WATERSHED WONDERS

THE LOS ANGELES RIVER AND THE ADVENTURES OF THE COLA KAYAK TEACHER RESOURCE GUIDE

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The Metropolitan Water District of Southern California

Boeing

Designed by Martha Crawford.

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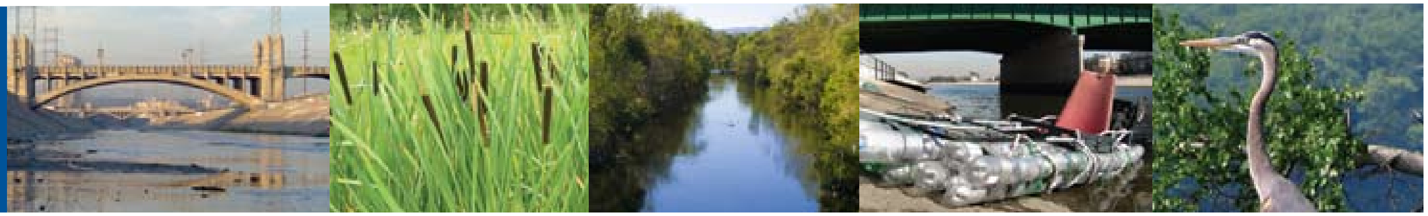
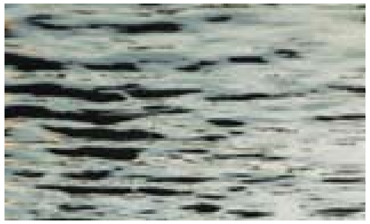
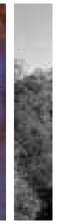


THE LOS ANGELES RIVER AND THE ADVENTURES OF THE COLA KAYAK

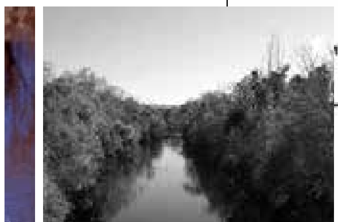
CHAPTER 1 CULTURAL HISTORY OF THE LOS ANGELES RIVER

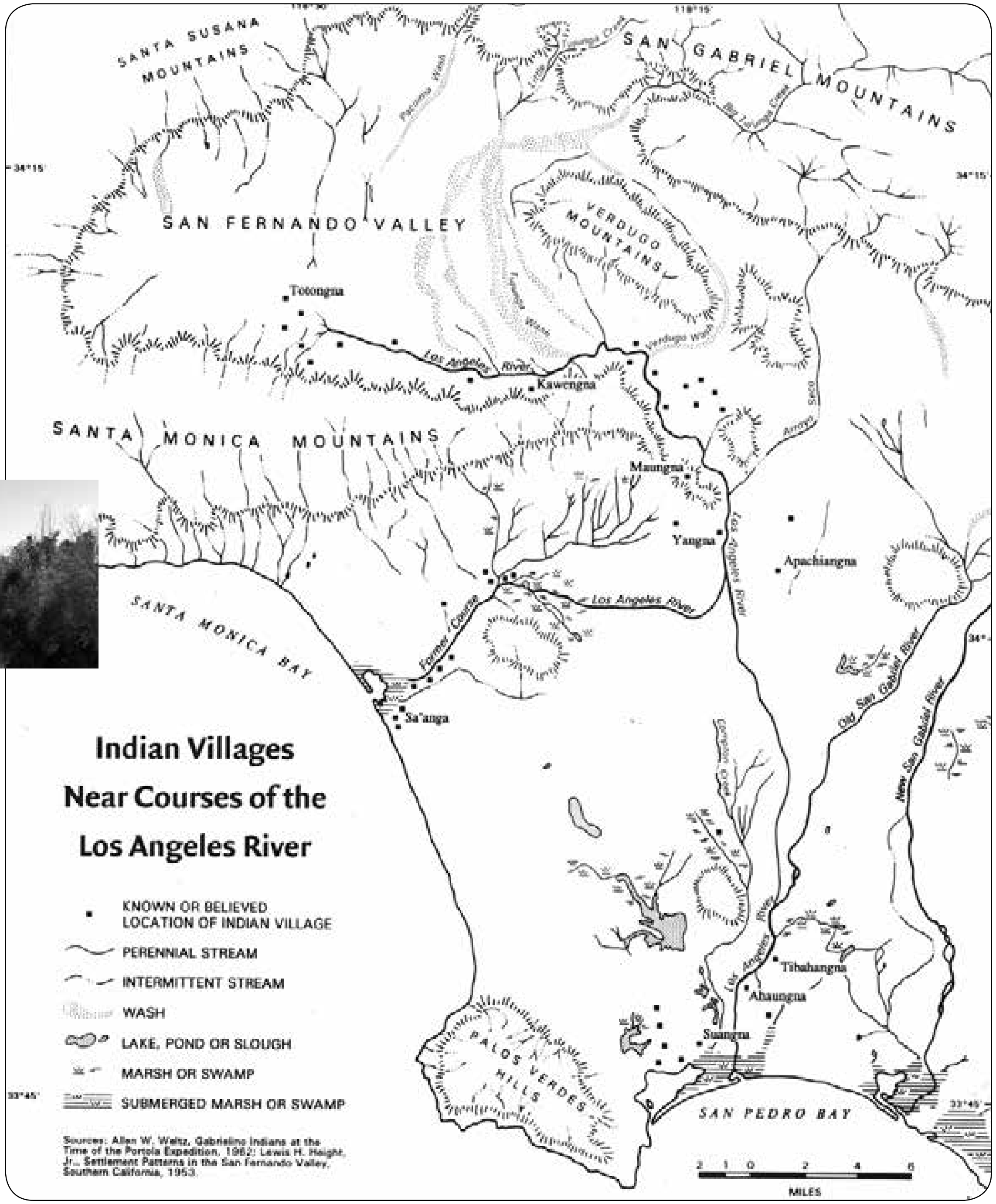







1000 + YEARS AGO The Tongva people were the original settlers along the Los Angeles River and they developed a way of life uniquely suited to this area. The lush environment provided them with food, water, clothing and tools. The Tongva acknowledged and respected their environment and the natural climate cycles of flooding and drought and built their settlements accordingly. Their dwellings were made out of willow and tule and located on higher ground well outside the floodplain.





Map by Blake Gumprecht, from *The Los Angeles River: Its life, Death and Possible Rebirth*. Johns Hopkins University Press. 1999 pg. 30

1771 When Spanish explorers first arrived in California, the Tongva had established over 40 villages throughout the area from Topanga Canyon to Laguna Niguel. The Yangna village was believed to be located on the hills near downtown Los Angeles. With the founding of the San Gabriel Mission in 1771, the Tongva were identified by the Spanish as the "Gabrielino" because of their association with the mission.

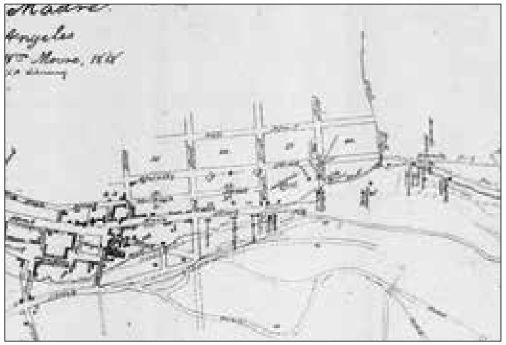
1769 Don Gaspar de Portola led an expedition that brought the first European explorers to California. The Spanish, having claimed California in 1542, sent Portola into California in search of sites for presidios and missions. Portola's group made their way into the basin, by way of the Arroyo Seco, and came upon the Los Angeles River. A member of the party, Spanish priest Father Juan Crespi, described what he saw:

"…*through a pass between low hills, we entered a very spacious valley, well grown with cottonwoods and alders, among which ran a beautiful River from the north-northwest*."

1781 The Spanish colonists founded El Pueblo de la Reina de Los Angeles near the River. The River was given the name Nuestra Senora de los Angeles de la Porciúncula (Our Lady of the Angels of Porciúncula) in commemoration of St.Francis of Assisi's Church in Italy. Eventually the name of the River was shortened to Rio de Porciúncula (porciúncula means "little portion").

Within the first two years the Spanish dug the Zanja Madre (mother ditch), Los Angeles' first public works project. This open ditch brought water from the Los Angeles River to the pueblo for domestic and irrigational purposes. A seasonal dam was also constructed. As the pueblo grew, the Zanja system grew. Farming fields were located to the east of the ditch, between it and the River, in a swampy area subject to floods. With ample grazing lands and water, the Pueblo produced an abundance of wine grapes, corn and cattle.

Ancient Ditch Found! In March 2000, Melody Carver and Craig Howell, a couple amateur archaeologists, took it upon themselves to locate and excavate a segment of the original Zanja Madre, the "mother ditch," that first carried water from the L.A. River to the pueblo. The vaulted, brick-covered ditch, about three feet wide, runs along the bottom of the slope below Spring Street, next to the Metro Gold Line Train. This fragment of the Zanja Madre is a crucial part of L.A. history. Not only does this discovery provide a rare glimpse of how Latinos built the foundation for present-day Los Angeles, but helped an alliance of community activists led by FOLAR to stop an industrial development from being built on the site. Now, instead, the State Department of Parks and built the Los Angeles State Historic Park on the site and you can see a portion of the Zanja Madre they uncovered at the west end of the park.



Map of the Zanja Madre 1888.
Courtesy of the Los Angeles Public Library Photo Collections.

Zanja Madre in the Los Angeles State Historic Park 2009.

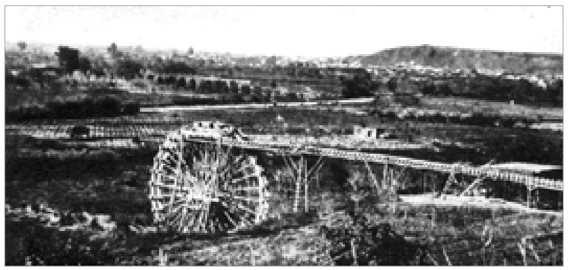
1825 Until it was encased in concrete in the late 1930s The Los Angeles River often flooded and shifted its course across the Los Angeles Basin. The most dramatic shift in course occurred in 1825 when the River broke through its banks near the pueblo and cut a second channel south that emptied into the Santa Monica Bay

1833 After the Spanish, more and more people came to the area and the city continued to grow. Between 1833 and 1846, the 1796 land grants were increased and 500 more grants were awarded. The first settlers were lured from Mexico by wages, farming and residential land, animals, common privileges of water, pasturage, firewood and timber. A pueblo was four square leagues of land which could be divided into house lots, farm lots, rental land and commons.

Agricultural development of the area led to the clearing of the lush plain. The wetlands dried up as the water was diverted to irrigation channels. The willows, cottonwoods and oaks were removed to provide farm and grazing land. The lush alluvial plain was transformed into an agricultural center as Los Angeles prospered. As a result, over-cultivation reduced much of the coastal plain to wash and gravel. The watershed began to change.

1849 Los Angeles experienced one of its first economic booms after the 1848 Gold Rush brought Mexican and American prospectors through the area.

1850 California became a state and migration increased.



Water wheel built in the 1850s to draw water from the L.A. River. Los Angeles Public Library/Security Pacific Collections.

1858 With the growing need for domestic water distribution, William Dryden created the Los Angeles Water Works Company and erected a water wheel at the Zanja Madre and a distribution system of wooden pipes. Four years later the system was washed out in heavy rains. Winter rains washed away dams, footbridges, and acres of farmland. Urban development increased the flood problems as buildings went up in the floodplain, and removed vegetation needed to slow the floodwaters.

1862 A three year drought began. As a result, cattle ranchers went into debt, and the cattle industry was destroyed. Spanish ranchers were forced to sell their large land grant ranches. This still did not deter the numbers of people coming to the area.

1863-4 Several droughts kill most of the livestock in the region. Rancheros face financial and legal pressures to give up their extensive land holdings.

1876 The transcontinental railroad reached Los Angeles and the city grew again, as settlers from all over the country were drawn by the promise of agricultural success.

Farms along the L.A. River in Elysian valley circa 1900. Department of Special collections, University of Southern California Library/Title Insurance & Trust Company Collections.

1899 A Supreme Court ruling in 1899, established Los Angeles' claim to the local water as a public commodity. William Mulholland took over as head of the once private Los Angeles City Water Company.

He soon expanded the Buena Vista pumping plant, built the Elysian Reservoir, and bought out the Los Angeles City Water Company. In 1903, he began digging a tunnel with the plan that the city would then sink wells into this tunnel and pump off the ground water that percolated into it.

1904 The pueblo had become a city of over 100,000 people. Water supply again became a major concern, as the Los Angeles River and local aquifers could no longer sustain the needs of the growing population. William Mullholland, Superintendent of the Los Angeles City Water Company, announces Los Angeles will need new water sources.

1913 The Owens Valley Aqueduct was built to bring water from the Owens Valley, east of the Sierra Nevada, into the city. The Owens Valley Aqueduct permanently changed the role of the Los Angeles River. Though it was no longer the sole source of water for the city, it was still a known force.

1922 The California grizzly bear (or brown bear) thrived in the valleys and low mountains of Southern California.

However, as settlers began to populate the area they were hunted down and killed as they fed on livestock. The last one was killed in Tulare County in August of 1922 and the species became extirpated in this area. Cousins of the California Grizzly live in other states and are now protected.

1930 Landscape architects Frederick Law Olmstead Jr. and Harland Bartholomew presented their plan, “Parks, Playgrounds and Beaches for the Los Angeles Region,” to the Chamber of Commerce. This plan recommended that the then natural Los Angeles River, and its tributary creeks and streams, be utilized as a system of Parkways, connecting the mountains to the sea. Had their plan been adopted, the River would have been left with room to spread, its wide floodplain undeveloped, and LA would have had a great park like New York’s Central Park (designed by Olmstead Sr.) Instead, the River was rendered useless as a viable public space when it was paved.

The River park would have served as a gathering place and respite for Los Angelenos. Unfortunately the Chamber of Commerce shelved the plan, and less than a decade later, after the flood of 1938, the River was subject, to engineers who narrowed and deepened its course, fixing it in concrete. While Los Angeles has been developed far beyond the point where the original plan could ever be fully realized, the plan still guides those working to resurrect the River’s potential. The county’s current Los Angeles River Master Plan is an initial attempt to resurrect and translate some of the Olmstead plan’s original vision.

Groundwater levels drop by 2 to 20 feet per year and the first spreading grounds are constructed.

1931 The newly established (1928) Metropolitan Water District of Southern California began construction of the Colorado River aqueduct. The aqueduct was completed in 1941 and has provided a reliable supply of water to southern California since that time.

1934 More floods came and devastated the foothill communities killing 40 people in the La Crescenta area and costing $100 million in damages.

1935 Congress appropriates $19 million under the Emergency Relief Act for the construction of storm drains and catch basins.

1936 The Flood Control Act of 1936 authorizes $70 million for improvements and changes the role of the U.S. Army Corps of Engineers from providing emergency relief to supervising permanent future flood control plans for the Los Angeles, Rio Hondo and San Gabriel Rivers.

1938 The most damaging flood in the history of Los Angeles struck in 1938 and caused $62 million in damages and 85 people died. Where channelization had been implemented, the engineers were able to see which of their control measures worked and which measures did not. Areas of reinforced concrete had withstood the flood, and so, a plan to increase the amount of

channelization was proposed and approved.

1938 flood near Griffith Park. Photograph by F.H. Baalbergen, G.C. Loomer and A.M. Reece of the Photo Taskforce, 1938. The County of Los Angeles Department of Public Works.

Southern Pacific line damaged in 1938 flood near Figueroa Street in Cypress Park.

The concrete channeling of the River took 20 years to complete the effort required three million barrels of concrete and over 10,000 workers. Over 400 miles of the River and its tributaries were narrowed, straightened, deepened, encased in concrete and connected to underground storm drains to create a 5,000 mile storm drain network running through the Los Angeles River watershed.

Top: Construction of channel walls at Laurel Canyon in Studio City in the L.A. River by the U.S. Army Corps of Engineers. Courtesy of the Los Angeles Public Library.
Bottom: U.S. Army Corps of Engineers. Department of Special Collections, Charles E. Young Research Library, UCLA. circa 1938.

1939 14 dams are completed in mountain canyons to control flooding and debris in downstream areas.

The 110 freeway is constructed on a narrow strip of land which parallels the Arroyo Seco eliminating most adjacent parklands.

1940 Population of Los Angeles County reaches 2.7 million.

The last record of a steelhead trout caught in the Los Angeles River. Steelhead trout are the only native California species that travel from the mountains to the sea and back. Recently, steelhead have been seen as nearby as Malibu and San Mateo Creek. It is believed that when the steelhead return to the Los Angeles River, the ecological health of the River will have been achieved.

1941 Sepulveda and Hansen Dams completed by the U.S. Army Corps of Engineers.

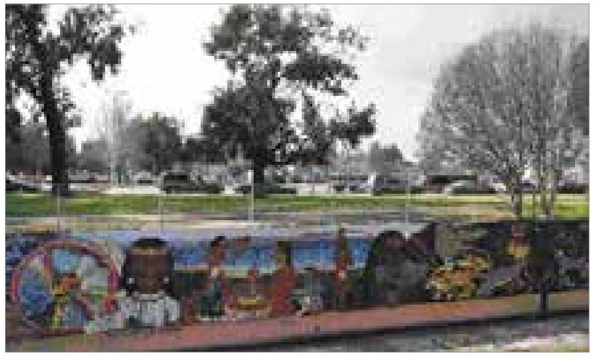
Sepulveda Dam 2008

1950 Population of Los Angeles County reaches 4.1 million

The LA River Cats have been around since the 1950's. No one knows who started it, but it must have been irresistible. Storm drain covers are in the form of cat faces. They are round with two small triangular hinge covers at the top. In the beginning, it was a few simple strokes with white paint, denoting eyes, nose, mouth & whiskers like Felix the Cat. In later years, local artist Leo Limon picked up the brush and began to create the multi colored, psychedelic cat faces we see today.

1960 Construction of the State Water Project began and was completed in 1972. The "California Aqueduct" was 444 miles and brought water to the central valley and southern California from northern California and the watershed of the western Sierra mountains. **1976-**

1984 Arts activist, community leader and visual arts professor Judy Baca begins constructing the Great Wall of Los Angeles, the first large scale public mural in the Los Angeles River (Tujunga Wash tributary). This half mile mural depicts the ethnic history of Los Angeles from prehistoric times to the 1950s. This 8 year project involved 35 artists working with over 400 youth. For a full history of the project please visit http://www.sparcmurals.org.



Social and Public Art Resource Center (SPARC) Great Wall of Los Angeles mural in the Tujunga Wash near Valley College.

1977 The Los Angeles River/Rio Hondo Channel (LARIO) trail opens and over 21 miles of bike and equestrian trails are built. http://www.labikepaths.com/Lario.html

1986 The Friends of the Los Angeles River (FoLAR) is founded by Lewis MacAdams, Pat Patterson, and Roger Wong.

1988 FoLAR holds the first La Gran Limpieza, the Great Los Angeles River Clean Up.

1991 The Los Angeles County Department of Public Works is directed by the Board of Supervisors to develop the Los Angeles River Master Plan. The goal of this plan is to identify and coordinate regional and local projects along the 51 miles of the Los Angeles River and 9 miles of the Tujunga Wash. http://ladpw.org/wmd/Watershed/LA/Larmp/

1994 The Algalita Marine Research Foundation was founded by Captain Charles Moore after discovering the massive accumulation of plastic waste in the middle of the North Pacific Gyre.

Los Angeles bike path and bridge over Los Feliz Blvd. in Atwater

1996 The City of Los Angeles constructs a 3.2 mile bike path, from Riverside Dr. (at Victory) down to Los Feliz Blvd. The next mile and a half to Fletcher Drive, opens in 2000 with the completion of the Los Feliz overpass and lighting. http://www.labikepaths.com/Lario.html

1999 The Algalita Marine Research Foundation first collected data showing plastic marine debris in the North Pacific Gyre at a rate of 6:1 when comparing the dry weight of plastic to zooplankton.

Great Heron Gates dedicated at the Earth Day Celebration of FoLARs 10th La Gran Limpieza. FoLAR commissioned this gate with funding from the MRCA. One of the first gateways to welcome visitors to the Los Angeles River, it was constructed by sculptor Brett Goldstone. Goldstone went on to create the Rocks and Water gate at Fletcher Drive commissioned by North East Trees and Acrecite Water Willow Gate in 2006 commissioned by the Friends of Atwater Village with funding from the City of Los Angeles Board of Public Works.

Great Heron Gates at Fletcher Drive in the Glendale Narrows. FOLAR

Acresite Gate in Atwater Village. Friends of Atwater Village

2001 After battles with developers, FoLAR along with a coalition of community organizations join forces to stop further urban development along the banks of the L.A. River in park poor and under represented communities in Elysian Valley and downtown Los Angeles. CA State Parks steps in and purchases over 74-acres and to create the Los Angeles State Historic Park and El Rio de Los Angeles State Park which convey a new approach to land use downtown and on the River.

2006 SEPTEMBER Los Angeles State Historic Park (formerly the Cornfields) opens to the public. This 32 acre park is dedicated to public open space

MAY The Mountains Recreation and Conservation Authority (MRCA) completes Marsh Street Park along the Los Angeles River in Elysian Valley.

The City of Maywood completes Maywood River Front Park. The first and only park in Maywood. Population of Los Angeles County 9,948,081.

2007 MAY The Los Angeles City Bureau of Engineering complete the Los Angeles River Revitalization Master Plan that outlines over 200 greening projects along 36 miles of the Los Angeles River. www.lariver.org

APRIL CA State Parks and the City of Los Angeles Department of Parks and Recreation open El Rio de Los Angeles State Park (formerly Taylor Yards). This 42-acre park is dedicated to passive and active recreation. Located at 1900 San Fernando Road in Los Angeles.

THE L.A. RIVER IS...ADIAMOND IN THE ROUGH, ARESOURCE JUST BEGGING TO BE RESTORED TO IMPROVE OUR ENVIRONMENT, PROVIDE GREATER FLOOD PROTECTION, AND ENHANCE THE QUALITY OF THE RESIDENTS THROUGHOUT THE REGION.

- U.S. SENATOR BARBARA BOXER

CHAPTER 2 NATURAL HISTORY OF THE LOS ANGELES RIVER

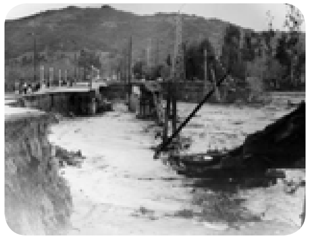
Much of what the River looked like hundreds of years ago exits only in tiny fragments along our mostly channelized River of today. The history of the River has been ever changing as topography, weather and human settlement have all had their influence.

Thousands of years ago, the LA Basin was largely grassland with the Los Angeles River meadnering its way through basin to the ocean. Naturally shallow, the River flooded and changed course throughout the year. Before it was channelized, the L.A. River shifted course several times across the coastal plain. (see Gumprecht map on facing page). Flooding deposited rich soil and created marshes and small ponds throughout the LA Basin turning it into a rich alluvial plain that in turn created ecologically diverse habitats for wildlife.

"NOT A DESERT!"

Southern California falls within a Mediterranean biome. Only 5% of the world's biomes are Mediterranean, including Central Chile, Cape of South Africa, Mediterranean Sea borderlands, and southwest Australia. Located on the western coasts of continents and influenced by cold offshore ocean currents, the climate of a Mediterranean biome is characterized by 6 months of cool, wet winters and 6 months of hot, dry summers. This type of climate makes for an incredible biodiversity. It was this biodiversity that provided the Native Americans with everything that they needed to survive for hundreds of years. The Los Angeles River was a vital resource, providing much of the needed plants and animals for every day aspects of their lives, including a waterway for travel.

A HISTORY OF FLOODS

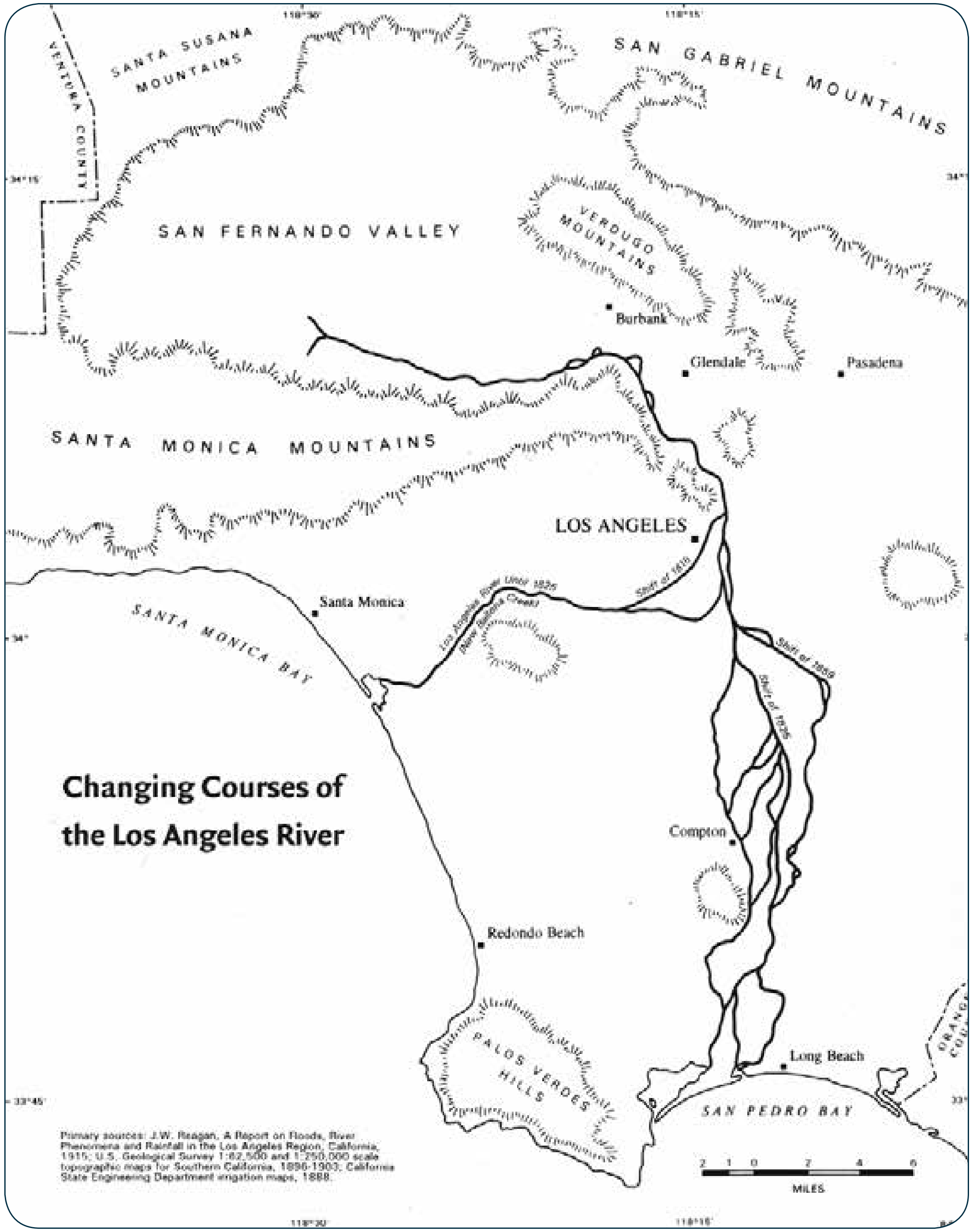


The first major flood to affect the city occurred in 1815. The pueblo was washed away, and a new one was built. Since that time the River changed its course several times and ran into what is now Ballona Creek. In 1825, another flood caused the River to change its course again. This time it flowed south to Long Beach. The River was known to flow gently for many years of low rainfall, and then rage wildly during occasional years of flooding. Because of the ever-changing nature of the River, settlements could be safe for years, then be washed away overnight. During the recorded history of Los Angeles, the River changed course at least nine times.

