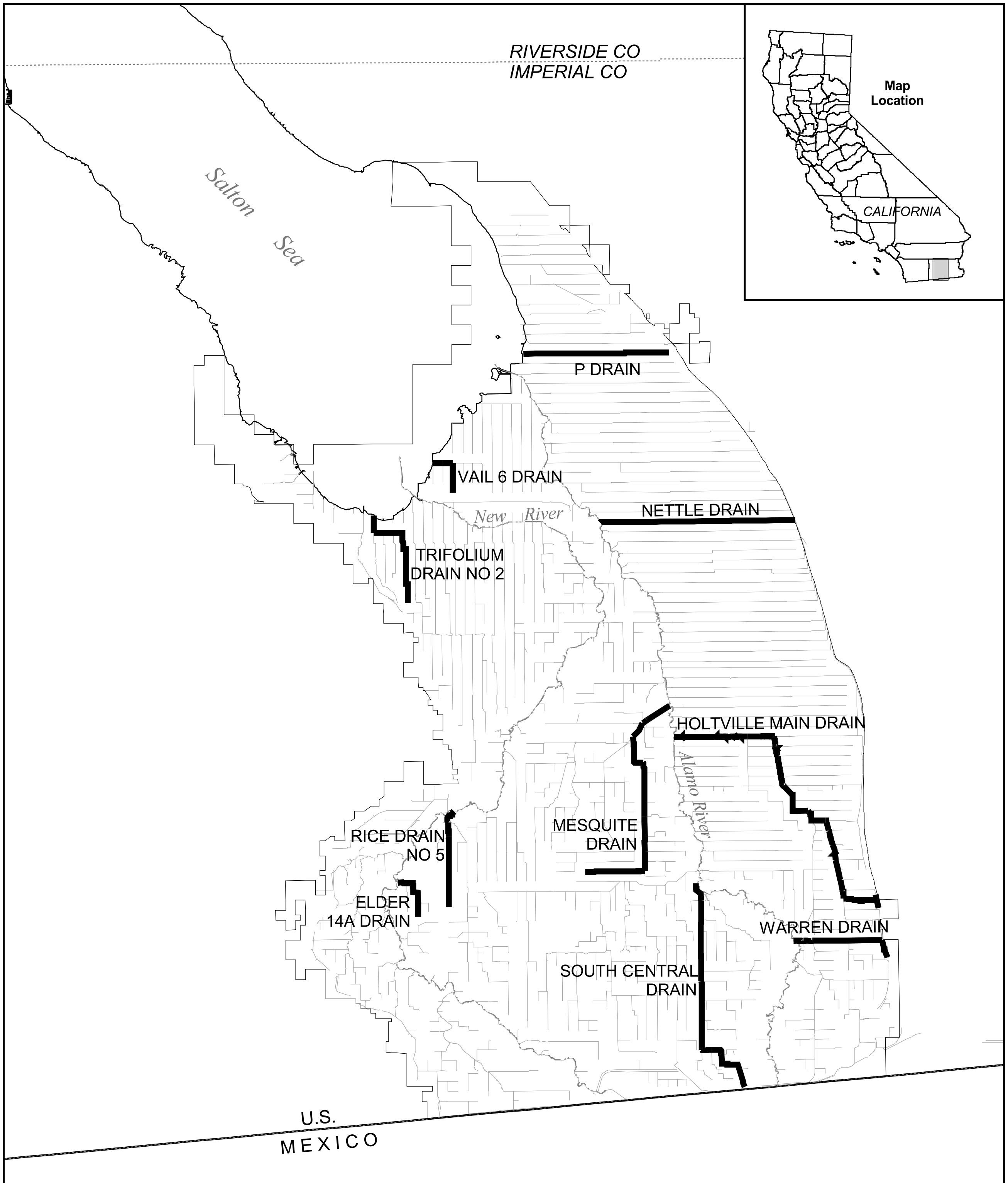

DRAINS SURVEYED BY HURLBERT ET AL 1997

DRAINS

COUNTY LINE

INTERNATIONAL BORDER

RIVER

N

Source:
University of Redlands, 1999;
DOI, 1999; USBR, 1999

5 0 5 Miles

SCALE IS APPROXIMATE

Figure 2.3-3
Drains Surveyed in HCP Area by Hurlbert, et al (1997)

IID Water Conservation and Transfer Project Draft HCP

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Hurlbert (1997) summarized the data in two ways. First, the percentage of the total drain covered by the major vegetation species and cover categories was calculated (Table 2.3-3). This method provides the most accurate characterization of the plant species composition and percentage of the drain supporting vegetation. The second method of summarizing the data focused on habitat characteristics rather than plant species composition (Table 2.3-4). In this method, survey locations with less than a median of 15 percent vegetation cover were classified as bare ground/herbaceous. Survey locations with between 15 and 37.5 percent vegetation cover were classified as sparse cover.

