ECOLOGICAL OVERVIEW

SAN PEDRO RIVER PARCEL
PINAL COUNTY, ARIZONA

Prepared for:

RESOLUTION COPPER COMPANY
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EXECUTIVE SUMMARY

WestLand Resources, Inc. (WestLand) was retained by Resolution Copper Company to prepare an Ecological Overview for approximately 1,295 hectares (3,200 acres) of land along the Lower San Pedro River near the Town of Mammoth in Pinal County, Arizona (referred to as the Property or San Pedro River Parcel in this report). The Property is located in the northern portion of the San Pedro River basin within the floodplain and adjacent upland areas of the San Pedro River. The nearest large metropolitan community is Tucson, Arizona, located approximately 64 kilometers (40 miles) southwest of the Property. The U.S.-Mexico border is approximately 160 kilometers (100 miles) south of the Property.

This ecological evaluation was conducted to identify the types, relative condition, and ecological value of the biological resources found on the Property, and to briefly assess their conservation values in the context of the San Pedro River watershed and the larger region.

Flowing northward from its headwaters in the Sierra Madre Occidental, the San Pedro flows for approximately 225 kilometers (140 miles), generally northward, into the State of Arizona, to its confluence with the Gila River near Winkleman. This unique river is one of only two major rivers that flow north out of Mexico into the United States and is one of the few remaining free-flowing rivers in the southwest. The unique qualities of the San Pedro River ecosystem have earned this riverine system the Nature Conservancy's designation as one of the "Last Great Places on Earth" and it is one of the most important riparian (streamside) habitats in the Sonoran and Chihuahuan Deserts.

The dominant landscape features within the Property, and among the most productive of habitats in the southwest, are the mesoriparian and hydroriparian habitats that line the river corridor. A remarkable mesquite bosque stretches for approximately 4.5 km on the east side of the San Pedro River in the center of the Property. Once relatively common and of great extent, the mesquite bosque is one of the rarest of riparian habitats in Arizona. Several attributes of the immediate landscape or of the mesquite trees themselves make this bosque notable. Two features are shared with all mesquite bosques - productivity and importance to wildlife. However, there are three additional features that set this bosque apart from nearly all surviving bosques today - an uncapped artesian well, the bosque's relatively great age, and the bosque's resilience to disturbance. In addition, we have been informed that this bosque may be the largest, most ancient, mesquite bosque remaining in Arizona (Troy Coreman, AGFD pers.comm).

The size, unique characteristics, and relatively undisturbed condition of the San Pedro River Parcel makes it an ideal candidate for conservation and would make a substantial contribution to the conservation of the San Pedro River system.

1. INTRODUCTION AND METHODS

1.1. PURPOSE AND ORGANIZATION OF REPORT

WestLand Resources, Inc. (WestLand) was retained by Resolution Copper Company to prepare an Ecological Overview for approximately 1,295 hectares (3,200 acres) of land along the Lower San Pedro River near the Town of Mammoth in Pinal County, Arizona (referred to as the Property or San Pedro River Parcel in this report).

The Property is located within the flood plain and adjacent upland areas of the San Pedro River near the Town of Mammoth (Figures 1 and 2), approximately 64 kilometers (40 miles) northeast of Tucson, Arizona. Access to the Property is via Arizona Highway 77, Copper Creek Road, and River Road.

This ecological evaluation was conducted to identify the types, relative condition, and ecological value of the biological resources on the Property, and to briefly assess their conservation values in the context of the San Pedro River watershed and in a larger regional context.

This report is presented in seven sections: this Introduction and Methods, Section 2 – Regional Setting; Section 3 – Existing and Adjacent Land Uses; Section 4 – Physical Resources; Section 5 – Biological Resources; Section 6 – Conservation Value and Opportunities; and Section 7 - References.

1.2. METHODS AND APPROACH

WestLand completed this analysis by conducting background research of available natural history information and aerial photography of the Property and surrounding region, and through field reconnaissance to identify, map, and photograph vegetation and habitat, and current site conditions.

WestLand obtained and reviewed available literature pertaining to biotic communities of the southwest, riparian ecosystems, and the San Pedro River. Primary sources of information that were reviewed include *Biotic Communities of the Southwestern United States and Northwestern Mexico* (Brown, 1994), a comprehensive reference of the desert southwest; wildlife abstracts from the U.S. Fish & Wildlife Service (USFWS); and various websites maintained by The Nature Conservancy (TNC), Arizona Department of Water Resources (ADWR), Bureau of Land Management (BLM) and other agencies and conservation organizations. Prior to conducting fieldwork, these references and existing aerial photographs were reviewed to identify potential vegetation communities on the Property and to prioritize field efforts.

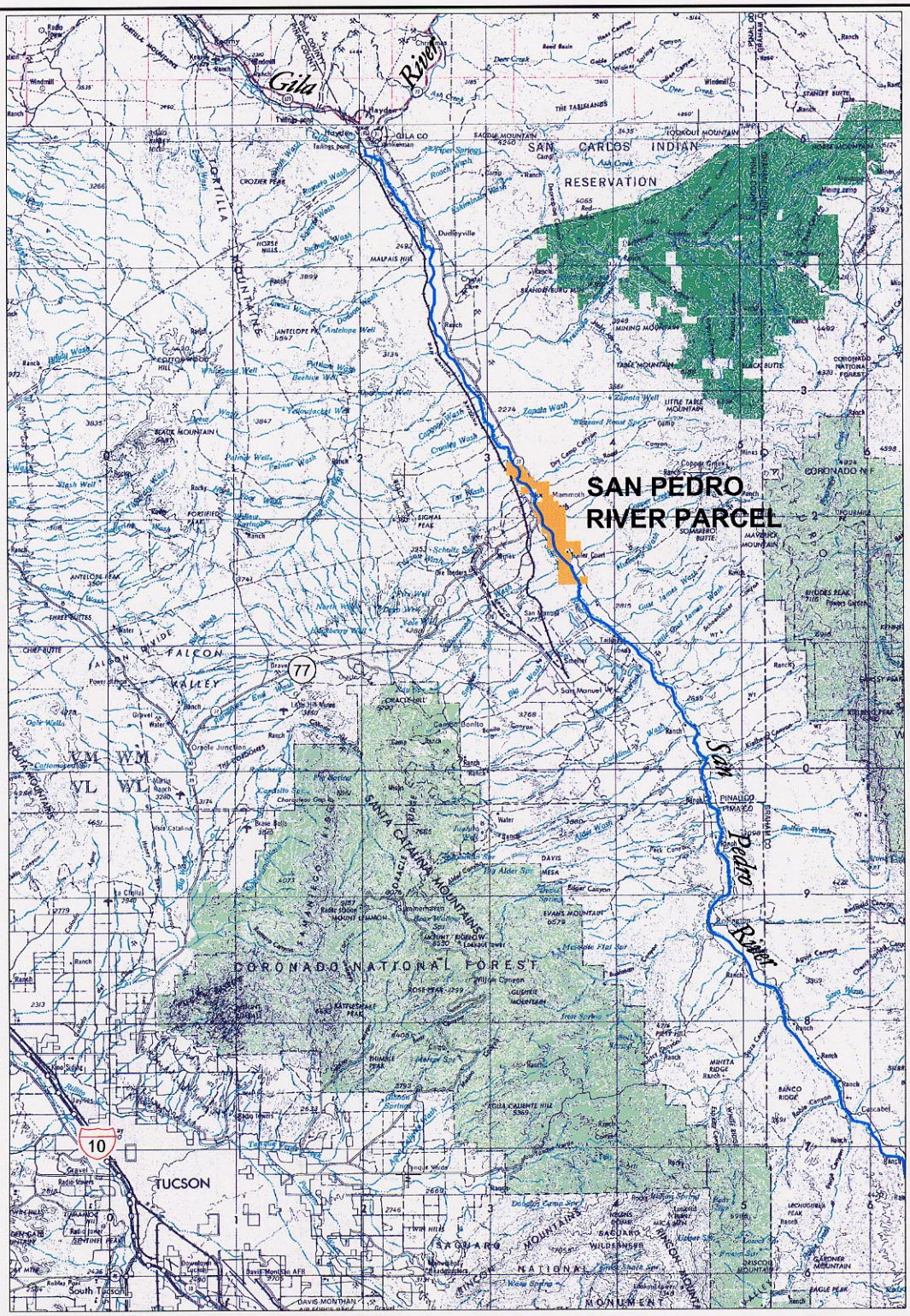
PROJECT LOCATION

Pinal County, Arizona

N
W E
S

0 6.5 13 KM

SCALE: 1" = 13 KILOMETERS



Base Maps: Mesa, Tucson, & Nogales USGS 1:250,000

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ECOLOGICAL OVERVIEW

San Pedro River Parcel

VICINITY MAP

Figure 1

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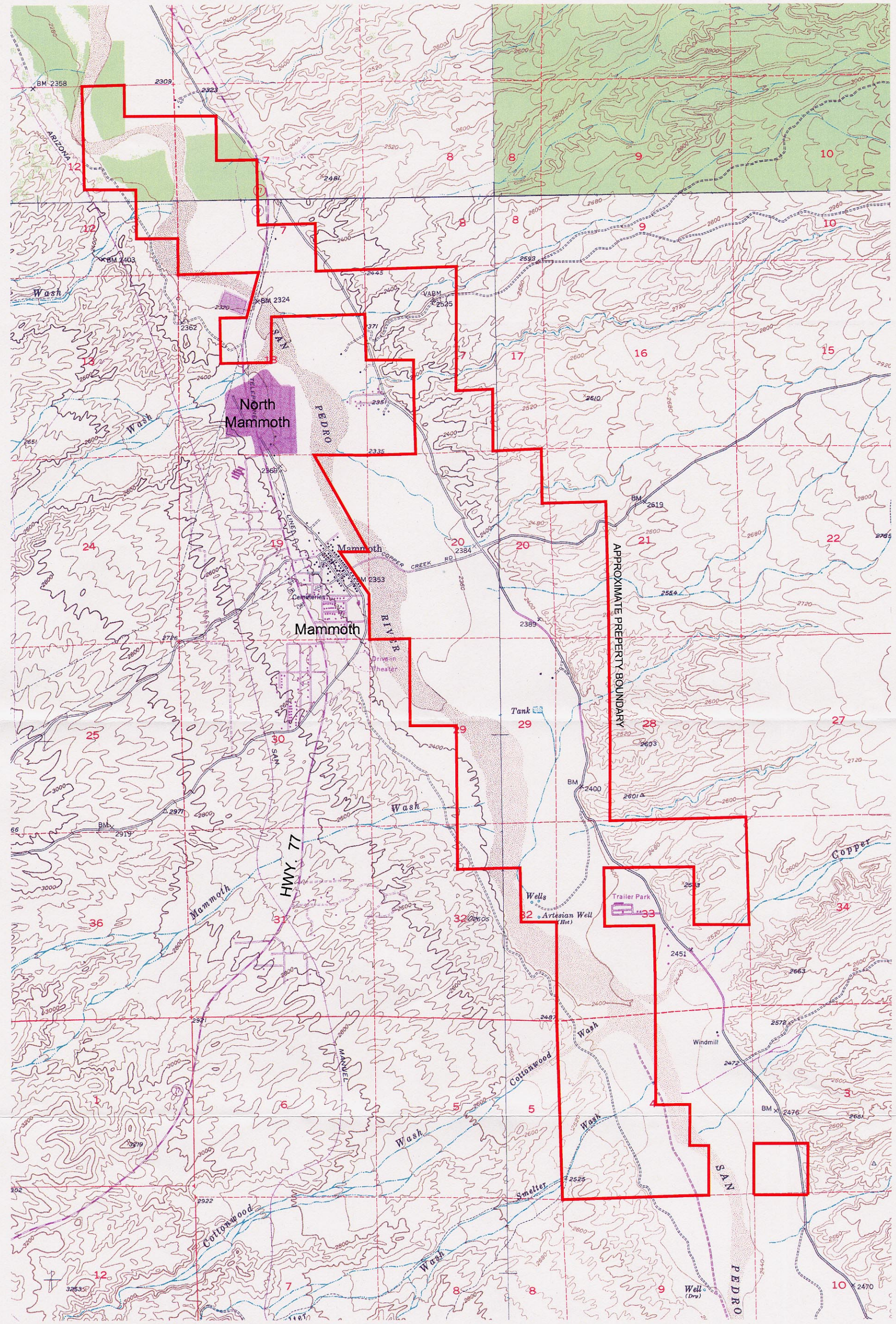

