Water Rights

The use of water in the 5-mile zone is regulated by (1) a 1989 Reclamation memorandum that is based in part on Public Law 93-320, as amended by Public Law 96-336; (2) IBWC 242 Minute; (3) existing water contracts; and (4) all applicable Federal and State regulations. Public Law 96-336 states that no contract shall be entered into that will impair the ability of the United States to continue to deliver to Mexico, on the Colorado River downstream from Morelos Dam, approximately 140,000 acre-feet of water annually, consistent with the terms contained in IBWC 242 Minute. Therefore, any request for water use from the study area would be subject to these limitations.

Environmental Consequences

Increased pumping from the aquifer, which could occur under alternatives that allow for development or land transfers or exchanges that would use or require more water, would affect groundwater availability in the study area. Some water use could occur in the 5-mile zone, west of the study area and outside of Reclamation's jurisdiction, such as near the city of San Luis. Some elements of the alternatives could also affect groundwater quality. Following are the anticipated effects of each alternative.

Alternative A

Under Alternative A, if groundwater were used to meet the water needs of new developments, the aquifer could be lowered. However, the quantities needed should not adversely affect Reclamation=s ability to meet its water delivery obligations to Mexico unless total pumpage for the 5-mile zone approaches 160,000 acre-feet per year, the limit stipulated by IBWC 242 Minute. Moreover, if the water supply is obtained from outside the study area, groundwater within the study area should not be affected.

In the future, irrigated agriculture on the Yuma Mesa likely would continue to lead to degradation of groundwater quality in the study area.

Alternative B

The effects of Alternative B on groundwater availability would be similar to the effects under Alternative A. In addition, Alternative B would allow land transfers or exchanges to benefit natural or cultural resources. If the Hillander "C" tract were exchanged or transferred and removed from agricultural production, TDS in the groundwater would likely decrease because of decreased consumptive use.

Alternative C

Alternative C would maximize recreation, community, and commercial development within the study area. Four elements of Alternative C could significantly affect groundwater availability in the study area: (1) land uses or exchanges or transfers to benefit recreation, community, or commercial development; (2) new land use authorizations for recreation, community, or commercial development; (3) campground development, especially long-term facilities for winter visitors; and (4) day use facilities, including urban recreation such as golf courses and athletic fields, in the western portion of the study area.

Under Alternative C, land use authorizations could be issued within the study area to maximize recreation, community, and commercial development. These new developments would require additional sources of water. If groundwater were the water source, the aquifer would be drawn down, which could adversely affect Reclamation's ability to meet its water delivery obligations to Mexico. Or, if Reclamation restricted the amount of water a land use applicant could pump, the applicant could be adversely affected.

The long-term use campgrounds and other recreational facilities that could be developed under Alternative C would require significant water and sanitary services. If groundwater were the water source, the aquifer would be drawn down, which could adversely affect Reclamation=s ability to satisfy its water delivery obligations to Mexico. At a minimum, the cost of pumping groundwater would increase. The more dispersed, limited stay (14-day) campgrounds would not require as much water or as many sewer services as the long-term facilities, and meeting these needs probably would not significantly affect Reclamation=s ability to meet its water delivery obligations to Mexico.

Day use facilities proposed under Alternative C could affect groundwater quality in the western portion of the study area near San Luis. The intensive irrigation needed for facilities such as golf courses and grass athletic fields could result in elevated TDS in groundwater near the water table due to evapotranspiration of applied water and leaching of salts by water percolating through and past the root zone to the water table. Also, percolating water bearing nitrates from fertilizers may cause nitrate levels in the groundwater to rise. If Colorado River water were used instead of pumped groundwater, the water table would tend to rise, and the TDS of the groundwater might increase more slowly or possibly decrease. Nitrates would likely increase, as when pumped groundwater is used.

Other elements of Alternative C would have similar effects on groundwater availability as Alternatives A and B. Overall, the potential effects of Alternative C on groundwater quality depend on whether water for the campgrounds and facilities were obtained from the 5-mile zone groundwater and the type of wastewater treatment to be used. Pumping groundwater could cause local cones of depression in the aquifer and increase water flow from the north, where a groundwater mound currently exists. The northern groundwater has a higher TDS, which could increase the TDS of existing aquifer water. If the wastewater were treated with septic systems, the water leaching to the aquifer could contain higher TDS and nitrates. If water supplies were obtained from other sources and the wastewater were treated at existing treatment facilities, this alternative would not significantly affect groundwater.

The effect on groundwater quality of removing the Hillander "C" tract from agricultural production would be the same as under Alternative B.

Alternative D

If groundwater pumping were required to meet the water needs of the limited stay campgrounds, it would probably not significantly affect Reclamation=s ability to meet its water delivery obligations to Mexico. In general, the adverse effects of Alternative D on groundwater availability would be less than under Alternative C and greater than under Alternatives A and B and should not affect Reclamation=s ability to meet its water delivery obligations to Mexico.

The effect on groundwater quality of removing the Hillander “C” tract from agricultural production would be the same as for Alternatives B and C.

Cumulative Impacts

If the additional water for Reclamation developments were obtained from groundwater, pumping could approach 160,000 acre-feet per year, the limit stipulated by IBWC 242 Minute. If Mexico were to pump at a similar level, maximum drawdowns in the aquifer would occur. Costs of pumping would increase due to increased lift. The extent, both horizontally and vertically, of the body of high quality groundwater in / near the 5-mile zone is not well established. Given that a well or group of wells initially are pumping high quality groundwater, the likelihood that the pumped water will deteriorate in quality increases as the pumping rate is increased toward the maximum and as the period of pumping is lengthened.

However, if the Colorado River, through re-allocation or some other surface water sources, were to supply increased water needs and the excessive pumping is prevented, these effects should not occur. Irrigated agriculture on the Yuma Mesa could result in cumulative adverse effects on groundwater quality in the study area. However, infiltration from irrigation with a surface water source could increase groundwater availability and may improve TDS, depending on the source water TDS and soil salinity.