A UNIQUE TYPOGRAHY

The topography of the Los Angeles River watershed is highly unusual. It ranges from 3,000 feet in the San Gabriel Mountains to sea level in a very short distance. The average grade of the mountain slopes is 65-70%. As an example, the Los Angeles River is 51 miles long and drops 30’ per mile. The Mississippi is 2,348 miles long and drops about 1’ per mile.

It is this topography that created to the once, rich alluvial soils that attracted farmers in the first place. The San Gabriel Mountains are young mountains, geologically speaking, and are still rising at a rate of about 3/4” per year. This means they are also eroding rapidly, and would naturally be depositing rich soils in the valleys and replenishing our beaches with sand via the natural transportation of the River systems. With channelization, these processes have been impaired.

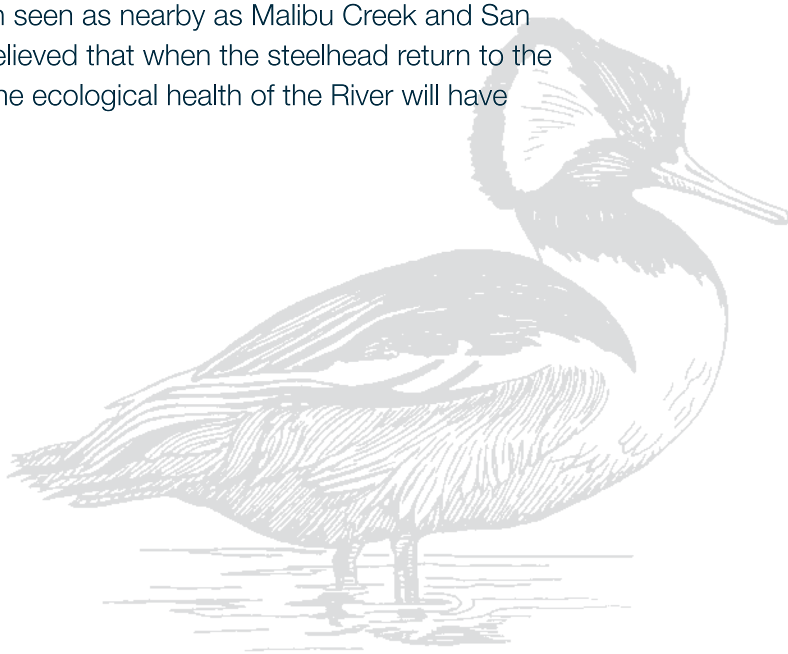


Map by Blake Gumprecht, from *The Los Angeles River: Its life, Death and Possible Rebirth.* Johns Hopkins University Press, 1999. pg. 140

WILDLIFE

The Los Angeles River was once a prime habitat for Mountain Lions and grizzly bears. The grizzly was once more prevalent in California than in any other state – it is our state symbol. The California grizzly bear (or brown bear) thrived in the valleys and low mountains of Southern California. As settlers began to populate the area they were hunted down and killed because they fed on the livestock of settlers. The last one was killed in Tulare County in August of 1922. The California Grizzly became extirpated in this area. Cousins of the California Grizzly live in other states and are now protected.

Steelhead Trout are one of the few species of trout that can survive in both warm and cool temperature climates. Steelhead Trout are the only native Southern California species that travel the waters from the mountains to the sea and back. Over time their habitat slowly began to disappear. The last Los Angeles River Steelhead was caught in the late 1940's. Recently, steelhead have been seen as nearby as Malibu Creek and San Mateo Creek. It is believed that when the steelhead return to the Los Angeles River, the ecological health of the River will have been achieved.



HABITATS OF THE LOS ANGELES RIVER

Willow trees growing in the natural bottom portion of the Los Angeles River in the Glendale Narrows. Photo by Peter Bennett.

FLOODPLAIN WILLOW FORESTS

In the days before channelization, the Los Angeles River was known to flood its banks periodically, meander along, and shift its course to the ocean. The resulting erosion and widespread deposit of sediments created flat strips of land called floodplains. These deposits resulted in the growth of willows, cottonwoods, and other aquatic and semi-aquatic plants. At one time these lowland forests formed one of the most biologically rich habitats of the River watershed. Since channelization, these areas are harder to find, but reestablished areas and remnants still exist. The best examples are behind damns including Hansen, Sepulveda, well as in the Glendale Narrows.

While there are numerous species of willow trees and shrubs in Southern California, the White Willow (*Salix alba*) and Arroyo Willow (*Salix lasiolepis*) are often found in the natural bottom portions of the River and its tributaries. Their leaves are almost four-times as long as they are wide, and have a pale underside. Willows are deciduous, shallow-rooting plants that favor moist soils typical of riverbanks. Floodplain plants and trees also have a natural ability to clean pollutants through the process of biofiltration and phytoremediation. In these processes, pollutants from urban run off found within the water and soil, are captured, broken down, and treated. Other important functions of these floodplain forests include stream bank stabilization (bioengineering), slope stabilization, soil erosion control, soil building, and wildlife habitat.

In addition, flood plain willow forests serve as a vital habitat for urban wildlife. These forests support a rich and diverse population of birds and migrating birds that nest in and under its lush canopy. The willow gold finch, willow flycatcher, yellow warbler, western wood pee wee, herons, egrets, cormorants, ducks, redtail hawks and osprey are a few of the species that can be seen in natural bottom portions of the Los Angeles River. In addition, these forests also provide shade required by a diversity of fish, aquatic insects and plants in the River's ecosystem.

The Ballona Wetlands, once a 2,200 acre coastal estuary is now less than 200 degraded acres today. The Santa Monica Bay Restoration Commission.

FRESH WATER MARSH

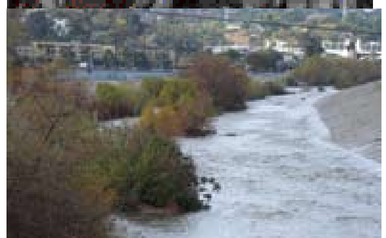
Thousands of years ago the Los Angeles River created and flowed through several fresh water marshes. Marshes can form in almost any shallow depression that is kept wet by streams or ground water. Along the Los Angeles River, these marshes formed in places where the water table was high year round. Fresh water marshes contain layers of low, non-woody vegetation in soil saturated with moisture. These wetlands serve important hydrolic, biological, and habitat functions. Hydrologic functions include long term and short term water storage, subsurface water storage for ground water recharge, energy dissipation, and moderation of groundwater flow or discharge. Fresh water marshes also convert water, sunlight and minerals to biomass at rates much higher than in dry ecosystems. They also provide a lush and safe environment for a wide range of life, from planktonic and filamentous algae to animals such as frogs and water fowl. Cattails are often a symbol for these wetland habitats and found with other plants such as duckweed that float along the surface and sedges and grasses that are found around the edges of the marsh. These plants stabilize sediments and add organic matter.

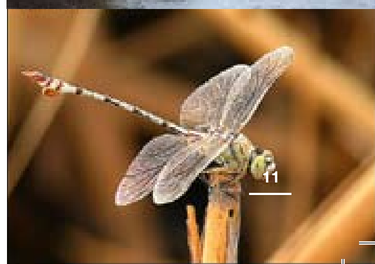
While many of these original wetlands along the Los Angeles River have disappeared as a result of changing typography and human development and growth, efforts are underway to restore portions of important wetland habitats along the Los Angeles River.

For more information please visit the Los Angeles River Revitalization Master Plan at www.lariver.org.

There are however a few coastal wetlands remaining in Southern California that are being protected and preserved through the efforts of the Friends of the Ballona Wetlands and Los Cerritos Wetlands.

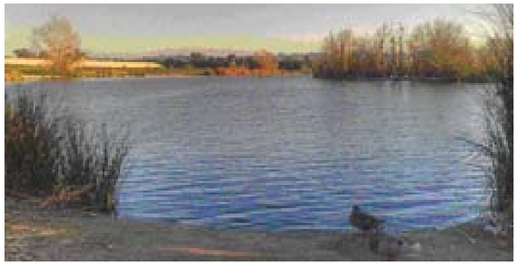
For more information please visit http://www.ballonafriends.org/ and http://www.lcwlandtrust.org/index.htm.





LAKES & PONDS

These fresh water ecosystems are non-moving water habitats and contain several important functions; they capture and hold natural rain water and help replenish ground water sources in addition to serving as an important habitat for migrating birds and waterfowl that include herons, American coots, mallards, pie-billed grebes,



and Canadian geese. Ponds are shallow enough to support aquatic vegetation whereas such vegetation is often found along the edges of lakes. Because of limited water volume in shallow ponds, water temperature varies greatly and parallels that of the air and this intern impacts the amount of dissolved oxygen in the water. Cooler waters produce more oxygen than warmer waters. Aquatic insects and organisms adapt to a certain temperature ranges. Dissolved oxygen levels also vary with daily and seasonally in both lakes and ponds and this can also impact fish and other aquatic species that need dissolved oxygen to breath. Living within the vegetation you will find a number of insects and their larvae such as dragon flies, water boatmen, and diving beetles, that are well adapted to the water temperature and dissolved oxygen levels within these habitats.
While human development and growth within the Los Angeles

River Watershed has decreased the amount of significant wetlands, natural lakes and ponds, recent conservation efforts have resulted in the development of River side parks containing man-made lakes and seasonal settling ponds along the Los Angeles River. These parks serve multiple benefits. They create habitat for many species of migrating birds, water fowl, aquatic insects and plants; they restore open green space in park-starved cities where the public can relax, slow down and engage in outdoor recreational activities.

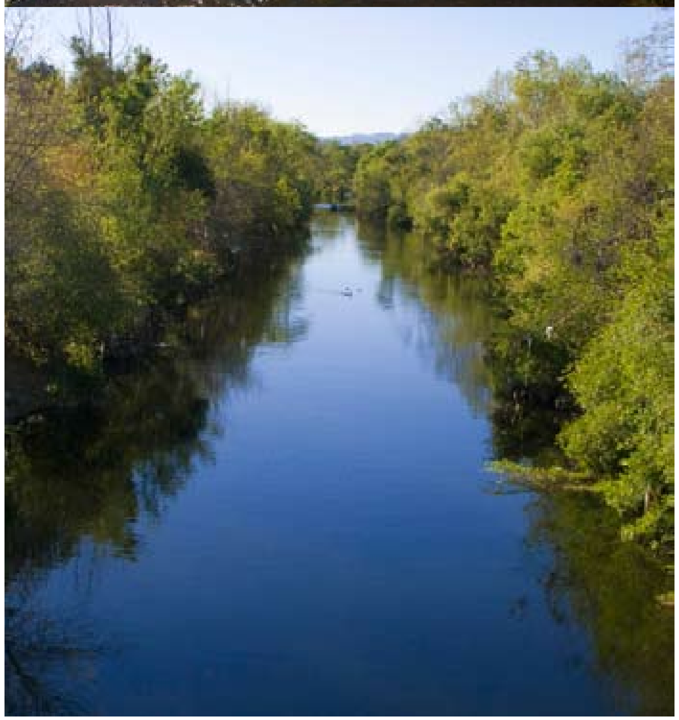
Above photo: Sepulveda Basin Wildlife Reserve. Photo by Al Pavangkanan.

Sepulveda Basin Wildlife Reserve is a 225 acre park completed by the City of Los Angeles Department of Parks and Recreation with funding from the U.S. Army Corps of Engineers. In the 1960s and 1970s forward thinking citizens and city planners saw the need to limit development into the lower flood-prone basin areas and “re-create” a natural habitat for birds and small animals with native vegetation where people would be welcome as visitors. This reserve contains trails that will lead you to a man made lake that serves as a refuge for many migrating bird and water fowl, a 3-mile natural bottom portion of the Los Angeles River between the Sepulveda Dam and Balboa, and Haskell Creek that runs from the Tillman Water Reclamation Plant to the Los Angeles River.

SOFT BOTTOM RIPARIAN

In four stretches along the course of the Los Angeles River you will find soft-bottom portions where the natural river bed has not been lined with concrete; north or upstream of the Sepulveda Dam, the Glendale Narrows, Compton Creek, and the Estuary downstream from Willow Street in Long Beach. Instead, the riverbed is lined with sediment and boulders and offers a glimpse of the River as it once was. Fortunately, the high water table in these areas made it impossible for the River bottom in these areas to be sealed in concrete, and the River’s natural bed have been preserved along with a diversity of plants and wildlife. Today, approximately 13 miles of the present day 51 mile River is natural bottom. For more information about these areas please see ***Down by the Los Angeles River*** by Joe Linton.

Islands of willow trees, sycamores spring up in the middle and long the sides of the River in the Glendale Narrows while thick layers of sedges and grasses line the bed of Compton Creek and both trees, shrubs and grasses line the banks of the River upstream from the Sepulveda Dam to Balboa Blvd. Oxygen content is high in



Photos top to bottom: Compton Creek. LASGWC
Glendale Narrows. Photo by Peter Bennett.
North of Sepulveda Dam. Photo by Peter Bennett.

moving parts of the River for several reasons; the agitated shallow water exposes a large surface to the air, oxygen consuming debris is washed away, and the water is often cooler in water that is constantly moving. As a result, these areas are rich with animal, plant, and macro-invertebrate life and are excellent places to conduct biotic surveys when it is not raining.

ESTUARY

Estuary at Willow Street, Long Beach, CA.
Photo by Tom Andrews. www.Laist.com

According to the Environmental Protection Agency, estuaries are places where rivers meet the sea. They are highly productive ecosystems and distinct from all other places on earth. The tidal, sheltered waters of estuaries also support an assortment of specialized plants, animals, and micro organisms especially adapted for life in unique waters. Estuaries are among the most productive ecosystems on earth, creating more organic matter each year. Thousands of species of birds, mammals, fish, and other wildlife depend on estuarine habitats as places to live, feed, and reproduce. They are called the nurseries of the seas as many species of fish spawn in their sheltered and protected waters. In addition, estuaries also filter out sediments and pollutants before it reaches the ocean. The plants and soils can act as a natural buffer between the land and ocean. However, most estuaries are at risk due to human activities, both past and present.

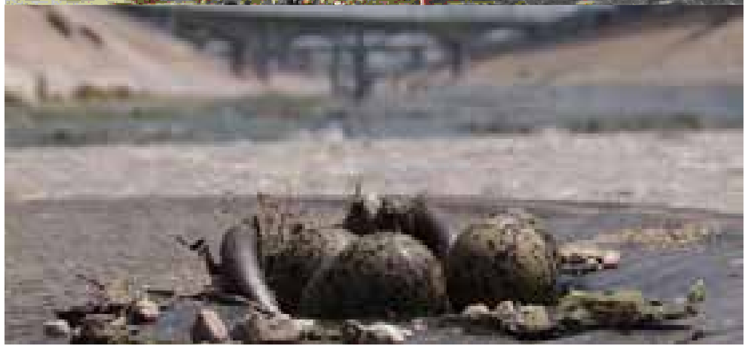
The Los Angeles River estuary is a 2.6 mile, soft bottom stretch of the river between the Willow Street Bridge to Queensway Bay in Long Beach.Year-round flow is maintained by urban and agricultural run-off, and discharges of treated wastewater. During the drier months up to 80 million gallons per day enter Queensway Bay. In an 100 year flood the U.S. Army Corps of Engineers has calculated a discharge of 175,000 cfs (cubic feet per second) from the river where it enters Queensway Bay.

WET CONCRETE CHANNEL

When the U.S. Army Corps of Engineers paved the Los Angeles River they straightened and thus shortened the River from 52 to 51 miles. Today, over 80% of the River is channelized and completely encased in concrete. While these areas may not appear to provide much habitat, nature has managed to survive amidst concrete walls.

During the warmer months of the year, the concrete channel bottom is covered by a shallow flow of water and there is extensive algal growth. Algae is an ideal habitat for many invertebrates which attract a variety of birds. From July through October, southbound migrating shorebirds can be found in the wet concrete channel areas of the Los Angeles River in Long Beach feeding in the shallow water. The most abundant species is the Western Sandpiper, a sparrow-sized bird with a long, narrow bill that easily pikes into the algae in search of food.

During low flow months (August-October), the black necked stilts not only feed but build their nests in the concrete portions of the Los Angeles River. These birds can be identified by their long red legs, black and white plumage, and long narrow beak. Shallow, slow moving waters and abundance of aquatic insects in these concrete portions of the River resemble wetland habitats in which these types of birds live.

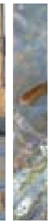


Photos, top to bottom: Low flow channel. Photo by Mark Lamonica.
Black necked stilt.Photo by Peter Bennett. 2008
Black necked stilt nest and eggs found in concrete channel of the L.A. River.
Photo by Marcus Ericsen. 2008

WHILE MANY OF THESE ORIGINAL WETLANDS ALONG THE LOS ANGELES RIVER HAVE DISAPPEARED AS A RESULT OF CHANGING TYPOGRAPHY AND **HUMAN DEVELOPMENT AND GROWTH**, EFFORTS ARE UNDERWAY TO **RESTORE** PORTIONS OF IMPORTANT WETLAND HABITATS ALONG THE LOS ANGELES RIVER.

CHAPTER 3 ADVENTURES OF THE COLA KAYAK

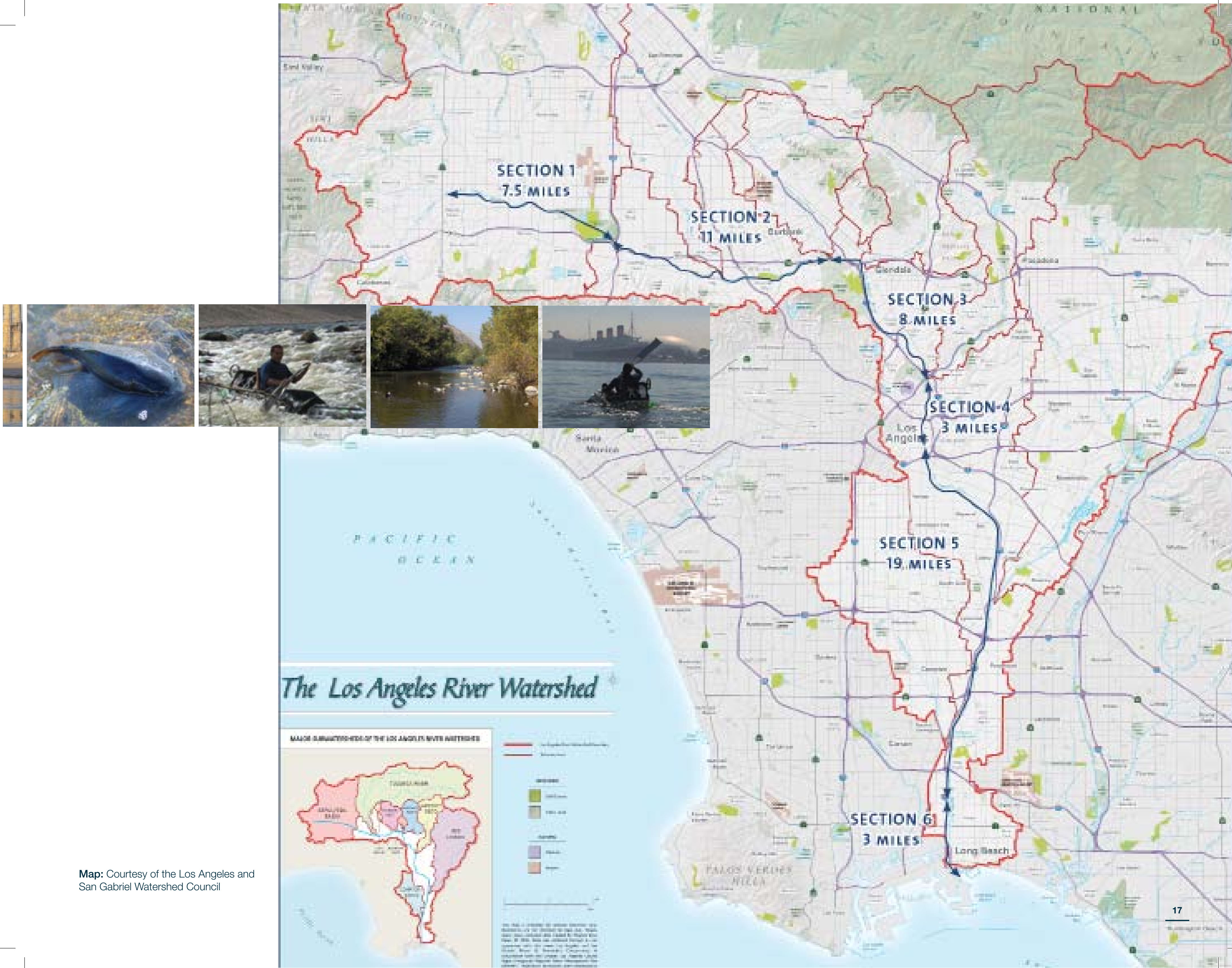


To know the Los Angeles River you've got to get in it, get your feet wet, and discover what an amazing resource we have flowing through our city. The river is nearly navigable all the way down thanks to water from underground springs, treatment plants, and urban runoff. It flows year round, 51.5 miles, from the football field of Canoga High School to the Queen Mary Ocean Liner docked in the Los Angeles Harbor. It meanders through quiet neighborhoods in the valley, wetlands in Balboa Park, rapids in Glendale Narrows, concrete canyons of downtown, and opens to the Pacific Ocean 51.5 miles from where it began. As it flows, its history unfolds, both cultural and natural. Like I said, you've got to get into it, so I built a boat and dropped it in the river where it began, high in the San Fernando Valley.

It took six days to see the whole thing. And each day was a completely different experience. The Los Angeles River drains the Los Angeles Watershed, which is like a 834 square mile bowl surrounded by mountains, with one side pouring into the ocean. It's a long way from the top of the watershed to the bottom. I needed a boat.

My friends, the "Green Ambassadors" at the Environmental Charter High School in Lawndale, suggested plastic bottles. "All you need is 150 plastic bottles, duct tape, and a pair of crutches for oars," one student said. It didn't take long to transform trash into a seaworthy vessel, complete with a broken classroom chair to sit on too. There might be a few shallow spots, so we added a pair of junk wheels from baby stroller. We called it the "Cola Kayak."



Map: Courtesy of the Los Angeles and San Gabriel Watershed Council

The air is crisp at the 50-yard line on the football field of Canoga High School. The Cola Kayak is flipped upside-down so that it rolls on the junk stroller wheels. The school building supervisor guides me over to a gate on the far end of the field.

"Past this gate is where the two streams come together," he says. Calabasas Creek and Bell Creek drain the upper regions of the Los Angeles Watershed. Both creeks are concrete lined, and where they meet is the official beginning of the Los Angeles River. A century ago, before the high school was here, and before orange groves spread across the valley, this spot was a dry streambed pebbled with granite boulders and lined with scrub oak. Today the two creeks meet where two 15-foot walls come to a point.

It is impossible to descend into the river here, but I can see a bridge and a path leading to the river's edge ahead. There's enough water to float the raft alone, as I slosh along by its side. The sloped walls are concrete, as is the floor of the river. Green algae flows in the slow moving current like waves of spaghetti. I can see the tops of homes, and windows of businesses facing the river. Cars are stuck in traffic on bridges I walk under.

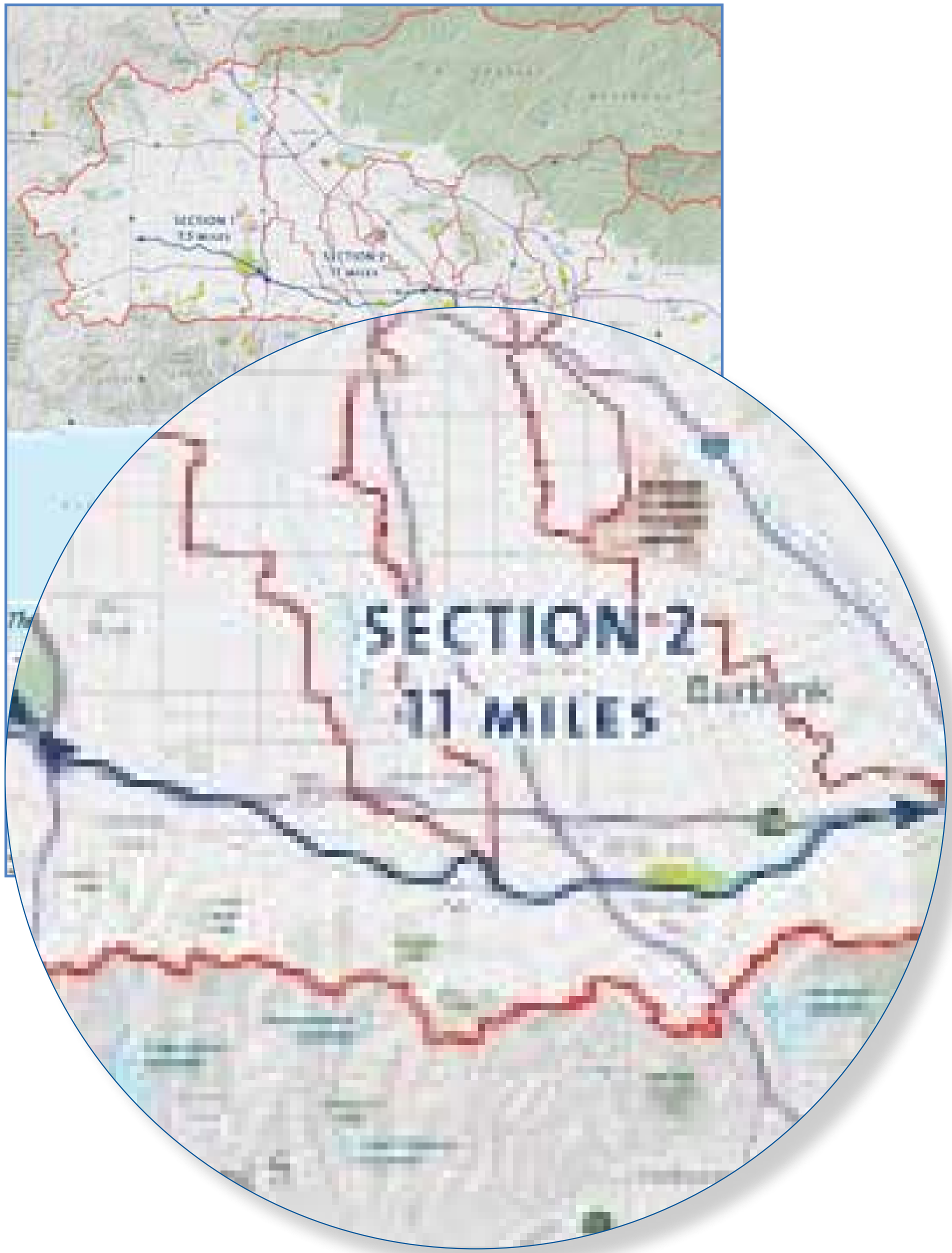
Sore feet and six miles later, the river changes abruptly. I can see trees ahead. The concrete disappears. What was a concrete corridor barricaded by high chainlink fences has evaporated into quite pools, like a necklace of natural pearls surrounded by a garden of grasses and willow trees. The distant hum of car horns blends with varied birdcalls, tweets, screeches and quacks. I recognize Burbank Blvd. ahead. I gently paddle in the shadow of the bridge. Looking up I see branches. Wedged in the crevices of the concrete pillars of the bridge there are branches and boughs of grasses. A piece of wood from the trunk of a tree, with roots sticking out, is dangling high above the water. "How did all of this get up there?" I wonder.