TABLE 2.3-3
Percentage of Drain Area Covered by Each Major Plant Species or Other Habitat Type for the 10 Drains Surveyed by Hurlbert

	Drains									
Vegetation Cover	**Vail Cutoff**	**Trifolium No. 2**	**Elder Nos. 14/14A**	**Rice No. 5**	**Nettle**	**Holtville Main**	**Warren**	**South Central**	**Mesquite**	**P[a]**
Herbaceous	70.7	44.9	32.2	29.2	55.5	22.9	46.3	40.7	34.9	*34.9*
Bare Ground	18.9	31.7	58.9	64.8	31.3	20.7	33.0	41.9	45.8	*45.8*
Atriplex		0.6				2		1.1	3.2	*3.2*
Phragmites	7.5	3.5	2.1	3.3	10.6	7.7	12.9	3.5	0.9	*0.9*
Pluchea		8.7		0.9	0.7	6.8		4.6	5.2	*5.2*
Tamarix		7.6	0.5			29.6	1.0	0.5	3.0	*3.0*
Typha						6.3	1.5	3.8	1.1	*1.1*
Other	2.7	2.9	6.3	1.7	1.7	3.8	5.1	3.7	6.1	*6.1*

[a] Numeric values reported of percent vegetation for P Drain are identical to Mesquite Drain and are inconsistent with other information presented for P Drain. Thus, these values are believed to be incorrect.

Source: Hurlbert 1997.

TABLE 2.3-4
Percent of Different Habitat Types Occurring at Drains Surveyed by Hurlbert

	Drains									
Habitat	**Vail Cutoff**	**Trifolium No. 2**	**Elder Nos. 14/14A**	**Rice No. 5**	**Nettle**	**Holtville Main**	**Warren**	**South Central**	**Mesquite**	**P**
Bare Ground/ Herbaceous	79.2	41.0	88.0	89.2	58.2	13.5	59.1	61.9	48.8	64.3
Sparse Cover	6.3	31.4	8.0	4.9	19.8	22.2	17.2	20.0	36.0	17.1
Phragmites	14.6	2.9	4.0	3.6	19.6	9.4	19.8	3.5	1.2	7.1
Pluchea	0	13.3	0	0	1.5	6.4	0	6.2	6.0	5.5
Tamarix	0	10.5	0	0	0	35.1	0	0.5	0	0
Phragmites/ Pluchea	0	0	0	2.5	0.5	0	0	0.5	0	5.5
Atriplex	0	0	0	0	0.5	0	0	0.5	0.4	0
Typha	0	0	0	0	0	7.6	0	0	0.8	0

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TABLE 2.3-4
Percent of Different Habitat Types Occurring at Drains Surveyed by Hurlbert

	Drains									
Habitat	**Vail Cutoff**	**Trifolium No. 2**	**Elder Nos. 14/14A**	**Rice No. 5**	**Nettle**	**Holtville Main**	**Warren**	**South Central**	**Mesquite**	**P**
Tamarix/ Pluchea	0	0	0	0	0	3.2	0	6.7	0	0
Phragmites/ Tamarix	0	1.0	0	0	0	0	3.9	0	0	0
Tamarix/ Typha	0	0	0	0	0	1.8	0	0	0	0
Tamarix/ Other	0	0	0	0	0	0.8	0	0	0	0
Pluchea/ Atriplex	0	0	0	0	0	0	0	0	0	0.7
Other	0	0	0	0	0	0.4	0	0.5	6.8	0

Source: Hurlbert 1997.

The qualitative descriptions from the 1994 EIR and Hurlbert (1997) data show that vegetation typically is very limited along the drains. Both studies also indicate that common reed (*Phragmites* sp.) is the most prevalent plant species. Cattails are uncommon and occur in small, localized areas. With the exception of small, localized areas of cattails and occasionally bulrushes, the drains do not support emergent vegetation. As such, habitat availability and quality for marsh-associated species are poor.

The data reported by Hurlbert (1997) were used to estimate the acreage of vegetation supported by IID's drainage network. Hurlbert (1997) only characterized vegetation between the drain banks. A standard lateral drain (excluding the water surface) is about 14 feet wide at the top of the drain embankment (Figure 2.3-4). Assuming all drains are 14 feet wide, the 1,456 miles (cited from IID Memorandum, dated October 4, 2000) of drains in the Imperial Valley cover 2,471 acres. However, as described above, potential habitat includes only a small proportion of the drains. The average percent cover of bare ground and herbaceous cover[2] was calculated for each of nine drains from data in Hurlbert (1997).[3] The remaining portion of the drain was assumed to be vegetated. It was then assumed that the drains surveyed were a representative sample of all drains in the Imperial Valley. Acres of vegetation supported by the entire drainage system were calculated based on the percentage vegetation supported by the drains surveyed weighted by the drain's length. With this method, an estimated 652 acres of vegetation are supported in the drains.

[2] Herbaceous cover consists of annual weedy vegetation that provides little or no habitat value to wildlife.

[3] As noted in Table 2.3-4, data presented for P Drain in Hurlbert (1997) are believed to be incorrectly reported. As such, data from P Drain were not used in this analysis.