Mitigation

Careful monitoring of groundwater levels and groundwater quality will be needed to evaluate current impacts and to project or estimate future groundwater levels and quality. If projected groundwater levels or groundwater quality approach unacceptable limits, appropriate mitigation will be to find an alternate surface water supply to replace all, or at least a sufficient portion of, the pumped groundwater to prevent an unacceptable drop of groundwater levels or degradation of groundwater quality.

Residual Impacts

No residual impacts have been identified.

VEGETATION AND WILDLIFE

Affected Environment

The 5-mile zone is located within the Yuma Desert portion of the Sonoran Desert. The Sonoran Desert encompasses 119,000 square miles in southern Arizona, southeastern California, northern Baja California, and northwestern Sonora. It is the only subtropical desert in North America, and about half of its plant and animal species are tropical in origin. It is also the most complex of the four North American deserts (which includes the Chihuanhuan, Mojave, and Great Basin) and has the greatest number of plant communities.

Slow-falling winter rains from Pacific Ocean storm fronts passing through the Sonoran Desert December through March and frequent violent summer thunderstorms with heavy rainfall in localized areas are responsible for much of the biodiversity present in the Sonoran Desert (Crosswhite and Crosswhite, 1986). When winter rains are adequate, huge populations of wildflowers and other annuals bloom from February to mid-April. A number of uniquely adapted species, such as the spadefoot toad, exploit ephemeral summer rain storms.

Broad flat plains sparsely vegetated with creosote bush and white bursage characterize the Yuma Desert. To the casual observer, this landscape appears bleak and monotonous, but it is home to a wealth of desert-adapted plants and animals able to flourish in one of the harshest environments on earth. **Map V-5** shows vegetation types within the 5-mile zone. **Photograph V-1** shows typical vegetation in the study area.

The Sonoran Desert is divided into seven subdivisions, each based on the distinctive vegetation communities shaped by elevation, latitude, geology, soil, and climate (Shreve, 1951). Of these, only two occur in the United States: the Lower Colorado Valley Subdivision, which encompasses the 5-mile zone, and the Upper Arizona Subdivision, in which most of the saguaros and other conspicuous cactus species occur. The remaining five subdivisions are in Mexico.

The Lower Colorado River Valley Subdivision is the largest, hottest, and driest of the seven Sonoran Desert subdivisions. It surrounds the lower Colorado River in parts of four States. Challenging the Mojave Desert’s Death Valley as the hottest and driest place in North America, summer highs may exceed 120 °F, with surface temperatures approaching 180 °F. Annual rainfall in the driest sites averages less than 3 inches, and some areas have gone nearly 3 years without rain (Arizona-Sonora Desert Museum, 1998). The vegetation community in this subdivision reflects this extreme heat and dryness.

Vegetation

Broad, flat valleys with widely scattered, small mountain ranges of mostly barren rock are characteristic of the Lower Colorado River Valley Subdivision. The 5-mile zone within the Yuma Desert consists mostly of low sandy plains dominated primarily by creosote bush (*Larrea divaricata*) and white bursage (*Ambrosia dumosa*) (**photograph V-1)**. These are the two most drought-tolerant plants in North America; but in the driest areas of this subdivision, even they are restricted to drainages courses. Stands of creosote bush and bursage are uniform in spacing, density, and height. Vegetative cover is usually 10 percent of the land surface but can be as low as 3 percent when rainfall is less than 3.9 inches (Crosswhite and Crosswhite, 1982). The creosote bush is often spaced more regularly than the bursage because creosote bush roots contain chemical inhibitors that reduce competition by other plants. White bursage grows better on deep, sandy loams than on deep clay loams that are adequate for creosote bush.

The dominance of creosote bush and white bursage over vast areas is unusual given the wide variety of soil types and depths that usually influence plant species distributions. Shreve (1951) believed that no other shrubs had evolved biological and physiological adaptations sufficient to allow them to compete successfully with creosote bush and bursage in areas of such extremely low rainfall.

Creosote bush uses a variety of methods to harvest soil water, as well as different adaptations to reduce transpiration during periods of water stress (Crosswhite and Crosswhite, 1982). Roots extend not only into the surface layers (0 to 8 inches deep) that saturate during the rainy season, but also into intermediate and deep layers (20 to 39 inches deep) that retain some moisture during the dry season (Solbrig, 1982). This species appears to be able to use water that condenses on the underside of rocks that cool more rapidly than surrounding soil at night. The plant may also be able to take up water on leaf surfaces (Stark and Love, 1969; Strain and Chase, 1966). In addition, creosote bush can tolerate some of the lowest levels of tissue water potential among desert plants.

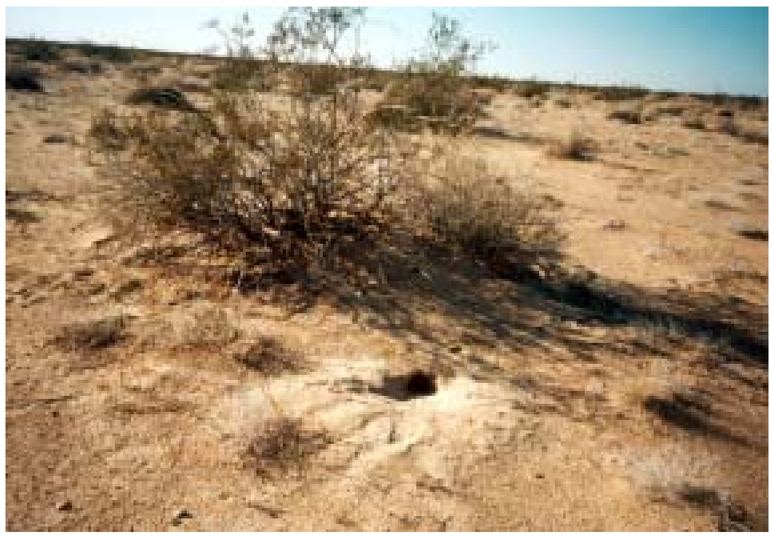
As the amount of sand in the soil increases, creosote bush becomes less common. Big galleta grass (*Hilaria rigida*) becomes more common, along with Indigo bush (*Psorothamnus schottii*) and mormon tea (*Ephedra trifurca*), branching cholla (*Opuntia ramisissima*), and ground cholla (*Opuntia wrightiana*). Species more abundant in washes, but that also occur on the open ground of the plains and lower bajadas[1] (alluvial fans), are western honey mesquite (*Prosopis glandulosa var torreyana*), blue palo verde (*Cercidium floridum*), graythorn (*Condalia lycioides*), tomatillo (*Lycium andersonii*), burrowbrush (*Hymenoclea monogyra*), and *Encelia frutescens*. Other plant species associated with the creosote bush-white bursage community include acacia (*Acacia paucipina*), fourwing saltbush (*Atriplex canescens*), and ocotillo (*Fourquieria spendens*) (MacMahon, 1992; Crosswhite and Crosswhite, 1982; and Arizona-Sonoran Desert Museum, 2003).