Project area found on the Mammoth, Lookout Mountain & Clark Ranch USGS 1:24,000 Quadrangles

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0 400 800 M

SCALE: 1" = 800 METERS

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ECOLOGICAL OVERVIEW

San Pedro River Parcel

SAN PEDRO RIVER STUDY AREA

Figure 2

In order to identify special status species that might occur on the Property, Westland obtained the current list of federally listed species for Pinal County from the USFWS database (USFWS, 2003). The life history of each these species was then studied to determine habitat features such as vegetation communities, elevation, presence of surface water, and other landscape features on the Property that might require investigation during the field reconnaissance portion of the evaluation. This information was also utilized in the screening analysis to eliminate certain species from further evaluation. Additional literature research was conducted and summarized for those species that have known ranges and habitat requirements close to, or which have a high likelihood of occurring on the Property.

WestLand biologists conducted field reconnaissance of the Property between June and August of 2003 to observe current site conditions and to observe the biological resources and the abiotic factors affecting their distribution and relative value within the Property. The reconnaissance consisted of a vehicular "tour" using roads and trails that cross the Property and pedestrian reconnaissance that focused on areas of interest identified during the background research phase of the evaluation. Inaccessible areas were scanned, using binoculars, to observe distant wildlife and vegetation communities. Field notes and photographs were recorded during the field reconnaissance to document the various physical and biological resources observed throughout the Property. While in the field, general patterns of vegetation were noted and common species recorded. These general vegetation patterns were delineated on an aerial photograph in the field and later transcribed onto a vegetation map of the Property. Direct and indirect (tracks, burrows, etc.) observation of wildlife was noted, and common plant species found on the Property were documented during the field reconnaissance.

Special attention was paid to the site's potential to provide habitat for special status species on the USFWS list of threatened, endangered, proposed and candidate species for Pinal County. Using the USFWS list of special-status species and data collected during field reconnaissance, we conducted a screening analysis to identify those special-status species that had the potential to occur on the Property. Screening information such as site elevation ranges, habitat type, availability of water resources, climate data, and other related information was compiled to predict the potential for occurrence of listed species in the project area. This information was obtained from existing topographic maps, reports, and wildlife agency databases. The screening analysis resulted in a list of target species that have potential to occur on the Property.

2. REGIONAL SETTING

The San Pedro River originates in Sonora, Mexico. Flowing northward from its source in the foothills of the Sierra Madre Occidental, the San Pedro flows for approximately 225 kilometers (140 miles), generally northward, into the State of Arizona, to its confluence with the Gila River near Winkleman, Arizona. This unique river is one of only two major rivers that flow north out of Mexico into the United States, and is one of the few remaining free-flowing rivers in the southwest (The Nature Conservancy, 2003a).

Photograph 1. Overview of San Pedro River Valley.

The Property is located in the northern portion of the San Pedro River basin within the Basin and Range Physiographic Province. The Basin and Range Province is characterized by northwest-southeast trending mountain ranges separated by broad alluvial valleys. The Galiuro Mountains form the northeast boundary of the San Pedro River valley in the vicinity of the Property and the Santa Catalina Mountain range forms the southwest boundary of the valley.

The closest large metropolitan community is Tucson, Arizona, located approximately 64 kilometers (40 miles) to the southwest. Mammoth (2000 census population = 1,762) is located at the northern end of the Property, along the western bank of the San Pedro River. Winkleman and Hayden (combined 2000 census population = 1,435) are approximately 33 kilometers (20 miles) north-northwest of the Property, and the City of Benson (2000 census population = 4,711) is approximately 106 kilometers (66 miles)

south-southeast of the property, along the San Pedro River. The U.S.-Mexico border is approximately 160 kilometers (100 miles) south of the Property.

3. EXISTING AND ADJACENT LAND USES

The San Pedro River Parcel is owned by BHP Billiton. The majority of the Property remains undeveloped and is being or has been used primarily for grazing and other agricultural uses. Approximately 15 percent of the Property had been cleared of native vegetation for agricultural uses and was farmed primarily for alfalfa for livestock feed (pers. com. Gerry Brunskill of BHP Billiton). These fields were fallow during our field reconnaissance. Evidence of past woodcutting exists throughout the Property.

Photograph 2. Ranching Facilities within the San Pedro River Parcel.

Several improved (paved) and unimproved (dirt) public roads cross the property. On the northeast side of the river, River Road is paved from its intersection with AZ 77 southeast through the property and adjacent properties, turning to dirt farther southeast. Copper Creek Road crosses the property from the northeast side of the river to Mammoth; it is paved except where it crosses the streambed. Camino Rio Road accesses the property and adjacent parcels on the southwest side of the river northwest of Mammoth. A dirt road southeast of Mammoth, on the southwest side of the river, is depicted on maps but was reportedly abandoned years ago. Vestiges of this road are present in some locations along the property. Numerous unimproved dirt roads and trails cross the property as well; these appear to have been formed by the general public as convenient access to the river or upland areas. Much of the property is not fenced.

Wide ranges of uses are evident on adjoining properties, including:

- Agricultural,
- Commercial,
- Industrial,
- Residential, and
- Recreational/undeveloped.

Agricultural land use on adjoining properties is limited to one ranch in Section 33, evidently used for raising cattle and growing feed (alfalfa) for cattle. This usage is limited to the overbanks, and the above-described mesquite bosque has been cleared for this purpose. One portion of the ranch had been very recently cleared of mesquite.

Commercial land use on adjoining properties along the margins of Mammoth, in Section 19, generally consists of a variety of small businesses, such as restaurants, bars, and retail establishments.

Industrial land use on adjoining properties consists of a sewage treatment plant (operated by the Town of Mammoth) in the northwest corner of Section 18, a Town of Mammoth maintenance yard in Section 18, an inactive sand and gravel quarry in Section 7, and a mine plant site (including a smelter and tailings impoundments) in Section 5. The town maintenance yard includes an informal (un-permitted) waste disposal site, in which empty drums were present but no evidence of hazardous substance disposal was observed. BHP Billiton owns the mining site. The mine facilities closest to the property are thewaste rock and leach dump, which are west of the Property. Undeveloped land lies between the property and mine facilities. The mine site has been inactive since 1999.

Residential land use on adjoining properties is present in the towns of Mammoth and North Mammoth (in Sections 19 and 18, respectively) and small, unnamed developments in Sections 17 and 33.

Recreational/undeveloped land surrounds the property in all other areas. Recreational use of the land is largely informal: off-road vehicles use the San Pedro River stream bed and numerous informal roads and trails cross the property and adjacent properties to access the stream bed. A town park is present in Mammoth adjacent to the property; the park includes a baseball diamond and picnicking facilities.

4. PHYSICAL RESOURCES

4.1. GEOLOGY/GEOMORPHOLOGY

The geology of the Mammoth area was described by Creasey (1967) as part of his mapping of the Mammoth 7.5-minute USGS Quadrangle. Within the area of the Property there are a limited number of geological units: 1) alluvium, 2) Tertiary "Gila" conglomerate, and 3) Tertiary lacustrine sediments. Each of these are briefly discussed below. Figure 3 depicts the distribution of geomorphologic features and processes within the Property.