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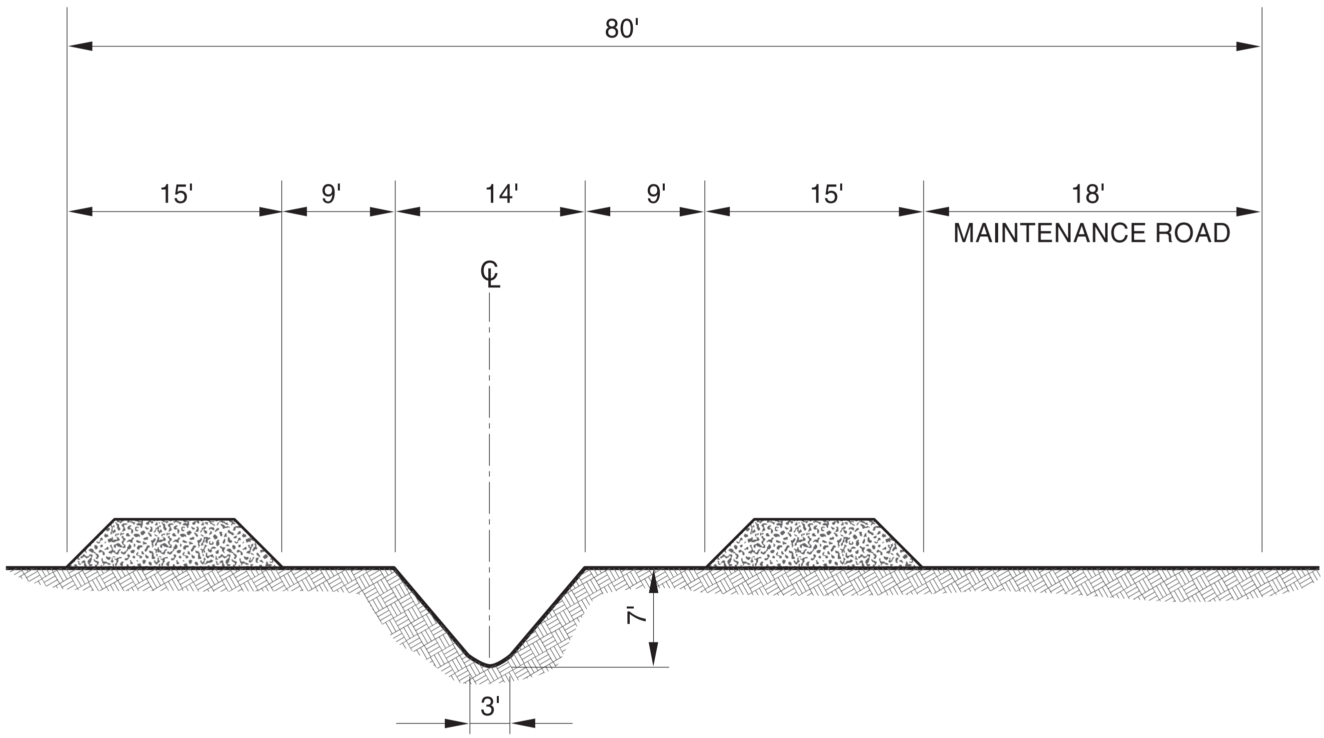

Figure 2.3-4
Typical Lateral Drain Profile
IID Water Conservation and Transfer Project Draft HCP

Survey locations with 37.5 percent vegetation cover or greater were classified according to the dominant vegetation species (Table 2.3-4). Values reported in Tables 2.3-3 and 2.3-4 are the average of winter and spring surveys.

Hurlbert's (1997) quantitative data are consistent with the qualitative descriptions of the drains reported in the 1994 EIR (IID 1994). The first method used to characterize vegetation showed that herbaceous cover and bare ground comprised the majority of the drains (median equals 82.7 percent, range 43.6 to 94 percent). With the exception of Holtville Main Drain, herbaceous cover and bare ground comprised about 75 to 95 percent of the drains. The second method used to characterize drain habitat showed a similar pattern. Bare ground/herbaceous cover and sparse cover comprised 72 to 96 percent of the drains, except for the Holtville Main Drain where these habitats covered only 35 percent of the drain.

As noted above, the nine drains surveyed were assumed to be a representative sample of the entire drainage system. This assumption may not be accurate but is necessary in the absence of more complete information. In particular, the Holtville Main Drain is an unusual drain. Good water quality combined with the drain's large size results in Holtville Main Drain supporting substantially more vegetation than is typical for drains. As shown by Hurlbert's data, Holtville Main Drain is 56 percent vegetated while the next most vegetated drain (Trifolium 2) is only 23 percent vegetated. The remaining drains surveyed have less vegetation. Holtville Main Drain was also the longest drain surveyed at 17.8 miles followed by South Central Drain at 12.2 miles. Because the estimate of the amount of vegetation in the drainage system was derived from the percentage of vegetation in each of the drains surveyed weighted by their lengths, inclusion of Holtville Main Drain (the longest drain with an atypical amount of vegetation) may have resulted in an overestimation of the amount of vegetation in the entire drainage system.