[1] Bajadas are gentle slopes that accumulate at the base of rocky hills. They are composed of a mix of boulders, gravel, sand, and silt. Such a complex soil structure retains water and supports a diverse vegetation community.

5-Mile Zone
Protective and Regulatory Pumping Unit
Vegetation

Plants in the Lower Colorado River Valley Subdivision are closely associated with drainage features. Runoff from the surrounding mountains and upper bajadas cross the plains and lower bajadas, covering the sandy soil with intricate patterns created by rills (MacMahon, 1992). Such areas with slightly more moisture can increase the plant diversity by permitting establishment of species with high water requirements, such as graythorn, burrowbush, or lycium (*Lycium*). When the drainage pattern is netlike (reticulate), the plants appear to be scattered over the entire surface of the land. When the pattern is branching (dendritic), the vegetation forms in linear bands and more clearly follows the drainage ways.

The level plains found in the 5-mile zone are characterized by windblown sand that settles around the bases of shrubs and grasses (**photograph V-6**). A surface layer of blue-green algae and two ground lichen species, *Lecidia* and *Acarospora*, develop on the surface of level sandy surfaces, stabilizing the sand and preventing continued wind erosion (Crosswhite and Crosswhite, 1982).



Photograph V-6.—Burrow in the soft sand deposited around a creosote bush.

In the driest Sonoran Desert communities, such as that found in the 5-mile zone, up to 90 percent of the plant species are fast growing annuals. Given adequate winter rainfall, these species rapidly exploit available moisture and open areas between the widely spaced perennial creosote bush and bursage. In the occasional wetter year, these ordinarily dull appearing sites produce more than 60 species of annuals, including desert sand verbena (*Abronia villosa*), desert sunflower (*Geraea conescens*), and numerous species of evening primroses (*Camissonia*) and cryptanthas (*Cryptantha*). Wildflower abundance directly correlates to the amount of winter moisture.

Most Sonoran Desert annual species germinate only during a narrow window in the fall and only if there is at least 1 inch of rainfall (Arizona-Sonora Desert Museum, 1998). Seedlings rapidly produce inconspicuous rosettes of leaves during the mild fall weather and remain flat against the ground, growing slowly through the winter. In spring, the plants rapidly bolt into flower.

The plains and lower bajadas of the Lower Colorado River Valley Subdivision are the harshest environments in the Sonoran Desert. Vegetation follows an elevational gradient, becoming more abundant as elevation and rainfall increases from the level, sandy plains through the lower bajadas to the upper bajadas toward the adjacent mountains. Thee coarser, rockier soils of the bajadas allow better infiltration of the precipitation, better conditions for germination, and establishment of a greater variety of cacti and other perennials (Shreve, 1951).

Wildlife

Much of the Lower Colorado River Valley Subdivision’s wildlife are small, nocturnal, camouflaged, and live below ground during the day. Most of the superbly adapted desert specialists and hardy generalists are unobserved by most people. However, this desert supports an abundant and diverse wildlife community, including foxes, coyotes, rabbits, lizards, snakes, and beetles, as well as a wide variety of diurnal lizards and ground squirrels. An understanding of the species that are found in the creosote-bursage plains of the Yuma Desert is essential to the development of a sound resource management plan that protects and enhances this habitat.

Mammals

Mammals are divided into desert specialists and generalists.

Desert Specialists.—The kit fox (*Vulpes macrotis*) prefers sandy soils where it can dig its dens in desert scrub or desert grassland. This fox dens great distances from any water and is able to obtain adequate moisture from its food. Its dens have multiple openings, and it constructs and uses multiple dens throughout the year. The kit fox feeds on kangaroo rats, round-tailed ground squirrels, pocket mice, cottontails and jack rabbits, mice of various species, insects, lizards, and birds.

Kangaroo rats (family Dipodomys) and pocket mice (family Perognathus) are very abundant in the creosote bush-white bursage flats. Usually, at least two species of each are present in any area (Hoffmeister, 1986).

Merriam’s kangaroo rat (*Dipodomys merriami*) occurs in any area where the soil can be dug and where a sufficient number of seeds can be harvested and cached. It digs its burrows deep enough to insulate itself from potentially lethal temperatures above 99 °F or below 45 °F. Around Yuma, Hoffmeister (1986) found Merriam’s kangaroo rat in gravelly soils and sandy washes. This opportunistic feeder relies on seed from grasses interspersed among creosote bush as well as spring annuals and insects. During the winter, it opens surface caches where seeds are stored. Seed caches that are not recovered appear to be important in the dispersal and establishment of various plant species, especially mesquite.

The desert kangaroo rat (*Dipodomys deserti*) inhabits loose, easily diggable sands in the bottoms of washes or the wind-drifted sands partially stabilized by creosote bush. It constructs large tunnels with wide entrances that it usually does not plug. South of Yuma, Hoffmeister (1986) found round-tailed ground squirrels and desert cottontails occupying the same burrow. While tolerant of other species, the kangaroo rat vigorously defends its burrow from other kangaroo rats.