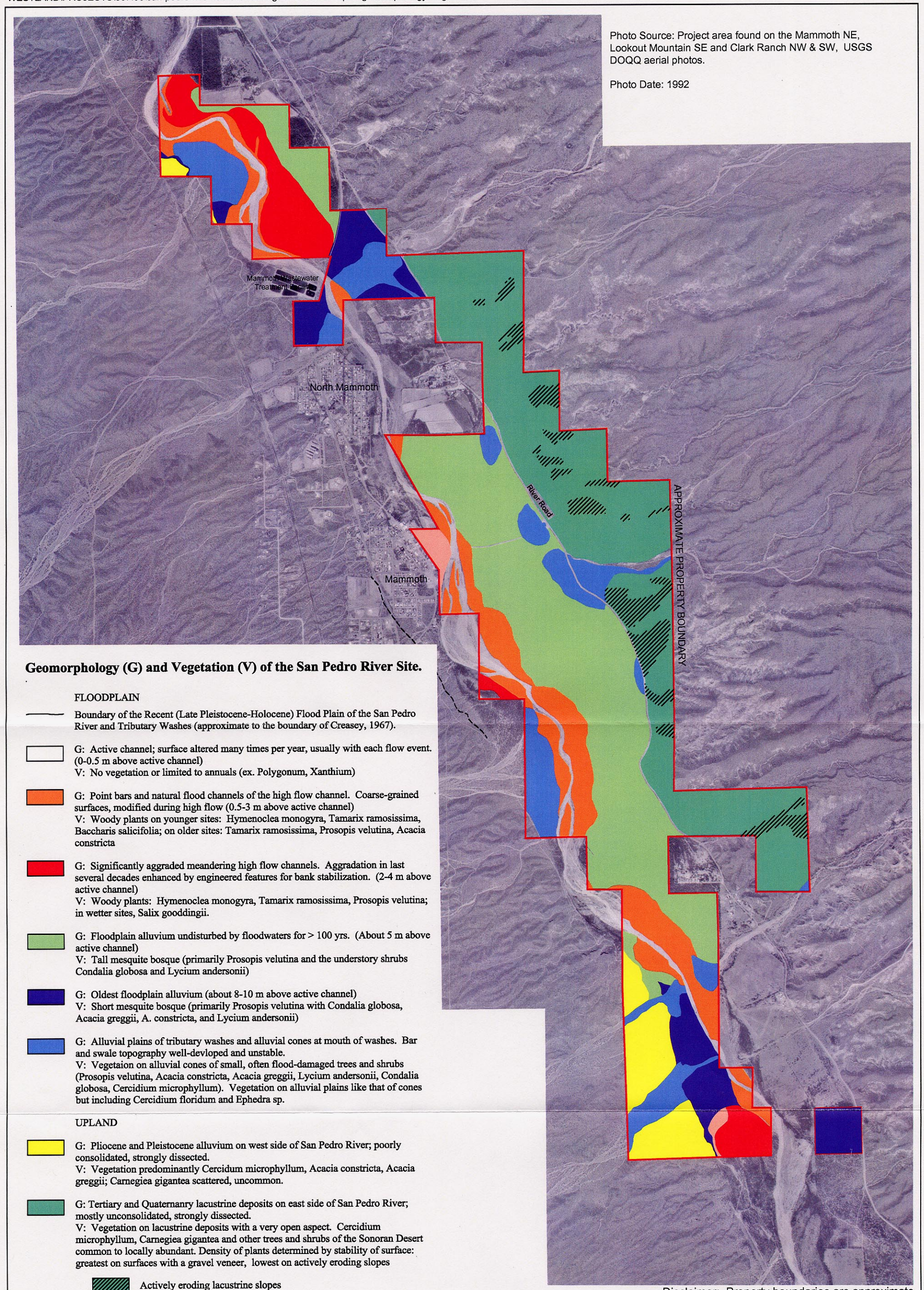
4.1.1. Alluvium

Creasey (1967) delineates the boundary of the Recent (Late Pleistocene-Holocene) flood plain of the San Pedro River as well as outlining the boundary of the active channel, although it is unclear whether the active channel's outline is that of the 1948 USGS topographic base map or whether he remapped it. Creasey's active channel outline differs in a number of features from that mapped by Huckleberry (1996) based on aerial photographs from 1947. Both Creasey (1967) and Huckleberry (1996) described the historic changes in the alluvial plain of the San Pedro River, Creasey drawing on Bryan's (1926) report and Huckleberry including in his review the more recent literature of Hastings (1959), Hereford and Betancourt (1993), Bahr (1991), among others. All reviewers of historic changes in the San Pedro valley agree that the river was not incised into the floodplain in the early 1800's but starting in the 1880's or 1890's, the river began down-cutting. Wood (1997) compiled the available archival information in describing channel entrenchment, widening, and meandering along the lower San Pedro River (including the northern half of the Property).

Since the 1890s, the San Pedro River's active channel has continued to widen but, characteristically for entrenched rivers in the Southwest, the rate of widening has slowed. Within the Property, there are still remnant portions of the original pre-entrenchment floodplain. Multiple terraces (separated by approximately 1 m heights) can be seen between the level of the active channel and the original floodplain on the wider parts of the floodplain. Meyer (1989) has described the general processes that occur after initial entrenchment. As the river cuts the banks, the high-flow channel width increases and channel depth decreases, reducing channel competence or the ability to carry coarse-grained sediments. Gravel bars are deposited in mid-channel and in time both entrenched walls (on either side of the channel) are eroded. This process is still on going in the channel of the San Pedro on the Property.

Photo Source: Project area found on the Mammoth NE, Lookout Mountain SE and Clark Ranch NW & SW, USGS DOQQ aerial photos.

Photo Date: 1992



Geomorphology (G) and Vegetation (V) of the San Pedro River Site.

FLOODPLAIN

Boundary of the Recent (Late Pleistocene-Holocene) Flood Plain of the San Pedro River and Tributary Washes (approximate to the boundary of Creasey, 1967).

G: Active channel; surface altered many times per year, usually with each flow event. (0-0.5 m above active channel)
V: No vegetation or limited to annuals (ex. Polygonum, Xanthium)

G: Point bars and natural flood channels of the high flow channel. Coarse-grained surfaces, modified during high flow (0.5-3 m above active channel)
V: Woody plants on younger sites: Hymenoclea monogyra, Tamarix ramosissima, Baccharis salicifolia; on older sites: Tamarix ramosissima, Prosopis velutina, Acacia constricta

G: Significantly aggraded meandering high flow channels. Aggradation in last several decades enhanced by engineered features for bank stabilization. (2-4 m above active channel)
V: Woody plants: Hymenoclea monogyra, Tamarix ramosissima, Prosopis velutina; in wetter sites, Salix gooddingii.

G: Floodplain alluvium undisturbed by floodwaters for > 100 yrs. (About 5 m above active channel)
V: Tall mesquite bosque (primarily Prosopis velutina and the understory shrubs Condalia globosa and Lycium andersonii)

G: Oldest floodplain alluvium (about 8-10 m above active channel)
V: Short mesquite bosque (primarily Prosopis velutina with Condalia globosa, Acacia greggii, A. constricta, and Lycium andersonii)

G: Alluvial plains of tributary washes and alluvial cones at mouth of washes. Bar and swale topography well-devloped and unstable.
V: Vegetaion on alluvial cones of small, often flood-damaged trees and shrubs (Prosopis velutina, Acacia constricta, Acacia greggii, Lycium andersonii, Condalia globosa, Cercidium microphyllum). Vegetation on alluvial plains like that of cones but including Cercidium floridum and Ephedra sp.

UPLAND

G: Pliocene and Pleistocene alluvium on west side of San Pedro River; poorly consolidated, strongly dissected.
V: Vegetation predominantly Cercidum microphyllum, Acacia constricta, Acacia greggii; Carnegiea gigantea scattered, uncommon.

G: Tertiary and Quaternanry lacustrine deposits on east side of San Pedro River; mostly unconsolidated, strongly dissected.
V: Vegetation on lacustrine deposits with a very open aspect. Cercidium microphyllum, Carnegiea gigantea and other trees and shrubs of the Sonoran Desert common to locally abundant. Density of plants determined by stability of surface: greatest on surfaces with a gravel veneer, lowest on actively eroding slopes

Actively eroding lacustrine slopes

DISTURBED LANDS

Disturbance. Aggregate operations and other significantly altered lands.

Map based on Creasey (1967), USGS DOQQ (1992), and several field trips to ground-truth landscape features.

Disclaimer: Property boundaries are approximate.

N
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0' 400 800 M

SCALE: 1" = 800 METERS

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ECOLOGICAL OVERVIEW

San Pedro River Parcel

GEOMORPHOLOGIC CHARACTERISTICS

Figure 3

The larger tributary washes on the Property, such as Copper, Mammoth, and Turtle Washes, still deliver alluvium directly into the San Pedro River. The sediment includes a significant portion of gravel and larger clasts. The input of this coarse-grained sediment facilitates the formation of point-bars. With additional surveys of the active channel, it might be possible to identify whether the coarse-grained deposits facilitate a particular braided stream pattern that may have contributed to the conservation of the higher, older alluvial terraces where the mesquite bosque occurs today. This bosque is referred to as the 7B Ranch bosque because of its proximity to the 7B Ranch.

4.1.2. Tertiary "Gila" Conglomerate

All of the older alluvial fans on the west side of the San Pedro River on the Property are part of Creasey's "Gila" conglomerate. This conglomerate was deposited during the later Tertiary phases when the valley was still closed. Subsequent faulting in the valley has tilted this conglomerate 5 to 10 degrees. This younger conglomerate is only poorly consolidated. It is now highly eroded, and across much of this unit are steep slopes, but no cliffs. There are exposures of at least one petrocalcic horizon approximately 0.5 meters in thickness.

4.1.3. Tertiary Lacustrine Sediments

East of the San Pedro River (and starting usually immediately east of River Road) on the Property are thick unconsolidated lacustrine sediments. These are fine-grained marls and limy silts. Thin layers of gypsum occur in portions of the sediment. Deposition history of these lacustrine sediments remains incompletely studied but occurred over an extended period in the Tertiary that involved a complex series of temporally isolated and interconnected lakes. The lacustrine sediments erode easily. Tall (10 to 20 meters) cliffs occur along portions of River Road and along the edges of most of the larger washes. Figure 3 shows light-colored regions on the lacustrine sediments. These lighter areas are areas near the ridgelines of the eroded sediments that are most actively eroding. There are several areas on the upper portion of the lacustrine sediments that are still covered with a gravel lag of Pliocene or Pleistocene age (Creasey's 'gravel veneer').

Photograph 3. Cliffs formed in upland areas of the Tertiary Lacustrine Sediment.

4.2. WATER RESOURCES

4.2.1. Surface Water Resources

As evidenced by the following charts prepared by the USGS, surface water flows along the reach of the San Pedro that traverses the Property are intermittent.[1] Chart 1 depicts mean stream flow data in cubic feet per second for USGS Gauge 09472500 on the San Pedro River, near Mammoth, Arizona. As is evident by the data present during this period, surface water flows at this point are not perennial, but rather appear seasonal and associated with seasonal weather patterns.

Photograph 4. Perennial Surface Water Feature Created by Uncapped Artesian Well located within the San Pedro River Parcel.

Chart 2 depicts the stream gauge data for the San Pedro River that was collected by the USGS near Redington, Arizona (USGS Gauge no. 09472000), approximately 20 miles downstream of the Property. While data for the property are incomplete from an historical perspective, they indicate that for many years this reach of the San Pedro was not perennial, but rather intermittent. Likely, it has been intermittent at least since arroyo cutting was initiated along the San Pedro in the late 1800's.

An uncapped artesian well [0535468E, 3617265N; NAD 27] that discharges water at a rate of about 200-400 liters/min (53-106 gallons/minute) (our estimate) creates a perennial surface water feature within the Property. The water flows west-northwest from the artesian well for about 100 meters before sinking below ground. This water source undoubtedly contributes to the extent and health of the 7B bosque.

[1] Intermittent: Surface water flows only at certain times of the year when receiving water from springs or from some surface source such as melting snow in mountainous areas (i.e., seasonal).
(source: http://www.adeq.state.az.us/environ/water/assess/305/2002/aadef.pdf)