Il realize that this is the Sepulveda Basin. The Corps of Engineers, determined to keep the Los Angeles River from flooding the city and risking lives and property, have designed this basin to hold water, and lots of it. This basin is basically a manmade bowl with a 57-foot tall dam on one end. The last six miles of concrete walls transport rainwater quickly from the streets of neighborhoods to this basin and holds it here. The natural debris stuck under the bridge high above me was lodged there when the last big rainstorm threatened to flood the city. The gates of the dam closed as millions of gallons of water filled the basin and covered Burbank Blvd. Where I'm sitting now was once covered with 20 ft. of water. This is why there are fences along the river. It's not always as quiet as it is today, with a light breeze blowing in the trees, and hundreds of white snowy egrets roosting on branches.

"Wait, that's not an egret," I say to myself. What I thought was an egret, a tall slender bird with a thin bill, thin black legs, and snow white feathers, is actually a plastic bag. Thousands of plastic bags hang high in the trees. Storm drains filled with plastic bags, plastic bottles, straws and cup lids, all flush into the Sepulveda Basin. What goes down the street, will go down the Los Angeles River. And then there are the pollutants I can't see, like oil drops from cars, pet waste, detergents from washing cars and fertilizers and pesticides from manicured lawns.

I continue paddling through a maze of boulders and trees hanging over a slow moving river. Balboa Park is nearby, occupying open fields within the basin. I can hear people cheering, as if a soccer game is in progress. A blue heron leaps out of the water ahead of me. There is wildlife here. Suddenly, a giant splash ahead, but it's not a bird. Then something big swims beneath the Cola Kayak. "What's that," I say aloud, as the large form disappears. I look ahead. A concrete wall stands in front of me, with four large metal doors, as if I'm approaching the entrance of a grand palace. I paddle in awe to the Sepulveda Dam.

Top and middle: The Cola Kayak paddles through a plasticized Sepulveda Basin.
Inset: Detail of the plastic debris.
Bottom: A natural stream precedes the Sepulveda dam ahead.



The dam towers over me as I enter the gates. I can feel the metal framework under my feet as I drag the Cola Kayak through. I stop in the middle. These giant metal doors, designed to hold back the weight of millions of pounds of water, they could crush anything that got in their way. Like a concrete hallway, I walk through the thickness of the dam. It opens into sunlight, a flat concrete expanse, like a small parking lot, with giant walls on both sides. The dam is behind me now, as is the natural beauty of the Sepulveda Basin. Similar to the first six miles, there's concrete all around with tall fences on top. This time I understand why.

It's another day and I've returned to the same place where I left off from the first day. There's no place to camp along the way, so I travel the river by daylight only. The river is shallow. It's late spring, so the dry season is just beginning. It will not rain for another five months, yet the river will flow continuously thanks to the Donald C. Tillman Water Reclamation Plant sewage treatment plant located in the Sepulveda Basin, which pumps a steady 20 million gallons per day into the Los Angeles River. Add to this urban runoff from people washing cars and watering lawns, and you get a navigable river year round.

The concrete walls are steep on both sides, and are roughly 50 feet apart. The river sloshes from side to side depending on which way the winding channel turns. For miles I meander slowly below quiet neighborhoods.

There's a long straight stretch through Studio City. Strangely, it looks dry ahead, as though the river narrows till it disappears. When I get closer I see white froth boiling in the middle of the river, and soon discover that the once wide river, as wide as the concrete walls, instantly becomes an 8-foot wide, deep channel in the middle.

“Here I go,” I say to myself as the white water grabs the plastic bottles at the front of the Cola Kayak. Like the moment at the top of a rollercoaster, the river hesitates briefly, then rolls over and plummets downstream, more than tripling it’s speed. I must be moving 6-8 miles per hour. “Yaahh!” I yell as the river carries me through Burbank and into Glendale. Movie studios are on the left. Hollywood hills are on the right. A canvas of graffiti covers the walls on both sides of the channel.

The hills of Griffith Park tower above on the right side of the river. The 134 freeway roars on the left, and crosses the river ahead. Far ahead I can see giant boulders and trees in the distance. The Sepulveda Dam is 11 miles behind me. Soon, the Los Angeles River is going to change again into something different, unpredictable.

Left: Exiting Sepulveda Dam.
Right: The bank of the Los Angeles River is a canvas for graffiti artists.

Another tributary, the Western Burbank Channel, joins the Los Angeles River just before the dark underbelly of the 134 freeway bridge. Beneath the highway, pigeons roost, graffiti marks territory, and the refuse of emptied storm drains litters the flat, flooded expanse of concrete, like a six-inch layer of water sitting over the runway at LAX. Here, the river is noisy. Traffic bustles above, while below everything changes. Giant granite boulders burst from the riverbed midstream, like breaching whales with salt and pepper skin. Willow trees stretch to the sky, their lower branches capturing more plastic bags, no longer imitating egrets in my mind.

There is more water, but not because of anything humans have created or controlled. Underground reservoirs percolate to the surface here. The water table emerges with little springs that bubble out of the concrete bank, like an overflowing kitchen sink spilling onto the floor. These little springs have kept the Corps of Engineers from pouring concrete over the river bottom here. So there's sand, rocks, mud, deep pools and falling water, and in every crack and crevice something grows, from renegade tomato bushes to willow trees. A bicycle path parallels the river. People walk along the high ground, or just sit, peering into the river, watching it flow, or bearing witness to the dance of mallard ducks, herons, stilts and egrets.

The Cola Kayak meanders over boulders into deep black pools. Something splashes in front of me, something big. It disappears below and surfaces ahead. Another splashes behind me. I paddle downstream quickly, and notice I'm not alone. I hop off and drag the boat over a swath of granite rocks, rounded by miles and centuries of tumbling down the Los Angeles River. The river becomes a thousand little streams fingering their way to the next pool. "There's another one," I say. There are fish here, big fish, with large round, bronze scales, like a coat made from pennies. These are the Asian Carp I've heard about. They're not from here, otherwise they might naturally be called California Carp. It is an invasive species that has settled down in this habitat, and is likely here to stay.











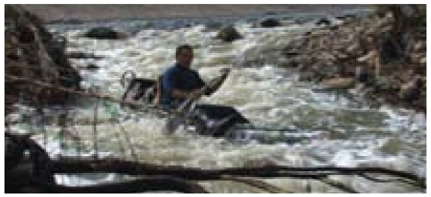


The hills of Griffith Park come close to the river's edge, with the 5 freeway sandwiched in between. But at the bottom of the concrete slope, hidden in the trees, behind little islands in the river, and the occasional shopping cart filled with rocks and straw, it is easy to imagine a wild California mountain stream, and ignore the 10 million other people surrounding you in Los Angeles County. The Cola Kayak drifts gently under the Los Feliz bridge and Fletcher Drive, where a family sits along the water's edge.

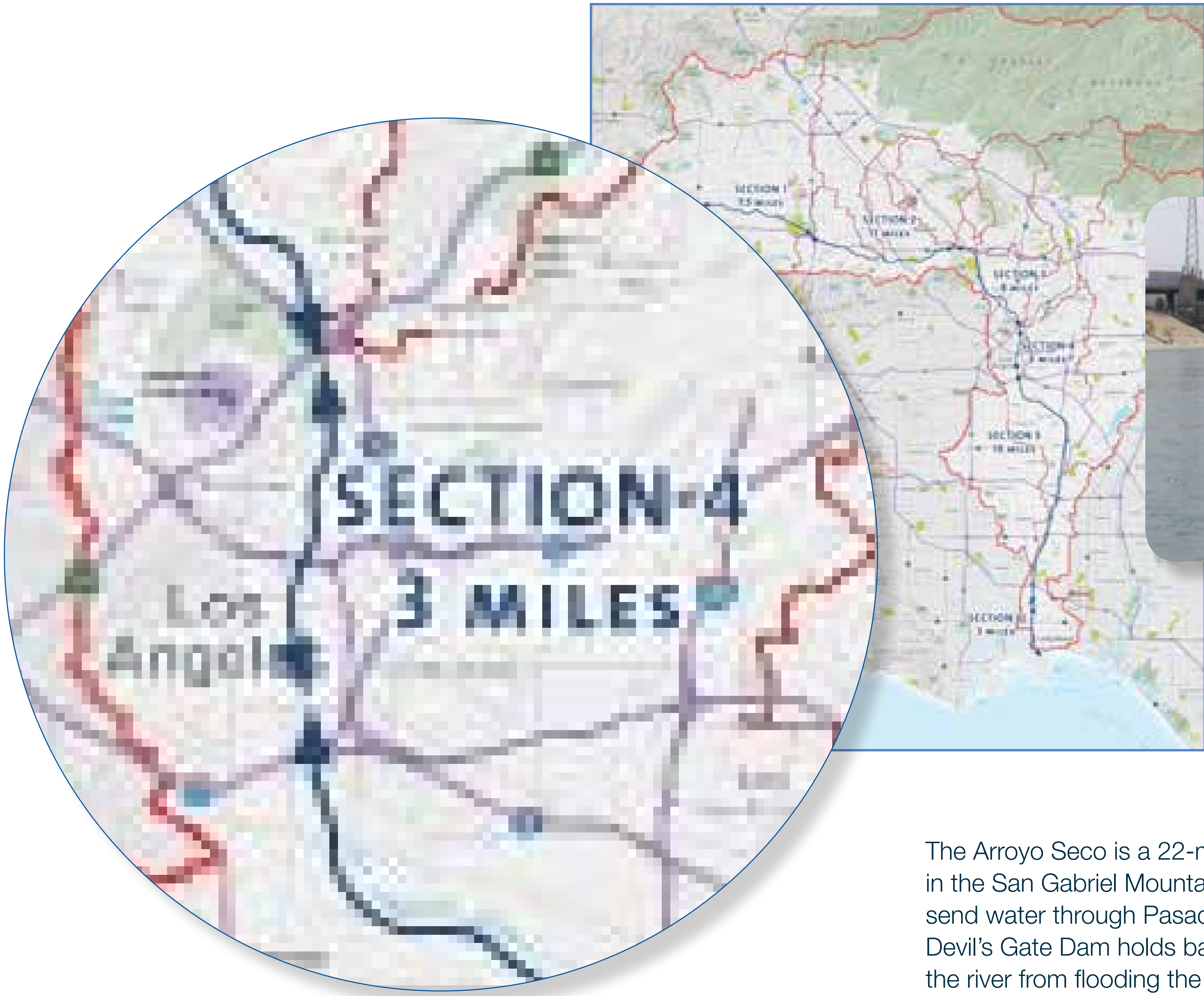
"What kind of a boat is that?" the father asks, holding a fishing pole in one hand."It's called the Cola Kayak," I reply, explaining how the Green Ambassadors from ECHS built it. "I've got one," his daughter exclaims, leaping to her feet as her fishing pole bends in her hands due to the size and strength of whatever is on the other end. She's a 10 yr. old urban angler reeling in her catch of the day. It's an Asian Carp. "And it's good to eat," she explains.Though others might be hesitant to serve up LA River Fish, the Friends of the Los Angeles River recently tested Asian Carp for pollutants and found their tissues to be surprisingly clean, but still recommended not eating them. I examine the wriggling fish close up, then hand it back to her. "What do you use as bait?" I ask."Tortillas," she replies.

Ahead, the dangling trees, decorated with mud-colored plastics bags, create a corridor of white water. I realize this after it's too late. These are the waterfalls on the Los Angeles River, where elevation drops 10 feet in only fifty feet of the river's length. Raising my oars high above my head, I race the rapids and barely keep my head above water. When it ends I want to do it again. Below I can see that I'm not alone. Dozens of Asian Carp race around the Cola Kayak, wriggling about in the shallow pools.

Soon, the 110 freeway bridge soars high above the river. Trees and granite disappear, giving way to a concrete channel again. Another tributary, the Arroyo Seco, joins the Los Angeles River, making it stronger and faster as it rushes by.



Left to right: The Asian Carp, an invasive species, thrives in the shallow pools of Glendale Narrows. Rapids on the Los Angeles River provide recreational variety for the urban canoeist. Los Feliz bridge over the Los Angeles River as it snakes around Griffith Park. The 110 freeway and Figueroa Avenue Bridge soar high above the river. Notice the fast moving water in the



The Arroyo Seco is a 22-mile canyon beginning near Mt. Wilson in the San Gabriel Mountains, where the waterfalls of Switzer Park send water through Pasadena to the Los Angeles River. The Devil's Gate Dam holds back the torrent on stormy days, keeping the river from flooding the Rose Bowl. Arroyo Seco means "dry streambed," which it was when it was explored during the late 1700's, but now treated water and urban runoff feed the concrete channel, much like the continuous flow of the Los Angeles River.

I drag the Cola Kayak to the edge of the 10-foot wide, low-flow channel, which is designed to keep water in the center of the Los Angeles River. The river is high today, spilling over the edge of the channel, creating a flat, inch-deep, reflecting pool over the rest of the concrete floor. Beautiful shore birds, called stilts, with long black legs and thin bills, create gentle ripples as they slowly stride across the surface, while in the low-flow channel, the river rushes by.

There are a few high spots where mixtures of sand, glass, and metal have created tiny islands. Standing on one, I look down and see why the stilts are squawking. Three green eggs, peppered with black freckles, are neatly arranged in a nest made from algae. I carefully look downriver again. With new eyes I notice dozens of stilts on or around little island nests as far as I can see.

In the seat of the Cola Kayak, bottles creak as the river carries it downstream. The walls of the river seem higher. Tall barbed fences dress the top of the bank. Bridges, adorned with beautiful arches, columns and light poles, tower high above, so I can't see cars, only hear them. Trains hurtle passengers too and from opposite ends of the city. The familiar "clack, clack" of railcars hopping over joints in the track echoes through the deep canyons of the river bed. The riverbank is sometimes slanted, sometimes vertical, yet always spraypainted. Beautiful murals of mythic figures, fanciful fonts of illegible form identifying their artist more by style than name, graphic gestures of urban tragedy or humor, all together offer a kaleidoscope of color and culture.

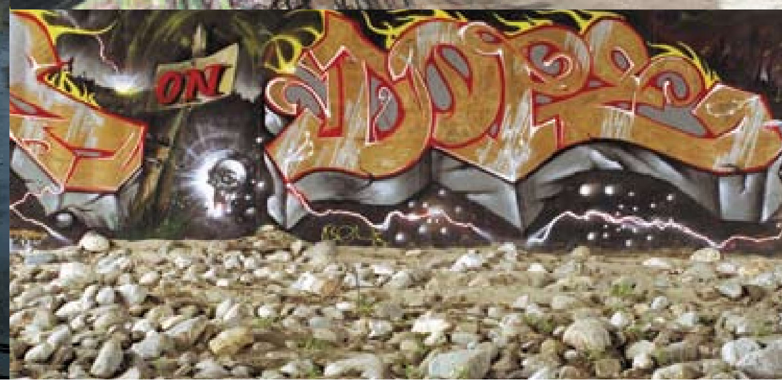
The 6th Street Bridge arches high above the river. On the west bank there is a tunnel, large enough to drive a car through. John is sitting there on a sofa. It's his sofa. It's his living room. Shirtless, with blue jeans and a chain around his neck, he offers me a cigarette, like the one dangling from his lip. He lives here, in the river, away from the streets.

"I've been here for two years," he says, adding, "It's peaceful here. Nobody bothers me." The diversity of Los Angeles exposes our greatest feats and failures, and the end of road for choices made long ago. John laughs at the design of the Cola Kayak as I haul it out of the water and march to the mouth of the tunnel.

The people that visit the river, those that live here, the graffiti artwork, the engineered concrete channel, and the natural beauty finding its niche, defines the Los Angeles River. The character of this city is reflected by these waters, and shows how wonderfully diverse we truly are. I'm beginning to understand that this river slices through our home, revealing everyone inside, our troubles and triumphs, our wild nature, and the powerful and powerless attempts to control it.




STILL
IN
PROGRESS



ON


ADVENTURES OF THE COLA KAYAK•DAY 5 6TH STREET TO WILLOW STREET

Returning days later through the tunnel, the river opens to a brightly lit concrete corridor, with fast moving water running down the center as far as I can see. This is the long haul to Long Beach, a gauntlet of urban sprawl till the ocean. Beginning in 1938, the Corps of Engineers transformed a meandering river on a flat floodplain, where high water could break a levee and go wherever it wanted, to a straight, deep canal designed to get millions of gallons off the streets and into the ocean as quickly as possible.

The Cola Kayak dips into the river. The current grabs the bottles on the bow with a jolt, as if it is warning me to hold on. When I let go of the edge of the bank, the raft zooms downstream. There are 19 miles to Willow St., where the concrete bottom ends. It's eight miles to the Florence Avenue Bridge in the city of Bell. I make it in less than three hours. It's smooth sailing until I see flashing lights.

"What on earth to you think you're doing?" the police officer says, stepping out of the squad car that came to a screeching halt in the riverbed ahead of me. They wait for me to float to them. I use my oars to come to a grinding halt as well, and then drag the Cola Kayak up the bank.

"You know you really shouldn't be here," he says, scratching his head, adding, "This river can be dangerous." We look at each other. He and I both know that there are 5 months of the dry season ahead, so the chance of a flash flood is rather slim. I whip out my Permit to Film, which I acquired from the city, allowing me to be here and document the journey on camera.

"How many bottles you got there? That contraption's not gonna fall apart is it? Why are you doing this again?" He and his partner ask dozens of questions about the raft, the reason, and the route. They know this section of the river better than I do. He's got a digital camera in his patrol car. We pose for a couple of shots. "My wife's never gonna believe this." I put the Cola Kayak back in the water, wave and paddle away as if nothing ever happened.

Top: Top: Railroad bridge 53-581, Cudahy. Photo by Mark Lamonica.
Bottom: 6th Street Viaduct. Photo by Mark Lamonica.

Willow street bridge. Photo by Mark Lamonica

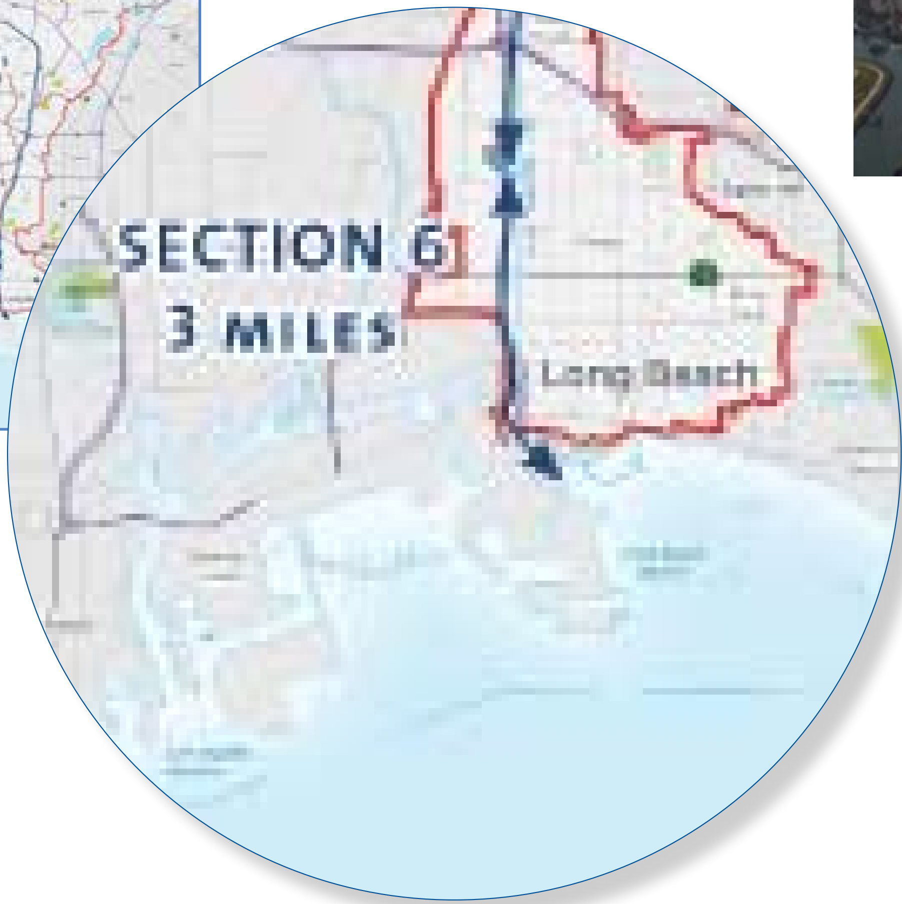
Another 9 miles and three hours later, the river has remained unchanged. Yet drop by drop the current is stronger as other streams and canals drain the watershed into the Los Angeles River. Rio Hondo appears on my left. Compton Creek appears on my right, draining approximately 42 square miles of the roughly 834 square miles of the entire Los Angeles watershed. Water from washing cars and watering lawns flows down the streets of Compton to the creek, feeding the wild patches of wetlands under the Artesia Blvd. Bridge, where herons and egrets watch turtles chase minnows. Though most, but not all, of Compton Creek is a concrete channel, it is refreshing to know that nature is resilient wherever it finds a hospitable place to grow.

Continuing down the Los Angeles River, the 405 freeway soars overhead and the low-flow channel disappears.Thick concrete walls, the size of several refrigerators placed end to end, appear in rows across the river. I slosh around the barricades dragging the raft. Sand, glass, metal and plastic are piled in front of them. Quickly, I pick up recognizable debris: a shoe, bottle cap, bullet, key still inside of a lock, two plastic CD's made from heavy polycarbonate, an arm from a doll, and a remote control car. Collectively they tell who we are, what we do value, and what we don't.

These sturdy concrete walls are designed to slow the raging torrent on those few rainy days throughout the year. Between two of the walls I recognize a granite boulder, twice the size of a basketball, like the ones I saw far upstream in Glendale Narrows. I realize that it was carried here by water, tumbling downstream, powerless to the force of water pushing it along. This is no place to be when clouds are swirling above. A light drizzle at the top of the watershed can sweep away anyone wandering in the waters below. I realize why the police officers came to talk to me. My worst fears have been a tragedy for others, and those officers have seen it before. Wet and tired, I drag the Cola Kayak out of the river, and onto the Willow St. Bridge.

Above left: Concrete barricades before the Willow Street Bridge slow rushing water.
Above right: A heron taking flight.
Bottom left: Debris, carried by wind, water or wheels, flows down storm drains and into the river.
Bottom right: Glendale Narrows. Photo by Sabrina Drill

ADVENTURES OF THE COLA KAYAK•DAY 6 WILLOW ST. BRIDGE TO THE PACIFIC OCEAN



From the top of the bridge I can see the concrete barricades and the channeled river to the north. On the south side there are wetlands, boulders, trees, and wildlife leaps into the air on wings or dives below with fins. I drag the Cola Kayak below the bridge and sit mid-stream in the shallow waterfall and slowly accelerate, sliding gracefully into a dark pool below. This is where the concrete floor gives way to a natural river bed.

The river meanders through a wide basin, with wetlands emerging on both sides. The slope on each side is covered with large irregular shaped rocks directing the river out to sea. There is open sky beyond the last bridge. Soon the grasses and quiet ducks and egrets disappear, giving way to open water, waves, and the effect of tides.

Near the mouth of the river, a giant net hangs beneath large floating pontoons, designed to catch trash before it floats out to sea. There are thousands of plastic bottles, bags, cup lids, and straws, and surprisingly there are hundreds of tennis balls. Beyond this net, the water of the Los Angeles River begins to blend with seawater in giant swirls of brown and green. Algae blossom in the nutrient-rich waters washing the land into the Los Angeles Harbor.

Three miles beyond the Willow St. Bridge, giant smokestacks, banded red and black, rising from the deck of the Queen Mary, tower over the harbor, a monument to the ocean liners that once shuttled thousands of people from continent to continent. In the shadow of this steel behemoth the Los Angeles River comes to an end.

52 miles from the football field of Canoga High School, and 780 feet lower in elevation, everything that washes down our streets flows into the Pacific Ocean, including the Cola Kayak.

THE LOS ANGELES RIVER WATERSHED

Today, the Los Angeles River runs 51 miles and through 13 cities before emptying into the Pacific Ocean in Long Beach. However this is only half the story. The land that drains into the LA RIver, or its watershed, is the other half of the story. All rivers have watersheds and everyone on the planet lives in a watershed. Imagine a bathtub. No matter where water falls in that bathtub it will make its way to the drain. Now, imagine that this bathtub is the Los Angeles River watershed. The Santa Susanna, Santa Monica, and San Gabriel Mountains are the walls of the bathtub and all the neighborhoods below make up the floor of the tub. The drain is the Los Angeles River. The California Environmental Protection Agency estimates there are 2,110 watersheds in the continental U.S. and 153 of these watersheds are in the state of California.

The Los Angeles River watershed is the largest in Los Angeles County. It is 834 square miles and made up of nine sub-watersheds. Major tributaries of the Los Angeles River include the Tujunga, Pacoima and Verdugo washes, Arroyo Seco, Rio Hondo, and Compton Creek. These tributaries connect cities in the San Fernando Valley, Pasadena, and cities between Downtown L.A. and Long Beach to the Los Angeles River and ocean. Even though these neighborhoods may be miles from the River or the ocean, an underground system of storm drains create a direct connection. When it rains, water flows off roofs, parking lots, play grounds, and our streets and carries with it all the oil, trash, and debris that has built up since the last rain. Rain water then becomes run off and flows directly to our Rivers and oceans.

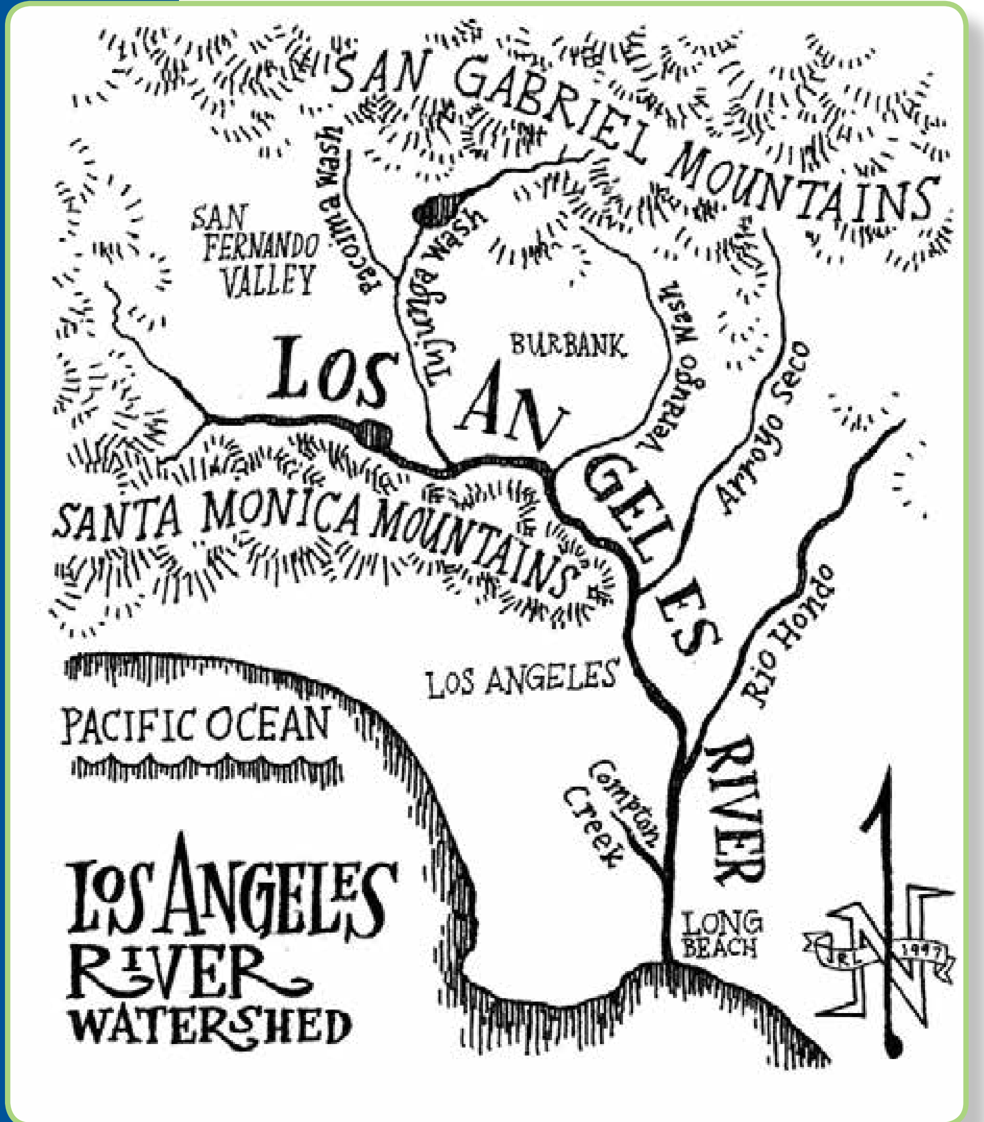


Illustration by Joe Linton from *Down by the LA River.* Wilderness Press. 2005

MAJOR SUBWATERSHEDS OF THE LOS ANGELES RIVER WATERSHED

MAP: The Los Angeles River Watershed.
Courtesy of the Los Angeles and San Gabriel Watershed Council.