The desert pocket mouse (*Perognathus penicillatus*) is the most abundant pocket mouse in the Sonoran Desert, preferring valley plains with sparse vegetation and loose soil. The kidneys of this species have exceedingly long renal papillae that concentrate urine, reducing water loss (Hoffmeister, 1986). This mouse is also able to burrow into hard-crusted soils by physically chewing its way through the crust. This seedeater can go into a state of topar (inactivity / hibernation) when seeds are not available (MaMahon, 1992).

The little pocket mouse (*Perognathus longimembris*) in the area south of Yuma lives in sandy soil with widely spaced creosote bushes, desert lilies, and verbena (Hoffmeister, 1986). This species is extremely abundant in certain parts of its range. For example, Hall (1946) found this species to be the most abundant mammal in some parts of Nevada; and in some places, he estimated the population to be 400 per acre. In the spring, the little pocket mouse has its peak of greatest activity from about 2 to 5 hours after sunset and another smaller peak again just before sunrise. A bright moon may curtail this activity (Hoffmeister, 1986).

The cactus mouse (*Peromyscus eremicus*) nests in burrows in very open, sparse vegetation. This desert specialist tolerates water deprivation and has a low basal metabolic rate. When deprived of water and food, it enters torpor within 12 hours at any ambient temperature below 86 °F with a significant drop in body temperature and oxygen consumption (MacMillen, 1965). The cactus mouse is rarely encountered above ground in July and August and is probably in torpor.

Fourteen subspecies of Botta's pocket gopher (*Thomomys bottae*) have been noted in Arizona (Hoffmeister, 1986). The subspecies in the Yuma area is *T.b. albatus*, which is characterized by its pale, almost white color; other subspecies range from pale to very dark. The pocket gopher lives almost its entire life below ground in burrows or tunnels that it digs to find tuberous roots, herbaceous plants, grasses, bulbs and roots of weeds, native plants, and shrubs. Burrow length corresponds to the amount of plant cover; in dense plant cover, burrows are shorter than in comparable areas of sparser vegetation. Burrow depth varies with soil conditions. In some rocky areas, burrows are less than 1 foot deep, while in sandy soil near Yuma, burrows can be 3 feet deep (Hoffmeister, 1986). Although the food habits of the desert-dwelling gopher in Arizona has not been studied, Hoffmeister speculates that food must be limiting and critical in the Sonoran desert scrub.

The round-tailed ground squirrel (*Spermophilus tereticaudus*) is common throughout the Sonoran desert in the creosote bush-saltbush habitat with sandy soils deep enough to dig extensive burrows. Burrows may be more than 3 feet deep. While midday summer temperatures can reach 156 °F on the ground's surface, temperatures in the burrows remain between 72 ° and 77 °F (Vorhies, 1945). In the Yuma Desert, this squirrel feeds on creosote bush seeds. It spends much of its life from late August through February in hibernation.

Harris' antelope squirrel (*Ammospermophilus harrisii*) occurs sympatrically (closely related species that occur in the same geographic area) through much of its range with the round-tailed ground squirrel. It is found in rockier habitats and rocky slopes. Unlike the burrow openings of the round-tailed ground squirrel, which are in open areas, Harris antelope squirrel burrows are located beneath bushes and rocks. This species is active during the day and does not hibernate. This squirrel is common in the 5-mile zone, where it lives without water most of the year (MacMahon, 1992).

Desert Generalists.—The gray fox (*Urocyon cinereoargenteus*) dens in the ground, rock piles, mine shafts, crevices in cliffs, and hollows in trees. In Arizona, the gray fox has been observed digging a burrow in the mound of a kangaroo rat with the rats still occupying part of the mound (Hoffmeister, 1986). Whilemostly nocturnal, it is often seen in early morning or at twilight. It eats small rodents, insects, fruit, and reptiles.

The coyote (*Canis latrans*) is abundant in Arizona, occupying every available habitat. It eats a great variety of plants and animals and, like the gray fox, can often be seen early in morning or in the late afternoon. The coyote is the best runner among the canids, with the ability to leap 14 feet and a normal cruising speed of 25 to 30 miles per hour with bursts to 40 miles per hour (Whitaker, 1980).

The badger (*Taxidea taxus*) in Arizona is most commonly found on the flats and alluvial fans adjacent to desert mountains and in open deserts many miles from free water. It feeds primarily on burrowing rodent species that it can readily dig out, such as ground squirrels, kangaroo rats, and pocket mice, as well as jack rabbits and cottontails (MacMahon, 1992).

The black-tailed jack rabbit (*Lepus californicus*) can be found in almost any desert habitat. During the day, it rests in forms, or shallow depressions dug by the rabbits, that are usually only a fraction of an inch deep. The rabbit moves from the forms into open places in late afternoon. If the form is in an area with insufficient forage, the rabbit may move up to 1 to 2 miles each way (Vorhies and Taylor, 1933). It consumes mostly mesquite and grasses.

The desert cottontail (*Sylvilagus audubonii*) requires brushier habitats than jack rabbits. It also avoids the midday sun and may enter burrows. The cottontail is more patchy in its distribution; but where it occurs, it is often more numerous (MacMahon, 1992).

Photograph V-7.—The California leaf-nosed bat is a year-round resident of the desert scrub feeding on night-flying beetles grasshoppers, and moths. Photograph from MacMahon (1992).

Desert Bats.—The California leaf-nosed bat (*Macrotus californicus*) is a highly adapted desert specialist (**photograph V-7**). It is the only leaf-nosed bat species from the tropical bat family *Phyllostomidae* in the Yuma Desert (Hoffmeister, 1986) and is a Federal species of concern. Its ability to hover enables it to search slowly close to the ground and pluck insects, such as caterpillars, directly from foliage. While primarily a visual hunter, it also uses a whispering echo-location call that can be heard no more than 3 feet away, which prevents most prey from anticipating its approach (Tuttle, 2000). It also feeds on large, night-flying beetles, grasshoppers, and moths, which it takes on the wing. This bat is the only one in North America known to catch caterpillars and is among the very few insect-eating bats that supplement its diets with cactus fruit (Tuttle, 2000). It is a year-round resident in southern Arizona (Hoffmeister, 1986) and roosts in warm mines and caves where temperatures are approximately 84 °F.