Only a small proportion of the vegetated acreage consists of cattails which are favored by wildlife species associated with drain habitats. The Holtville Main Drain had the greatest percentage of cattails at 6.3 percent followed by the South Central, Warren, and Mesquite Drains at 3.8, 1.5, and 1.1 percents, respectively. The remaining five drains did not support cattails. For the nine drains, the average percent cover of cattails weighted by drain length was 2.5 percent. Based on this average, the entire IID drainage system supports about 63 acres of cattail vegetation.

Conveyance System

Canals that convey water from the Lower Colorado River to customers within the IID service area support little vegetation. Approximately 70 percent of the 1,667 miles (cited from IID Memorandum, dated October 4, 2000) of canals in Imperial Valley are concrete-lined or in pipes, and therefore do not support rooted vegetation. Embankment slopes of the lined canals also are maintained free of vegetation. About 537 miles (cited from IID Memorandum, dated October 4, 2000) of the delivery system consist of earthen channels. The canal slopes can support vegetation that typically consists of bands of vegetation at the water surface. The bands of vegetation consist of common reed, saltgrass, Bermuda grass, and seedling salt cedar. Tree and shrub cover are rare or nonexistent on most canals and laterals (IID 1994). Along the AAC, an almost continuous thick stand of common reed, 3- to 15-feet wide) grows along both sides of the canal for the majority of its length. The 30-mile long section of the AAC between Pilot Knob and Drop 4 supports about 30 acres of common reed (Reclamation and IID 1994). Vegetation along the canals is of minimal value to wildlife because it has little emergent vegetation and water velocity and depth in the canals are too great for most species.

Water seepage has induced phreatophytic vegetation[4] to develop along the AAC in a landscape previously dominated by dry, desert scrub. Between Drops 2 and 3, about 100 acres of scattered phreatophytic vegetation is supported by seepage. Only about 1 acre is emergent wetland vegetation. The remaining vegetation consists of screwbean and honey mesquite (22.6 acres), salt cedar (28.7 acres), and arrowweed (47.2 acres). However, under the AAC lining project this portion of the AAC will be abandoned and this vegetation will be lost. Effects of loss of this habitat on listed species have been evaluated in a previous Section 7 consultation. For this HCP, the lining project is assumed to be in place. A larger (1,422 acres) marsh complex that will not be affected by the AAC lining project is located between Drops 3 and 4. Marsh vegetation comprises about 111 acres of the complex. The other vegetation present within the complex includes salt cedar (755 acres), arrowweed (233 acres), screwbean mesquite (251 acres), cottonwood and willow (39 acres).

In addition to these areas, phreatophytic vegetation supported by seepage from the AAC exists between Drop 4 and the East Highline Canal. This area is about 100 to 150 acres in size. Closer to the Lower Colorado River in the vicinity of Mission Wash, seepage from the AAC probably contributes to supporting several areas of phreatophytic vegetation totaling about 100 acres. The vegetation composition of these areas has not been determined, but would be expected to exhibit a plant species composition similar to that found in other seepage areas along the AAC.

Seepage communities along Imperial Valley canals are rare and are generally limited to areas adjacent to the East Highline Canal. As part of the system-based water conservation activities, IID may install seepage recovery systems along portions of the west side of the East Highline Canal (Chapter 1, Section 1.7.2.2). Seepage communities in the vicinity of proposed seepage recovery systems were digitized from Digital Orthophoto Quarter Quadrangles (DOQQ) and visited during May 2001 to assess general vegetation characteristics. Seepage communities also occur on the east side of the East Highline Canal but these areas would not be affected by covered activities. The location of seepage communities in the vicinity of proposed seepage recovery systems is shown on Figure 2.3-5 and the sizes of the seepage areas are listed in Table 2.3-5.

The plant species composition of the seepage communities is diverse and varies substantially among the seepage areas. Arrowweed, common reed, and tamarisk are the most common species in the seepage communities, with mesquite, cattails and a few cottonwoods present in some areas. About 412 acres of vegetation supported by seepage from the East Highline Canal occurs in areas where seepage recovery systems are under consideration.

Unmanaged Vegetation Adjacent to the Salton Sea

Vegetation has naturally developed in some locations along the margins of the Salton Sea. This phreatophytic vegetation occurs above the shoreline and shoreline strand community (see the following discussion of tamarisk scrub habitat). Unmanaged vegetation includes

[4] Phreatophytic vegetation is vegetation associated with wet areas. In the HCP area, phreatophytic plant species include tamarisk, common reed, willows, and cattails.