THE WATER CYCLE IN LOS ANGELES

In the past, rain would wash rich sediments from the mountains down into the valleys where they would enrich the soil. At the same time, water would saturate the soil and collect in natural wetlands and marshes as it flowed across the valleys where it would have time to absorb and replenish ground water supplies. Until the turn of the century, the L.A. River and its watershed made up of mountains, wetlands, lakes, and ponds, supplied water as well as replenished the regions groundwater supplies. Eventually, increases in human populations and development taxed this water source and open space within the Los Angeles River watershed was covered up almost indiscriminately with impermeable surfaces like concrete and asphalt. Natural rain water was seen as a threat and began being diverted out of the city to the ocean as fast as possible through a system of concrete channels and pipes called storm drains. Today, approximately 75% of the L.A. River watershed is paved with non permeable surface.

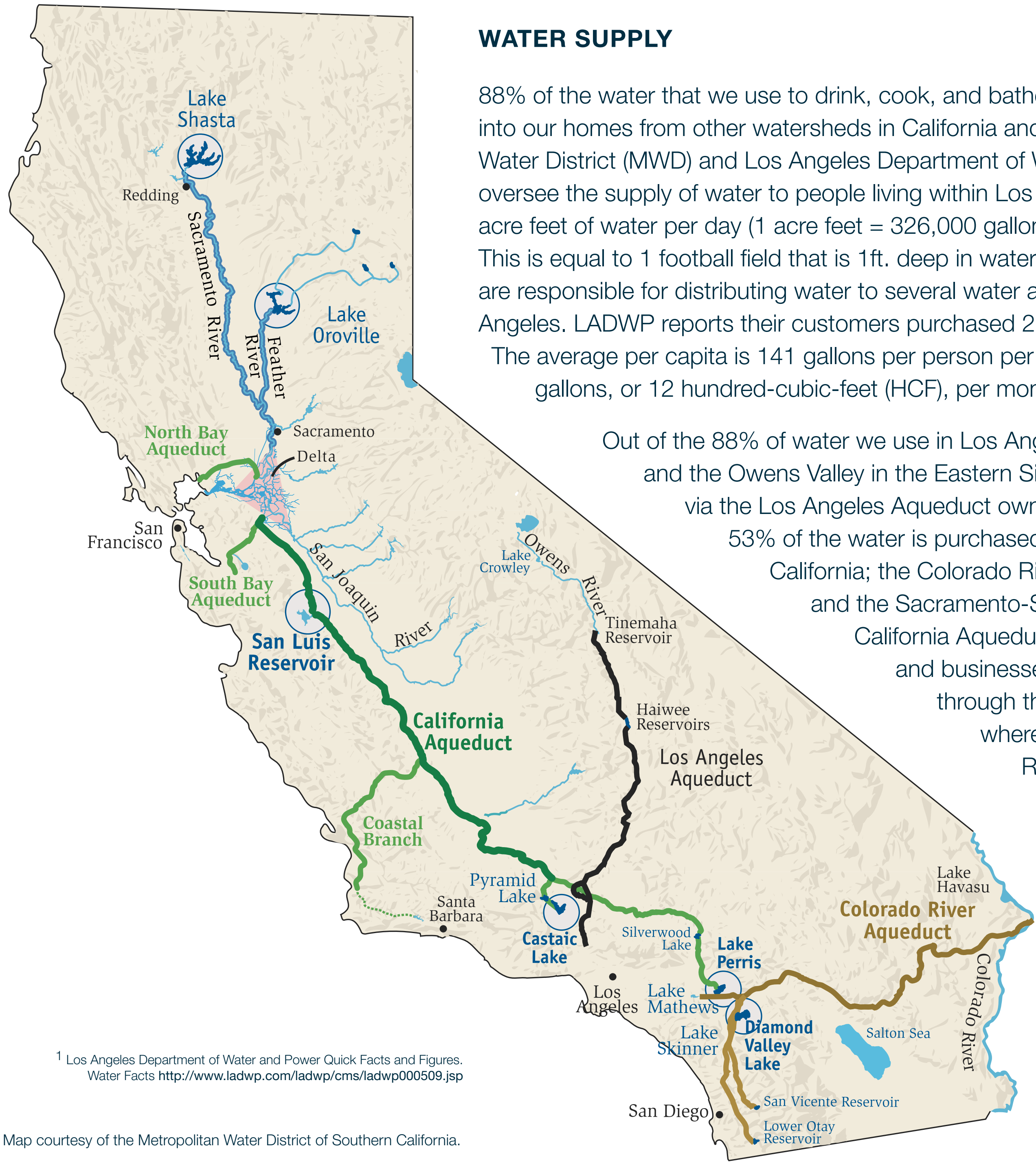
Water cycles through our urban environment much differently than it did in the past. Natural rain water has less area to collect and absorb into the ground to replenish underground water supplies. Prior to 1960, approximately 80% of rainwater percolated into the ground and replenished underground aquifers. Today, only approximately 8% of rainwater percolates into the ground, and like most cities in California, ground water supplies only a small portion (11%) of the water we use in Los Angeles.

WATER SUPPLY

88% of the water that we use to drink, cook, and bathe, do our laundry, and water our lawns is piped into our homes from other watersheds in California and beyond (Colorado River basin). The Metropolitan Water District (MWD) and Los Angeles Department of Water and Power (LADWP) are two agencies that oversee the supply of water to people living within Los Angeles County. On average, MWD imports 6,023 acre feet of water per day (1 acre feet = 326,000 gallons from the Colorado River and Northern California). This is equal to 1 football field that is 1ft. deep in water. Their service area is 5,260 square miles and they are responsible for distributing water to several water agencies throughout six counties, including Los Angeles. LADWP reports their customers purchased 207 billion gallons of water between 2006 and 2008. The average per capita is 141 gallons per person per day and a typical household uses close to 10,000 gallons, or 12 hundred-cubic-feet (HCF), per month.[1]

Out of the 88% of water we use in Los Angeles, 35% of this water comes from Mono Lake and the Owens Valley in the Eastern Sierra Nevada watershed in Northern California via the Los Angeles Aqueduct owned and operated by the LADWP. The remaining 53% of the water is purchased by the Metropolitan Water District of Southern California; the Colorado River (via the Metropolitan Colorado River Aqueduct) and the Sacramento-San Joaquin Delta (via the State Water Project / California Aqueduct). Once this water is used in our homes, schools, and businesses it becomes waste water and is then piped through the sewage system to a water treatment facility where it is cleaned before being released into the L.A. River where it then flows to the ocean in Long Beach. On a dry day, approximately 100 million gallons of cleaned sewage water flows through the storm drain system.

- 85% of the water is treated water that comes from the Tillman Water Reclamation Plant in the Sepulveda Basin, the Glendale WRP and the Burbank WRP.
- 10% is urban run off from our streets and neighborhoods.
- 5% comes from ground water flow or underground aquifers.



[1] Los Angeles Department of Water and Power Quick Facts and Figures. Water Facts http://www.ladwp.com/ladwp/cms/ladwp000509.jsp

Map courtesy of the Metropolitan Water District of Southern California.

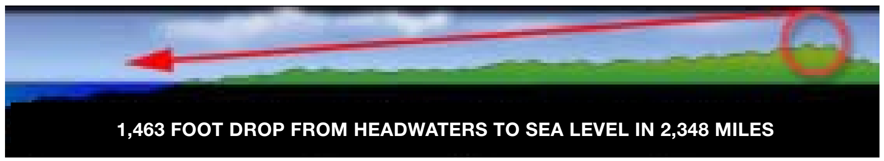
The water that runs off our streets when it rains or, on a dry day, when someone may be washing their car, goes through a different system of pipes called the storm drain system. Unfortunately, water within this system is not treated before it is released back into our waterways. Today, storm drain run off has become a major pollutant of our waterways and oceans.

HISTORY OF STORM DRAINS

Main Street Bridge. Photo by Kevin Break

Los Angeles experienced a growth spurt between the 1920s and 1930s, and human population and development began to encroach into the natural flood plain of the L.A. River. As a result, the region the region experienced several damaging floods that destroyed property and took lives. Waterways like the L.A. River and its tributaries that naturally flooded the during heavy rains became a threat to growing populations along its banks. In response, the Army Corp of Engineers narrowed, straightened, and lined the Los Angeles River with concrete and initiated the development of an underground urban drainage system know today as the storm drain system to drain rain water out of the city as fast as possible. This project began shortly after the flood of 1938 and took approximately 25 years to complete. Today there are over 1,500 miles of underground pipes, 100 miles of open channels, and a total of 35,000 catch basins that comprise the Los Angeles City storm drain system within the Los Angeles River and Ballona Creek watersheds. In total, runoff from approximately 1,060 square miles of developed land reach the ocean through approximately 60 storm drain outfalls . Ironically, when it rains, the Los Angeles River is still an incredibly dangerous place. Even though the River has not flooded since 1938, more water is moving through the River at faster speeds than before. Rain water from our streets is drained to the River through 1500 miles of storm drains and the paved and straightened River flushes this water out to the ocean at high speeds. On a dry day there are about 100 million gallons of water running through the River. On a rainy day this amount increases to 10 billion gallons of water. In addition, water velocities can reach 35 mph and the River can swell to depths of 25 feet during heavy rain events. In comparison to the Mississippi River that drops approximately one and a half feet per mile, the L.A. River is much steeper and drops 15 feet per mile. As a result, gravity assists in draining storm water out to the ocean through the Los Angeles River as fast as possible.

From its headwaters, the Los Angeles River drops 795 feet in 51 miles.



From its headwaters, the Mississippi River drops 1,463 feet in approximately 2,348 miles.

WATER QUALITY

While paving the city and its River and creating a system of storm drains was successful in preventing our streets and neighborhoods from flooding during heavy rain, this system is also responsible for flushing tons of non-point source pollution into the Los Angeles River and ocean in Long Beach after a single storm. The City of Long Beach estimates that approximately 4,000 tons of debris and trash from storm drain run off are being hauled from local beaches every year. Oils, copper, fertilizers, pesticides, cigarette butts, pet waste, plastic bags and food wrappers that have collected on streets, parking lots, freeways are examples of non-point source pollutants. When it rains, these pollutants are washed off the streets and into storm drains that lead directly to the L.A. River and ocean in Long Beach. Unfortunately this is not just in Los Angeles County, non-point pollution and urban run off is the major source of pollution in most waterways throughout the United States.

The trash boom at the end of the Los Angeles River in Long Beach.
Los Angeles County Department of Public Works.

In 2002, Los Angeles River and many of its tributaries made the EPA's 303(d) listing of impaired waterways. This means levels of trash, bacteria, nitrogen compounds, and metals found in the L.A. River and tributaries exceeded acceptable levels and impair warm, freshwater, and wildlife habitats, as well beneficial recreational uses within a water body. These impairments are due to point and non-point sources. Point source pollution originates from an identifiable location such as an oil refinery or paper mill. The origins of non-point source pollution such as plastic bags, pet waste and other trash is not as easy to identify. According to the Los Angeles Bureau of Sanitation, 6% of the pollution is from point sources or facilities like publicly owned treatment plants and factories. In these cases, facilities can be identified and required by the Clean Water Act to amend their disposal practices to protect water quality. The remaining 94% of the pollution comes from non-point sources and consists of trash and chemical build up of toxins on our streets. Some of the large trash gets caught in the natural bottom portions of the L.A. River most of it still makes its way to the ocean in Long Beach. Groups like Friends of the Los Angeles River organize community River clean ups that pull between 25-30 tons of trash from the river bed in natural bottom areas where there are large populations of birds, fish and plants.

HABITAT AND WILDLIFE

Even though much of the Los Angeles River has been paved and its habitat significantly altered from its original state, there remains a rich and diverse population of both native and non-native bird, fish, and plant life that can be observed within the natural bottom stretches of the River. In these sections the River functions as a habitat for many marsh birds such as the great blue heron, green heron, egret, and black-necked stilt. These areas also serve as an important resting spot for migrating birds such as widgeons, merganser and bufflehead ducks. Shorebirds such as the double-crested cormorant can also be found nesting and feeding in the Sepulveda basin and Glendale Narrows. For a list of birds found in the L.A. River birds please refer to the bird survey in Chapter 5: Activities.

While steelhead trout no longer swim up the River to spawn in slow moving creeks and streams, other species of fish still remain and inhabit the River. In 2007, FoLAR conducted a fish study led by Cam Swift and Sabrina Drill and caught eight species of fish, bullfrog larvae and red swamp crayfish. For a copy of this study, please visit www.folar.org. Many native plants and trees may also be found along the banks and in the islands of the Los Angeles River. These include willows, cotton woods, and sycamore trees. For a listing of common native and non-native plants please refer to the plant. See survey on page 74.

PROTECTING OUR RIVERS AND OCEANS

In 1972 the Clean Water Act was signed by President Nixon and waterways in the United State became protected under federal law. While the Clean Water Act created regulations that protected waterways from point source pollution from industrial and some agricultural polluters, Congress and the EPA are still working to better manage land-based, non-point source pollution within the nation. Continued research is still being done to determine water quality standards for recreational water bodies like rivers, lakes, and bays. Today, the City of Los Angeles is working in conjunction with other state water agencies to create a standard of Total Maximum Daily Loads (TMDLs) in storm water discharge. TMDLs are levels of trash, bacteria, nutrients, and heavy metals that impair a water body. Currently the City of Los Angeles working towards a zero trash TMDL by 2013 and reducing trash loads by 10% for the next ten years. The Watershed Protection Division of the Bureau of Sanitation in the City of Los Angeles has also begun to implement trash control devices like catch basins, storm drain screens and other systems throughout the city to cut down on the amount of trash that gets washed into the L.A. River where it makes it way to the ocean. According to their studies 6% of the total maximum daily loads come from point sources and 94% of the city's total maximum daily loads come from non-point sources.

For more information on TMDLs for the Los Angeles River please visit:

- Los Angeles Stormwater Program
  http://www.lastormwater.org/ siteorg/program/TMDLs/tmdls.htm.
- CREST: Clean Rivers through Stakeholder TMDLs
  http://www.crestmdl.org/activities/projects_lariver.html

HERE ARE A FEW OTHER THINGS YOU CAN DO TO HELP PROTECT THE L.A. RIVER WATERSHED AND OCEAN FROM NON-POINT SOURCE POLLUTION:

- Reduce non-point source pollution at its source by avoiding non-recyclable items and recycling your plastics, paper, Styrofoam, glass and aluminum.

- Reduce post consumer plastic waste by using canvas or reusable shopping bag and stainless steel water bottles.

- Collect and dispose your motor oil, paints, and other household chemicals properly at a hazardous waste facility. **http://www.lacity.org/san/solid_resources/special/hhw/safe_centers/index. htm**

- Ask your city council to install screens over catch basins in your neighborhoods or areas of high trash.

- Volunteer at a local River or beach clean up.

- FoLARs La Gran Limpieza/Great Los Angeles River Clean Up **www.folar.org**

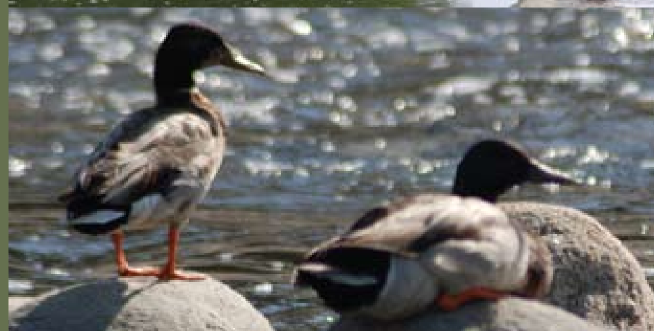
- Heal the Bay www.healthebay.org

- California Coastal Commission Coastal Clean up Day **www.coastal.ca.gov**

- Justin Rudd and the Surfrider Foundation 30-minute beach clean ups **http://www.beachcleanup.org/**

- Sweep your sidewalks and drive ways rather than hosing them down.

- Fix broken sprinklers that leak or overspray onto the pavement and help reduce urban run off.



RIVER REVITALIZATION

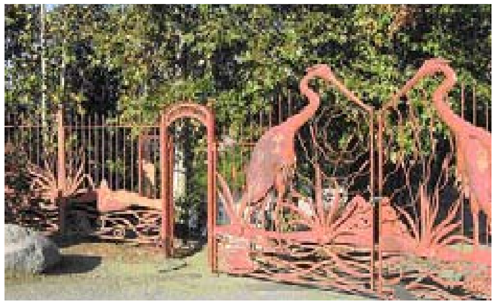
River revitalization was first introduced to Los Angeles by the Olmsted Brothers in the 1920s. However, their initial plan to create a green corridor of parks along the Los Angeles River and its tributaries from the mountains to the sea was never implemented due to a lack of city funds and changing priorities. In the 1980s, Lewis MacAdams sought to revive this vision and founded The Friends of the Los Angeles. However, back then, many people scoffed at the mention of wetlands let alone habitat restoration within the Los Angeles River Watershed. Since then, however, interest in the possibility of reviving the Los Angeles River is growing. Many government agencies and community groups are working to improve recreational and open space opportunities as well as habitat values along the Los Angeles River in order to realize the vision of a green corridor that extends along the Los Angeles River.

BENEFITS OF RIVER REVITALIZATION ON WATER QUALITY AND SUPPLY.

Today, restoring wetland habitat along the Los Angeles River takes many forms. Projects that replace impermeable surfaces like concrete with wetlands or open recreational space improve our watershed's capacity to absorb water and replenish underground aquifers. These projects also create much needed green space in highly industrial and underserved, park poor communities within the watershed. Lastly, restoring habitat along the River also creates the potential to help improve water quality. Today, parks that mitigate storm water and urban run off before it reaches the Los Angeles River and our oceans are being developed along the banks of the Los Angeles River!

REVITALIZATION PROJECTS ALONG THE LOS ANGELES RIVER:

RATTLESNAKE PARK
In 1996, Northeast Trees, a non-profit urban forestry organization, built Rattlesnake Park, the first of seven pocket parks along the Los Angeles River in the Glendale Narrows. Rattlesnake park is along the L.A. River near Fletcher Drive and Ripple Street.



GREAT HERON GATES
In 1999 FoLAR commissioned Brett Goldstone with funding from the Mountains Recreation and Conservancy Authority, to build the Great Heron Gates at Rattlesnake Park in Atwater. Replacing chain link fence that prohibited people from access, this project was the first to open the River and bring it into public consciousness.

Marsh Street Park. Photo by Glen Dake.

MARSH PARK The Mountains Recreation and Conservancy Authority completes Marsh Park in 2006, a 3 acre park that contains a seasonal pond designed to capture and clean urban run off from adjacent streets and recharge ground water. Marsh Park is located at 2960 Marsh Street, Los Angeles, 90039. This was completed by the Mountains Rivers Conservancy Authority in 2006 and that is especially designed to capture and clean storm drain run off and recharge ground water.

STEELHEAD PARK In 2000 Northeast Trees completed Steelhead Park. This project replaced impermeable surfaces with decomposed granite and native plantings and created a public space for the local community to enjoy. This park is also designed to capture and clean urban run off from adjacent streets before it reaches the Los Angeles River and makes its way to the ocean. Steelhead park is located at the end of Oros Street in Elysian Valley.

LOS ANGELES STATE HISTORIC PARK provides 32 acres of open space in downtown Los Angeles. Originally slated for industrial development, FoLAR led a coalition of local community organizations and the city council to redirect the development of this land from a million square feet of warehouses to a 32 acre park created and managed by the California State Parks. This was a landmark victory for the coalition who had been working to revitalize the River and restore open public spaces. The park is located at 1245 North Spring Street and is open from 8am to sunset.

RIO DE LOS ANGELES STATE PARK This 42 acre park opened in 2007 and provides both active and passive recreational opportunities to an underserved and park poor community along the L.A. River. A River wetland environment has been restored in one section of the park that is e City of Los Angeles Department of Parks and Recreation. It is located at 1900 San Fernando Road, Los Angeles, 90065 and the hours are 9am to 10:30pm.

MAYWOOD RIVERFRONT PARK As the Los Angeles River travels its final stretch to Long Beach, the amount of open space and parkland decreases and level of industrialization increases. Maywood Riverfront Park enhances an area criss-crossed by railroad tracks and a former brownfield. The park offers a green oasis in one of the most densely populated portions of Southern California. A level area provides green lawns, rapidly growing shade trees, and small hillocks a stone's throw from the Los Angeles River channel. This park is managed by the Mountains Recreation and Conservancy Authority and located at 60th Street and Walker Avenue in Maywood.

Dominguez Gap Wetlands. Photo by Dave Wielenga

DOMINGUEZ GAP WETLANDS is made up of 50 acres of treatment wetland and spreading ground. Completed by the Los Angeles County Flood Control District in 2008, the east basin is 37 acres and the first large scale wetland restoration project along the Los Angeles River that captures and treats polluted storm water and urban run off and replenishes ground water supply. It can capture and treat up to 1.3 to 3.2 million gallons, or enough water to fill 5 olympic size swimming pools, and the 15 acre west basin spreading grounds can capture, treat and absorb 450 acre feet of water per year. This project is the largest and most recent project from the Los Angeles River Master Plan created by the County Department of Public Works. **cfm** The Dominguez Gap Wetlands are located at the Los Angeles River off Del Amo Boulevard and are currently being managed by the Long Beach Department of Recreation, Parks and Marine. For more information please visit **http://www.ladpw.org/wmd/watershed/LA/LA_River_Plan.**

THE CITY OF LOS ANGELES RIVER REVITALIZATION MASTER PLAN

This plan was created by the Los Angeles City Bureau of Engineering and adopted by the Los Angeles City Council in 2007. It outlines over 200 projects along 36 miles of the Los Angeles River starting at the headwaters in Canoga Park and ending at the L.A. River and 7th street in downtown Los Angeles. Projects within this plan are also multi-benefit projects that address issues of water quality and conservation, habitat restoration and open green space for the public within the City of Los Angeles. **For more information please visit www.lariver.org.**

HEADWATERS IN CANOGA PARK

PAST

PRESENT

FUTURE

Left to right: 1956. Photo by Clement Padick "Control and Conservation of Natural Runoff Water in the San Fernando Valley, California, Master's thesis, University of California Los Angeles, 1956.

2006. Photo by Joe Linton.

© City of Los Angeles 2007. Los Angeles River Revitalization Master Plan

THE LOS ANGELES RIVER THROUGH THE SAN FERNANDO VALLEY

PAST

PRESENT

FUTURE

Left to right: L.A. River near Reseda. 1935

L.A. River near Studio City. 2006. Photo by Joe Linton

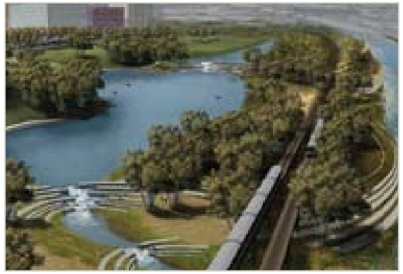
Plan to revitalize the L.A. River in Studio City. © City of Los Angeles 2007. Los Angeles River Revitalization Master Plan

THE LOS ANGELES RIVER THROUGH DOWNTOWN LOS ANGELES

PAST

PRESENT

FUTURE



Left to right: Los Angeles River near downtown circa 1935.

L.A. River from the First Street bridge. 2006. Photo by Joe Linton.

Plan to revitalize the L.A. River downtown.
© City of Los Angeles 2007 Los Angeles River Revitalization Master Plan

THE LOS ANGELES RIVER THROUGH ELYSIAN VALLEY

PAST

PRESENT

FUTURE

Left to right: Elysian Valley circa 1935.

Taylor Yard around 2000.

The City Project Taylor Yard Opportunity site.
© City of Los Angeles 2007 Los Angeles River Revitalization Master Plan

THE L.A. RIVER IS...A FORTY YEAR ARTWORK.

-LEWIS MACADAMS, FOLAR CO-FOUNDER

CHAPTER 5 PLASTIC DEBRIS: RIVERS TO SEA

The mouth of the Los Angeles River is the lowest point in the 834 square miles of the Los Angeles Watershed. What blows and flows into storm drains makes its way downstream, and much of it is plastic. A floating net stretched across the river captures some plastic waste before it leaves the river, but plenty misses the net. What happens to that trash? Where does it go? Does it impact our environment? Does it impact human health? It is not uncommon to find plastic waste on our beaches, throughout our watershed, hanging in trees, or collecting in the middle of the world's oceans. It wasn't always this way.

Plastic made from petroleum wasn't common half a century ago. Before WWII there wasn't much plastic in the world. In the 1940's all you might see in someone's home might be a pair of nylon stockings. During World War II there was plenty of research and development to create new kinds of fuel and lubricants from petroleum, as well as synthetic materials, like plastic. After the war, production continued as factories switched from making canteens to coffee cups. In 1955 an article in Life Magazine presented the idea of "Throw Away Living." The article boasted that the average housewife would never need to wash a dish again.

The production of plastic began to soar. Every child needed a plastic hoolahoop. Plastic wrap became the ultimate defense against germs on food, dishes and utensils, and even clothes could be wrapped with sheets of plastic for clean storage. In 1992 the Environmental Protection Agency reported that the United States produced more than 60 billion pounds of plastic nationwide. It took half a century to reach this capacity. By 1997, in only 15 years, that rate of production had doubled. The 19th century had been dominated by the Industrial Revolution, which transitioned into 20th century technology and the Space Age, but by 1979 the production of steel took a backseat to the production of plastic, ushering in the "Age of Disposable Plastic."

IN A "THROW AWAY" SOCIETY, WHERE IS AWAY?

In 2003 the California Integrated Waste Management Board studied this issue. Of the plastic we produce in the United States, roughly half is destined for a landfill. The burial of plastic is not a long-term solution. Landfills are like time capsules, preserving materials for decades or centuries. Even newspaper excavated from ancient landfills can be read to see what was happening half a century ago. Biodegradation in landfills isn't efficient, but chemical degradation happens. Leachate, the liquid that leaks from buried trash, blends the toxins of everything from battery acid to plasticizers, and is considered hazardous waste.

If 50% of that 120 billion pounds of annual production goes to a landfill, where's the rest of it? 20% becomes durable goods, the kind of products that last a while, like car bumpers, circuit boards in computers, refrigerator doors, or skateboards. These products, and thousands of others like them, are less disposable than the bags and bottles designed to be thrown away after single use. Though they may eventually wind up in a landfill, we call them durable goods.