Nine species of *Myotis* bats occur in Arizona in the 5-mile zone. They are members of the Vespertilionid family. Arizona Myotis species are distributed by vegetation type and elevation (Hoffmeister, 1986). Only three of the nine *Myotis* species are found in the lowest elevations that encompass creosote bush; the cave Myotis (*Myotis vellifer*) is the most strongly associated with this vegetation type. The cave myotis inhabits mine shafts, tunnels, caves, and under bridges in creosote bush, palo verde, brittlebush, and cacti. While it is found in dry areas, it is never more than a few miles from some water, such as canals or rivers. The California Myotis (*Myotis californicus*) inhabits a broad range of vegetative types, including creosote bush. The Yuma Myotis (*Myotis yumanensis*), a Federal species of concern, is strongly associated with rivers, irrigation canals, and ponds and has been observed foraging along the Colorado River (Hoffmeister, 1986).

Five additional species of *Vespertilionid* bats occur in the Lower Colorado River Valley Subdivision. The Western pipistrelle (*Pipistrellus hesperus*) is a year-round resident of southern Arizona. It hunts along canyons, stream beds, and water holes but never far from rocky canyon walls, cliffs, or rocky outcrops where it roosts during the day. It is the smallest U.S. bat and is usually the first bat to appear in the evening. The Southern yellow bat (*Lasiurus ega*) in Arizona is commonly found roosting in Washington fan palms. It emerges early in the evening and feeds on insects. The big brown bat (*Eptesicus fuscus*) is a year-round resident of southern Arizona and is present in creosote bush. It forages frequently during the winter (Hoffmeister, 1986). The hoary bat (*Lasiurus cinereus*) is found throughout Arizona, but in winter only in the southernmost part of the State. The spotted bat (*Euderma maculatum*) is extremely rare and is a Federal species of concern. One was caught about 4 miles south of Yuma, and another was found 40 miles east of Yuma (Vorhies, 1935). Habitat requirements are not clearly defined as yet, but it appears that cliffs and rocks are a dominant habitat requirement (Hoffmeister, 1986).

Two species of free-tailed bats (family Molossidae) can be found in the 5-mile zone. The Brazilian free-tailed bat (*Tadarida brasiliensis*) roosts in caves, mines, buildings, bridges, and in desert scrub, traveling 50 miles in a single evening to find suitable foraging sites. This bat flies high in the sky, feeding on flocks of migratory moths (Tuttle, 2000).

The big free-tailed bat (*Tadarida macrotis*) is not abundant in Arizona but has been found in Sonoran desert scrub. A few may overwinter in southern Arizona, while most migrate south into Mexico (Hoffmeister, 1986).

Photograph V-8.—Black-throated sparrows thrive in the hottest and driest deserts without water by eating green vegetation and insects. Photograph from MacMahon (1992).

Birds

The density of breeding bird species can be quite low in deserts. Typical Sonoran Desert sites generally have fewer than 25 breeding bird species (MacMahon, 1992). In the most severe sites, such as a creosote bush flat in the Yuma Desert, there may be only a single breeding species, such as the black-throated sparrow (*Amphispiza bilineta*) (**photograph V-8**). As elevation increases and the vegetation becomes increasingly complex, the number of bird species also increases. On the lower parts of bajadas and on valley plains, there may be no birds or just one for each 3 acres of land (MacMahon, 1992).

Gambel's quail may be seen near water sources and more succulent vegetation. The greater roadrunner (*Geococcyx californianus*) may be seen in the early morning searching for lizards. The roadrunner mates for life and has a year-round territory. LeConte's thrasher (*Toxostoma lecontei*) prefers creosote bush flats with some chollas for nesting. It feeds on insects found in the litter. The crissal thrasher (*Toxostoma crissale*) prefers denser vegetation along rivers or in large washes. The mourning dove (*Zenaida macroura*) occurs in a wide variety of desert sites, including the creosote bush flats. The verdin (Auriparus flaviceps) and black-tailed gnatcatcher (*Polioptila melanura*) both nest in larger shrubs and subtrees but have been observed feeding in creosote bush, an unusual habitat for desert birds, which seem to avoid this shrub despite its abundance (MacMahon, 1992). The common raven (*Corvus corax*) and turkey vulture (*Cathartes aura*) are common carrion feeders, often seen along roads in the study area.

The burrowing owl (*Athene cunicularia*), loggerhead shrike (*Lanius ludovicianus*), and red-tailed hawk (*Buteo jamaicensis*) are also commonly seen in the study area (Federal Highway Administration, et al., 2001). Gulls and egrets forage along canals and drains in the agricultural areas adjacent to the study area.

The Bureau of Land Management's Yuma office publishes a birding checklist with 340 bird species listed. However, most of these species are found in nearby unique habitats, including the Colorado River, Algodones Dunes, Kofa National Wildlife Refuge, Imperial National Wildlife Refuge, or in Mexico.

Reptiles

Reptiles are abundant and diverse in the Sonoran Desert, occupying a wide range of habitats and niches. Lizards and snakes in the Sonoran Desert can be tree dwelling, rock dwelling, detritus dwelling, digging, sand swimming, burrowing, insectivorous, carnivorous, herbivorous, diurnal, and nocturnal (Crosswhite and Crosswhite, 1982).

***Adaptations for Extreme Heat and Aridity*.—**Desert lizards and snakes have developed a number of adaptations to regulate their body temperatures. Periods of peak activity change from midday in the spring and fall to early morning and late afternoon in the summer. For example, the common kingsnake (*Lampropeltis getulus*) and pine-gopher snake (*Pituophis melanoleucus*) normally are diurnal (active during the day) but become nocturnal (active at night) during hot weather.