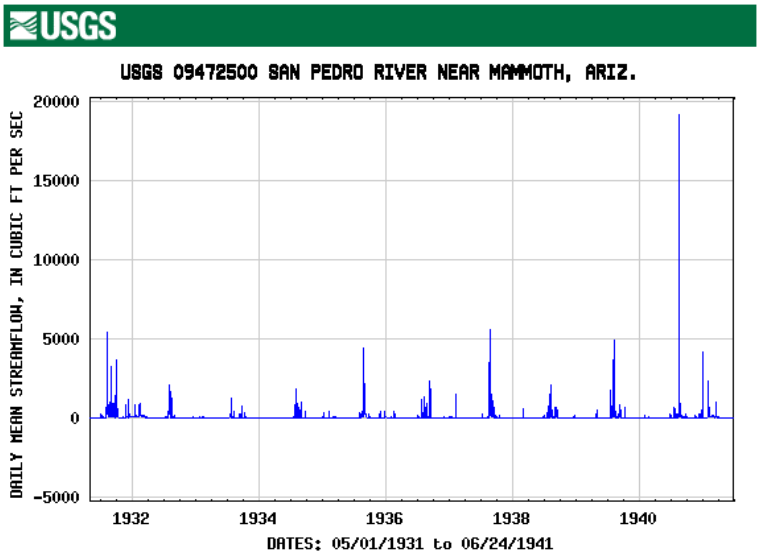

Chart 1. USGS Stream Gauge Data – San Pedro River Near Mammoth Arizona

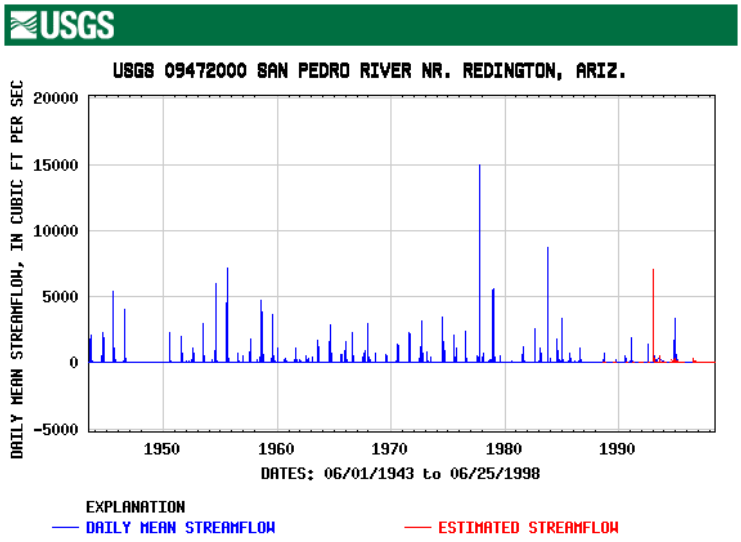

Chart 2. USGS Stream Gauge Data -- San Pedro River Near Redington, Arizona

4.2.2. Ground Water Resources

Based on our review of approximately 40 wells in the Mammoth area [in the Arizona Department of Water Resources Groundwater Site Inventory Database], groundwater depth in the vicinity of the Property ranges from 0 m to 15 meters (0 to 49.2 feet) below surface elevation within the San Pedro River floodplain. Much of the 7B bosque has groundwater only 2 to 6 meters (6.6 to 19.7 feet) below the surface. Depth to groundwater tends to be deeper (8 to 15 meters; 25.7 to 49.2 feet) near or on the alluvial cones of tributaries such as Copper Creek and the small tributary immediately north of Copper Creek Road. This condition is reflected in the smaller stature and lower density of mesquite trees in these areas. Figure 4 depicts depth to groundwater and well location obtained from the ADWR Groundwater Site Inventory Database.

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4-15m
14m
Mammoth Wastewater Treatment Facility
11m
19m
10-15m
16m
13m
10m
7m
16m
14m
9-17m
19m
12m
7m
13m
North Mammoth
27m
4-10m
4m
12-30m
10-20m
7m
6m
5m
8m
71m
18m
8m
77m
6-17m
10m
1-7m
84m
12m
7-18m
29m
5-16m
Mammoth
1-4m
59m
RIVER ROAD
APPROXIMATE PROPERTY BOUNDARY
7B RANCH
2-5m
8-11m
Wells
1-3m
Artesian Well (Hot)
0m
10m
14m
HWY. 77
Mammoth
Cottonwood Wash
Copper Creek Rd
Cemeteries
Drive-in Theater
Windmill
Tank
Smelter
SAN PEDRO RIVER
Wash

Pinal County, Arizona
Look Out Mountain, Mammoth & Clark Ranch USGS 1:24000 Quadrangle

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0' 1200' 2400'
SCALE: 1" = 2400'

LEGEND

42 Depth to Water in Meters

● ADWR Recorded Well Location (approximate)

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ECOLOGICAL OVERVIEW

San Pedro River Parcel

DEPTH TO GROUNDWATER

Figure 4

5. BIOLOGICAL RESOURCES

5.1. VEGETATION AND HABITAT DESCRIPTION

The Property occurs in a diverse region of the state influenced by three major biotic communities. Figure 5 depicts the distribution of biotic communities found along the entire length of the San Pedro River, from its headwaters to its confluence with the Gila River. The headwaters of the San Pedro originate in Petrane Montain Conifer Forest (Brown and Lowe, 1980), near Cananea, Sonora, Mexico. The river then flows north through Plains and Great Basin Grassland and Semidesert Grassland biotic communities. Shortly after crossing the international boundary into Arizona, the river traverses Chihuahuan Desertscrub and finally the Arizona Upland Subdivision of the Sonoran Desertscrub biotic community.

The following section provides a summary of the vegetation associations that occur within the Property and the geomorphic processes that influence their distribution and character. Common plant species observed during field reconnaissance or provided in Appendix A.

5.1.1. Riparian Habitats

The dominant landscape feature within the Property and the most valuable habitat feature of the Property are its mesoriparian and hydroriparian habitat components. Riparian vegetation is defined by its occurrence along stream channels and these vegetation zones are typically more diverse in both flora and fauna populations than surrounding drier regions. Because mesoriparian and hydroriparian vegetation depends on at least intermittent stream flows and/or shallow groundwater from the regional groundwater aquifer, these riparian zones play an important role in the hydrology of a watershed (ADWR, 1990). Riparian habitats that occur in the Property are strongly influenced by geomorphologic processes and depth to groundwater.

The following sections briefly describe the riparian habitats found within the Property. The reader is referred to Figures 3 and 6 for an understanding of the general distribution of these habitats within the Property.

Active Channel/Riverbed: Low flow occurs in the channel many times during each year. The channel is generally sandy to gravelly. As flows subside, finer silts and clays are deposited in the channel. Generally the active channel is bare. The only plants that might colonize the active channel itself would be short-lived plants such as cockleburr (*Xanthium* sp).

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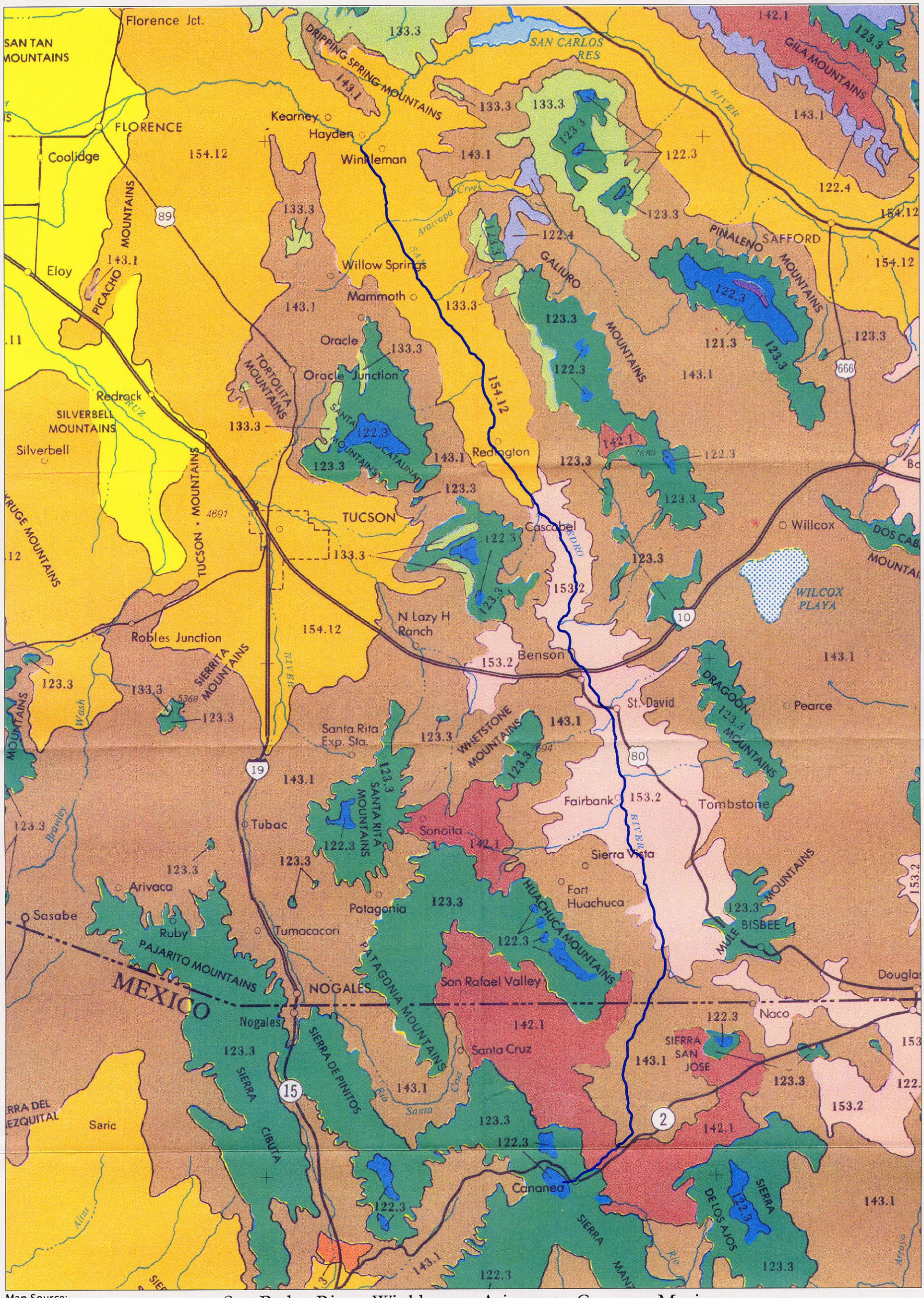

Map Source:
David Brown & Charles Lowe
August 1980

San Pedro River: Winkleman, Arizona to Cananea, Mexico

10 0 10 KILOMETERS

10 0 10 MILES

- San Pedro River
- 122.3 Petran Montane Conifer Forest
- 123.3 Madrean Evergreen Woodland
- 142.1 Plains and Great Basin Grassland
- 143.1 Semidesert Grassland
- 153.2 Chihuahuan Desertscrub
- 154.12 Arizona Upland Subdivision

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ECOLOGICAL OVERVIEW
San Pedro River Parcel

REGIONAL BIOTIC COMMUNITIES MAP
Figure 5

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Photo Source: Project area found on the Mammoth NE, Lookout Mountain SE and Clark Ranch NW & SW, USGS DOQQ aerial photos.

Photo Date: 1992

Mammoth Wastewater Treatment Facility

North Mammoth

Mammoth

River Road

7B Ranch

APPROXIMATE PROPERTY BOUNDARY

HWY. 77

LEGEND

Acreage	Description
1074	Upland Habitat - Sonoran Desert Scrub Arizona Upland (Brown 1994)
270	Xeroriparian Habitat Mesquite Dominant
411	Riverbed
1010	Mesoriparian Habitat Mesquite Bosque
42	Mesoriparian Habitat Tamarisk
176	Degraded Mesoriparian Habitat
193	Agricultural Lands (some may be fallow)
22	Disturbed Habitat
3198	Acres Total Project Area

Disclaimer: Property boundaries are approximate.

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SCALE: 1" = 800 METERS

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RESOLUTION COPPER COMPANY

ECOLOGICAL OVERVIEW

San Pedro River Parcel

VEGETATION HABITAT MAP

Figure 6

Point bars and natural flood channels of the high flow channel. Within the floodway or active channel are a number of point -bars. Point- bars include coarser gravels than the adjacent portions of the active channel and, as a consequence, are stable geomorphic features during low flow events and only modified during high flow events. Woody plants on the point bars are burrobrush *(Hymenoclea monogyra),* saltcedar (*Tamarix chinensis),* and Seepwillow *(Baccharis salicifolia)*. Each of these is capable of resprouting after being knocked over or partially buried during floods. The high flow flood channels can persist undisturbed for years or decades between high flow events. On these older surfaces, woody plants include desert seep weed *(Suaeda torreyana* var. *ramosissima),* velvet mesquite (*Prosopis velutina),* and whitethorn acacia *(Acacia constricta)*. Herbaceous plants include cockleburrs, sacred datura *(Datura meteloides),* and others tolerant of full sun and often sandy soils.