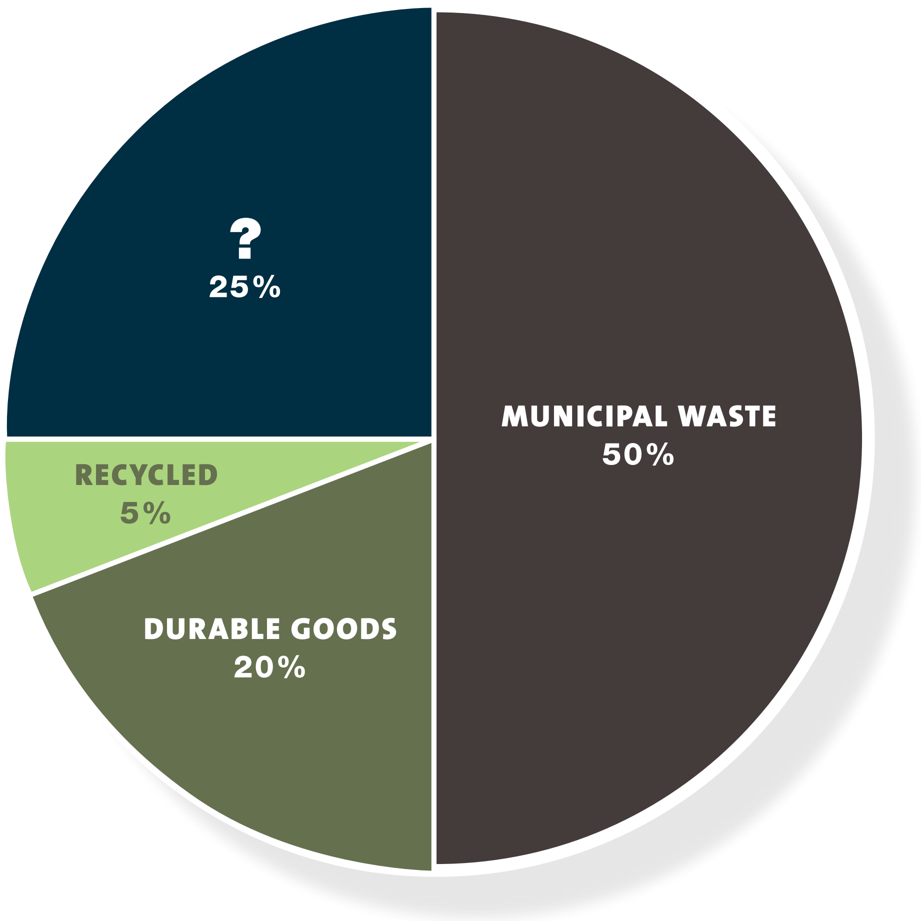
Only 5% of plastic produced is recovered by recycling centers. This doesn't mean that plastics are recycled. They are recovered. Recycling centers also collect glass, metal and paper. It is technically and economically feasible to turn a cardboard box into another cardboard box. Paper is returned to wet pulp, dried and remanufactured into a box. That's true recycling. A box is cycled again into a box in and endless loop of production. Whatever is not recovered is biodegradable.

Glass and metal are also truly recycled. A glass bottle can be melted at 2700°F. As it melts, food waste, paper labels and other impurities are burned away, leaving clean glass to be remanufactured into a bottle. An aluminum can be melted down to pure aluminum and remanufactured into

FLOATS OR SINKS? PLASTIC DENSITY CHART

DENSITY OF SEA: SEA WATER 1.02-1.03 G/ML, FRESH WATER<1.015G/ML

			Polymer Density grams/cubic cm.	
1 PETE	**Thermoplastic polyester – polybutylene terephthalate (PET and PBT)** Carbonated drink bottles and oven-ready, meal trays.		(PET) 1.29-1.40 (PBT) 1.30-1.38	**SINKS**
2 HDPE	**High-density polyethylene (HDPE)** Bottles for milk and dishwashing liquids.		(PET) 1.29-1.40 (PBT) 1.30-1.38	**FLOATS**
3 PVC	**Polyvinylchloride (PVC)** Food trays, cling film, shampoo bottles.		1.30-1.58	**SINKS**
4 LDPE	**Low-density polyethylene (LDPE)** Grocery bags and bin liners.		0.89-0.94	**FLOATS**
5 PP	**Polypropylene (PP)** Margarine tubs, microwaveable meal trays.		0.89-0.91	**FLOATS**
6 PS	**Polystyrene (PS)** Yoghurt cups, foam meat or fish trays, egg cartons, vending cups, plastic cutlery, and packing material.		1.04-1.08	**SINKS**
7 OTHER	**Polycarbonate** CDs and DVDs, tail lights on cars, hard plastic canteens.		1.2	**SINKS**



an aluminum can again. These materials, when recovered, are recycled into the same product of the same quality. This is a closed loop, from production to recovery and remanufacture. Plastic is different.
Plastic has a very low melting point. A common PETE soda bottle has a melting point of 260°F, which doesn't burn away food waste. Also, many other kinds of plastics, like PETE, PLA and polypropylene, can contaminate a batch of polyethylene, making it difficult to extract pure polyethylene. Although plastic waste can technically be refined into a single type of plastic, the expense of removing food waste and other impurities makes it far more expensive today than using new virgin plastic.

So where does plastic go when we think it's being recycled? Puente Hills Landfill is the largest landfill in the United States, with a steady stream of trucks dumping more than 1,300 tons of trash each day. Adjacent to the landfill there's a Materials Recovery Facility (MRF) occupying a single building with an area larger than a few football fields inside. Dry trash is dumped here and sorted by hand on large conveyer belts. Workers in hard hats pull plastic, paper and metal out of the waste stream and compact it into car-size bales. The supervisor on site gives tours and answers questions. "Where does all of the plastic go?" one might ask. "China," is the answer. Thousands of empty shipping containers returning overseas often carry our plastic waste.

Some post-consumer plastic waste is reused by companies in the United States to make products like carpeting, fleece clothing and plastic lumber, which we call "Downcycling". Downcycling is the reuse of a material into a material of lesser quality. Recovery rates on downcycled products is not known. Some companies have shown limited examples of plastic recycling, by blending post-consumer plastic with new plastic to make food-grade products, but these examples are few. The cycle is not complete.

PLASTICS OUT TO SEA

If 50% is sent to landfills, 20% becomes durable goods and 5% is recovered, that still leaves 25% unaccounted for. Where does all that plastic go? We can find much of it rapidly accumulating in the marine environment. Of the 120 billion pounds of plastic produced annually in the United States, roughly half floats and half sinks, according to a 1992 report on plastic production from the Environmental Protection Agency. Plastics like polypropylene, high-density and low-density polyethylene can be found floating out to sea. Whereas, PETE, polystyrene, PVC, polycarbonate, and all thermoset plastics will not make it too far offshore, unless air is trapped inside.

Digging in the streambed of the Los Angeles River one can find broken DVD's, fragments of tail lights from cars, soda bottles without caps, and broken fragments of polycarbonate and PVC buried in sediment. In coastal wetlands, estuaries, rivers, streams and the nearshore environment, negatively buoyant plastics are accumulating. In some areas of Cerritos Marsh in Long Beach, there is more plastic than exposed sediment, creating an impermeable membrane where gasses cannot exchange. In this anoxic environment the natural organisms, worms, clams and snails, are gone.

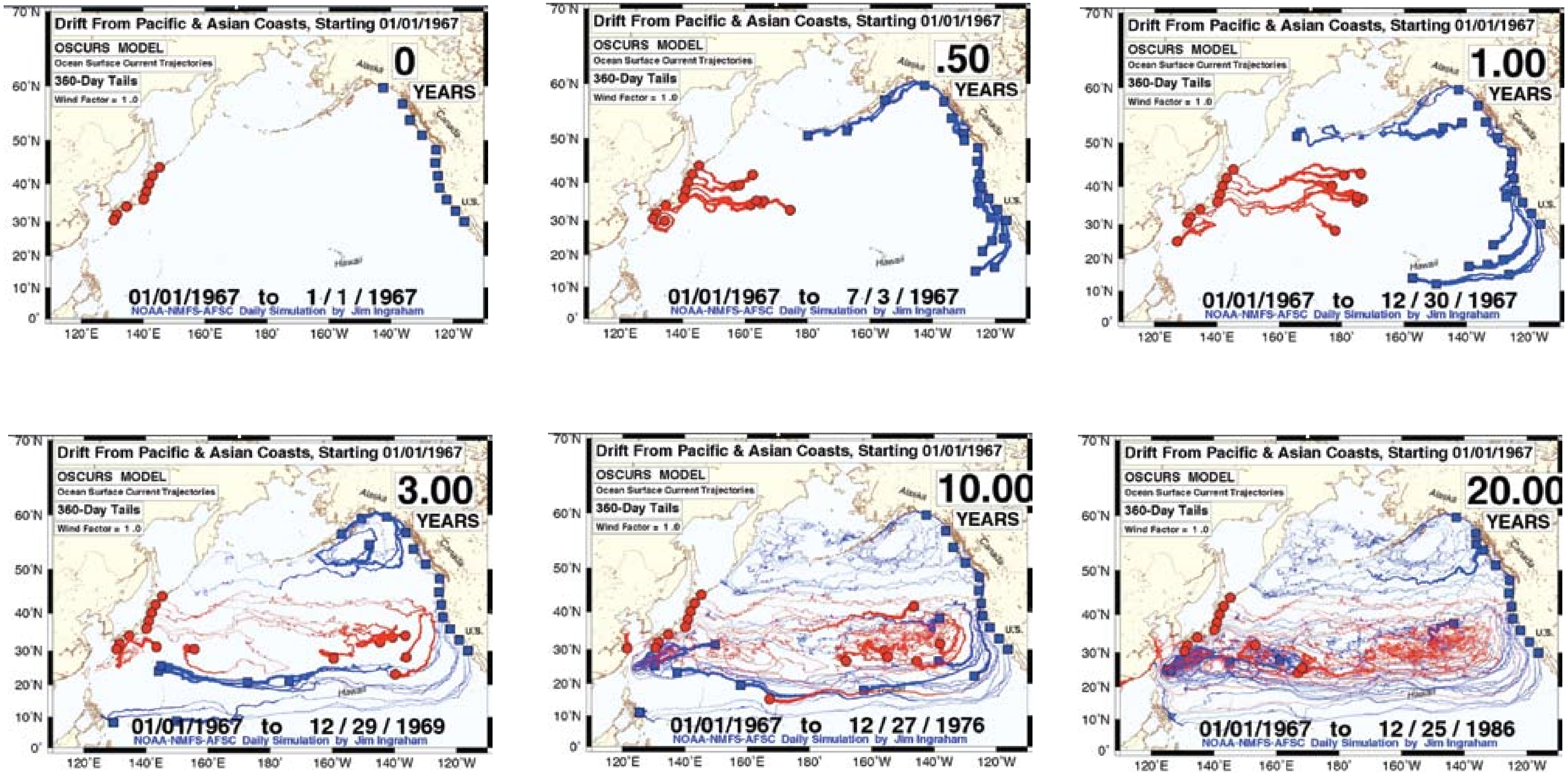
What happens to the plastic that floats? The path of floating plastic waste begins high on the watershed, gravitating toward the sea. Urban areas, like Los Angeles, have begun to place a few catch basin inserts in storm drains. There are screens or filters that capture or deflect waste that enters storm drains. These are expensive to install and maintain. Today a fraction of the city's stormdrains are screened, so plastic waste floating along the curb into storm drains becomes plastic waste in the Los Angeles River. Other structural controls include river booms. These nets cross the river and are designed to capture floating plastic waste. After heavy rains one can see may tons of bottles, bags, cup lids, straws, utensils, and other single-use disposable plastic products flushing out of storm drains and collecting in a river boom at the mouth of the Los Angeles River, where crews with cranes extract the debris and send it to a landfill.

WHERE DOES PLASTIC GO ONCE IT LEAVES THE LAND?

Coastal currents can take trash out to sea or wash it up on the beach. After rain falls in Los Angeles, coastal waterways and beaches become inundated with plastic waste flushed off the land. Coastal currents may take it down the coast or offshore, and possibly into the North Pacific Gyre. In the gyre, new plastic marine debris joins old plastic debris, including lost nets and line from the fishing industry.

There are five sub-tropical gyres in the world, which occupy the north and south Pacific Ocean, north and south Atlantic Ocean, and the Indian Ocean. We have recent data from just one. The North Pacific Gyre is a clockwise rotating body of water that occupies nearly the entire North Pacific Ocean. A twenty-year study by Jim Ingraham identied the path of currents around the Pacific Ocean. He released transmitting buoys from the west coast of the United States and the east cost of Japan. For twenty years he followed their movements. Imagine one bottle cap leaving the Los Angeles River. In six months it travels halfway to Hawaii, and in one year it's washed ashore there, unless it's drifted by. In three years that bottle cap is near the coast of Japan, being swept northward by the Kurishio Current.

In ten years it has made the return trip, but not all the way back to shore in California. It get stuck in the eastern edge of the North Pacific Gyre. In 20 years it is still there, meandering from east to west in the middle of the Pacific Ocean. Ultraviolet light and wave



action will break plastics into smaller pieces, but the basic plastic polymer doesn't go away. The North Pacific Gyre is analogous to a giant toilet bowl that never flushes, yet is filling with a non-biodegradable material – plastic.

HOW MUCH PLASTIC IS OUT THERE?

Marine debris refers to anything in the sea that didn't grow there, like wood, seeds, pumice, and manmade materials like shipwrecks, glass fishing floats and plastic. A 2002 meta-analysis by Jose Derraik, published in the Marine Pollution Bulletin, reviewed dozens of reports on marine debris. He estimated that 60-80% of marine debris found in the world's oceans is plastic. But what does that mean in terms of total weight, distribution and particle size? In 1999 Captain Charles Moore, founder of the Algalita Marine Research Foundation, ventured into the North Pacific Gyre to answer those questions.

Captain Moore, a lifetime surfer and sailor, native of Long Beach, California, ventured 1000 miles west of Los Angeles into the eastern edge of the North Pacific Gyre. It wasn't his first time there. A few years earlier he had participated in a Trans-Pacific race from the mainland to Hawaii. He took a short-cut through the doldrums, where wind and currents are slow and not very appealing to sailors. In those relatively calm waters Capt. Moore witnessed a never ending trail of plastic particles. That was the edge of the gyre, what would later be called the Eastern Garbage Patch. He returned with scientific protocols and a manta trawl, akin to a giant pool skimmer to sample the surface of the ocean. The trawl has a mesh size of 333 microns, therefore it captures the biomass of the top 20 centimeters of the ocean surface. His findings were startling.

After skimming several square miles of the ocean surface, he returned with dozens of sample jars filled with a mixture of plankton and plastic. In the laboratory, volunteers with the Algalita Marine Research Foundation carefully separated all plastic particles from the plankton. The resulting data from averaging the dry weight of each sample showed that the weight of plastic was six times greater than the weight of plankton. The plastic density on the ocean surface was .002 grams per square meter. The North Pacific Gyre had become a plastic soup.

WHAT IS THE IMPACT OF PLASTIC ON THE MARINE ENVIRONMENT?

Midway Atoll is one of many islands in the Hawaiian Archipelago, and is home to one of the largest breeding colonies of Laysan Albatross. With a wingspan of 7 feet, adult albatross can soar at sea for weeks, even sleep on the wing. As scavengers, they forage the oceans surface for fish, squid and anything else floating by. On Midway Atoll they regurgitate food for their chicks. In a colony of 10,000 birds there will be carcasses lying around. In most skeletons one can find their chests filled with plastic bottle caps, lighters, parts of toys, medical waste, pen caps, fishing floats, and a variety of random fragments. In 1997 David Laist described 267 species of marine organisms that were reported to have either ingested or were entangled by plastic marine debris, including 44% of seabird species, 43% of marine mammal species, and 86% of sea turtle species. A growing list of fish species impacted by plastic waste is quickly growing longer.

Petroleum-based plastic is non-biodegradable, and many kinds of plastics are chemically designed to have high tensile strength and resistance to ultraviolet degradation. In the marine environment these compounds persist for an unknown length of time. We know that sunlight will eventually break plastic into smaller particles, yet those particles are still plastic. Every piece of petroleum-based plastic created in the world, if not incinerated, is still here, either buried in landfills, buried in sediment, or floating out to sea. As Captain Moore has said, “plastic is forever.”

Plastic marine debris is also bioactive in the marine environment. There are many pollutants that wash off our watersheds, like pesticides, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs), which are compounds from the incomplete burning of fossil fuels. These compounds are hydrophobic, which means they do not mix with water. But they are lipophilic, finding a friend in plastic to bond to. Captain Moore and other scientists studied plastic particles found in the middle of the North Pacific Gyre and discovered that these pollutants contaminate plastic marine debris in high concentrations. Tokyo University geochemist Hideshige Takada has found that plastic pellets floating in the western edge of the North Pacific Gyre, near the coast of Japan, concentrate toxic chemicals to as high as one million times their normal levels in seawater.

HAD IT CHANGED IN A DECADE?

In 2008 the Algalita Marine Research Foundation returned to the North Pacific Gyre for the 6th time. Captain Moore and his crew returned to the same location they had sampled in 1999. After repeating every step from the first voyage, dragging the manta trawl in the same area, the same distance in the same direction, the results we're shocking. 1999 surface density of plastic marine debris was .002 g/m2, and in 2008 it was .004 g/m2. It took half a century for plastic waste to cover the North Pacific Gyre, and less than a decade for the amount to double.

For the first time Captain Moore collected fish to analyze stomach contents. At night tiny fish of the family Myctophidae, commonly called Lanternfish, rise from the depths to the surface to feed on zooplankton. As the manta trawl was retrieved after several miles of being towed, it revealed a rich diversity of nocturnal creatures. Months later, in the lab, those fish would bring to light the potential human health threat from plastic marine debris. One-third of the hundreds of fish sampled had ingested plastic. The record holder contained 84 pieces nearly the size of rice grains.

Later in 2008 other scientists returned to the sea, rafting from Los Angeles to Hawaii. Halfway across, 1000 miles from land in all directions, they began fishing. The Rainbow Runner is a common fish found in restaurants and fish markets around the world. Inside its stomach they found 17 large fragments of plastic. Like the lanternfish, the plastic fragments did not move past the stomach. In each of these fish, the mouth is bigger than the other end of the digestive tract. The valve between the stomach and small

intestines restricts large particles from passing through. This allows undigestible, non-biodegradable plastic fragments to remain in the stomach until the fish either grows larger or dies.

Plastic marine debris is not a harmless material that passes through marine organisms leaving them unscathed. There are mechanical complications, like entanglement, which can immobilize, strangle or slow an animal down making it an easy target for predators.

Ingestion of plastic marine debris can cause blockages of the esophagus or trachea, restricting feeding or breathing. Ingested plastic also creates a false sense of satiation, or feeling full when you're not. Dr. Heidi Auman reported that Laysan Albatross with stomachs filled with plastic were more prone to lose weight, body fat and dehydrate. Other scientists searched for POPs in albatross tissues and organs. They found several different pollutants, including 19 different congeners of polychlorinated biphenyls (PCBs). The concentrations of POPs in these albatross was at or above the thresholds known to cause adverse effects in other fish-eating bird species (Jones, 1996).

The potential human health impact lies in the concentration of POPs in our bodies because of the food we eat from the sea. We know that many marine organisms, from whales to worms, harbor pollutants in their tissues and organs. Scientists have studied the relationship between plastic marine debris ingestion and the accumulation of POPs in the tissues of seabirds, benthic worms and clams. We also know that humans around the world carry a body burden of pollutants in our tissues and organs from multiple avenues of exposure throughout life. Exposure to synthetic compounds occurs through cosmetics, the thousands of synthetic materials we touch, use to package our food and water, and through the food we eat. Today scientists are working to understand how plastic waste pollutes the fish we harvest from the sea.

WHAT CAN WE DO TO END THE PLASTIC PLAGUE IN OUR OCEANS?

It's a global case of material negligence, our having invented a non-biodegradable, bioactive material, then inventing products from it that are designed to be thrown away. "Well just scoop it up?" is a common first reaction to plastic marine debris, but the ocean is too vast to be scooped and the plastic is too thinly dispersed to be collected in any practical or economically viable way. There's also the difficulty of keeping all the organisms on the surface of the ocean out of the net. Imagine a handful of plastic particles, from the size of rice grains to flour, spread over an area of the ocean surface as big as a football field. Now imagine 9 million football fields in the North Pacific Gyre alone.

In time the ocean could heal itself, as plastics are reduced to single polymer chains, then monomers, and finally sequestered in sediment, after cycling though many organisms, including ourselves. The solution, like the physician's creed, is to "Do no more harm." We must keep plastic waste from entering the ocean. But how?

The solution will require a multi-faceted approach. Recycling is a small part of the solution. Recovery rates for post-consumer plastic are very poor. And plastics are not easily recycled, like paper, metal and glass. Of the small amount of plastic that is recovered, a smaller amount is truly recycled. We do need recycle bins, but there's much more to be done. Many organizations conduct beach clean-ups and reef clean-ups. Coastal cities install structural controls, like nets across the mouths of rivers, or catch basin inserts inside storm drains or screens over their openings. These post-consumer solutions are essential, but insufficient.

There are several pre-consumer solutions that are working around the world, like new product material and design, consumer education, and legislative efforts to decrease the consumption of single-use disposable plastics.

Some companies that manufacture and distribute disposable plastic products are beginning to use alternative materials, like cellulose fiber and bioplastic. Bioplastic is a plant-based polyester that feels and behaves just like petroleum-based plastic. The most common types are polylactic acid (PLA) and Polyhydroxyalkanoate (PHA). These bioplastics will biodegrade in a moist microbe-rich, warm environment. In the ocean, bioplastics degrade very slowly and can absorb pollutants much like petroleum-based plastic can.

Dozens of countries have restricted or placed fees on disposable plastic products. After Ireland imposed a 15-cent fee on plastic bags, they observed a 90% reduction in consumer use. Other countries, like China and Bangladesh, have banned some single-use plastic products altogether. Public education about the rapid accumulation of plastic marine debris, as well as the health effects associated with different plastics, has created cultural shifts toward reusable products. Many companies now sell reusable mugs, water bottles, canvas shopping bags, lightweight steel containers for packing meals, and utensils in pocketed napkins.

Around the world, people are forming organizations dedicated to conserving the marine environment, and understanding that what we do on land, we do to the sea.

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Pre and Post lesson survey

Pre-visit activities:

Gifts from the River
The Los Angeles Water Cycle
Water Audit

Field Labs:

Plant survey
Bird survey 6 need drawings
Macro invertebrate survey
Plastic debris survey
Water Quality Testing

Post-visit activities:

Classroom trash/plastic audit and awareness campaign
Designing Your L.A. River

PRE AND POST STUDENT SURVEY

Please photocopy and have students complete and return these pre and post tests for each chapter before and after you complete an activity. Please return surveys to Alicia Katano at the Friends of the Los Angeles River, 570 West Avenue 26, Ste. 250, Los Angeles, CA 90065

PRE-TEST

Student Name: **Grade:**

School: **Teacher:**

Lesson: **Chapter:**

1. I have

- **a.** ____ rode my bike along the L.A. River
- **b.** ____ walked along along the L.A. River
- **c.** ______________________________________
- **d.** ____ only seen the River from the freeway or street.
- **e.** ____ only heard of the L.A. River.
- **f.** ____ never heard of the L.A. River.

2. I think the L.A. River is a __________________________ place where you will see ____________________________________

____

____.

3. I think it is River is ____ important ____ not important to protect the Los Angeles River.

Use the back of this form for additional comments.

POST-TEST

Student Name: **Grade:**

School: **Teacher:**

Lesson: **Chapter:**

1. List 5 new things you have learned about the Los Angeles River:

1.
2.
3.
4.
5.

2. What is the most important thing you have learned about the L.A. River ____

____

____

3. I think it is ____ important ____ not important to protect the Los Angeles River because ________________________________

____

____

____

____

____

4. List 2 things you can do to help protect the Los Angeles River.

1.
2.

Use the back of this form for additional comments.

BACKGROUND

Thousands of years ago, the Tongva (Gabrielino) Indians built their villages throughout the Los Angeles basin. They built their villages near the River because of the many resources the River had to offer. They were also aware of the frequent natural flooding of the shallow Los Angeles River and built their villages in the adjacent hillsides. The River had a rich and biologically diverse ecosystem that supported many daily needs such as drinking and bathing not only for the Tongva peoples but it also supported a diversity of animals that depended on the water, fish, birds, and plants growing and living by the River as well. Many plants and trees that grew by the River providing shade for fish, aquatic insects, and places to nest for birds but they also were used by the Tongva as food, medicine, tools, baskets and building materials. This biodiversity of plants, insects, fish, and animals made the River an ideal place to hunt, fish, and gather food and supplies needed for daily life for many life forms. The Tongva had respect for nature and the River and had a symbiotic relationship with their environment in which nothing was wasted. They new maintaining balance and biodiversity within the environment was needed to survive because all the living things of the River were connected and dependent upon each other to survive. The Tongva did not have supermarkets, hospitals, and stores like we have today. Instead, they relied on and used a variety of the plants and animals that lived near the Los Angeles River.

OBJECTIVE

- Students learn the many ways the River functioned as a resource to people in the past.
- Students understand the interconnected relationships between living organisms within the River's ecosystem.
- Students understand how loosing one part of the ecosystem weakens the whole system.

CALIFORNIA SCIENCE STANDARDS

K Earth sciences 3c	Grade 4 Life sciences 2a-c, 3a-c
Grade 1 Life sciences 2 a-e	Grade 6 Ecology 5a-e
Grade 2 Earth sciences 3e	Grade 7 Life science 3e
Grade 3 Life sciences 3a-d	Grades 9-12 Ecology 6a,b,c

MATERIALS

Bio-diversity cards template
Ball of yarn
Los Angeles River Timeline
Gumprecht map pg. 30

PROCEDURE

1. Photocopy the biodiversity card template and cut them into cards. Be sure to make copies double sided so that the object is on the front and the use is on the back. Hole punch cards and string them up to allow students to wear around their necks.

2. Have students sit in a circle and then read activity background. When you are done explain each student is going to represents a resource that lived near the Los Angeles River.

3. Pass out one biodiversity card to each student. Have each student introduce themselves by reading the front and back of their cards. Then have students identify if they are one or more of the following:

a. Producer – organisms that capture energy from the sun to produce food and then passes that energy and nutrients on to consumers (example: plants)

b. Consumer—organisms that can not make its own food and must obtain it from their environment (examples: herbivores, carnivores, omnivores, and bacteria and fungi)

c. Decomposer—organisms that breaks down the remains of dead animals and plants recycling valuable nutrients into the environment to be used by other members of the ecosystem. (example: bacteria and fungi)

4. Starting with your picture (example: sun), read your description and holding on to the end of the yarn toss the ball to a resource you depend on or that depends on you (could be anyone since all forms of life depend on the sun).

5. Explain to the student who catches the ball of yarn they must now toss the ball of yarn to a resource they need or that needs them. Have students give an explanation for their choices.

6. Continue until each student is holding a piece of the yarn (one person may get tossed to more than once if needed).

7. Point out they have created a "web of life" that existed in the Los Angeles River thousands of years ago and that the elements they represent are all connected to one another in terms of what they needed to survive and what they provided in terms of survival for others.