Nocturnal reptiles, such as the banded gecko (*Coleonix variegatus*) and most snakes, passively exchange heat with the air and soil. In contrast, diurnal lizards absorb heat by basking in the sun. Lizards are able to maintain relatively uniform body temperatures by timing their daily activities, moving in and out of shade, changing body orientation to the sun by adjusting contact with the surface to regulate heat transfer, and by changing color (dark skin absorbs heat faster).

Additionally, some desert reptiles can tolerate high body temperatures. For example, the normal body temperature of a common inhabitant of the Yuma Desert, the desert iguana (*Dipsosaurus dorsalis*), is 114 °F. When this iguana exceeds even this high temperature, it climbs into creosote bushes to reach cooler air layers (San Diego Natural History Museum, 1999). It lives in the sandy plains with creosote bush, which provides food, shelter, and kangaroo rat burrowing sites that it uses to escape predators and extreme heat.

During periods of environmental stress, such as prolonged drought, desert reptiles spend long periods of inactivity in burrows dug by rodents or other mammals. Animals in burrows that hibernate in the winter or estivate in the summer have greatly reduced metabolic processes. They live on water and nutrients stored in the body, while wastes accumulate to potentially toxic levels in the body. For example, the western spadefoot (*Scaphiopus hammondi*) is numerous where soil conditions favor burrowing. Deep burrows provide a suitable microhabitat with moderate temperatures and humidity.

***Sand Swimming – Adaptations for Loose Windblown Sand*.—**Species in the Lower Colorado River Valley Subdivision have a number of specializations for living in loose windblown sand. Sand lizards, a group of five species that includes the fringe-toed lizard (*Uma notata*), Mojave fringe-toed lizard (*Uma scoparia*), greater earless lizard (*Cophosarus texanus*), lesser earless lizard (*Holbrookia maculata*), and zebra-tailed lizard (*Callisaurus draconoides*) are superbly adapted for swimming and breathing in loose sand (MacMahon, 1992). Sand swimming is a strategy used to avoid capture or to avoid extreme temperatures by rapidly burrowing into the sand within 2 to 2.4 inches of the surface. The fringe-toed lizard provides a good example of these adaptations (**photograph V-9**). Its fringed toes act like snowshoes to stop its feet from sinking and provide extra push through sand. Its upper jaw overlaps the lower, preventing the intrusion of sand particles; scaly flaps close against the ear openings when moving through sand; scales on the upper and lower eyelids interlock to prevent sand from getting into the eyes; and valves in the nostrils can close at will.

Photograph V-9.—Fringe-toed lizards are sand swimmers, burrowing quickly into the sand to avoid predators or to avoid extreme heat or cold. Photo from Behler and King (1991).

Three snake species present in the Yuma Desert are also highly specialized sand swimmers. The banded sand snake (*Chilomeniscus cinctus*) occupies fine sandy areas in open desert dominated by creosote bush. It has a spadelike snout, streamlined head with nasal valves, glossy skin, and angular-ended belly scales to enable it to swim through fine sand. Serpentine-shaped grooves in the sand between bushes reveal its presence. The western shovel-nosed snake (*Chionactis occipitalis*) has a small shovel-shaped head, valved nostrils, flattened belly, and smooth scales which allow this burrower to move quickly through sand. The spotted leaf-nosed snake (*Phyllor-hynchus decurtatus*) is also an adept burrower in sandy creosote bush desert.

Other Reptile Species.—In addition to the sand swimmers discussed previously, other diurnal lizards present in the 5-mile zone include the desert horned lizard (*Phrynosoma platyrinos*) and the flat-tailed horned lizard (*Phrynosoma mcallii*). (Also see “Special Status Species.”) These two species freeze if danger approaches when they are out in the open, relying on their camouflage for safety. This strategy, however, does not work well as a defense against vehicles. Crushing by vehicles is a significant source of mortality as OHV use increases and as Border Patrol activities continue.

The herbivorous chuckwalla (*Sauromalus obesus*) prefers open flats and rocky areas, especially where large boulders are present. The side-blotched lizard (*Uta stansburiana*) and western whiptail (*Cnemidophorus tigris*) are abundant in a variety of habitats. The long-tailed brush lizard (*Urosaurus graciosus*) prefers loose sandy desert with abundant creosote bush. Also present are the common tree lizard (*Urosaurus ornatus*) and the desert spiny lizard (*Sceloporus magister*).

Other snakes present in the 5-mile zone include the glossy snake (*Arizona elegans*), western blind snake (*Leptotyphlops humilis*), long-nosed snake (*Rhinocheilus lecontei*), and ground snake (*Sonora semiannulata*), all of which are excellent burrowers in soft sand. Two species of very fast diurnal snakes are the coachwhip *(Masticophis flagellum*) and the western patch-nosed snake (*Salvadora hexalepis*), which like barren creosote bush desert flats. Also present are the night snake (*Hypsiglena torquata*), which hides under rocks or plant litter; the rosy boa (*Lichanura trivirgata*), a nocturnal constrictor; the lyre snake (*Trimorphodon biscutatus*), and the extremely venomous Mojave rattlesnake (*Crotalus scutulatus*). The sidewinder (*Crotalus cerastes*) travels quickly over shifting surfaces using a sidewinding motion in which the snake makes use of static friction to keep from slipping when crossing soft sandy areas, touching the surface in only two points. It is primarily nocturnal and occupies mammal burrows during the day.

Other toad species present in the study area include the Colorado River toad (*Bufo alvarius*) and red-spotted toad (*Bufo punctatus*), which prefer damp areas near permanent springs or manmade watering holes.