Photograph 5. Active Channel and Point Bar Features

The Property contains approximately 165 hectares (411 acres; 12.8 %) of the Point-Bar and Active Channel zones.

Significantly Aggraded Meandering High Flow Channels. In two areas of the floodplain that become channels or backwaters of the meandering high flow channel, significant aggradation has occurred. We examined closely the one immediately northwest of Highway 77 bridge and found that there was a large revetment that engineers had established within the last several decades. The revetment was built of 12-inch iron pipes driven vertically along the riverbank with additional horizontal pipes and vertical boards. The bank stabilization has been successful with saltcedar trees now freely established in the debris piles against this structure. The revetment begins 40 meters (131.2 feet) downstream from the bridge. During high flow, the river floods through the gap between the bridge and the revetment and deposits sand and silt to depths of 1 meter (3.3 feet) or more across an area about 1.5 km by 500 meters (1640.4 to 546.8 yards). Just how many flood events have been responsible for the deposition is unclear.

However, within the mesquite bosque behind this revetment, most trees have died back about 60 to 80% and some trees are completely dead. Most live mesquite trees are actively resprouting this year. Sediment has been deposited to the greatest depths at the tree bases. Swales 1 meter (3.3 feet) deep occur throughout this area. Aside from herbaceous plants, no colonization of the fresh alluvium by woody plants is evident. Saltcedar is not (yet?) establishing on this fresh alluvium. It appears that these mesquite were unable to tolerate this amount of sedimentation. A contributing factor to the observed dieback and die-off of this mesquite grove may be the depth to groundwater in this area. One well

immediately upstream from the bridge reports depth to groundwater of 5 to 16 meters (16.4 to 52.5 feet). Depth to groundwater for this well does not show a declining trend over the last several decades but there appears to be greater variance in depth over the last decade. Mesquite trees that have received a meter of sediment may no longer rely on lateral roots to match their evapo-transpirative demands. With a sudden loss or series of losses of the groundwater, the trees died. This area totals approximately 71.45 hectares (177 acres; 5.5%) in area.

The second area (on the southwest corner of the Property) is a dense stand of saltcedar with some willow and cottonwood closer to the edge of the active channel. It appears as if this area is flooded during high flow events and the flooding may be influenced by a revetment across the river and upstream from farm fields. The sediment within this area, because the channel is similar in elevation to the active floodway, is likely to be coarser than the sediment in the area downstream from the bridge. The total area of this Mesoriparian saltcedardominated habitat is approximately 16.99 hectares (42 acres; 1.31%) of the Property.

Saltcedar was introduced to the United States approximately 100 years ago (USFWS, 2002a) and has invaded most river systems in the southwestern United States. This species tends to form nearly impenetrable, dense monotypic stands in riparian areas. Researchers have noted that saltcedar tends to replace native riparian vegetation in areas subject to periodic flooding and where the water table is close to the surface (Brown, 1994). The saltcedar stand is located along the inside bend of the river channel. Periodic flooding is more severe in this area than the more upland floodplain terraces where mesquites thrive. Saltcedar stands provide habitat suitable for some species of wildlife, including the endangered southwest willow flycatcher (Brown, 1994; USFWS, 2002a).

Floodplain Alluvium Undisturbed By Floodwaters For More Than 100 Years (Mesquite Bosque). Approximately 811 acres (328 hectares; 25.3%) of the Property contain a healthy, intact mesquite bosque. Velvet mesquite is a common woody legume in southern Arizona. Within the San Pedro Valley, mesquite occurs along the San Pedro River in channels that lead into the San Pedro River, as well as across most of the uplands. On the upland sites, mature mesquites tend to be small shrubs 1 to 4 meters (3.3 to 13.1 feet) in height and occur as scattered individuals. In lowland areas where groundwater is within 15 meters (49.2 feet) of the surface, mesquite occurs in dense stands as trees rather than shrubs (Cannon, 1913). Dense stands of mesquites found in optimal river bottom habitats of southern Arizona are referred to as “bosques” (Spanish for forest). Mesquite bosques attain their maximum development on alluvium of old dissected flood plains, especially those laid down at the confluence of major watercourses and their larger tributaries (Brown, 1994).

Historically, mesquite bosques could be found along major waterways throughout central and southern Arizona. The vast majority of mesquite bosques in Arizona have been reduced or eliminated by woodcutting, conversion to agriculture, urbanization, and groundwater pumping. Because mesquite bosques cannot maintain themselves when ground water levels fall below 15 meters (49.2 feet), the loss

of historic mesquite bosques at San Xaviar, Casa Grande, Koetke, and elsewhere has been attributed to groundwater pumping (Brown, 1994). High demands for fuel wood, groundwater, and agricultural land threaten all remaining mesquite bosques in Arizona.

Because mesquite trees are demonstrably able to tap into groundwater (Unland et al., 1998) and are also capable of N-2 fixation by bacteria in root nodules (Rundel et al., 1982), productivity of mesquite bosques is essentially "decoupled" from the normal limiting factors of water and nitrogen availability.

There is an exemplary mesquite bosque that stretches for about 4.5 km on the east side of the San Pedro River in the center of the Property (Figures 3 and 6). We will refer to this bosque as the 7B Bosque since the old 7B Ranch is located in its center. Copper Creek Road bisects the northern third of the bosque. The confluence of Copper Creek with the San Pedro River marks the southern boundary of this bosque. River Road lies along its eastern length and the San Pedro River channel runs along its western length. The width of this bosque varies from about 500 to 800 meters (546.8 to 874.9 yards). Several attributes of the immediate landscape or of the mesquite trees themselves make this bosque remarkable. Two features are shared with all mesquite bosques - productivity and importance to wildlife. However, there are three additional features that set this bosque apart from nearly all surviving bosques today - an uncapped artesian well, the bosque's relatively great age, and the bosque's resilience to disturbance.

Photograph 6. Mesquite bosque within the San Pedro River Parcel.

One of the features shared with all mesquite bosques in the American Southwest is the remarkable productivity (kg fixed-carbon/ha/yr). Interpolation of various estimates of mesquite bosque productivity would suggest the 7B mesquite bosque produces about 3,000 kg/ha/yr of wood, as much as 2,000 kg/ha/yr in pods, and a significant quantity of leaves, pollen, and nectar annually (based on Duff et al., 1994; Parker and Martin, 1952; Bean and Saubel, 1972; Lovell, 1926; Root, 1966; O'Neal and Waller, 1984). In his review of productivity of vegetation in desert ecosystems, Noy-Meir (1973) identified water as the most limiting factor and nitrogen as the second most limiting factor. Mesquite bosques, unlike most desert plant communities, occur along rivers and their tributaries. It has long been recognized that a primary condition required for the establishment and maintenance of a healthy mesquite bosque is a fairly reliable source of alluvial groundwater less than 15

meters (49.2 feet) below the surface (Cannon, 1913). Shallow depths to groundwater - and mesquite bosques - are generally present only along rivers and their tributaries.

Xeroriparian Habitats. Approximately 270 acres (109.27 hectares; 8.4%) of the Property can be classified as xeroriparian, mesquite-dominant habitat. Xeroriparian habitats are generally associated with ephemeral water. Because water is typically available only during storm events, mesquites in this habitat do not achieve the stature or levels of productivity of mesquites found in bosque habitats. These communities typically contain plant species also found in upland habitats; however, these plants are typically larger and occur at higher densities than adjacent uplands. These xeroriparian habitats are typically associated with desert washes that drain adjacent upland areas on the property. Several well-defined xeroriparian washes flow into the San Pedro River from adjacent uplands to the east and west. These drainages contain well-defined vegetated corridors dominated by mesquite. This habitat type is valuable to both upland and riparian species, providing corridors of increased cover and productivity that link the upland and riparian areas within the region.

Photograph 7. Xeroriparian and Adjacent Upland Habitat within the Property.

Fallow Agricultural Lands. The river floodplains typically occupied by riparian stands consist of deep, well-drained soils that are some of the most agriculturally productive areas in the San Pedro River watershed. Consequently, much of the cultivated lands within the watershed are located in areas that formerly contained riparian vegetation. Approximately 72 hectares (177 acres; 5.5%) of the Property consists of fallow agricultural land. The native mesquite bosque in this area was originally cleared for agricultural uses. If it remains fallow, this agricultural land is expected to readily develop into a mesquite bosque provided sufficient water, as is currently the case, remains available.

Photograph 8. Saguaro within the Property.

5.1.2. Upland Habitats

Approximately 435 hectares (1,074 acres; 33 percent) of the Property is upland, generally classified as Paloverde-Cacti Mixed Scrub Series of the Arizona Upland Subdivision of the Sonoran Desertscrub biome (Brown, 1994). This vegetative community is best represented on bajadas above the San Pedro River floodplain. Dominant plant species in this portion of the Property include foothill palo verde (*Cercidium microphyllum*), saguaro cactus (*Cereus giganteus*), velvet mesquite, triangle leaf bursage (*Ambrosia deltoidea*), creosote bush (*Larrea tridentata*), and several species of cholla cacti (*Opuntia* spp). Representative photographs of this habitat type are provided in Appendix A. There are differences on the east and west sides of the valley that result from differences in the geology of these sites.

Gila Conglomerate. The dominant vegetation within this landform is primarily foothill palo verde, cat-claw acacia *(Acacia greggii),* and whitethorn acacia. Saguaro cactus is uncommon to absent on most of the ridges compared to the upland lacustrine sediments on the east side of the valley. Although we did not quantify the plant cover, our impression is that generally plant cover and woody plant density is greater on the Gila Conglomerate than on the lacustrine sediments. A contributing factor in the greater density is the greater amount of rocks and gravel on the surface and perhaps the greater stability of the slopes.

Lacustrine Sediments. Upland vegetation within this landform is very similar to that on the Gila Conglomerate. Foothill palo verde and acacias are common trees or shrubs in this category. In addition, saguaro cacti are present on nearly all of the ridges and, on some south-facing slopes, locally abundant. The vegetation is sparse or absent on actively eroding surfaces near the tops of ridges. The density of plants (both shrubs and herbs) appears to be denser where the gravel lag or veneer occurs on the ridges. Herbaceous plants also are denser beneath chain fruit cholla (*Opuntia fulgida*). Older chain fruit cholla plants accumulate a dense mat of fallen dead spiny branches on the ground beneath the plant. The fallen joints provide safe-sites for germinating seedlings, safe from foraging rodents and rabbits.

Photograph 9. Desert Tortoise Observed on Upland Habitats within the Property.