8. To show this connection have them hold on to the string as you explain that you are now traveling through time. Using the timeline state it is now.

a. 1800s and the Spanish and new settlers are diverting some of the water from the Los Angeles River. Have the student representing water tug on the string and ask students who feel a tug to raise their hand. Call on these students and have them identify themselves and discuss as a group how they would be affected by less water.

b. 1938 and people have started to pave the Los Angeles River with concrete to prevent floods. Have the student representing soil tug on the string and ask students who feel a tug to raise their hand. Call on these students and have them identify themselves and explain how they would be affected by less soil. Take it a step further and ask those two students to tug and reveal other resources. Have students identify themselves and discuss as a group how they are affected by less soil. You can continue the tugging until everyone has spoke and this will show how everything in an ecosystem is connected.

c. Continue this to discuss other events on the L.A. River timeline in terms of their impact on water quality, supply, river habitat, wildlife, and changes in the Los Angeles River through time.

9. WRAP UP QUESTIONS

a. What materials were used by the Tongva to build homes/as medicines/for clothing/for food?

b. What parts of the web of life in the Los Angeles River still exist today? What parts are missing?

c. How does this affect the Los Angeles River?

d. What would help the web today?

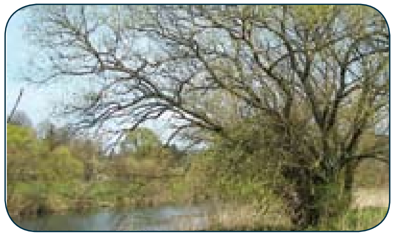
SUN

AIR

WATER

TULE REEDS/ GRASSES

WILLOW TREE



ELDERBERRY

WILD RABBITS

PEOPLE

FROG

SQUIRREL

• Air is necessary for all forms of life—insects, algae, fish, plants, trees, mammals. • Plants release oxygen through the process of photosynthesis.	• Sun is a form of energy necessary for all life. • It provides algae, plants, grasses, and trees with the energy to produce food and oxygen. • The sun also helps humans produce vitamin D.
• The Tongva used its leaves were for the walls homes and for weaving mats, its roots were ground into flour, and its seeds were eaten raw or ground into mush • Birds, lizards, frogs, and small animals hide or build their nests and use as a source of food • Fish and aquatic life depend on them for shade • They require water, soil, and sunlight.	• Water is necessary for all forms of life. • It is habitat for fish, frogs, and aquatic insects and plants. • Animals and plants need water to survive. • People use water to drink, bath, and cook.
• The Tongva ate their berries, used their blossoms for medicine, and made bows and musical instruments from its branches. • Also a source of food for mammals and birds.	• Leaves were used for medicine and branches for building homes. • A place birds could build their nests. • Provided shade needed for survival by fish and aquatic insects if growing by water.
• The Tongva depended on many things from their environment to survive.	• Was a source of food for Tongva and carnivorous mammals. • The Tongva used its fur for clothing and blankets and bones were used for tools
• Eaten as food by the Tongva and other mammals • Require water and plants for food and shelter.	• Eaten as food by the Tongva and other mammals. • Require water and plants for food and shelter.

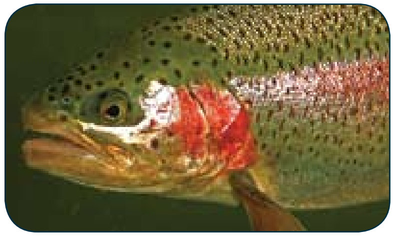
RIVER STONES

SOIL

MULE DEER

BLACK BIRD

STEELHEAD TROUT/FISH



GRASSHOPPERS/ INSECTS

LIZARD

BLACK WALNUT

WILD ROSE

SNAKE

• Lined the River bottom and prevented soil from eroding.	• Were used by the Tongva for grinding acorns.
• A source of food for the Tongva and other mammals. • Feathers were used as decoration by the Tongva. • Birds also ate insects and were important in keeping populations in balance in the ecosytem.	• A source of food for the Tongva who also used their skin was for clothing and blankets and bones to make tools.
• A source of food for the Tongva and other mammals. • Fish ate aquatic insects and helped maintain balance in their populations in the ecosystem.	• A source of food for the Tongva and other mammals. • Require water and plants to survive.
• A source of food for people, mammals and large birds. • Lizards ate insects and help keep a balance in the ecosystem.	• A source of food for people, mammals, birds, and fish. • Tongva used hulls for dying and half shells for games.
• A food source. • Maintained populations of insects, mice, and other rodents.	• A source of vitamin C and food for Tongva. • Buds were eaten, blossoms were made into a tea that relieved stomach aches.

BACKGROUND

Water cycles through our city much differently today than it did in the past. In the past rain water that fell within the Los Angeles River watershed supplied most of the water for the region. Then there was far less cement covering the L.A. basin and water could percolate into the soil and replenish underground aquifers. In addition, the Los Angeles River was a naturally shallow river and zig-zagged across the basin bringing rain water to large areas where it would collect and form marshes. Some of this water would evaporate but most of it supported lush marsh ecosystem full of insects, plants, birds and fish. Some of this water also naturally absorbed into the ground and helped replenish the underground water table.

Today, over 75% of our city is paved with non-permeable surfaces so instead of absorbing into the ground and replenishing our underground water supplies, rain water runs off our city streets into storm drains that lead to the Los Angeles River and ocean. Where water used to slow down and collect, we have build roads, homes, businesses, schools, etc. In order to prevent devastating floods, we have designed storm drains that funnel rain water from our streets to the L.A. River. The L.A. River has also been paved with cement, deepened, and straightened, in order to get rain water out of the city as fast as possible. In the River water can reach speeds of up to 35 miles per hour and depths of 25 feet during a rain storm. So instead of collecting and absorbing into the ground most of the rain water that falls in the L.A. basin is being flushed into the L.A. River and out to the ocean.

Pollutants like oil and brake dust from our cars, pesticides from our lawns, plastic bags and trash littering our streets are also washed off our streets during a rain storm. These pollutants end up polluting the Los Angeles River and ocean. These pollutants are known as non-point source pollution because they often can not be traced back to their source. Today, non-point pollution has become the number one pollutant of our rivers and oceans.

Today we depend on other resources and watershed to supply the water we use on a daily basis.

PROCEDURE

1. Create large cards (8”x10” is ideal) for each of the following. You may choose to turn this into a activity and have students draw or search for images through magazines or on the computer.

PARKS OR LAWNS
PLANTS AND TREES
SOIL
UNDERGROUND WATER SUPPLY

PAVED ROADS
STORM GUTTER
STORM DRAIN
LOS ANGELES RIVER

MONO LAKE
OWENS VALLEY
LOS ANGELES AQUEDUCT
HOMES
SEWER SYSTEM

Tillman Water Treatment Facility
Los Angeles River

2. Place 2 small containers in the front of the room and label "Home" and "Ocean"

3. Hand out cards to students randomly and give each student with a card an empty cup. These cards contain different steps along three paths of water takes within the Los Angeles River watershed:

> **Path 1**: Rain water on our streets or pavement. NOTE: 75% of land within our watershed is paved with non-permeable surfaces.
>
> **Path 2**: Rain water on parks and open green space. NOTE: 8% of the water we use is pumped from ground water resources.
>
> **Path 3**: Imported water we use in our homes. NOTE: 80% of the water we use comes from other watersheds.

4. Assign non-point source pollutants to 5 students without cards and define each pollutant and where it is found to the whole class. Use the key below as your guide. Instruct students are responsible for inserting these into the activity at the appropriate place.
5. Work with the remaining students to recreate the path of natural and imported water through our watershed. Start the activity by

CONFETTI = LITTER. This represents the plastic bags, bottles, food wrappers, cigarette butts, etc. that collect on our streets.

COFFEE BEANS = PET WASTE people don't pick up when walking their dogs.

GREEN FOOD COLORING = PESTICIDES used on plants and lawns. Please explain that while most of it is absorbed and cleaned by the soil some of it runs off onto the side walk before it can absorb and ends up in our waterways.

ORANGE FOOD COLORING = OILS from our cars that build up on our city streets.

PAPRIKA = COPPER DUST we release onto the road every time we step on the brake.

BLUE FOOD COLORING = CLEANERS and detergents that may get hosed off driveways and into storm drains.

stating that it's raining or you are doing the dishes then pour water into one of the students cups. Be sure to start with the student holding the first card from one of the paths. Use chart below as a key and go through one path at a time. Have that student stand at the front of the room. Please be sure to follow the water amounts noted below.

> **PATH 1**: **pour ¼ cup**
> **Parks/Open green space > Soil > Plants and trees > Undergound watersupply**
>
> **PATH 2: pour ¾ cup**
> **Paved roads and streets > trash, pet waste, oils, copper, > storm gutter > storm drain system > L.A. River > ocean**
>
> **PATH 3: pour full cup**
> **Mono Lake > Owens Valley > L.A. Aqueduct > Homes > Sewer system > treatment plant > L.A. River > ocean**

6. What happens to water next? Out of the remaining students select one to identify the student holding the card that shows where water goes next. You may want to have students holding cards standing along the sides of the room so their cards are easier to see. Encourage them to work with their peers to determine the next step. When they have identified it have the student holding that card stand at the front next to the first student so they begin to create a visual path of water for all the students. Have the first student pour their water into the next students cup. Continue until you get to the end of the path.

7. When you reach the last student have them work with the class to determine whether they pour their water into the Home bucket or the Ocean bucket.

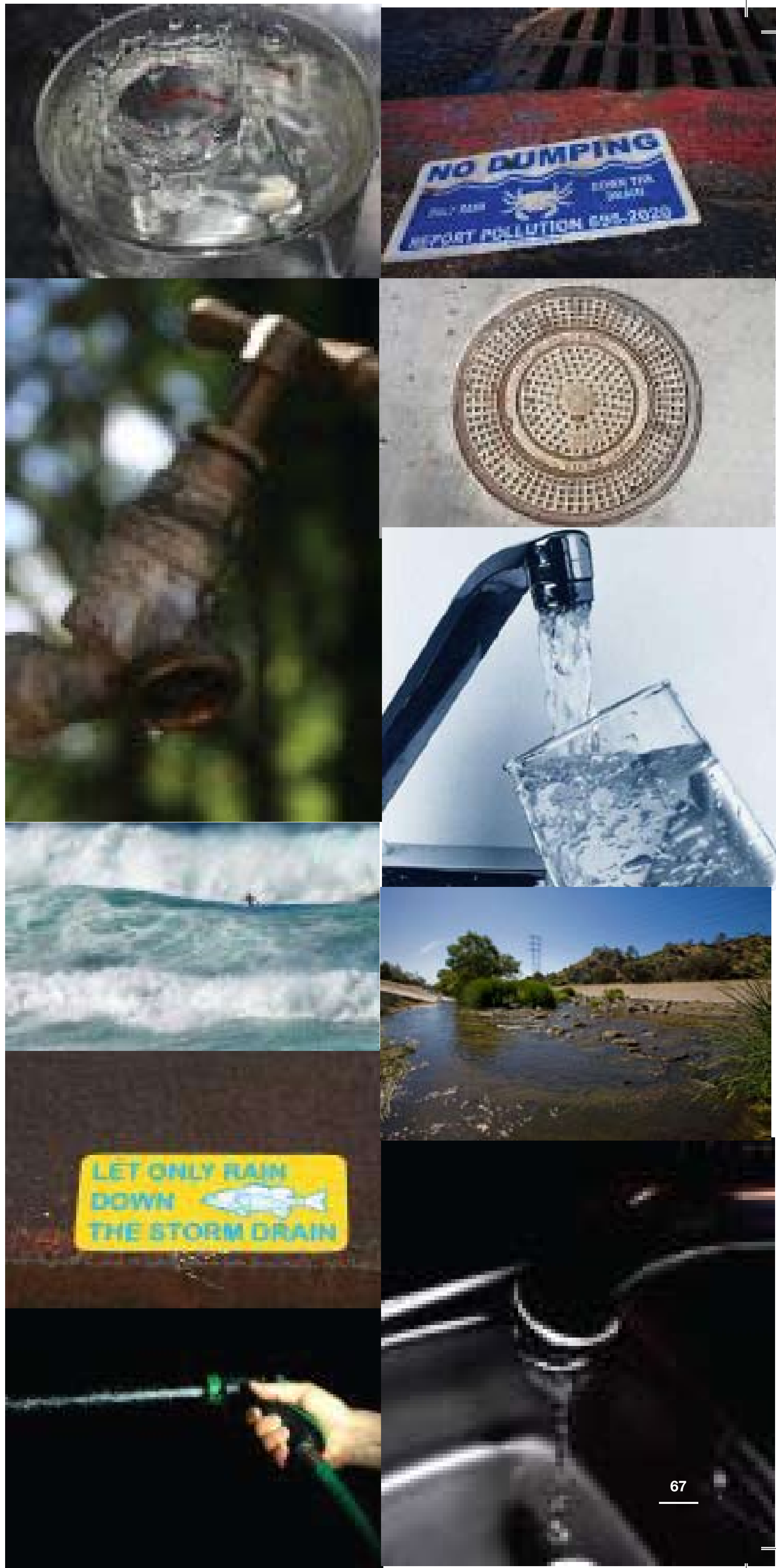
8. At the end of the activity students will be able to see the difference between the water that ends up in our underground water supply compared to the amount of natural and imported water that ends up in our oceans.

9. **QUESTIONS FOR DISCUSSION:**

Is this a sustainable way to manage our water resources? Why or why not?

If we continue to depend on imported water supplies what are things we can do to conserve the water we are buying?

What are some ways we can collect and reuse more natural rain water in the Los Angeles River Watershed?



BACKGROUND:

Once the main source of water for the region, the Los Angeles River has since been paved with concrete and designed to alleviate floods and move rain water out of the city as fast as possible. As a result it has virtually disappeared from public consciousness. As populations increased and developed they also grew to depend upon on other water resources to support a growing demand for water. Water is not an unlimited resource and today many of our communities must work hard to conserve water in order to stretch our current supplies. There are multiple community benefits that can result in revitalizing the Los Angeles River. Restoring wetland habitats that retain water is one of them and can help communities increase underground water supplies. The goal of this lesson is to introduce students to local water issues and work to promote a holistic vision of River revitalization for the future.

OBJECTIVE:

- Promote greater awareness of how water is used in our communities and demonstrate the need for water conservation.
- Introduce students to how water is managed in their communities.
- Illustrate the various demands for water by individuals and communities.
- Document and track individual daily and weekly water usage.

STANDARDS CORRELATION: 3, D, C, 9A, B, C,

K Earth sciences 3a,c
Grade 1 Life sciences 2 b,e
Grade 2 Earth sciences 3c,e
Grade 3 Physical sciences 1f
Grade 4 Earth sciences 5c
Grade 5 Physical sciences 1g, Earth sciences 3a-e
Grade 6 Resources 6b
Grades 9-12 California geology 9c

PROCEDURE:

1. For one week have students chart their individual and household uses of water using the table below. Have students chart their weekly water use on a graph.

X axis = water use
Y axis = amounts in gallons.

2. Review the sections Health of the Los Angels River Watershed and Water Supply in Los Angeles in Chapter 3 and introduce students to the cycles of water in our community (rain water and purchased water) Emphasize that we depend on outside sources for 88% of the water we use yet once it is used and treated it is released into the L.A. River and from there, the ocean. Ask students if this is a sustainable way to manage water.

3. Have students work in teams to research and brainstorm 10 ways they can conserve water as individuals in their homes. You may have them research at the following sites:

Water Saving Tips, The Metropolitan Water District's Be Water Wise Program **http://www.bewaterwise.com/tips.html**
The Los Angeles Department of Water and Power's 14-gallon Challenge **http://www.ladwp.com/ladwp/cms/ladwp008588.pdf**

4. Follow up with an in-class presentation through the Metropolitan Water District of Southern California Education Program. **http://www.mwdh2o.com/mwdh2o/pages/education/sc_teacher/teach03_17.html**

EXTENSIONS

1. School water audit and conservation campaign. Have students research and document direct and indirect ways water is used on campus and then brainstorm ways your school can work toward conserving water (i.e. fixing leaky faucets, installing low flow toilets, building a cistern to capture rain water to use to water grounds, sweep instead of using a hose. Create a series of posters that educate your school community about water and tips they can follow at school and at home.

2. Additional elementary, middle, and high school lessons and resources are also available through the Metropolitan Water District of Southern California at **http://www.mwdh2o.com/mwdh2o/pages/education/sc_teacher/teach03_01.html**

Table adapted from *Project WET Curriculum & Activity Guide.* 1995 The Watercourse/Project WET and the Council for Environmental Education.Pgs. 271-278.www.projectwet.org

TABLE 1. DIRECT USES OF WATER — INDIRECT USES OF WATER

DIRECT USE	APPROX. AMOUNT	INDIRECT USE	APPROX. AMOUNT
Drinking water	1 cup = 1/16 gal.	Pair of jeans made from cotton	1,800 gal. of water is used to wash textiles and in the dying process.
Flushing toilet	1.6 gal.	2 lb. loaf of bread	1000 gal.
Brushing teeth with water running	1 gal.	1 lb.of hamburger	4000 gal.of water is used in cooking and cleaning equipment and facility.
Dish washing Water running w/ sink stopper	30 gal. divided by # of people in household 10 gal. divided by # of people in household	12 oz. can of soda	16.5 gal. of water is used to sanitize equipment and in production of the beverage
Load of laundry	40 gal. divided by # of people in household	Ton of finished steel used to make a car	32,000 gal.
Shower and bath	2.5 gal. per minute when water is running.	40 sheets of non-recycled paper [recycled paper uses 60,000 gal. less water]	100 gallons
Watering the lawn (with hose)	100 gal. per use		
Washing the car	40 gal. per use		

SPECIES HERONS

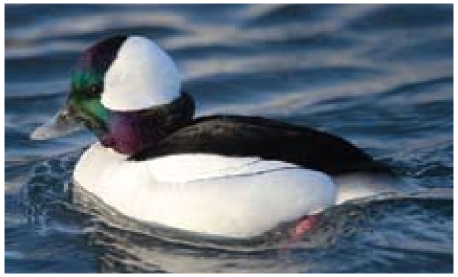
Great Egret

Great Blue Heron

Green Heron

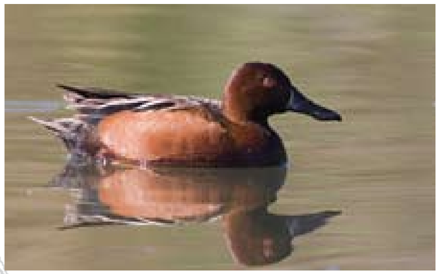
SPECIES DUCKS

Mallard male (left), female (right)

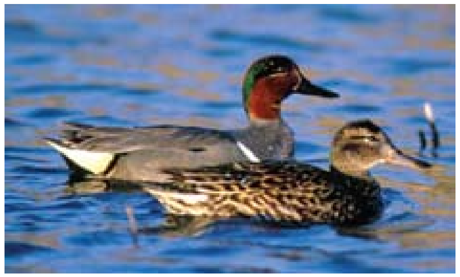


Bufflehead male

Bufflehead female



Cinnamon Teal



Green-winged Teal
male (left), female (right)

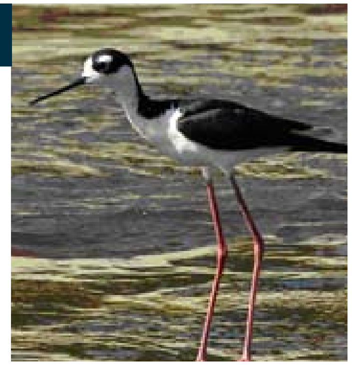
Muscovy male (left), female (right)

SPECIES SANDPIPERS

Greater Yellowlegs

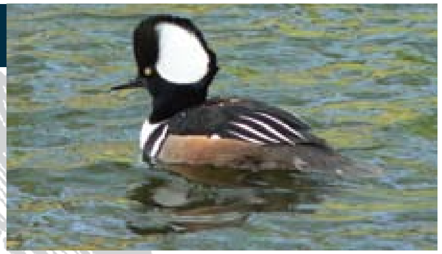
Long-billed curlew
Photo by Alan D. Wilson, www.naturespics.

SPECIES STILTS



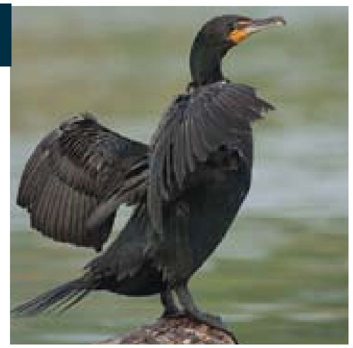
Black-necked stilt

SPECIES MERGANSER



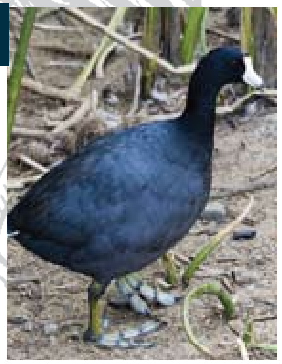
Hooded merganser

SPECIES CORMORANT



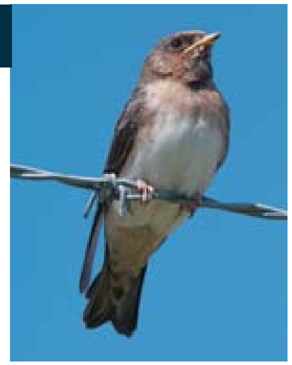
Double breasted cormorant

SPECIES COOTS



American Coot

SPECIES SWALLOW



Cliff Swallow

SPECIES HAWKS

Red-tail Hawk

Osprey

SPECIES PIGEON

Rock dove

BIRD SURVEY DATA SHEET

Name: ______________________________

School: ______________________________

Date: ____________ Location: ____________

Cloud cover: ◯ clear ◯ scattered ◯ overcast

Observations:

Species: Herons **Count** ________

- Great Blue Heron ______________________
- Green Heron ______________________
- Great Egret ______________________

Species: Ducks **Count** ________

- Mallard ______________________
- Green-winged Teal ______________________
- Cinnamon Teal ______________________
- Bufflehead ______________________

Species: Sandpiper **Count** ________

- Greater yellowlegs ______________________
- Long-billed curlew ______________________

Species: Stilt **Count** ________

- Black-necked stilt ______________________

Species: Merganser **Count** ________

- Hooded merganser ______________________

Species: Coot **Count** ________

- American Coot ______________________

Species: Dove **Count** ________

- Rock Dove ______________________

Species: Sparrow **Count** ________

- Song Sparrow ______________________

Species: Hawks **Count** ________

- Red-tailed hawk ______________________
- Osprey (fish hawk) ______________________

Total # of birds observed = ________

Total # of species observed = ________

Five minute observation

Type of bird: ______________________

Feet: ◯ webbed ◯ clawed Beak: ◯ flat ◯ pointed

Sketch

FIELD LAB 2 NATIVE AND INVASIVE PLANTS OF THE LOS ANGELES RIVER

This activity is meant to pique students interest in the rich diversity of the riparian community in the Los Angeles River. You will learn to recognize both native and invasive plant species.

A number of native trees and shrubs create the green ribbon we associate with the River. These common or native species have evolved in the bioregion and adapted to the area. They also provide valuable habitat for birds, insects, lizards and other plants and animals. These include:

Arroyo Willow
California Sycamore
Freemont Cottonwood
Black Walnut
Alder
Elderberry
Mulefat
Mugwort

Invasive species are now recognized as a major threat to the biological integrity of our remaining native habitat. Riparian ecosystems are especially vulnerable, as river habitats are rapidly disappearing and severely impacted in Southern California. Most of the sensitive species are dependent on the ribbons of vegetation associated with available water. Many exotic species do not provide for the habitat requirements of sensitive species; hence the sensitive species become further compromised.

IDENTIFICATION GUIDE

Prepared by Ellen Mackey and Barbara Eisenstein for the Friends of the Los Angeles River with funding from the Los Angeles Regional Water Quality Control Board and the Los Angeles Turf Club. May 2002

We have chosen five species of invasive exotic plants to identify and sample. These include:

Castor bean
Tree-of-Heaven
Arundo
Fan Palm

We hope this introduction to riparian plants will spark your interest and that you will continue to research and visit the Los Angeles River.

CALIFORNIA SCIENCE CONTENT STANDARDS

Kindergarten Physical Sciences 2c,
Investigation and experimentation 4d,e
Grade 1 Life sciences 2a-3,
Investigation and experimentation 4e
Grade 2 Earth sciences 3e,
Investigation and experimentation 4c,g
Grade 3 Life sciences 3b,d
Investigation and experimentation 5c
Grade 4 Life sciences 3a,b
Investigation and experimentation 6f
Grade 5 Investigation and experimentation 6a,g
Grade 6 Ecology 5c,e Investigation and experimentation 7b
Grade 7 Investigation and experimentation 7a

NATIVE PLANTS SPECIES

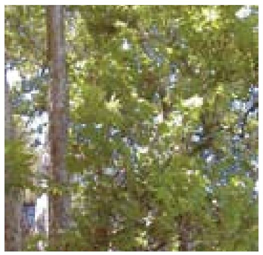
Coastal Live Oak, *Quercus agrifolia*

California Live Oaks are an evergreen live oak with dark green, oval


leaves often convex in shape. Coast Live Oak is the only California native oak that actually thrives in the coastal environment, although it is rare on the immediate shore; it enjoys the mild winter and summer climate afforded by ocean proximity, and it is somewhat tolerant of aerosol-borne sea salt. The coastal fog supplies further buffering from the rainless California summer heat. Normally the tree is found on well drained soils of coastal hills and plains, often near year round or perennial streams. The name Quercus agrifolia literally means “sharp-leaved oak.”

California Sycamore, *Platanus racemosa*

The California Sycamore is a deciduous tree that stands up to 80’


tall. Its leaves are arranged in an alternate phyllotaxy. Small hairs on the underside of the leaf help capture evaporating water. The smooth top side of the leaf keeps moisture from evaporating back into the atmosphere.

Freemont Cottonwood, *Populus fremontii.* A riparian zone tree.


Arroyo Willow, *Salix lasiolepis*


There are over 300 species of willow trees. The Arroyo willow is native to western and southwestern North America and is deciduous large shrub or tree measuring 60’ tall. Its leaves are simple, lanceolate to olanceolate and pale on the underside. It has an alternate phyllotaxy. It was used for basket making by Native Americans and contains salicin which is used in asprin.

Black Walnut, *Juglans californica*


Black Walnuts are deciduous shrubs and trees that stand up to 30’ tall. Their leaves are an odd-pinnatedly compound and their phyllotaxy is an alternate leaf with a leaflet opposite to alternate. Its nut has been used in cooking for flavor and for dying.

White Alder, *Alnus rhombifolia*

White alder is a fast growing deciduous tree that can reach up to 70’ tall and is native to western North America. It is also monoecious and with male flowers appearing on twig ends and female cones appearing further back. Its leaves are alternate, simple oval serrate leaves. The seeds are small compressed winged nuts and it has smooth gray bark.

Elderberry, *Sambucus mexicana*

Elderberry is a large deciduous shrub that can stand 20’ tall. Its

leaves are odd-pinnately compound with 3-9 serrate leaflets. It has an opposity phyllotaxy with hollow, spongy stems. It produces lacy white flower clusters in spring followed by clusters of black or blue berries which have been used by Native Americans for its medicinal properties.

Mule fat, *Baccharis salicifolia*

Mule fat is a tall herb or shrub that stands up to 12’tall with simple, lanceolate (long and wider in the middle), entire-toothed leaves and an alternate phyllotaxy. Whitish flowers appear on tips of branches and have a musty odor. It is commonly found near creek beds.

Mugwort. *ArtemisiaVulgaris*

While native to many parts of Europe, Asia, and North Africa, Mugwort is also found in North America where it is considered an invasive weed. It is a very common plant growing on nitrogenous soils, like weedy and uncultivated areas, such as waste places and roadsides. It stands up to 6’ tall with a red-purplish stem.
The leaves are dark green, pinnate, with dense white hairs on the underside.

Cattails, *Typha latifolia*

Cattails are wetland plants that stand up to 20' tall. The plant's root systems help prevent erosion, and the plants themselves are often home to many insects, birds and amphibians. Many of its parts are edible by humans and considered a nutritious, energy rich food source high in starch. Hairs from the cattail have been used in nest building by birds and in moccasins and papoose boards by Native Americans.

