heading east on I-10, exit at Prince Road. Turn due west on Prince (going under the freeway and then north (right) at Business Center Dr. Make a left (west) at River Park Dr and then turn right at Commerce Dr. (Here's where it gets tricky.) Make the next left (before the Emissions Facility) and then turn left again on Sweetwater Drive. Parking is on the left (south) side of the street. For more information call Joaquin Delgado at 791-5080, ext. 1461.



PIO-10-00