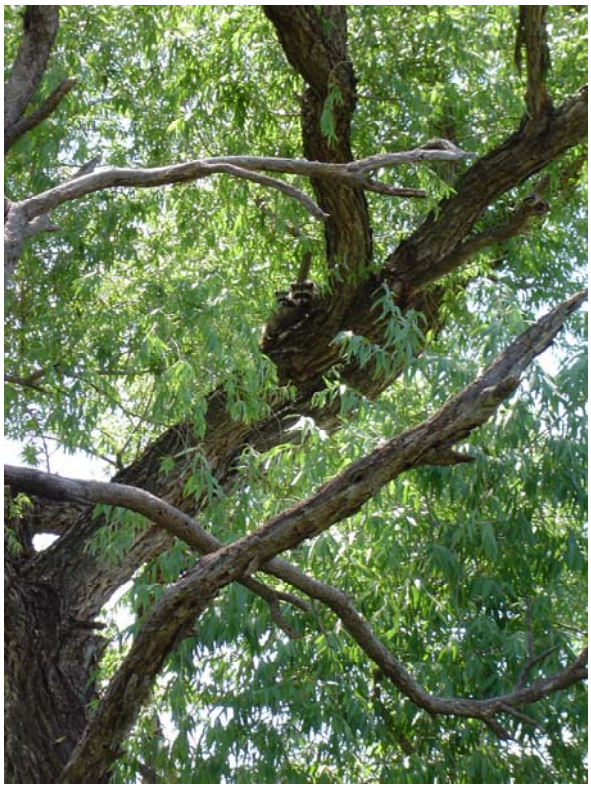
5.1.3. Disturbed Lands

Disturbance includes farmfields, house sites and lots, old canals, sand and gravel borrow pits, and areas of wood cutting. We described in the section on the 7B bosque the rapid reinvasion by mesquite of abandoned farm fields and the rapid regrowth in small areas of woodcutting on the 7B Ranch. In general for most of the Property, disturbed lands are likely to become dominated by mesquite, becoming mesquite bosques close to the river but becoming a

shrubland of short (<2 meters)(6.4 feet) mesquite in the upland areas. The portion of the Property immediately east of Mammoth has possibly been used as a sand and gravel quarry. Large amounts of alluvium have been moved and berms have been created, especially towards the active channel of the river. A few very large athel saltcedar grow at this site.

5.2. WILDLIFE

In general, wildlife species found in the non-riparian areas of the Property are expected to be typical of that found in the Arizona Upland Subdivision of the Sonoran desert scrub biotic community with similar habitats. As with other vegetation communities in the southwestern United States, habitat values for breeding territorial bird species on the Property are expected to be positively correlated with the amount of vegetation (vegetation volume) (Mills et al., 1986). Common reptile and amphibian species that can be expected to occur on the subject parcel include diamondback rattlesnake (*Crotalus atrox*), gopher snake (*Pituophis catenfer*), tree lizard (*Urosaurus ornatus*), desert tortoise (*Gopherus agassizi*); Gila monster (*Heloderma suspectum*), Couch's spadefoot toad (*Scaphiopus couchii*), and red-spotted toad (*Bufo punctatus*). Common bird species expected to occur include northern mockingbird (*Mimus polyglottos*), Gambel's quail (*Callipepla gambelii*), ash-throated flycatcher (*Myiarchus cinerascens*), cactus wren (*Campylorhynchus brunneicapillus*), black-throated sparrow (*Amphispiza bilineata*), Gila woodpecker (*Melanerpes uropygialis*), and verdin (*Auriparus flaviceps*). Common mammals expected to occur on the Property include desert cactus mouse (*Peromyscus eremicus*), desert cottontail (*Sylvilagus audubonii*), desert mule deer (*Odocoileus hemionus crooki*), javelina (*Tayassu tajacu*), and coyote (*Canis latrans*).



Photograph 10. Raccoon with young in Goodding's Willow within the Property.

Wildlife values will be highest in the riparian areas of the Property, particularly within the mesoriparian mesquite bosques. An estimated 60 to 75 percent of Arizona's wildlife species depend on riparian habitats (The Nature Conservancy, 2003a). Virtually all species found in upland areas of the Sonoran Desert are also well represented in, if not dependent upon, riparian habitats. Nesting use of riparian communities by colonies of white winged doves (*Zenaida asiatica*) and mourning doves (*Zenaida macroura*) is well documented (Brown, 1994). Riparian habitats in the San Pedro region are also

important to avian species such as the Abert's towhee (*Piplio aberti*), vermillion flycatcher (*Pyrocephalus rubinous*), cardinal (*Cardinalis cardinalis*), pyrrhuloxia (*Cardinalis sinuatus*), and phainopepla (*phainopepla nitens*), to name a few. A list of species observed by WestLand personnel on the Property is found in Appendix A.

A number of reviews have brought attention to the value of mesquite bosques in providing food and shelter for a large number of animals (ex. Simpson, 1977). When mesquite leafs out in mid-April, the leaves are more nutritious for insects than the mature leaves later in the year (Cates and Rhoades, 1977) and as much as 40 percent of the leaf production is consumed by herbivores annually (Nilsen et al., 1987). Large numbers of both migrant and resident birds feed on the insects feeding on the new mesquite leaves. The Nature Conservancy has estimated that one to four million migratory birds representing 250 species use the San Pedro valley as a migratory corridor each year (www.lastgreatplaces.org/sanpedro/migratory_birds). Many of these birds (ex. Lazuli Buntings [*Passerina amoena*], Black-throated Gray Warblers [*Dendroica nigrescens*], Townsend's Warblers [*Dendroica townsendi*]) are feeding on the herbivorous insects among the new mesquite leaves. The flowers provide nectar and pollen for a wide array of native bees (Simpson et al., 1977), which in turn support a large number of predators including the tarantula hawk wasp (*Pepsis* sp.), crab spiders, ambush bugs and birds. Common reptiles within mesquite bosques include desert spiny lizard *(Sceloporus magister)*, Clark's spiny lizard *(Sceloporus clarkii)*, ornate tree lizard, whiptail lizards *(Cnemidophorus* sp.*)*, gopher snakes, common kingsnakes *(Lampropeltis* sp.*)*, and black-headed snakes *(Tantilla* sp.*)*. Insects and fungi eventually consume dead wood. A subterranean termite (*Heterotermes* sp.) is a significant consumer of mesquite wood. Several times each summer, during or shortly after a monsoon rain, billions of winged termites fly out of mesquite bosques. The numbers of flying termites give the impression of a fog above the bosque. When these flights occur, all kinds of animals - toads, centipedes, bats, birds, lizards - can be seen feeding on the winged termites. A comparable number of animals feed on the mature pods of mesquite. Cattle, deer, javelina, jackrabbits, cottontails, packrats (to name a few) - all include mesquite pods as a significant or primary source of food when the pods mature and fall to the ground in late June and early July. Cattle and javelina dung contain a surprising number of (viable) mesquite seeds at this time. When we visited the 7B mesquite bosque on August 24th, we saw one coyote feeding for several minutes on at least a dozen fallen mesquite pods.

5.3. SPECIAL STATUS SPECIES

The following species list was provided by the USFWS and contains all federally listed Threatened, Endangered, Proposed, and Candidate Species for Pinal County, Arizona. Prior to conducting field reconnaissance, WestLand biologists reviewed this species list, and compared available natural history data for each species with known parameters for the subject lands. This information was used to determine which species have the potential to occur on the Property. The list includes the species' common and scientific name, federal listing status, known distribution and habitat requirements, and the likelihood of occurrence on the Property.

The screening analysis conducted by WestLand indicates that three (3) federally listed threatened, endangered, proposed, and candidate species for Pinal County, Arizona have the potential to occur on the Property. These species include the cactus ferruginous pygmy owl *(Glaucidium brasilianum cactorum)*, southwestern willow flycatcher *(Epidonax traillii extimus),* and yellow-billed cuckoo *(Coccyzus americanus)*. Each of these species is discussed in detail in the following sections.

Table 1. Federally Listed Threatened, Endangered, Proposed And Candidate Species For Pinal County, Arizona

Species	Federal Status	Known Distribution and Habitat Needs	Likelihood of Occurrence in the Project Area
Arizona hedgehog cactus (*Echinocereus triglochidiatus* var. *arizonicus*)	Endangered	Gila, Pinal Counties, 1,128 to 6,615 meters (3,700 to 5,300 ft) elevation above mean sea level. Interior chaparral and madrean evergreen woodland. Grows on open slopes, in narrow cracks between boulders, and beneath the understory of shrubs.	None; The elevation of the subject property ranges from 701 to 792 meters (2,300 to 2,600 ft) elevation, which is below the elevation range for this species.
Bald eagle (*Haliaeetus leucocephalus*)	Threatened	Large trees or cliffs near water (reservoirs, rivers, and streams) with abundant prey.	Low; no potential nesting habitat (large trees or cliffs near water with abundant prey), likely to fly over site.
Cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*)	Endangered	Mature cottonwood/willow, **mesquite bosques**, and Sonoran desertscrub 1,219 meters (<4000 ft) elevation.	Possible; habitat on the property is consistent with that which is known to support CFPO. **Last reported from the lower San Pedro at Dudleyville in the 1980s.**
California brown pelican *(Pelecanus occidentalis californicus)*	Endangered	Coastal land and Islands. Occasionally found on Arizona lakes and rivers.	None; no coastal habitat; found in Arizona only as transient along lower Colorado River or when blown inland by storms.
Desert pupfish *(Cyprinodon macularius)*	Endangered	Shallow springs, small streams, and marshes	None; there is no perennial surface water source that would provide habitat for this species
Gila topminnow *(Occidentalis occidentalis)*	Endangered	Small streams, springs, and cienigas with shallows.	None; there is no perennial surface water source that would provide habitat for this species
Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*)	Endangered	Desertscrub habitat with agave and columnar cacti present as food plants. Occurs at Elevations below 1,829 meters (< 6,000 ft).	Unlikely; Project area is located within summer range of this species. Saguaro cacti may provide a food source.
Loach minnow *(Tiaroga cobitis)*	Threatened	Habitat requirements for this aquatic species include large flowing streams with swift shallows, cobble substrate, and dynamic hydrography.	None; there is no perennial surface water source that would provide habitat for this species
Mexican spotted owl (*Strix occidentalis lucidia*)	Threatened	Nests in canyons and dense forests with multi-layered foliage structure. Occurs between 1,250 to 2743 meters (4,100 to 9,000 ft) elevation.	Not likely to occur in the project area. Project area is below the preferred elevation for this species and does not contain mixed

Table 1. Federally Listed Threatened, Endangered, Proposed And Candidate Species For Pinal County, Arizona

Species	Federal Status	Known Distribution and Habitat Needs	Likelihood of Occurrence in the Project Area
			conifer or old growth ponderosa pine/gambel oak vegetation communities.
Nichol Turk's head cactus *(Echinocactus horizonthalonius var. nicholii)*	Endangered	Habitat is limited to Sonoran desertscrub at the foot of limestone mountains and on inclined terraces and saddles on limestone mountains.	None; the subject property does not contain the limestone habitat required by this species.
Razorback sucker (*xyrauchen texanus*)	Endangered	Lives in backwaters of flowing rivers and streams below 1,829 meters (6,000 ft) in elevation.	None; there is no perennial surface water source that would provide habitat for this species.
Southwestern willow flycatcher (*Epidonax traillii extimus*)	Endangered	Cottonwood/willow and saltcedar vegetation. This species ranges up to 2,591 meters (8,500 ft) in elevation.	Possible; this bird is known to occupy the lower San Pedro River near Dudleyville and Cook's Lake. Patches of suitable habitat on the property have the potential to support this bird.
Spikedace (*Meda fulgida*)	Threatened	Flowing rivers and streams with gravel cobble substrate and swift current. Adapted well to disturbance from frequent flooding and fluctuation in the natural hydrograph.	None; there is no perennial surface water source that would provide habitat for this species.
Yuma Clapper Rail (*Rallus longirostris yumanensis*)	Endangered	This elusive bird requires freshwater and brackish marshes with dense herbaceous vegetation.	None; the subject property lacks the requisite marshes with dense herbaceous vegetation required by this species.
Mountain plover (*Charadrius montanus*)	Proposed Threatened	Open and arid plains, short-grass prairies, and cultivated farms.	Does not occur in the project area. Nearest knows sightings in Arizona are on the Tribal and state lands in Apache County in northeastern Arizona.
Gila chub *(Gila intermedia)*	Proposed Endangered	Found in pools, springs, cienegas and streams at 610 to 1067 meters (2,000 to 3,500 ft) elevation.	None; there is no perennial surface water source that would provide habitat for this species.
Yellow-billed cuckoo (*Coccyzus americanus*)	Candidate	Requires large blocks of dense riparian woodlands. Ranges in elevation up to 1,981 meters (6,500 ft).	Likely; the subject property contains habitat elements suitable for the yellow-billed cuckoo.
Acuña Cactus (*Echinomastus erectocentrus var. acunensis*)	Candidate	Found on well-drained soils on knolls and gravel ridges in Sonoran desertscrub at elevations between 396 and 610 meters (1,300 to 2,000 ft).	None; the elevation of the subject property is greater than the maximum elevation where this species is known to occur.