INVASIVE PLANT SPECIES

Castor Bean

Despite its name, the seeds on this plant are not a true bean. The seed coat is also highly poisonous and ingesting as few as 1 seed can kill a human. The seed itself is the source of castor oil which has various medicinal and cultural uses. The glossy leaves are 15–45 cm long, long-stalked, alternate and palmate with 5–12 deep lobes with coarsely toothed segments. Their colour varies from dark green, sometimes with a reddish tinge, to dark reddish purple or bronze. the male flowers are yellowish-green with prominent creamy stamens and are carried in ovoid spikes up to 15 cm long; the female flowers, borne at the tips of the spikes, have prominent red stigmas). [3]

Brickell, Christopher (ed) The Royal Horticultural Society A-Z Encyclopedia of Garden Plants (1996) pp884–5, Dorling Kindersley, London, ISBN 0 7513 0303 8

Tree of Heaven *(Ailanthus altissima)*

The tree was first brought from China to the United States in 1784. It is a fast growing, deciduous tree that has become an invasive species due to its ability to quickly colonize disturbed areas and suppress other plants with chemicals that inhibits growth of other plant species. Its root system can spread up to 50 feet from the parent tree. It has an alternate leaf phyllotaxy with odd-pinnately compound leaves. The Tree of Heaven is considered a noxious weed in several countries. This tree also re-sprouts vigorously when cut, making its eradication difficult and time consuming.

Arundo *(Arundo donax)*

Arundo donax was introduced from the Mediterranean to California in the 1820s and it has become naturalized throughout warm coastal freshwaters of North America, and its range continues to spread. It uses large amounts of water from its wet habitat to supply the rapid rate of growth, up to 5 cm per day in spring. It is capable of growing in dense stands, which may crowd out other plants and prevent their recruitment. It is among the fastest growing terrestrial plants in the world (nearly 10 cm/ day). To present knowledge Arundo does not provide any food sources or nesting habitats for wildlife. This results in resources provided by the crowded-out native plants not being replaced by the Arundo. For example, it damages California's riparian ecosystems by out competing native species, such as willows, for water. A. donax stems and leaves contain a variety of harmful chemicals, including silica and various alkaloids, which protect it from most insect herbivores and deter wildlife from feeding on it. A waterside plant community dominated by A. donax may also have reduced canopy shading of the in-stream habitat, which may result in increased water temperatures. This may lead to decreased oxygen concentrations and lower diversity of aquatic animals.

Mexican Fan Palm, *Washingtonia robusta*

While the fan palms are native to the desserts of the southwestern United States it is considered an invasive plant by the California Invasive Plant Council because they invade wetland areas and crowd out many native species.

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www.nps.gov/plants/alien/fact/ardol.htm

www.calepa.org

geogweb.berkeley.edu/GeoImages/QTVR/Berkeley/EucalyptusWrinkleL.html

www.calflora.org
http://en.wikipedia.org/wiki/Arundo_donax

California Invasive Plant Council
http://www.cal-ipc.org/landscaping/dpp/plantpage.php?region=socal&type=Palms

PLANT SURVEY

Name: ______________________________

School: ______________________________

River location: ______________________________

OBSERVATIONS:

Native Plants:

	#	Edge type	Vein type	Composition	Phyllotaxy
White Alder					
California Sycamore					
Freemont Cottonwood					
Black Walnut					
Arroyo Willow					
Elderberry					
Mule Fat					
Mugwort					
Cattail					

Invasive/exotic Plants:

	#	Edge type	Vein type	Composition	Phyllotaxy
Tree-of-heaven					
Arrundo donax					
Mexican Fan Palm					
Castor bean					

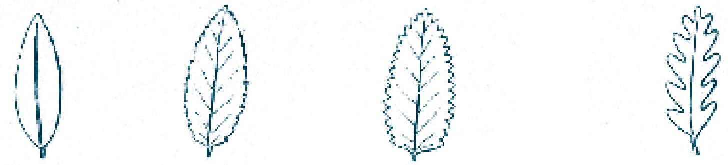
Total # of plants observed ______________________________

Total # of native plants observed ______________________________

Total # of invasive/exotic plants observed ______________________________

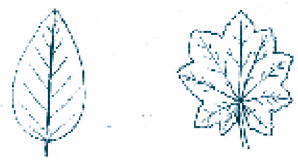
LEAF PROFILE

Leaf Edges



Entire-smooth   Serrate   Dentate or toothed   Scalloped or lobbed

Leaf Veins



Pinnate   Palmate   Parallel

Leaf Composition

Simple   Compound

Leaf Phyllotaxy

Alternate   Opposite

Leaf sketch

One method for measuring the health of the River is to monitor the types of macro-invertebrates that live there. Macro-invertebrates are small insect larvae and organisms that lack an internal skeleton and are large enough to be seen by the naked eye. These organisms spend all or most of their life in water and can indicate the health of a water body. A variety of environmental stressors impact macro-invertebrate populations .

• **Water temperatures**. Removal of trees along the banks of the River along with changes in water velocity alter water temperature and some organisms depend on certain temperatures to regulate life cycles.

• **Levels of dissolved oxygen**. Urban run-off such as oils, fertilizers, pet waste, etc. can induce the growth of algae and bacteria that consume oxygen within river environments.

• **Sedimentation**. An increase in sediment due to run off from construction sites or poorly protected farmland can add sediment to the water. These sediments get caught and build up in rocky areas of the water body and can smother habitat used by macro-invertebrates.

Some macro-invertebrates are sensitive to changes in a river body brought about these environmental stressors. As a result, their presence can indicate a healthy environment. Other macro-invertebrates are tolerant of altered water conditions and can live in stagnant or polluted water bodies as well as in areas with good to fair water quality.

EQUIPMENT

• Kick net • Rubber gloves • Field magnifying glass
Shallow container • Eye dropper • Identification chart
• Waders gloves

SAFETY RULES

1. NEVER go to the River during or after a rain event. Water can reach up to 35 mile velocities and the River is UNSAFE. You must wait 24 hours after rain ends before visiting the River to do a survey.
2. ADULT SUPERVISION is required for this activity.
3. PARTNERS are required for this activity. Do not conduct survey alone always go with another student.

INSTRUCTIONS

In the Classroom:

1. Go over different types of macro-invertebrates.
2. Go safety rules and assign teams.

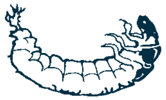
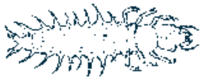
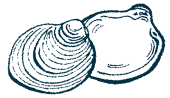
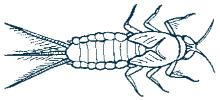
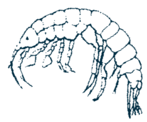
On the River

1. Find two areas of the River where the water is shallow (1-2 feet) and slow moving. Areas with a rocky bottom and overhanging vegetation are optimal habitat. Your first sample site should be down stream and the second upstream.

Resources
Insects of the Los Angeles Basin. Charles L. Hogue. Natural History Museum of Los Angeles County. 1974

MACRO INVERTEBRATE DATA SHEET

NAME: ______________________________ **DATE:** __________

SENSITIVE (group 1 taxa): macro-invertebrate species		**SOMEWHAT SENSITIVE** (group 2 taxa): macro-invertebrates		**TOLERANT** (group 3 taxa): macro-invertebrates	
Caddisfly larvae		black fly larvae		snails	
Dobson fly larvae		clams		leeches	
Mayfly larvae		cranefly larvae		midge larvae	
Rifle beetle adult		damselfly nymphs		aquatic earthworms	
Stonefly nymphs		dragonfly nymphs		blackfly larvae	
Water penny larvae		scuds		water boatman	
		aquatic sowbugs			
_____ x 3 = ____ TOTAL		_____ x 2 = __________TOTAL		_____ x 1 = _______ TOTAL	

POLLUTION TOLERANCE INDEX

•Take the totals for each group and multiply them by the given point value • Add the TOTALs together to determine the river's health using the Pollution Tolerance Index using the chart on the right•

___________ **TOTAL SENSITIVE +**

___________ **TOTAL SOMEWHAT SENSITIVE+**

___________ **TOTAL TOLERANT**

___________ **= RIVER HEALTH**

POLLUTION TOLERANCE INDEX	
> 23	EXCELLENT
17-22	GOOD
11 – 16	FAIR
< 10	POOR

INTRODUCTION:

We are a culture immortalized by plastic. Average Americans consume 63 pounds of plastic each year. Multiply that by 300 million U.S. citizens and you get a picture of how much plastic we produce. Industry estimates of plastic production are more than 120 billion pounds annually in the U.S. alone. Only 3.5% of these plastics are recycled in any way. Much of this plastic enters the Pacific Ocean from our rivers, streams and beaches. On the eastern edge of the North Pacific Gyre, 1000 miles off the California coast, broken, degraded pieces of plastic outweigh surface zooplankton by a ratio of 6 to 1. That only represents what floats.

Roughly half of all plastics produced are negatively buoyant. They sink. Photodegradation, exposure to heat and UV light, doesn't work on plastics that have sunk or are buried in rivers, lakes wetlands or the ocean. There is a tremendous amount of plastic in our coastal sediments. There's also plenty of positively buoyant plastic sitting on our beaches and coastline waiting to be carried out to sea if it doesn't get collected.

One important way to change our culture of consumption is to monitor our trash and bring the issue to the attention of the public and politicians. Many environmental scientists working privately or for government agencies monitor the land and sea for debris and other pollutants. This data is used to regulate the sources of those pollutants. In this activity you will be able to collect real data which can be used to begin local change.

CALIFORNIA SCIENCE STANDARD:

3rd Grade, Life Sciences (3d) When the environment changes, some plants and animals survive and reproduce; others die or move to new locations.
4th Grade, Life Sciences (3b) In any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.
5th Grade, Earth Sciences (3a,b,c,d,e)
Water on Earth moves between the oceans and land through the processes of evaporation and condensation.

OBJECTIVES:

1. Students will understand that collecting data is an important component of scientific research.
2. Students will recognize that human behavior impacts natural spaces.
3. Students will recognize that collecting data in the same location at different times will yield information that cannot be gathered by a single sample.

MATERIALS:

- One five-gallon bucket
- 2 metal scoops
- 1 colander with 1mm sieve
- 1 loop of rope with a 4-meter circumference
- Box or bag to hold sample

PROCEDURE:

1. In student groups of 3-4 students, gather all materials and travel to beach.

2. Select a beach sand collection site at the high tide debris deposit line, also known as the “wrack-line”. Make a detailed map of the site with the exact location identified. This is just in case you come back later for more data.

3.Take the 4-meter rope grid and stretch the loop to make a perfect square 1m x 1m over the high tide wrack-line. Use pencils or sticks as stakes to hold down the corners.

4. Remove big pieces of natural debris, like seaweed, leaves and wood. Brush them off and throw them away. We don’t need them in this study.

5. Measure the 10-liter mark, or halfway point, on the large plastic bucket. Mark this point with a line around the bucket using a permanent marker.

6. Using the small shovel, scoop an inch of the surface of the grid into the 5-gallon bucket. Scrape the surface EVENLY! Do not dig a hole in the sand. We are measuring the quantity of plastic over a square meter of area. This is the total amount of sand that you will collect.

7. Use the colander to sieve the 10 liters of sand in the bucket.

8. Transfer the contents of the colander to the collection bag or box.

3

6

7

8

9. Fill out the label below and place it with the sample.

SYNTHETIC SEDIMENT SAMPLE
Detailed Location of sample collection site
Date:
Collected by:

10. Sort the sample back in your classroom. Empty the bag of plastic debris into a pan and sort items into the seven categories listed on the data sheet titled "Data Sheet: Sorting for Size Class and Type of Plastic."

10

11. Prepare a final report. Include a bar graph of your data.

ANSWER THE QUESTIONS BELOW.

1. How does your research build on information already known about plastic debris in the marine environment or the watershed?

2. How is your data similar or different from other student groups?

3. Do you think it would be better to combine all of the data from the entire class?   Why do you think this?
4. What are the most common types of plastic in your sample?

5. Create a public awareness campaign to reduce the kind of pollution you collected.

DATA SHEET

SORTING BY TYPE OF PLASTIC

Type of Plastic Debris	#	Description
Pellets Pre-production plastic pellets, also known as "nurdles."		
Fragment Pieces of hard plastic debris that is unrecognizable.		
Film Flat and flexible plastic debris, such as pieces of bags or wrappers.		
Foam Expanded polystyrene used for insulation or packaging,		
Filament Fishing line, rope, synthetic cloth.		
Cigarette butts		
Other Glass, rubber, metal or tar		
Date:		
Collected by:		

WE ARE A CULTURE IMMORTALIZED BY PLASTIC. AVERAGE AMERICANS CONSUME 63 POUNDS OF PLASTIC EACH YEAR. MULTIPLY THAT BY 300 MILLION U.S. CITIZENS AND YOU GET A PICTURE OF HOW MUCH PLASTIC WE PRODUCE. INDUSTRY ESTIMATES OF PLASTIC PRODUCTION ARE MORE THAN 120 BILLION POUNDS ANNUALLY IN THE U.S. ALONE. ONLY 3.5% OF THESE PLASTICS ARE RECYCLED IN ANY WAY. MUCH OF THIS PLASTIC ENTERS THE PACIFIC OCEAN FROM OUR RIVERS, STREAMS AND BEACHES.

OBJECTIVE:

The goal of this activity is to introduce and engage students in the science of protecting water resources using the Los Angeles River as a classroom. In this field lab students learn how to gather baseline data on water temperature, pH, transparency, dissolved oxygen, conductivity, alkalinity, and nitrates and determine water quality conditions in the Los Angeles River based on their findings. These labs are designed as lessons that follow up an in class presentation and guided River tour led by FoLAR staff. To schedule a presentation or tour please call 323.223.0585.

CALIFORNIA SCIENCE STANDARDS:

Chemistry
Atomic and Molecular Structure: 1b
Chemical bonds: 2a,b,f
Conservation of Matter and Stoichiometry: 3a,e
Gases and their properties: 4b,c,h
Acids and Bases: 5a,d,g
Solutions: 6a,b,c,d,f
Chemical thermodynamics: 7a,b,c
Reaction rates: 8b
Chemical equilibrium: 9a
Organic chemistry and biochemistry: 10b
Investigation and Experimentation: 1b,c,d,k,l,m

MATERIALS:

- Water testing supplies
- FoLAR facilitator (optional)
- FoLAR's La Gran Limpieza Los Angeles River Clean Up

RIVER SAFETY

Personal safety is our utmost concern. Please follow these guidelines to ensure you and your students have safe field lab.

- Do not do to the River to conduct testing during or right after rain when water levels are high. During rain, water can reach speeds of up to 35 miles and hour and the River becomes a very dangerous place no one should be in.
- Always work in pairs and never go off alone.
- Wear sturdy, close-toed shoes and long pants to protect your body from brush and other sharp debris you may encounter.
- Avoid loose gravel and green algae on the River bank it is VERY SLIPPERY.
- Avoid getting water in your mouth, eyes, or open wounds. If you do flush with clean water.

Safety with Chemicals

- Wear gloves and goggles.
- Read all instructions and follow them carefully.
- Store chemicals in a safe place.
- Collect and dispose all used chemicals responsibly. Do not dump them down the drain or in the River! Please take them to a hazardous waste drop off site in your city. For LA County call 1(888)CLEAN LA or visit http://dpw.lacounty.gov/epd/hhw/collection.cfm for collection dates and locations.

ADDITIONAL RESOURCES:

- To share your results with others or to purchase water testing kits please visit the World Water Quality Monitoring Day website at http://www.worldwatermonitoringday.org/index.html
- Generation Earth Campus Water Audit. http://dpw.lacounty.gov/prg/generationearth/doc/lessonPlanBuilder_11thGradeChemistry.doc

WATER TEMPERATURE

Water temperature measures the amount of heat absorbed by the water. Measurements in Celsius are generally used and general water quality standards for lakes and rivers suggest that water should be above 17.8 C. Water temperature affects the amount of oxygen that can be dissolved. Fish and other aquatic organisms need dissolved oxygen to breath. The colder the water, the more oxygen can stay dissolved. Temperature also influences the rate of photosynthesis of plants and algae. When temperatures are high, algae blooms and can cut down oxygen levels in the water. Lastly, many aquatic organisms become the temperature of the water around them and it influences their metabolic rate. Different animals can adapt to a wide range of temperatures. However, once established, most aquatic animals adapt to a certain temperature range. Therefore, it is important to note any major changes in temperature over time.

EQUIPMENT

- Thermometer attached to a string
- Stopwatch or watch with second hand

PROCEDURE

Conduct three tests at two sites—one upstream and one down stream and note any changes in temperature. Have students work in groups of 2-3, one data recorder, spotter, and tester.

1. Secure the thermometer string around your wrist so you cannot drop it into the River.

2. Note the temperature on the thermometer before you begin and confer it is comparable to the current air temperature.

3. Immerse the thermometer to a depth of 10 cm in the water. Make sure the thermometer is not touching the bottom of the stream/river/lake.

4. Hold the thermometer in the water for at least 3 minutes using a timer.

5. Record the temperature on the datasheet.

6. Have two other students repeat and record steps 1-6.

7. Calculate the average temperature of the three recordings. If necessary, convert temperature from degrees Fahrenheit to degrees Celsius for the final recording. C=(F – 32.0) / 1.80

WATER pH

Water pH measures the H+ (hydrogen) ions and OH- (hydroxyl ions in a liquid and determines if a liquid is acidic (like lemons) or basic (like soap). Pure, deionized water contains an equal number of H+ and OH- ions and has a neutral value of 7 on a pH scale of 0-14, being neither acidic nor basic. Every whole number change on the scale represents a 10 – time change in pH. A pH range from 6.5 and 8.5 is tolerable for most fish. A slightly acidic water (6.5) is better than slightly basic (> 8.5). Less than 4.5 or greater than 9.6 is the limit for most adaptable fish species. Mosquitoes, however, have been seen to live at 3.3. Changes in pH are very important to note because most species have adapted to live within a certain range. Acid rain (sulfur and nitrogen oxides in smog combine with water in the air to form acids and fall in rain) or chemical spills can change the pH drastically.

EQUIPMENT

- pH tester
- deionized water
- paper towel
- 7.0 pH buffer
- 1 small beaker
- Waste water collection bottle (1-2 empty
- 1-gallon containers for sample water)
- Alternative: pH test strips, and sampling containers

PROCEDURE

1. CALIBRATION

a. Remove the cap on the tester, and rinse electrode with deionized water. Blot any drops of water off with a clean paper towel. Never touch the electrode.

b. Press the CAL button.
c. Immerse the electrode in 7.0 pH buffer. Stir gently, and wait for the reading to stabilize at or near 7.0.

Press the HOLD/CON button. The pH tester is now calibrated. Leave it on.

2. MEASUREMENT

a. Fill the small beaker with a water sample.
b. Rinse the electrode in deionized water.
c. Immerse the electrode in the beaker of sample water, and read and record the measurement on the data sheet.
d. Dispose sample water into empty 1-gal container and rinse beaker with deionized water. Pour rinse water into disposal container as well and dispose of properly.

See instructions.

e. Have two other students repeat step 2 a-d.
f. Average the results.

3. ALTERNATIVE METHOD

a. Dip pH paper strip in the beaker of sample water.
b. Match the paper strip color with a pH chart.
c. Record data.
d. Dispose sample water into empty 1-gal container and rinse beaker with deionized water. Pour rinse water into disposal container as well and dispose of properly.

See instructions.

e. Have two other students repeat step 3 a-d.
f. Average results and record.

TRANSPARENCY

Transparency measures the clearness or murkiness of a waterbody.

Turbidity is a measure of the solid particles suspended in the water and causing murkiness by deflecting light. When the water is too turbid, the light cannot reach the lower depths. When this happens, the growth of plants, which depends on photosynthesis, stops. Because plants emit oxygen as a byproduct, this lowers the dissolved oxygen available for fish. Then, algae grows mainly on the surface, further increasing the darkness below. Most natural waters have a transparency ranging from 1 meter to a few meters. A transparency less than 1 meter affects the quality of life.

EQUIPMENT

- **Turbidity tube**
- **Pail or scoop**

PROCEDURE

1. Note the cloud cover on your data sheet.

2. Collect a large amount of water in a pail or other container. Make sure that you collect flowing water, and do not disturb the sediment (dirt, sand, algae) on the bottom of the river bed during collection. Do not include algae mats floating on the surface.

3. One person should pour water into the tube, while another frequently looks down from the top through the water column. Rotate the tube while looking down at the image, and stop adding water when you can no longer detect the black and white pattern on the bottom of the tube.

4. Record the depth at which you can no longer see the bottom of the tube. If you have filled the tube and can still see the bottom, record as > total depth of the tube.

5. You may empty water back into River and have two students repeat steps 1-4. Record and average your findings.

DISSOLVED OXYGEN

Oxygen gas, about 10% of our air, dissolves in water. Its molecules (O2) intersperse with water (H2O), at an approximate rate of 1 to 10 molecules of oxygen per every million molecules of water. The measure of dissolved oxygen is the most important indicator of water quality that we have. Warm water cannot hold as much oxygen as cool water. If water is overheated by the sun or industrial effluents, dissolved oxygen levels may be low. If water is muddy or cloudy, less unlight will reach aquatic plants, and they will in turn produce less oxygen. Bacteriaalso use oxygen as they break down dead plants and animals. As run-off from land or sewage effluents carry excess nutrients into the water, algae nourished by the nutrients may explode into a bloom. As a result, huge amounts of oxygen are taken from the water. When dissolved oxygen levels fall below 5 milligrams per liter (mg/l) fish and other marine organisms are stressed and some cannot survive. Fist and water animals breathe oxygen in the water just as we do in the air. Fish will suffocate without enough dissolved oxygen.

The range of dissolved oxygen depends on many variables:

- Temperature: warmer water contains less dissolved oxygen.
- Stream flow: still waters contain less dissolved oxygen.
- Number of aquatic plants: photosynthesis produces oxygen.
- Turbidity: high turbidity decreases dissolved oxygen.
- Amount of decaying organic matter (bacteria consume oxygen).
- Air pressure.

At 0 degrees Celsius, freezing water can contain 14.6 milligrams of oxygen per liter. Water at 47 degrees Celsius, may contain only 5.7 milligrams per liter of water. The Los Angeles River water at 76 degrees Fahrenheit (24.4 degrees Celsius) would be 100% saturated at 8.4 milligrams per liter of water.

EQUIPMENT

- Water sampling bottle (60ml)
- Titration tube, marked at 20 ml, with titration cap
- Direct reading titration syringe
- Manganous Sulfate Solution
- Alkaline Potassium Iodide Azide
- Sulfuric acid 1:1
- Sodium Thiosulfate 1.025 N
- Starch indicator solution
- Gloves
- Eye protection
- Empty waste water collection bottle

PROCEDURE

A. Collecting the water sample

1. Rinse the water sampling bottle and cap in River water. Place the cap bac on the bottle, and submerge the bottle and cap. Uncap the bottle underwater, and allow the bottle to fill. Tap the sides of the bottle to get rid of air bubbles, and place the cap back on while still holding everything underwater.
2. Examine the bottle to make certain there are no air bubbles. If you see air bubbles, empty the bottle and repeat step 1!

B. Add the Reagents

1. Uncap the bottle and immediately add 8 drops of Manganous Sulfate Solution.
2. Immediately add 8 drops of Alkaline Potassium Iodide Azide.
3. Cap the bottle, and mix by inverting several times. A precipitate will form. Let the precipitate settle below the shoulder of the bottle.
4. Carefully add 8 drops of sulfuric acid 1:1.
5. Cap the bottle and invert several times, until the precipitate has completely re-dissolved. The dissolved oxygen in the sample is now fixed.

C.Titration

1. Pour 20ml of the fixed sample into the glass titration tube.

2. Fill the titration syringe with Sodium Thiosulfate:

- **i.** Depress the plunger completely
- **ii.** Insert the titration syringe in the hole on the top of the sodium thiosulfate bottle.
- **iii.** Turn the whole thing upside down and carefully draw back the plunger on the syringe. Watch for air bubbles in the syringe, and if you get any pump the solution out and fill the syringe again. Cotinue until the bottom of the plunger is at the 0 mark.
- **iv.** Turn the bottle upright and carefully remove the syringe.

D. Test Procedure

1. If the sample is pale yellow, skip to step 4. If the sample is dark yellow, go to step 2.

2. Slowly depress the plunger on the titration syringe, while gently swirling the sample tube. Stop when the sample turns yellow.

3. Carefully remove the cap and syringe, and set them aside, being careful not to depress the plunger.

4. Add 8 drops of Starch Indicator Solution. The sample should turn blue.

5. If you completed steps 2-3, carefully replace the cap and titration syringe. If you skipped from step 1 to step 4, carefully insert the titration syringe into the cap of the sample bottle. Be careful not to depress the syringe.

6. Continue, or begin, depressing the plunger in the titration syringe slowly, swirling the sample tube after each drop. Stop immediately when the sample turns from blue to clear. If you depress the plunger completely and this has not happened, note the total volume of the syringe for adding to the total and refill the syringe completely. Then continue adding solution slowly, until the sample turns clear.

7. Carefully read the smount of sodium Thiosulfate solution you added, by seeing where the bottom of the plunger is. Each minor division on the syringe equals 0.2ppm.

8. Record on the data sheet the milligrams of oxygen per liter.

9. Dispose waste water in waste water container.

10. Two other students repeat steps 1-5.

CONDUCTIVITY

Conductivity is the ability of a material to pass an electrical current. Dissolved salts increase water's ability to conduct electricity. Pure water does not conduct electricity very well; a high conductivity level indicates impurities and dissolved solids, such as salts in the water. Mountain snow may have a conductivity as low as 5-30 microSiements/cm. Water with impurity above 1000 parts per million (ppm) is considered to be too high.

EQUIPMENT

- **TDS Tester 20**
- **2 small beakers**
- **Empty waste water collection bottle.**

PROCEDURE

1. Fill the two beakers with water samples.

2. Remove the cap of the tester. Rinse the electrode with deionized water.

3. Press the ON/OFF button, and let the tester show zero.

4. Immerse the electrode in the first water sample, swirl gently.

5. Immerse the electrode in the second water sample and swirl gently. Read and record the measurement on your data sheet.

6. Have two other students repeat steps 1-5. Average the results.

7. Dispose waste water in waste water container.

ALKALINITY

Alkalinity is the measure of water's ability to absorb acids without raising pH. The greater the quantity of dissolved calcium carbonate or limestone, the greater is the ability to absorb acids. When the alkalinity falls below 100 milligrams of Calcium Carbonate per liter of water, there is too little alkalinity to consume the acids that may fall in rainwater.

EQUIPMENT

- **Titration tube, marked at 5ml, with titration cap**
- **Direct reading titration syringe**
- **BCG-MR indictor tablets**
- **Alkalinity titration reagent B**
- **Empty waste water collection bottle**

PROCEDURE

1. Fill the titration tube to the 5ml line with sample water.

2. Add one BCG-MR Indicator tablet. Remove the tablet by shaking one tablet into the indicator tablet bottle cap.

3. Cap and mix the titration bottle until the tablet dissolves completely. The solution will be blue.

4. Depress the plunger of the titration syringe. Put the tip of the titration syringe into the opening in the bottle of Alkalinity Titration Reagent B. Invert the bottle and syringe, then fill the syringe by pulling back the plunger slowly, making sure there are no air bubbles in the syringe. If you get air bubbles, pump the solution out and start again. Fill completely until the bottom of the plunger reaches zero.