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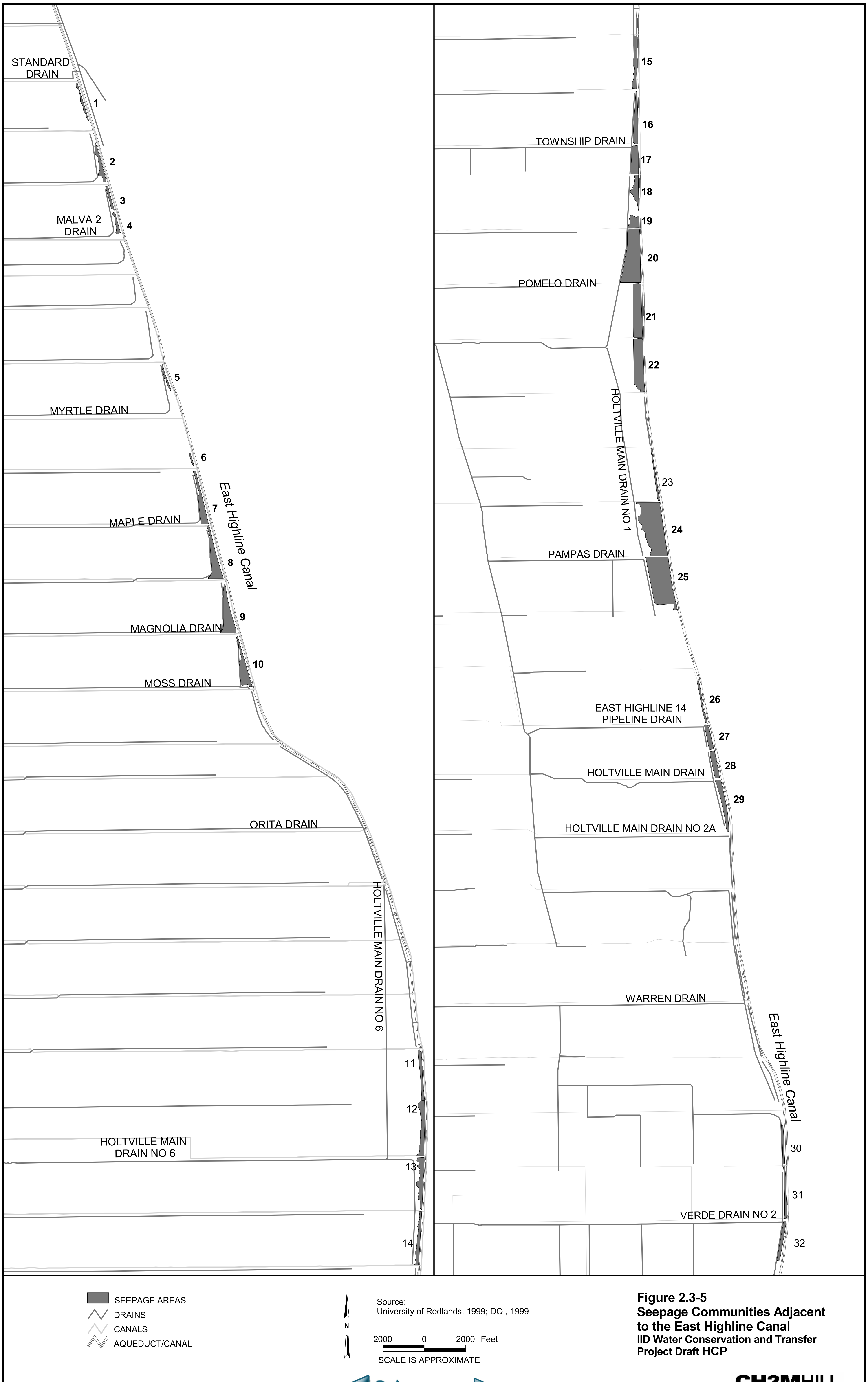
TABLE 2.3-5
Seepage Communities Along the East Highline Canal. Area ID refers to Figure 2.3-5.

Area ID	Acres	Area ID	Acres
1	3.2	17	10.2
2	6.8	18	7.9
3	3.1	19	6.1
4	3.3	20	43.3
5	2.0	21	24.8
6	0.9	22	26.6
7	11.9	23	3.8
8	16.1	24	56.6
9	18.1	25	54.9
10	13.5	26	3.6
11	6.8	27	5.7
12	13.4	28	7.0
13	12.3	29	11.0
14	8.3	30	3.5
15	6.5	31	5.6
16	9.4	32	6.0
Grand Total		**412.2**	

diked wetlands that are below the water surface elevation of the Salton Sea. The Salton Sea database (University of Redlands 1999) refers to these unmanaged areas of phreatophytic vegetation as "adjacent wetlands."

The Salton Sea database (University of Redlands 1999) classifies 6,485 acres along the Salton Sea as adjacent wetlands, and 64 acres as mudflat. Tamarisk and iodine bush are the most common species of adjacent wetlands (Figure 2.3-6; Table 2.3-6). Cattails and bulrushes are identified as the primary vegetation on 217 acres of adjacent wetlands. In the HCP area, the Salton Sea database identifies three parcels as being dominated by cattails: one on the southwestern edge of the Salton Sea (35 acres), and two on the southern edge (32 acres). A fourth parcel on the eastern edge of the Salton Sea is dominated by bulrushes (17 acres). However, three of these areas are misclassified in the Salton Sea database. The first parcel of 35 acres is a managed duck club and therefore does not meet the definition of an "adjacent wetland" (i.e., unmanaged areas). Of the two parcels totaling 32 acres, one is an IID drain and the other is a marsh managed by the U.S. Fish and Wildlife Service (USFWS). The drain parcel is managed by IID as part of its drainage system. Habitat in this drain was accounted for in the quantification of habitat in the drainage system above. The other parcel managed by USFWS does not meet the definition of an adjacent wetland (i.e., unmanaged areas). The last parcel encompassing 17 acres is sustained by runoff from the California Department of Fish and Game (CDFG's) managed marsh area in the Wister Unit. The remaining 133 acres