Threats to the Vegetation and Wildlife of the Yuma Desert Portion of the Lower Colorado River Valley Subdivision

While the native species of the Sonoran Desert are well adapted to its extreme conditions, they are vulnerable to physical disturbance and habitat destruction. Nabhan and Holdsworth (1999) noted that, since World War II, the deserts of the Southwest have been the setting for the largest in-migration in human history. In 1990, the Sonoran Desert Ecoregion had 6.9 million residents, nearly double the 1970 population. The population is expected to reach 12 million by 2020. Under such human growth pressure, the threats to Sonoran Desert biodiversity reported by Nabhan and Holdsworth (1999) will likely become more severe. Conversion of natural habitat to urban, suburban, industrial, and agricultural use has resulted in, and likely will continue to result in, extensive habitat loss (U.S. Department of Defense, 2001). Increased recreational use of the desert is resulting in habitat damage and declines in some species. Additionally, improper livestock management and the spread of invasive plants and animals threaten the viability of both terrestrial and riverine/riparian systems alike.

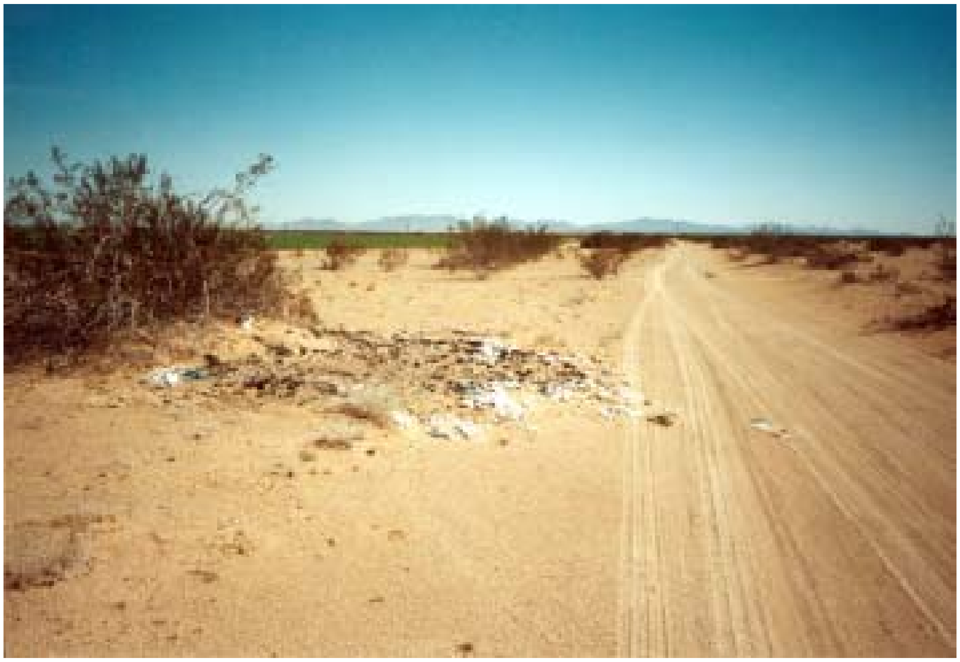
Recent observations in the study area indicate that many sections are relatively undisturbed creosote bush—bursage, primarily along the eastern portion of the study area. However, numerous disturbances have been observed, including trash dumping (**photograph V-10**) and numerous Border Patrol roads that are outside the authorized drag roads[2] (**photograph V-11**) and OHV roads. These roads are a significant source of mortality to sand swimming lizards and snakes, which burrow into the shallow top layers of soil and can be crushed, as well as to flat-tailed horned lizards and desert horned lizards, which rely on camouflage for protection. A flat-tailed horned lizard was found crushed on a road near the prison on an October 2001 site visit.

Environmental Consequences

Alternative A

No comprehensive land use strategy currently exists for the 5-mile zone, except for the approximately 16,000-acre Yuma Desert Management Area (shown on **map V-6**), which Reclamation has been managing under the 2003 Rangewide Management Strategy. (See chapter II, "Flat-Tailed Horned Lizard Interagency Coordinating Committee.") The Yuma Desert Management Area is subject to special management actions that are the same for all alternatives and which are discussed in detail under "Mitigation." Lands outside the Yuma Desert Management Area are primarily in the western portion of the study area. Under the No Action Alternative, these lands would be considered for development on a case-by-case basis, as under current conditions.

[2] Drag road is a method used by the Border Patrol to detect and interpret disturbances in natural terrain conditions that indicate the presence or passage of people, animals, or vehicles.



Photograph V-10.—Illegal dump sites are common in the undeveloped portions of the study area.

Photograph V-11.—The Border Patrol maintains the drag road along the International Border. Recreationists create other unofficial roads.


5-Mile Zone
Protective and Regulatory Pumping Unit
Flat-tailed Horned Lizard
Management Area
(Yuma Desert Management Area)
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
Colorado River
West Main Canal
Central Canal
East Main Canal
Avenue J
Avenue I
Avenue H
Avenue F
Avenue E
Avenue D
Co 21th Street
Co 23rd Street
Juan Sanchez Blvd
R 24 W
R 23 W
R 22 W
R 25 W
T 10 S
T 11 S
T 12 S
36
31
1
6
Main Outlet
Drain Extension
Southerly
International
Boundary (SIB)
Yuma Desert
Management Area
Management Areas
Flat-tailed Horned Lizard Management Area
Managed by Reclamation
Flat-tailed Horned Lizard Management Area
Managed by the Military
Boundary Pumping Plant
Study Area Boundary
Non Reclamation Land
(not included in the study)
Colorado River
Canals
242 Lateral
(approx. location)
N
0
1
2
3
4
5 Miles

Map V - 6

Rapidly increasing human populations and the resulting urbanization in fragile desert environments is the foremost cause of habitat loss and degradation in the Sonoran Desert ecosystem. The No Action Alternative could result in poorly planned growth around San Luis and the new commercial port-of-entry and, in the face of tremendous population growth pressures, could result in leap frog development; poor use of available land; destruction or degradation of natural areas, cultural resources, and sensitive plant and animal life; poorly planned and sited highways and utility corridors; inadequate water supply; and adverse effects on well fields and groundwater.