5. Insert the titration syringe into the hole on the cap of the titration tube. Slowly depress the plunger, swirling the titration tube so that each drop mixes completely before adding the titration tube. Slowly depress the plunger, swirling the titration tube so that each drop mixes completely before adding the next one. Stop when the solution changes completely to pink. If the plunger empties before the solution turns pink, note the total volune of the plunger (220ppm) to add the final results and repeat 4-5.

6. Read the results from the bottom of the plunger in the titration syringe and record on your data sheet.

7. Have two other students repeat steps 1-5. Average the results.

8. Dispose waste water into waste water container.

NITRATES

Nitrogen is an element that makes up approximately 80% of our air. Plants use nitrogen for their growth, so nitrates are a vital part of fertilizer. High quantities of nitrates stimulate algae to grow, creating an increase of turbidity, lowered dissolved oxygen, and many other problems. Good water quality will be water with less than 0.30 ug/g of total nitrogen in it. Safe drinking water might have less than 10mg/L of nitrate. The Los Angeles River water is often high in nitrates because much of it comes through the Tillman Water Reclamation Plant.

EQUIPMENT

- **5 ml plastic test tube with cap**
- **Stopwatch**
- **Octa-side viewer with nitrate nitrogen color standard**
- **Nitrate #1 tablet**
- **Nitrate #2 tablet**
- **Empty waste water collection bottle**

PROCEDURE

1. Fill the test tube to the 5 ml line with the water sample.

2. Add one Nitrate #1 tablet. Cap the tube and mix gently until the tablet fully disintegrates.

3. Add one Nitrate #2 tablet. Cap the tube and mix genty until the tablet fully dissolves.

4. Wait 5 minutes.

5. Insert the test tube into the Octa-slide viewer, and match the sample color to the color standard.

6. Record ppm Nitrate Nitrogen on the data sheet.

7. Have two students repeat steps 1-6.

8. Dispose of waste water in empty waste water bottle.

WATER QUALITY DATA SHEET

NAME: ____

DATE: ____

SCHOOL: ____

RIVER WATCH LOCATION: ____________________________

A. Water Temperature

#1: ____ Celsius #2 ____ Celsius #3 ____ Celsius

Average: ____ Celsius

B. Water pH

Method: ____ meter ____ test strip

#1: ____ Celsius #2 ____ Celsius #3 ____ Celsius

Average:____ Celsius

C. Transparency

Cloud cover: ____ clear ____ scattered ____ overcast

Method:____ meter ____ test strip

#1: ____ Celsius #2 ____ Celsius #3 ____ Celsius

Average: ____ Celsius

D. Dissolved Oxygen

#1: ____ Celsius #2____ Celsius #3 __________ Celsius

Average: ____ Celsius

E. Conductiity

Conductivity standard ______________MicroSiemens/cm.

#1: ____ Celsius #2 ____ Celsius #3 ____ Celsius

Average: ____ Celsius

F. Alkalinity

Kit manufacturer and model: _________________________________

#1: _____________________ mg/L as CaCO3

#2: _____________________ mg/L as CaCO3

#3: _____________________ mg/L as CaCO3

Average: ________________ mg/L as CaCO3

G. Nitrates

Kit manufacturer and model: _________________________________

#1: ___________ mg/L NO3 – N + NO2 __________ mg/L NO2-N

#2: ___________ mg/L NO3 – N + NO2 __________ mg/L NO2-N

#3: ___________ mg/L NO3 – N + NO2 __________ mg/L NO2-N

Average: ______ mg/L NO3 – N + NO2 __________ mg/L NO2-N

1 mg/L (milligram per liter) = 1 ppm (part per million)

WATER QUALITY INDEXES

TURBIDITY

In NTU	Q value
0	97
10	76
20	62
30	53
40	45
50	39
60	34
70	28
80	25
90	22
100	17
>100	5

PH

pH	Q value
<2.0	0
2	2
3	4
4	8
5	24
6	55
7	90
8	85
9	50
10	22
11	7
12	2
>12	0

NITRATES

Nitrate-Nmg /LNO3 -N	Q value
.00	98
.25	95
.50	90
.75	80
1	73
1.5	63
2	53
3	44
5	36
10	15
15	6
20	2

DISSOLVED OXYGEN

Percent saturation	Q value
0	0
10	8
20	13
30	20
40	30
50	43
60	56
70	77
80	88
90	95
100	100
110	95
120	90
130	85
140	78

WATER QUALITY INDEX DATA

Measure + Q value	Measure + Q value
Turbidity ________ + ______________	Nitrates ________ + ______________
Ph ________ + ______________	Dissolved Oxygen ________ + ______________

100 75 50 25 0

+ ⟵⟶ **-**

Sum = ______________ /4

Average Q value = ______________

Water Quality ____

____

____

____

BACKGROUND

The vision for a park system along the Los Angeles River dates back to the 1930s report created by the Olmsted Brothers and Bartholomew Associates, entitled Parks, Playgrounds and Beaches. Their report warned that urban growth was occurring at the expense of public parkland, which had placed Los Angeles well short of the national park per capita ratio. They recommended the city adopt a systematic park program that would create a greenway along the Los Angeles River. Such a plan would not only create public park space but it would also preserve the River's natural flood plains. However, after the flood of 1938, their plan was replaced by the U.S. Army Corps of Engineers plan to pave and straighten the Los Angeles River and its tributaries with concrete.

In 1986 three local citizens founded the Friends of the Los Angeles River based on Olmstead-Bartholomew's vision of a Los Angeles River greenway and began holding River clean ups and public programs to promote public awareness. During this time, FoLAR also play a lead role in activating local environmental and community associations in engaging in land use issues within their own back yards. Working with local and state government agencies, the coalition was able to stop the construction of 2 large scale commercial properties along the L.A.River. They then continued to work with these agencies to build two state parks—The Los Angeles State Historic Park in downtown Los Angeles, and El Rio State Park in Elysian Valley. It was not until 1996 that the Los Angeles River Master Plan was published by Los Angeles County and then in 2007 City of Los Angeles published River Revitalization Master Plan which includes a network of parks, pedestrian, bike and equestrian trails, natural areas and community spaces all along the Los Angeles River and its tributaries.

OBJECTIVE:

The goal of this activity is to introduce students to public and urban space and engage them to think critically about land use and its impact on the environment.

CALIFORNIA SCIENCE STANDARDS

Kindergarten Earth sciences 3a, Investigation and experimentation 4e

Grade 1 Investigation and experimentation 4a

Grade 2 Investigation and experimentation 4g

Grade 5 Earth sciences 3d,e

Grades 9-12 California geology 9c Investigation and experimentation 1m

PROCEDURE:

1. Divide students into groups of 4-6 and explain each group represents a community along the Los Angeles River. Hand out an 8x10 board or sheet of paper per member and explain each board/ sheet represents 1 block of property along the Los Angeles River. Explain to students they get to decide how this land will be used. **NOTE:** Student groups could represent actual areas along the River within their own neighborhoods or they could represent different cities along the entire River. Use the L.A. River Watershed map as a guide.

2. Assign roles to team members from the chart below and have students individually select 1-2 land use options from **CHART C.** Students will represent citizens that either work or live in that community. They may also come up with their own design options.

3. Then have the team work together to present, debate, and select as a group 4-6 land use options to incorporate into their final design. First have students present two design idea to the group. Have team members present possible “cons” to this form of development on their property and then have presenter give the “pros” to this form of development. Continue until all members have presented.

4. Then as a group have team members vote and select one land use per member. Have them create living spaces in the extra space they may have. Questions to consider:

- **a.** Do they have enough land or do they need to negotiate a partnership with another team member?

- **b.** Do they have a balanced community that meets the needs of its members? Are there redundancies? What is missing? Would they like to live in their community? Why? How does your land use impact wildlife? The river and its habitat? Our oceans?

5. Then have students start designing. This can be done simply and quickly with colored markers or you could extend the activity and add colored paper, magazines clippings, and game pieces as materials.

6. Using blue ribbon or yarn lay out the Los Angeles River along the center of the classroom. Have students set up their communities along the River.

7. As a class go through communities to identify and discuss projects that promote, mitigate, or potentially threaten one or all of the following:

Non-point pollution • Wildlife habitat • Air quality • Rain water capture • Public recreational space

CHART A: COMMUNITY MEMBER ROLES

This is only a partial list. Students can also choose to play themselves or family members or can brainstorm other roles.

Urban farmer
Parks and Recreation ranger
Commercial Developer
Local small business owner
Parent of 4 children under the age of 16
Pet owner

CHART B: DESIGN PROS/CONS

Design Pros: Creats benefits to environment and local community (partial list)

- Increased green space or natural wetland habitat
- Improves natural water capture and retention
- Improved public spaces
- Improves air quality
- Provides jobs to community members
- Provides affordable housing to community
- Provides community with basic needs/services

Design Cons: Produces negative impacts for the natural environment and local community (partial list)

- Impermeable surfaces prevent rain water from reaching underground aquifers and increases urban run off or debris that can pollute local waterways (have students identify pollutants).
- Fencing the prevents access to the River.
- Produces post consumer waste products that are costly for the environment.

CHART C: LAND USE OPTIONS

Community Garden or farm
School
Factory
Golf course
Park-soccer, baseball, basketball
Construction site
Restored wetlands
Shopping malls
Bridges
Bike paths
Affordable housing/apartments
Grocery stores
Small community business
Homes
Gas stations
Fast Food Restaurants

NOTE: acreage is not to size
1 city block = approx. 1 acre

BACKGROUND

Almost every day, hundreds of millions of gallons of water make its way down the Los Angeles River when it is not even raining! Growths in population and urban development have led to the paving of the L.A. River and creation of the storm drain system to prevent flooding. However, now our Los Angeles River watershed not only drains water into the River but everything else on land. Not only does storm water flow off our streets into the Los Angeles River but so do tons of non-point pollutants such as plastics, Styrofoam, paper food wrappers, cigarette butts, pet waste, and chemicals. Today, non-point source pollution has become the number one pollutant of our waterways. Ultimately this type of pollution affects the plants and animals that inhabit and depend on the River and ocean for food, water, and shelter but also humans who recreate along the banks of the River or on the beaches in Long Beach.

CALIFORNIA STATE STANDARDS

K Physical Science 1a, Investigation and experimentation 4b
Grade 1 Investigation and experimentation 4b, e
Grade 2 Investigation and experimentation 4c
Grade 3 Life sciences 3c
Grade 5 Life sciences 6g, Investigation and experimentation 6a,c
Grade 6 Investigation and experimentation 7e

OBJECTIVE:

This lesson is designed to follow up your class visit to a River or beach clean up and emphasizes the need to reduce waste at its source. Students will:

1. Investigate the waste produced in your classroom or school.
2. Understand the impacts these products have on our environment.
3. Create posters that educate others about non-point source pollution and its impact on our rivers and ocean.
4. Start an educational campaign in your classroom or school and

PROCEDURE

1. Using gloves, conduct a clean up and trash sort with your students back at your school. This can be done in the classroom, on campus or cafeteria.
2. Have students identify, sort, list and count the trash they collect. You may have them chart their findings on a graph.
3. Then using the lifespan chart below have students chart the life span of the trash they found on a separate graph. Explain that this is how long these materials remain in our environment (either in our waterways or landfills). Have them imagine what our land, rivers or oceans might look like 10, 20, 30 years from now if we don't reduce the amount of these products in our environment. Emphasize the need for communities to reduce the amount of waste they produce, use re-useable containers and products, and recycle as much as possible.

THE LIFESPAN OF LITTER

MATERIALS	YEARS
Plastics	450 Years
Aluminum Can	200 – 500 Years
Plastic water bottle	70 Years
Rubber Boot Sole	50 – 80 Years
Steel Cans	50 Years
Leather	Up To 50 Years
Nylon fabric/rope	30 – 40 Years
Painted Wooden Stake	13 Years
Disposable Diapers	10 – 20 Years
Chewing gum	5 Years
Wool or cotton clothing	1-5 Years
Cigarette Butt	1-5 Years
Rope	3 – 14 Months
Cotton Rag	1-5 Months
Newspaper	2-6 Weeks
Orange Peel/Banana Peel	2-5 Weeks
Piece of Paper	2-4 Weeks
Candy Wrapper	1-3 Months
Polystyrene	undetermined over 500 Years
Rubber gloves	undetermined
Glass	undetermined
Rubber tires	undetermined

4. Then have students research and then sort trash into groups of biodegradable or compostable, recyclable and non-recyclables to determine how much of what you found makes its way to the landfills.

5. Ask students if they were aware of the following:

- The California Department of Transportation, Division of Maintenance spends a total of approximately 41 million dollars on litter removal.
- The California Department of Transportation, Division of Maintenance spends a total of approximately 41 million dollars on litter removal.
- Only about 20% of ocean pollution comes from activities at sea. Activities on land contribute most of the remaining 80%.
- In 2006, the Los Angeles County Stormwater Public Education Program has determined that each month residents:
  - — Drop cigarette butts on the ground more than 800,000 times
  - — Drop litter on the ground or out car windows nearly 900,000 times
  - — Allow paper or trash to blow in the street more than 565,000 times
  - — Throw something into the gutter or storm drain more than 360,000 times
  - — Empty car ashtrays into the street nearly 69,000 times

6. Have students recycle (and compost if available) appropriate trash in school recycle bin(s).

7. Have students work in teams to brainstorm and create posters to put up in your classrooms or around campus that educate others about:

a. Non-point source pollution in the River and oceans.
b.The impact of these pollutants in the Los Angeles River and ocean, and
c. ways to reduce the amount of waste we produce to prevent it from reaching our rivers, oceans, and landfills.

EXTENSIONS:

1. Work with students to create a composting bin for paper and food waste (do not compost dairy or meat products). Then use compost instead of chemical pesticides to fertilize school gardens and plants.

Other Resources:

Litter Free Long Beach
http://www.litterfreelb.org/education/elementary_school.htm

State Water Resource Board's Erase the Waste Campaign
Neighborhood Action Tool Kit
http://www.waterboards.ca.gov/water_issues/programs/outreach/erase_waste/nak.shtml

THE LA RIVER IS...A BEAUTIFUL, LIMPID, LIITLE STREAM WITH WILLOWS ON ITS BANKS...SO ATTRACTIVE TO ME THAT IT AT ONCE BECAME SOMETHING ABOUT WHICH MY WHOLE SCHEME OF LIFE WAS WOVEN, I LOVED IT SO MUCH.

- WILLIAM MULHOLLAND, 1877

GLOSSARY

Aqueduct A conduit designed to bring water from a remote source, usually by gravity

Aquifer A water bearing layer found beneath the Earth's surface.

Age of Sustainability In the Age of Sustainability our civilization is discovering that in order to survive on this planet, healthy and indefinitely, we must create ways of living that give and take equally.

Bio-based Product A product (other than food or feed) that is produced from renewable agricultural (plant, animal, and marine) or forestry materials.

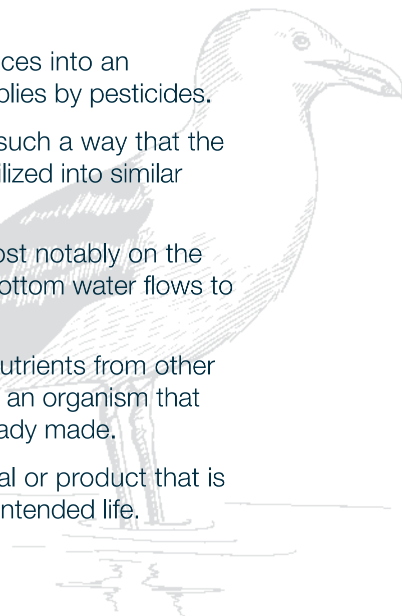
Biodegradable Capable of decomposing in nature within a reasonably short period of time.

Biodiversity The sum total of different organisms within an ecosystem.

Bioremediation Bioremediation can be defined as any process that uses microorganisms, fungi, green plants or their enzymes to clean environments altered by contaminants.

Catch Basin Any place or drain that receives run off from natural or man-made surfaces.

Channelization For rivers prone to flooding, a way to deepen one stream bed to hold greater quantities of water. On the LA River, the Army Corp of Engineers straightened and deepened the river bed then paved the bottom and sides with concrete



Chemical Pollution The introduction of toxic substances into an ecosystem, e.g., acid rain, contamination of water supplies by pesticides.

Closed-loop Recycling The process of recycling in such a way that the components of the original product are reclaimed or utilized into similar products without the process of downcycling.

Coastal Upwelling An ocean process that occurs most notably on the western coasts of continents when cold nutrient-rich bottom water flows to the surface along the continental coastlines.

Consumers A consumer is an organism that obtain nutrients from other organisms. This is also a heterotroph. A heterotroph is an organism that cannot synthesize their own food and must obtian it ready made.

"Cradle-to-cradle" A term used to describe a material or product that is recycled into a new or similar product at the end of its intended life.

"Cradle-to-grave" A term used to describe a material or product that is disposed (landfill, incineration, etc.) of at the end of its intended life.

Deciduous Trees that drop their leaves annually

Decomposers A decomposer is an organism of decay. These are also called saprobes. They break down the remains of dead animals and plants, releasing the substances that can be used by other members of the ecosystem.

DDT A common pesticide first used to combat insects in WWII, then banned around the world during the early 1970's. DDT has been linked to breast cancer and development problems in newborn infants. In the marine environment DDT is absorbed by pelagic plastics, creating a vector for pollution in the food chain when plastics are ingested.

Diversity The variety of different species in a community

Ecological Footprint The resulting impacts on the environment based on the choices we make (i.e. raw materials selection, energy selection, transportation, etc.).

Ecological Pollution Stresses ordinarily created by natural processes, like extreme tides that pour saltwater into habitats ordinarily protected from sea water, and abnormal increase in sediments in runoff water producing silt. Also, altering the level or concentration of biological or physical components of an ecosystem, like invasive species that inhabit a new ecosystem.

Ecosystem The interaction of organisms from the natural community with one another and their environment to sustain one another.

Emergent Vegetation rooted at the bottom of and rising above the surface f a body of water.

Environmental Protection Agency (EPA) An independent executive agency of the federal government, established in 1970, responsible for the formulation and enforcement of regulations governing the release of pollutants, to protect public health and the environment.

Exotic Refers to a foreign plant or animal that has been introduced into a new area.

Extinct A plant or animal no longer existing as a living species- occurs when the last living individual of a species dies.
Exterpated- Extinct in a specific area or region but still found in other regions.

Fauna Animals (as opposed to plants or fauna)

Flood Control Channe Open waterway that is designed to carry large amounts of rain water. These structures are often lined with concrete to help control flood waters.

Floodplain The low lying land along a river or stream that is inundated regularly when water levels are high.

Flora Plants (as opposed to animals or fauna)

Gabrielinos Name given to the local indigenous people living in the LA River basin by the Spanish ; makes reference to the Indians of the San Gabriel Mission.

Groundwater Water that is stored in open spaces underground and within sediment.

Gutter a channel for draining off water at the edge of a street

Habitat Natural environment of an organism where it finds the food, water, shelter, and space it needs to live.

Hydrology The scientific study of the properties, distribution and effects of water in the atmosphere, on the Earth's surface and in soil and rocks.
Indicator Species- plant or animal species used to indicate the general condition of a habitat

Introduced species A non-native species; species that are introduced have been known to eradicate native species, discrupting the local ecosystem

Invasive Species Non-native plants and animal species that have been introduced to an area where they do not occur naturally.

Invertebrates Animals without backbones.

Lake A large inland body of water.

Larva An immature animal before it metamorphosises into its adult form.

Levee An embankment along the shore of a river, built for protection against floods.

Marsh Anon wooded, well drained wetland.

Macroinvertebrate Bugs (insects).

Marine Debris Any trash, natural or man-made, that is found in the marine environment.

Migration The seasonal movement of entire populations of species from one location to another.

Native Species Plants and animal species that have evolved in a specific area over a period of time; naturally occurring species; indigenous.

Niche The special role in a community of a particular species of plant or animal.

Nonpoint Source Pollution Nonpoint source pollution is contaminated runoff originating from an indefinite or undefined place, often a variety of places (e.g., farms, city streets and parking lots, yards and landscaping, construction sites, and logging operations).

Nonrenewable energy Sources of energy that cannot be replaced in a reasonable period of time. Fossil fuels (coal, petroleum, natural gas) are examples of nonrenewable energy sources.

One-hundred year flood A flood of such magnitude that is likely to occue only once a century. A flood of this magnitude affected LA in 1938 an caused the LA River to be paved.

Organic Pollution Oversupplying an ecosystem with nutrients, e.g., fertilizer inflow.

Outfal Opening at the end of a storm drain system that allows water to flow into a channel, lake, river, bay or ocean.

Perennial A plant that usually lives for several years

Phytoplankton Microscopic marine algae that are the primary producers in the marine food web.

Plankton A general term for the entire community of microscopic free-floating organisms, including phytoplankton, zooplankton, and a host of other marine organisms. Plankton serves as the primary food source for most marine ecosystems. Many animals feed entirely on planktonic organisms and are important stops in the food chain.

Point source pollution Point source pollution originates from a specific place such as an oil refinery or a paper mill.

Pollution Any substance, biological or chemical, in which identified excess is known to be harmful to desirable organisms (both plants and animals). Some pollutants are toxic or poisonous. Others are dangerous because they stick to feathers (oil and tar) making it impossible for birds to fly or find food, or clog throats and stomachs, and entangle necks (plastic bags and plastic 6-pack rings) of marine creatures.

Pollutant Human by-product that is harmful to the ecosystem
Pond- a body of still water smaller than a lake

Post-consumer Recycled Content Material that has been recovered after its intended use a consumer product. Examples include reclaimed carpet tiles (for new tile backing).

Post-industrial Recycled Content Material that has been recovered from the manufacturing waste stream before it has served its intended purpose. Example: Nylon 6,6 extrusion waste.

Precipitation The fall of condensed moisture as rain, snow, hail or sleet.

Producers Producers are organisms, like green plants, that produce organic compounds from inorganic compounds. These are also a type of autotroph. An autotroph is an organism that makes its own food from inorganic substances. Then green plants, for example, are are eaten by consumers in this case, grazing animals like the zebra.

Recycling The series of activities, including collection, separation, and processing, by which materials are recovered from the waste stream for use as raw materials in the manufacture of new products.

Reach The unbroken stretch of a stream or river.

Relief A three dimensional map that shows contours.

Riparian Related to rivers, can be used to describe riparian zones, or lush life by the river

Renewable Energy Energy derived from sources, which are regenerative or recurring. Examples include wind energy, hydro-, geothermal, or wave action.

Renewable Resources A resource that can be replenished at a rate equal to, or greater than its rate of depletion. Examples include corn (for PLA products), trees, soybased products, etc.

Runoff Water that flows over land surfaces and does not percolate, or sink, into the ground.

Settling pond A depression, like a lake, to hold water so that It can seep into the ground and Replenish the water table; sometimes settling ponds are used to clean water by letting the toxins and heavy metals settle to the bottom.

Soft bottomed Portions of the LA River that have channeled concrete walls, but a soil based bottom.

Storm drain Above or below ground pipes and channels that transport storm water to the ocean for flood control purposes.

Taylor Yards A railway yard near the Glendale narrows reach that is now a state park.

Thermal Pollution Varying temperatures above or below the normal condition, e.g., power plant turbine heated water.

TMDL Total maximum daily load refers to the maximum limit of trash or pollutants agreed by the regulatory agencies as acceptable.

Storm Water Runoff in the storm drain system.

Sustainability "Humanity has the ability to make development sustainable – to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs." (World Commission on Environment and Development, Brundtland Commission, "Our Common Future") "Leave the world better than you found it, take no more than you need, try not to harm life or the environment, make amends if you do." (Paul Hawken, The Ecology of Commerce, 1993, p. 139).

Tongva The name of an indigenous people that originally lived in what is now the LA Basin area.

Tributary Small creeks and rivers draining into a larger river.

Turbid A description of the degree of organic and or inorganic material suspended in a body of water. High turbidity limits sunlight penetration

Wastewater Water that comes from showers, toilets and kitchen basins, that contain high levels of bacteria that requires processing at sewage treatment facilities before being returned to the natural environment or used for irrigation.

Water Table The level below the ground where ground water is closest to the surface.

Watershed An area that is drained by rivers and streams and includes geographical structures like mountains, valleys, and man-made structures like buildings, parking lots and highways, but it also includes a rich biodiversity that is supported by the ecosystems within.

Wetland An ecological boundary between terrestrial and aquatic ecosystems where a rich biodiversity thrives, and a geographical boundary between land and water, where the ground and surrounding area is submerged all or part of the time, including swamps, bogs, and marshes.

Velocity Speed

Vertebrate Animals having a backbone.

Zanja Spanish word for ditch.

Zanja Madre Means "mother ditch" and refers to the open ditch that was built near downtown Los Angeles that provided water for agriculture ad drinking.

Zooplankton Small, free-floating marine organisms that live in the world's oceans and drift with the currents. These small creatures usually feed on phytoplankton.

WEB RESOURCES

ENVIRONMENTAL ORGANIZATIONS AND EDUCATIONAL RESOURCES

Adopt-Your Watershed
www.epa.gov/adopt/

Algalita Marine Research Foundation
www.algalita.org

Ballona Wetlands
www.ballonafriends.org/Education%20Program.htm

Cabrillo Marine Aquarium (watershed exhibition)
www.cabrilloaq.org

California State Water Boards, Erase the Waste Neighborhood Tool Kit
www.waterboards.ca.gov/water_issues/programs/outreach/erase_waste/docs/nak/english_nak.pdf

California Native Plant Society
www.cnps.org

California Regional Environmental Education Community
www.creec.org

City of Los Angeles Stormwater Program Education Page: programs, resources and video for primary and secondary educators.
www.lastormwater.org/siteorg/education/k6.htm

888Clean LA
dpw.lacounty.gov/epd/

El Dorado Nature Center
www.longbeach.gov/naturecenter/education/default.asp

Friends of the Los Angeles River
www.folar.org

Generation Earth
www.generationearth.com/

Heal the Bay
www.healthebay.org/

Long Beach Litter Abatement Program
www.litterfreelb.org/education/elementary_school.htm

Los Angeles Audubon, L.A County Bird Checklist & Bird Walks
www.losangelesaudubon.org

The Los Angeles Department of Water and Power
www.ladwp.com/ladwp/cms/ladwp002006.jsp

The Los Angeles River Revitalization Master Plan The City of Los Angeles Bureau of Engineering
www.lariver.org

The Los Angeles River Master Plan Los Angeles County Department of Public Works
www.ladpw.org/wmd/watershed/LA/LARMP/LARMP-02%20I.%20Executive%20Summary.pdf

The Los Angeles and San Gabriel Rivers Watershed Council
www.lasgrwc.org/

30-minute Beach Cleanup
www.beachcleanup.org/

The Marine Mammal Center
www.marinemammalcenter.org/learning/education/teacher_resources/resources.asp

The River Project
www.theriverproject.org/

Metropolitan Water District of Southern California
www.mwdh2o.com/mwdh2o/pages/education/education01.html

Metropolitan Water District of Southern California
Be Water Wise www.bewaterwise.com

Northeast Trees
www.northeasttrees.org/

Project Wet Curriculum
www.projectwet.org/

The Tujunga Watershed Project
www.theriverproject.org/tujunga/

Tree People: Rainwater as a Resource
www.treepeople.org/vfp.dll?OakTree~getPage~&PNPK=207

The Great Backyard Bird Count (Audubon & Cornell University)
www.birdsource.org/gbbc/

San Gabriel and Low Los Angeles River Rivers and Mountains Conservancy
www.rmc.ca.gov/

Surfrider Foundation
www.surfrider.org/

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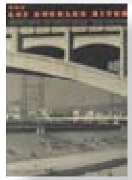

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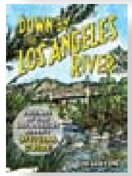

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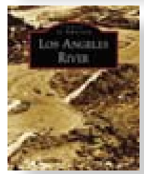

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