Source:
University of Redlands, 1999; DOI, 1999

Figure 2.3-5
Seepage Communities Adjacent to the East Highline Canal
IID Water Conservation and Transfer Project Draft HCP

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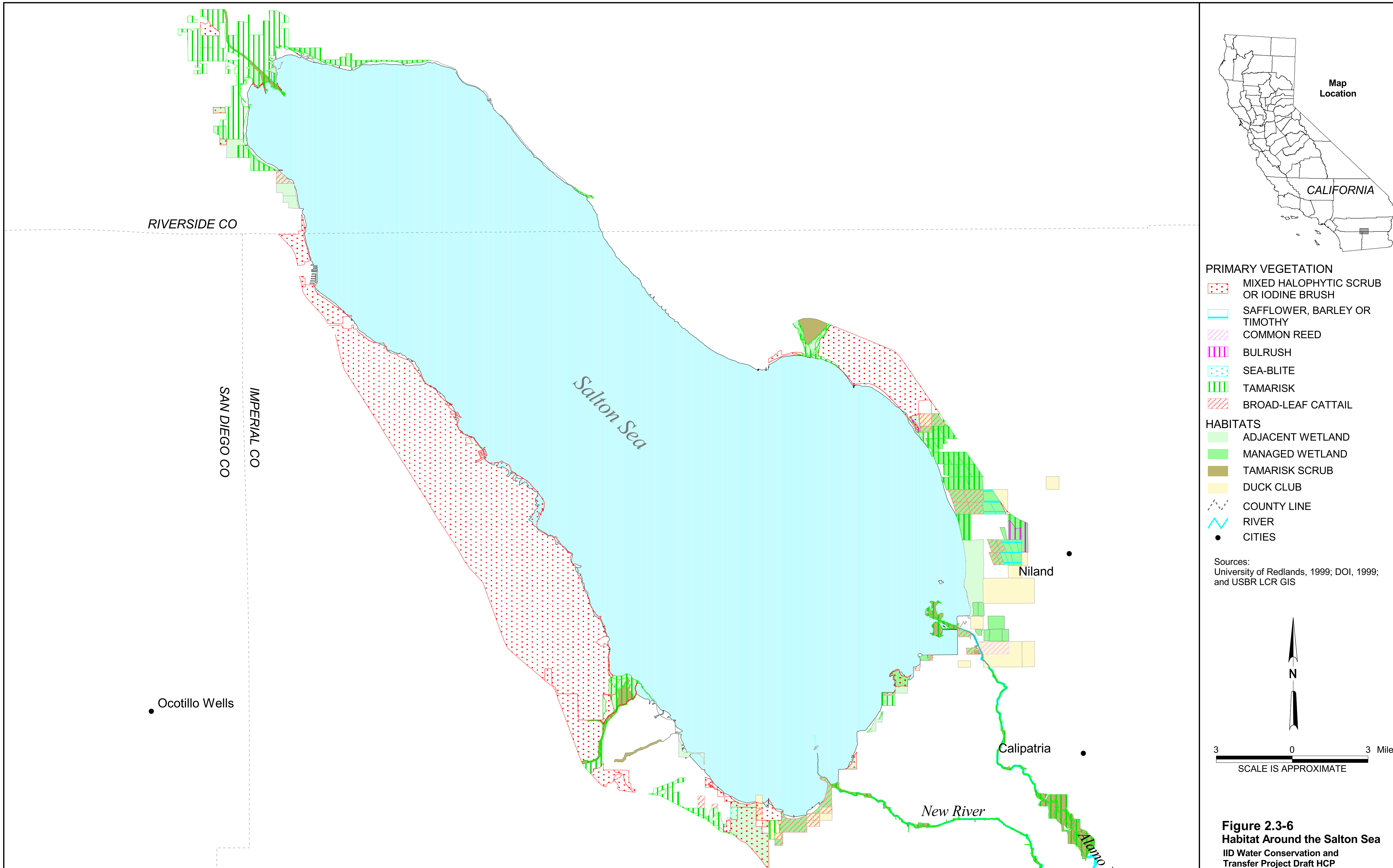

Figure 2.3-6
Habitat Around the Salton Sea
IID Water Conservation and Transfer Project Draft HCP

identified as adjacent wetland dominated by cattail or bulrush occur adjacent to the northwestern portion of the Salton Sea. This area is outside of the HCP area.

TABLE 2.3-6
Primary Vegetation of Areas Classified as Adjacent Wetlands in the Salton Sea Database

Primary Vegetation	Total Acres at Salton Sea	Percentage of Adjacent Wetlands	Acres in HCP Area
Iodine bush	1,577	24	1,509
Mixed halophytic shrubs	65	1	-
Arrowweed	597	9	-
Bulrush	17[a]	<1	17
Sea-blite	86	1	86
Tamarisk	2,349	36	437
Cattail	200[a]	3	67
No primary wetland vegetation	1,595	25	1,305
Total	**6,485**		**3,421**

[a]See text for further description of these areas.
Source: Salton Sea Database (University of Redlands 1999)

Managed Marsh

Managed marsh consists of areas that are actively managed for one or more marsh habitat values and functions. In the HCP area, managed marsh occurs primarily on the state and federal refuges. Private duck clubs also support managed marsh.