5.3.1. Cactus Ferruginous Pygmy-owl

The cactus ferruginous pygmy-owl (CFPO) are known to occur from lowland central and southern Arizona (at elevations below 4,000 feet), south through western Mexico to the states of Colima and Michoacan, and from southern Texas south through the Mexican states of Tamaulipas and Nuevo Léon. They are considered non-migratory throughout their range.

CFPO have been reported to be formerly much more widespread in Arizona, occurring regularly as far north as New River (Millsap and Johnson, 1988) though there is little, if any, empirical evidence to support this position. Historically, in Arizona, these owls were found in mesquite woodlands, broadleaf riparian forests, and less commonly in paloverde-mixed cactus forests. However, most recent observations in the Tucson area have been in Upland Sonoran desertscrub habitats associated with low density residential developments. These areas are characterized by dense vegetation dominated by large trees (including desert ironwood, blue paloverde, and mesquite), and having high numbers of mature saguaros and high structural diversity (i.e., well-developed understory, mid-story, and canopy layers). There are some records of CFPO in areas with low densities of saguaros such as in the Altar Valley. Cartron et al. (2000) report that:

> *"the range of vegetation types and diversity of areas cactus ferruginous pygmy-owls are found in Arizona have made it difficult to identify what specific habitat characteristics these owls are selecting."*

Specific habitat requirements for this species have not been identified; however, the wide variety of habitats in which the species has been found throughout its geographic range appear to indicate that the species is adaptable to a wide ranch of upland Sonoran Desert Scrub and riparian habitat types and can be categorized as a habitat generalist.

Within Arizona, the northernmost historic record for CFPO is from New River, Arizona, approximately 35 miles north of Phoenix, where Fisher (1893) reported CFPO to be "quite common"[2] in thickets of intermixed mesquite and saguaro cacti. The Museum of Vertebrate Zoology contains a clutch of four eggs collected by G.F. Breninger on May 18, 1898 in Phoenix, Maricopa County. One additional record exists and is filed under R.D. Lusk with the U.S. National Museum Smithsonian Institution. This record indicates that five eggs were collected at Cave Creek on April 12, 1895 (Caruthers and Johnson, 2003). CFPO were also detected at the Blue Point Cottonwoods area, at the confluence of the Salt and Verde rivers, in 1897, 1949, 1951, and 1964 (AGFD, unpubl. data; Phillips et al., 1964). They were also

[2] There is apparently no quantitative data that defines the qualitative "quite common" reference and the phrase may refer to an individual field evaluation or a perception derived within a limited geographic area. For example: researchers working on CFPO visited an upland site in the Altar Valley several years ago and on a single evening of survey detected seven CFPO along a several mile stretch of road. Based upon these observations and absent other data, they could have concluded that CFPO are "quite common".

detected at Dudleyville on the San Pedro River as recently as 1985 and 1986 (AGFD, unpubl. data and Hunter, 1988).

Throughout the species' range, CFPO nest in cavities in large trees and columnar cacti, and have been known to use artificial nest boxes. The majority of recent nest sites in Arizona have been in mature saguaros; however, currently there are two known nests located in trees (S. Richardson, AGFD, pers. comm. 2001).

The diverse diet of CFPO includes birds, lizards, insects, small mammals (Bendire, 1888; Sutton, 1951; Sprunt, 1955; Earhart and Johnson, 1970; Oberholser, 1974), and frogs (Proudfoot et al., 1996). Recent studies in Texas reported that the numerically most abundant prey items were insects and reptiles (Proudfoot et al., 1996); however, studies in both Arizona and Texas have determined that lizards comprise the largest percentage of biomass to the species' diet (G. Proudfoot, Texas A&M University, pers. comm., 1997; S. Richardson, AGFD, pers. comm., 1997). Abbate et al. (1996) noted that, of 84 prey items either captured near or delivered to the nest, 60 percent were lizards, 8.3 percent were birds, and 4.8 percent were mammals. Cicadas were the only insects large enough to be identified during nest monitoring and represented 4.8 percent of the total prey items. The remainder of the prey items could not be identified through observation (Abbate et al., 1996).

Potential for Occurrence on the Property: Riparian areas and Mesquite Bosques adjacent to upland habitats with saguaro cacti provide suitable habitat for CFPO (USFWS, 2003). Focused surveys for CFPO have not been conducted on the Property. However, there are recent (1980s) records of CFPO occurrence approximately 23 kilometers (14.5 miles) north of the Property along the San Pedro at Dudleyville (Johnson and Carothers, 2003). The majority of potential CFPO habitat in Arizona, including the Property, has not been surveyed as of this writing (USFWS, 2003). Previously unknown populations of CFPO continue to be found in Arizona as previously unsurveyed areas of potential habitat are investigated (USFWS, 2003). The fact that the Property contains high quality potential habitat and is proximate to recent known CFPO locations indicates that the occurrence of CFPO on the Property, while not probable considering the known generally low population numbers of this species at the northern extent of its range, is possible.

5.3.2. Southwestern Willow Flycatcher

A seasonal migrant to southern Arizona, the southwestern willow flycatcher was listed as endangered by the USFWS in 1995 (60 FR 10715). This species winters in parts of Mexico, Central America, and northern South America, though details about its wintering habitat are not well known. Breeding range occurs in parts of California, Arizona, New Mexico, western Texas, southwestern Colorado, southern Nevada and Utah, and extreme northwestern Mexico (USFWS, 1997).

In Arizona, the southwestern willow flycatcher breeds very locally along the Colorado River, the Alamo Lake area, at the headwaters of the Little Colorado and San Francisco rivers, along the middle Verde

River, at Roosevelt Lake, and along the middle Gila and the San Pedro rivers. Five or fewer pairs occupy many of the breeding sites. Birds begin to arrive in early May and are generally gone again by the end of September. Preferred breeding habitat in Arizona varies, but generally consists of dense willow, cottonwood, and saltcedar thickets and woodlands along streams and rivers.

Potential for Occurrence on the Property: The saltcedar thicket along the west side of the riverbed on the Property's south end contains the vegetative components of suitable habitat for the willow flycatcher. However, the absence of surface water within and adjacent to the site likely precludes the occupation of this area under current conditions (USFWS, 2003). The Property is between to two known breeding areas of this bird (upper and lower San Pedro River). The San Pedro River provides a north-south migration route for this species and it is assumed that the Property is utilized by migrating willow flycatcher. If surface water conditions improve, it is possible that the site may become occupied by breeding willow flycatchers in the future.

5.3.3. Yellow-billed cuckoo

The yellow-billed cuckoo (YBC) is a seasonal migrant to the western United States, including Arizona. The species is considered a candidate for listing, but due to current budgetary constraints, higher priority taxa are currently being addressed by USFWS. The species winters in Central and South America, arriving in Arizona in late May and early June for the breeding season (AGFD, 1999). The species has been documented in Arizona as late as September.

The western populations of yellow-billed cuckoo are considered obligate riparian species requiring large tracts of undisturbed riparian forest (AGFD, 1999). Optimal breeding habitat is comprised of tall cottonwoods and mid-successional stage willows, with dense foliage below 10 meters, high relative humidity, and close proximity to water. Less optimal habitat may be important as resting and feeding stops during migration. YBC are known to utilize large mesquite bosques for foraging and breeding, but occur in these habitats a much lower densities (Phillips et. al., 1964).

Breeding for this species in Arizona is presumed to occur along several major river drainages and their tributaries, including the Bill Williams, Colorado, Verde, Gila, Santa Cruz, San Pedro, San Francisco, and the Santa Maria and Big Sandy Rivers (AGFD, 1999). Breeding populations have also been documented on the Tonto Creek inflow to Roosevelt Lake, and Sonoita, Cienega and Arivaca creeks. The highest populations of breeding birds is believed to occur at Cienega Creek (Pima County), Sonoita Creek (Santa Cruz County), and the San Pedro River (Cochise County). Hunter, Ohmart, and Anderson (1986) indicate that on the lower San Pedro River (the reach of the river containing the Property) that YBC populations are still present, in stable condition. The Arizona Game & Fish Department Heritage Database indicates that in 2003, YBC were documented along the San Pedro River approximately four miles north of the Property (Sabra Schwartz, AZGFD pers. comm. September 5, 2003). We have received additional, unconfirmed reports of YBC within the Property from the mid 1980s (Troy Coreman, AGFD pers. comm.).

Hughes (1999) reviewed studies of diets of YBC in the United States and found that YBC feed primarily on large insects. Caterpillars, when abundant, are well represented in their diets. In the western United States, YBC are particularly dependent on cicadas. There are a number of native cicada species in western United States but the best-studied one is the Apache cicada (*Diceroprocta apache*).

Large numbers of Apache cicadas are produced per ha in riparian vegetation in southern and western Arizona. In Arizona, Glinski and Ohmart (1984) monitored 14 riparian plots and three upland plots in the lower San Pedro valley by counting weekly the number of cicada exuvia. They found that upland plots produced no adult Apache cicadas, saltcedar had the highest density of exuvia (136,000/ha/yr), with 14,000 in cottonwood and 7,000 in velvet mesquite. Ohmart et al. (1988) also found higher densities (ca one order of magnitude greater) of Apache cicada in saltcedar compared to cottonwood *(Populus fremontii)*-willow stands in the lower Colorado River. However, Andersen (1994) studying a more homogeneous grove of cottonwood-willow near Parker on the Colorado River found the highest densities of Apache cicada to occur in *cottonwood willow stands*. Andersen (1994, p. 31) found it "noteworthy...that the highest densities reported in these three studies are similar, about 10 cicadas/m²." In a follow-up paper, Ellingson and Andersen (2002) found a negative association between cicada density and saltcedar canopy cover and a positive association between cicada density and canopy cover of*Goodding's willow*. Another study, of the 17-year periodical cicada (*Magicicada cassini*), gives some indication of the significant contribution cicadas can make to biomass productivity. The study by Whiles et al. (2001) and Callaham et al. (2000) was done in riparian and tallgrass vegetation in Kansas. They found that cicada emergence contributed about 3 g N/m² in areas with high cicada densities and, along the Kings Creek riparian forest, approximately 19.6 million cicadas or 4.6 metric tons of ash-free dry mass to the ecosystem.