Increasing population pressures result in more roads, recreational use, and law enforcement needs in the adjacent open lands because of unregulated recreational and OHV use, as well as continued illegal dumping and unregulated shooting. Wildlife habitat becomes increasingly fragmented and degraded. Increasing pressure is placed on Federal agencies—in this case, Reclamation—to convert land use from natural areas to urban uses and to transfer land out of the public domain. The net effect on vegetation and wildlife resources in the study area under the No Action Alternative would be an overall loss and degradation of habitat, particularly in the western portion of the study area, where most of the growth pressures are occurring.

No land exchanges would occur under the No Action Alternative. The public land base within the 5-mile zone could be diminished, and opportunities to acquire lands to replace lost wildlife habitat would not occur. New land authorizations would continue to be considered on a case-by-case basis.

OHV use would continue unchanged, resulting in continued habitat degradation in certain areas, primarily in the western portion of the study area. New road construction and improvements to existing roads would be permitted on a case-by-case basis. Without an overall strategy for protecting large blocks of intact habitat, fragmentation of habitat could increase.

The current level of agency coordination would continue. Opportunities to cooperate with other agencies to provide law enforcement, as well as to cooperatively develop and implement wildlife and special status species inventory and management projects, and to coordinate with the Border Patrol to reduce OHV impacts on flat-tailed horned lizard and other wildlife species would continue to be lost.

Alternative B

The comprehensive land use strategy proposed under Alternative B would actively discourage growth and growth-promoting activities, such as constructing new roads, widening and paving existing dirt roads, constructing utility corridors, and considering proposals to further develop public lands, in the lands outside the Yuma Desert Management Area. This strategy would benefit vegetation and wildlife in all the remaining Sonoran Desert habitat within this area. Land exchanges would be considered to prevent the loss of public land in the study area and would be designed to benefit wildlife rather than to promote recreation, community, and commercial development.

New land use authorizations would be limited only to those for the public benefit. Some land use authorizations have been granted to a number of projects prior to the development of this resource management plan (RMP). Several projects have agreed-upon mitigation measures for wildlife habitat losses that would occur upon project implementation (such as the proposed SR195). Alternative B would ensure that agreed-upon mitigation is implemented fully and completely. If no mitigation is in place for losses of habitat on public lands, such mitigation would be developed, agreed-upon, and implemented. All new land use authorizations would require mitigation.

Recreational development would not be allowed within the study area, which would benefit vegetation and wildlife. Areas damaged by unregulated OHV use would be revegetated. An agreement would be put in place in which Reclamation would install closure signs and the Arizona Game and Fish Department (AGFD) would provide law enforcement to ensure that closures are adhered to, which would greatly benefit vegetation and wildlife. The development and deployment of interpretive signs to educate the public about the Sonoran Desert ecosystem would be beneficial as well.

No new roads or road improvement projects would be permitted, except for those already planned, which would benefit wildlife by retaining large blocks of intact habitat.

Alternative B would actively improve agency coordination. The primary action that would benefit wildlife and vegetation would be implementation of the signing and law enforcement agreement, as discussed previously. Additionally, an agreement between the AGFD and Reclamation to coordinate management of the flat-tailed horned lizard, other special status species, and game species, such as doves, would benefit wildlife. Coordination with the Border Patrol to increase protection for the flat-tailed horned lizard and other wildlife species from OHV use associated with patrol activities would also improve conditions for wildlife.

Alternative C

The comprehensive land use strategy proposed for this alternative would actively encourage community, commercial, and recreational development in the western portion of the study area, outside the Yuma Desert Management Area. Land use authorizations would favor recreational, community, and commercial development, rather than natural resource protection, resulting in adverse effects to the remaining relatively undamaged wildlife habitat that exists throughout the western portion of the study area.

Land exchanges would be conducted to ensure no net loss of public land within the study area but would benefit community or commercial development, and not necessarily wildlife habitat.

Alternative C would maximize recreational development, with large-scale, long-term (6-month stay) campgrounds and short-term (14-day stay) campgrounds in the western portion of the study area. These developments would result in significant disturbance and degradation of large areas of remaining relatively intact Sonoran desert. Nonmotorized trails would be constructed within certain areas. The opportunity to manage recreational use, instead of the unregulated recreational use that occurs now, would somewhat offset the habitat degradation and fragmentation that large-scale recreational development would produce. Public education through the use of interpretive signs would be beneficial.

OHV use would be promoted in designated areas, and an OHV plan would be developed. This approach to regulating OHV use would be an improvement over existing conditions. New roads and road improvements would be permitted, as needed, to provide access to developments within the study area, potentially increasing habitat fragmentation and the risk of increased vehicle collisions with vulnerable wildlife species.

Alternative D

The comprehensive land use strategy proposed for Alternative D, the preferred alternative, would promote limited development in the western portion of the study area outside the Yuma Desert Management Area. Land use proposals would be compatible with conservation of the Sonoran Desert habitat that exists within the study area. This land use strategy would protect wildlife and vegetation habitat in the study area. Currently, proposals are considered on a case-by-case basis with no overall guidance for protection and management of the habitat that still remains relatively intact within the study area.

No net loss of land within the study area would be allowed. Land transfers or exchanges would conserve and protect natural resources and provide for limited recreation, community, and commercial development. This approach could possibly benefit wildlife habitat and the Sonoran Desert ecosystem that exists in the study area compared to the No Action Alternative and current conditions, in which the public land base can be and has been diminished.

Recreation development would consist of construction of limited, short-term camp-grounds in the western portion of the study area as well as day use facilities and trails. These facilities would provide an opportunity to control and regulate recreational use as well as an opportunity to educate the public on the unique plants and wildlife present in the Sonoran Desert through an active interpretive sign program.

Vehicle use would be restricted to designated existing roads. All off-road activity would be eliminated, and regulations would be enforced, which would benefit desert wildlife, especially those species such as flat-tailed horned lizard and other sand swimmers that rely on freezing and blending into the environment rather than fleeing oncoming vehicles. No new roads would be permitted (except those associated with the proposed SR195, the truck route, and Rolle Airfield), which would protect currently existing blocks of intact habitat remaining in the western portion of the study area.

See “Special Status Species” for cumulative impacts, mitigation, and residual impacts.