The Imperial Wildlife Area (WA), managed by the CDFG, and the Sonny Bono - Salton Sea National Wildlife Refuge (NWR), managed by the USFWS lie within the HCP area (Figure 2.3-7). Both of these refuges were established to provide winter habitat for migratory waterfowl. However, in addition to providing habitat for migratory waterfowl, both refuges are managed to provide habitat for a wide diversity of resident and migratory wildlife. The refuges are also managed to provide marsh habitat and offer the highest quality, year-round marsh habitat value in the HCP area. Both Imperial WA and the Sonny Bono Salton Sea NWR receive irrigation delivery water from IID. Agricultural drainage water is not used on the refuges.

The HCP area also contains 17 private duck clubs, covering about 5,582 acres. Most of the duck clubs are near the Salton Sea. These clubs are managed exclusively to attract wintering waterfowl, although other wildlife will use these marsh areas when available. Managed marsh units on the duck clubs are flooded in fall and winter when wintering waterfowl are present in the valley. They are not flooded during other times of the year; therefore they do not provide habitat for year-round resident wildlife that are associated with marsh habitat. Generally duck clubs receive irrigation delivery water from the IID.

2.3.2.2 Tamarisk Scrub Habitat

Native riparian plant communities in the southwestern desert are dominated by cottonwoods and willows, but palo verde and mesquite also occur. Much of the native riparian plant communities in the desert southwest has been replaced by nonnative plant species, particularly tamarisk. Tamarisk scrub communities supplant native vegetation

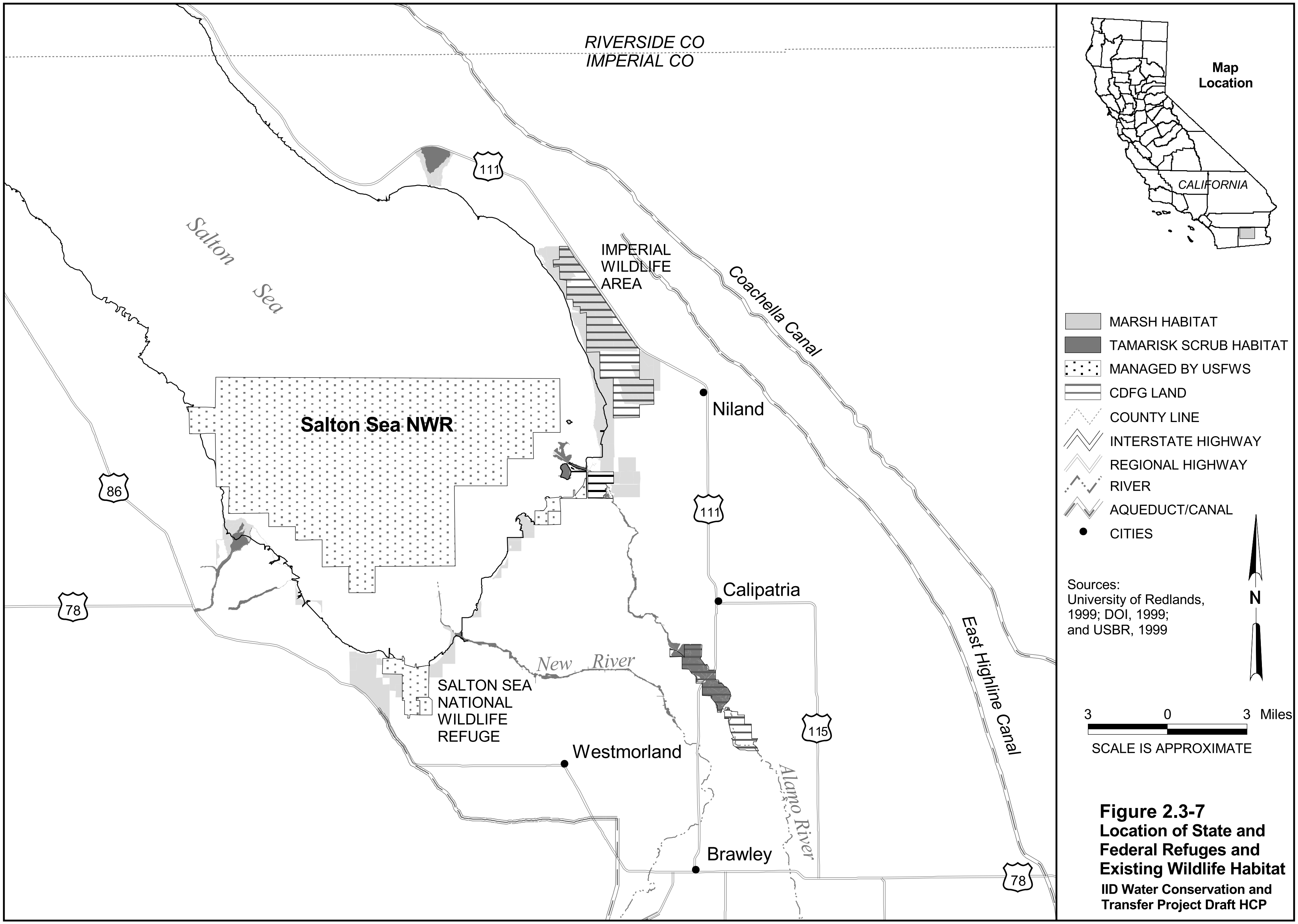

Figure 2.3-7
Location of State and Federal Refuges and Existing Wildlife Habitat
IID Water Conservation and Transfer Project Draft HCP