Rosenberg et al. (1999) considered Apache cicadas to be critical for eight species of birds, including YBC, nesting in riparian vegetation in the Bill Williams River. From their Figure 6 (p. 271) it appears that cicadas, grasshoppers, and mantis each contributed about 30 percent to the summer diets of these birds, both in percent-volume and in percent-frequency. Cicada numbers at least briefly greatly exceed the metabolic requirements of birds dependent on cicadas; they can satiate their predators. In Hughes' (1999) review of YBC, she reports the western US populations of YBC "arrive on the breeding grounds starting mid to late May, 4-8 wk later than eastern cuckoos at the same latitude" (p. 5 and citing Franzreb and Laymon 1993). In fall, the birds depart in late August with most gone by mid September (also earlier by several weeks than the eastern populations of YBC). Hughes also points out that YBC have the shortest developmental period of any altricial bird in North America, **only 17 days** from onset of egg-laying to time of fledgling.

Hughes (1999) review of nest site selection indicates that YBC nest close to the ground. In California, the mean height was 3.5 meters; in Texas, 2.3 meters. The nest is an open structure, poorly constructed on a horizontal branch. Laymon (1980) and Gaines and Laymon (1984) found that thick bushes, vines, or

hedgerows providing dense foliage within 10 m of the ground (Hughes, 1999, p. 13) were important features associated with YBC nests in eastern North America. Cover may protect the nest from discovery by some predators and provide protection from rains and high winds.

There is much here to suggest that YBC natural history, ecology, and probably evolution is integrated with the relative spatial abundance and timing of adult cicada emergence in North America.

Potential for Occurrence on the Property: No YBC were detected by biologists familiar with this species during the four days of field reconnaissance conducted for this ecological overview. However, no focused, protocol surveys were conducted for the YBC and much of the field work occurred outside of the primary breeding season when birds are most vocal (June 15 to August 31) (AGFD, 1999). Without focused surveys, YBC are difficult to detect (AGFD, 1999). For example, Hamilton and Hamilton (1965) estimated that observers would hear less than one call a week if they spent 3 hours a morning in the field. However, they are relatively easy to detect by playing recorded YBC calls. The riparian vegetation on the Property probably should not be considered the most optimal breeding habitat for yellow-billed cuckoo, considering the probable densities of suitable forage material and the general availability of suitable nest locations. However, considering the persistent reports of this species occurrence within the lower reach of the San Pedro River, it seems likely that this species occurs in the Property at some unknown but probably low density.

6. CONSERVATION VALUES AND OPPORTUNITIES

The unique qualities of the San Pedro River ecosystem have earned this riverine system The Nature Conservancy's designation as one of the "Last Great Places on Earth" and it is one of the most important riparian (streamside) habitats in the Sonoran and Chihuahuan Deserts. These "Last Great Places" are special natural areas in the United States, Latin America, Carribean, and the Pacific. Each place harbors concentrations of rare species and excellent examples of endangered terrestrial and aquatic ecosystems. Any of these places, including the San Pedro, provide critical stopover points for migratory birds (The Nature Conservancy, 2003b). The San Pedro's unique location at the crossroads between various eco-regions supports one of the most biologically diverse assemblages of species in the world. This includes over 350 species of birds (almost ½ of the total number of North American bird species), 80 species of mammals, and 65 species of reptiles and amphibians (The Nature Conservancy, 2003a).

The following quote from a TNC web site summarizes the regional values of the San Pedro River system, underscoring the importance of Property to conservation efforts.

> *"The San Pedro River, with its north-south orientation, surface water, and resource abundance, is one of the most important migratory corridors for birds in the Western Hemisphere. Millions of birds that winter in the tropics of Mexico and Central and South America take advantage of the San Pedro's food, shelter, and water on their journeys to and from nesting grounds in the western United States and Canada. The river, a bright green oasis in a desert environment, is like a highway with numerous rest stops, where migrants can rest and refuel. Without these critical stopover areas, many birds might not complete the journey.*
>
> *As a migratory corridor and a lifeline for neotropical migrants, the San Pedro River has hemispheric importance."*
> *(FROM:http://www.lastgreatplaces.org/SanPedro/migratory_birds.html)*

Perhaps the most significant conservation development in the basin was the designation by the U.S. Congress of the San Pedro Riparian National Conservation Area (SPNCA). Designated on November 18, 1988, the SPNCA was established to protect and enhance approximately 23, 4726 hectares (54,000 acres) of riparian habitat along 64 kilometers (40 miles) of the upper San Pedro River between the Mexican border and St. David, Arizona.

In addition to the SPNCA, approximately 31,879 hectares (78,774 acres) of land along the San Pedro River are currently protected within preserves or conservation easements (Pers. comm., The Nature Conservancy, 2003) (Figure 7). Although these protected lands are located throughout the length of the river, the majority of these lands are found within the upper and middle portions of the valley.

SOUTHWEST WILDLIFE SANTUARY

SAN PEDRO RIVER PARCEL

THREE LINKS FARM

SAN PEDRO RIPARIAN NATIONAL CONSERVATION AREA

Base Maps:
Mesa, Tucson, & Nogales
USGS 1:250,000

Conservation Lands Data Source: The Nature Conservancy

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SCALE: 1" = 14 KILOMETERS

WestLand Resources Inc.
Engineering and Environmental Consultants
2343 E. Broadway Blvd., Suite 202
Tucson, Az 85719 (520) 206-9585

RESOLUTION COPPER COMPANY

ECOLOGICAL OVERVIEW

San Pedro River Parcel

CONSERVATION LANDS

Figure 7

Protected lands are less well represented along the lower San Pedro River where the Property is located. Riparian habitats have been placed into conservation status as outcome of permitting efforts, notably the PZ Ranch restoration project implemented by ASARCO as part of its Elder Gulch Tailings Impoundment 404 Permit and the Cooks Lake Conservation area set aside by ASARCO and the Bureau of Reclamation.

Because of its size, the values of the habitats found within the Property, and the relatively undisturbed state of many of its habitats, the conservation and management of the Property for its ecological values would make a substantial contribution to the ongoing efforts to protect and preserve the San Pedro River riparian ecosystem.

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APPENDIX A

COMMON PLANT AND WILDLIFE SPECIES OBSERVED DURING FIELD RECONNAISSANCE

TABLE A1. Plant and wildlife species observed on the 1,295-hectare (3,200-acre) San Pedro River site. This is not intended to be an exhaustive list, just a list of those common species observed.

Common Name	Scientific Name	Common Name	Scientific Name
Plants			
Arizona walnut	*Juglans major*	Fremont cottonwood	*Populus fremontii*
Arrow weed	*Pluchea purpurascens*	Goodding willow	*Salix gooddingii*
Blue palo verde	*Cercidium floridum*	Graythorn	*Ziziphus obtusifolia*
Burrobrush	*Hymenoclea munogyra*	Ocotillo	*Fouquieria splendens*
Canyon ragweed	*Ambrosia ambrosioides*	Prickly pear cactus	*Opuntia englemannii*
Catclaw acacia	*Acacia greggii*	Sacred datura	Datura meteloides
Cholla (spp.)	*Opuntia spp.*	Saguaro cactus	*Carnegiea gigantea*
Cockleburr	*Xnthium sp.*	Saltcedar	*Tamarix chinensis*
Creosote	*Larrea tridentata*	Seepwillow	*Baccharis salicifolia*
Desert broom	*Baccharis sarothroides*	Tree tobacco	*Nicotiana glauca*
Desert seep weed	*Suaeda torreyana var. ramosissima*	Triangle leaf bursage	*Ambrosia deltoidea*
Desert willow	*Chilopsis linearis*	Velvet mesquite	*Prosopis velutina*
Fish hook barrel cactus	*Ferocactus wislizenii*	Whitethorn acacia	*Acacia constricta*
Foothill palo verde	*Cercidium microphyllum*		
Mammals			
Antelope ground squirrel	*Ammospermophilus harrisi*	Desert mule deer*	*Odocoileus hemionus crooki*
Black tailed jackrabbit	*Lepus californicus*	Javalina	*Tayassu tajacu*
Bobcat *	*Lynx rufus*	Raccoon	*Procyon lotor*
Coyote	*Canis latrans*	Rock squirrel	*Citellus variegates*
Mountain lion *	*Felis concolor*	Spotted skunk *	*Spilogale putorius*
Grey fox *	*Urocyon cinereoargenteus*	Striped skunk *	*Mephitis mephitis*
Desert cottontail	*Sylvilagus auduboni*	Woodrat	*Neotoma spp.*
Birds			
Abert's towhee	*Pipilo aberti*	Northern beardless Tyrannulet	*Camptostoma imberbe*
American goldfinch	*Carduelis tristis*	Northern cardinal	*Cardinalis cardinalis*
Barn swallow	*Hirundo rustica*	Northern mockingbird	*Mimus polyglottos*
Black-tailed gnatcatcher	*Polioptila melanura*	Northern rough winged swallow	*Stelgidopteryx serripennis*
Bronzed cowbird	*Molothrus aeneus*	Phainopepla	*Phainopepla nitens*
Brown-crested flycatcher	*Myiarchus tyrannulus*	Pyrrhuloxia	*Cardinalis sinuatus*
Cactus wren	*Campylorhynchus brunneicapillus*	Red-tailed hawk	*Buteo jamaicensis*
Cassin's kingbird	*Tyrannus vociferans*	Road runner	*Geococcyx californianus*
Common raven	*Corvus corax*	Scott's oriole	*Icterus parisorum*
Cooper's hawk	*Accipiter cooperii*	Solitary vireo	*Vireo solitarius*
Curve-billed thrasher	*Toxostoma curvirostre*	Summer tanager	*Piranga rubra*
Gambel's quail	*Callipepla gambelii*	Turkey vulture	*Cathartes aura*
Gila woodpecker	*Melanerpes uropygialis*	Vermilion flycatcher	*Pyrocephalus rubinus*
Great-horned owl	*Bubo virginianus*	Western flycatcher	*Empidonax difficilis*
Hooded Oriole	*Icterus cucullatus*	Western kingbird	*Tyrannus verticalis*
Lesser nighthawk	*Chordeiles acutipennis*	Western wood-pewee	*Contopus sordidulus*
Mourning dove	*Zenaida macroura*	White-winged dove	*Zenaida asiatica*
Northern (Gilded) flicker	*Colaptes auratus*	Wilson's warbler	*Wilsonia pusilla*
Reptiles & Amphibians			
Desert Tortoise	*Gopherus agassizi*	Bullfrog	*Raun catesbeiana*

* These animals were identified by their tracks and/or scat.