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following major disturbance, including alterations in stream and river hydrology, and can form extensive stands in some places. Characteristic species include salt cedar (*Tamarix chinensis, T. ramosissima*), big saltbrush (*Atriplex lentiformis*), *Coldenia palmeri*, and saltgrass (*Distichlis spicata*); associate species can include common reed (*Phragmites communis* var. *berlandieri*) and giant reed (*Arundo donax*).

In the HCP area, tamarisk scrub is found along the New and Alamo Rivers. Areas along the New River are composed of a virtual monoculture of tamarisk, with only a few areas of native vegetation. Vegetation along the Alamo River is similarly dominated by tamarisk. Dredging has extended the river channels of both the New and Alamo Rivers into the Salton Sea. The banks of the extended river channels support a thick strand of tamarisk and common reed.

The width of tamarisk scrub stands adjacent to the New and Alamo Rivers varies substantially along their lengths. Based on a review of DOQQs, much of the length of the rivers supports only a narrow band of tamarisk of less than 50 feet on both sides of the channels. In more limited portions of the rivers, larger stands of tamarisk have developed that may extend 500 feet or more from the river channel. To estimate the amount of tamarisk scrub habitat occurring along the floodplains of the New and Alamo Rivers, vegetation along the rivers was digitized from the DOQQs. Vegetation along the rivers was assumed to consist of tamarisk scrub. Based on this work, the New and Alamo Rivers support about 2,568 acres and 962 acres of tamarisk scrub habitat respectively, for a total of 3,530 acres.

Tamarisk scrub occurs in other portions of the HCP area, wherever water is available, including the margins of the Salton Sea (Table 2.3-4). Tamarisk scrub is also one of the major plant species comprising vegetation along the drains and is found in seepage areas adjacent to canals. The HCP area contains about 438 acres of the tamarisk-dominated areas adjacent to the Salton Sea (University of Redlands 1999). The source of the water that supports tamarisk adjacent to the Salton Sea is uncertain, but is likely the result of shallow groundwater and seepage rising to the surface at its interface with the sea. In addition to the adjacent wetlands, tamarisk is a primary component of areas designated as shoreline strand community in the Salton Sea database. The shoreline strand community occupies about 293 acres (University of Redlands 1999) immediately adjacent to the Salton Sea and consists of tamarisk and iodine bush. As with the tamarisk-dominated areas adjacent to the Salton Sea described above, the source of water supporting this community is undetermined, but is likely the result of shallow groundwater and seepage rising to the surface at its interface with the sea. Along IID's drainage system, Hurlbert (1997) can be used to estimate the acreage of tamarisk scrub supported by the drains. Of the drains surveyed by Hurlbert (1997), the percentage of drain area comprised of tamarisk varied from 0 to 29.6 percent (Table 2.3-3), yielding a weighted average percentage of 8.7. Assuming that tamarisk covers 8.7 percent of the drains, the drainage network in the HCP supports about 215 acres of tamarisk scrub habitat.

Cottonwood-willow habitat is largely absent from the HCP area. Cottonwoods and willows occur in seepage communities along the AAC. In addition, some remnant cottonwoods occur in Imperial Valley at distances of 20 to 60 feet from the East Highline Canal (IID 1994). A few patches of willow also persist along the Alamo River.

2.3.2.3 Agricultural Field Habitat

Irrigated agricultural land is the predominant land cover type in the Imperial Valley, and comprises most of the HCP area. Agricultural fields attract a variety of wildlife species. The crops grown, the methods used and the total acreage in production within IID's service area are based on the decisions of individual farmers. Current and anticipated market prices have an important role in the types of crops that are economically beneficial for farmers to grow. As a result, the total acreage in agricultural production and the types and amount of crops grown fluctuate from year-to-year. The different types of crops and the range of acreage of each of the major crops grown within the service area for 1999 are shown in Table 2.3-7. The cropping pattern is likely to be similar to Table 2.3-7 for the short term, but could change during the term of the permit as markets for various crops or other conditions change.

2.3.2.4 Salton Sea Habitat

Wildlife habitats at the Salton Sea have been largely described previously in Section 2.3.2.1, Drain Habitat and Section 2.3.2.2, Tamarisk Scrub Habitat. However, for the species covered by the HCP, use of the Salton Sea is a function of the abundant food resources, availability of a large, open body of water, and the presence of unique habitat features, rather than vegetation composition. The following discussion focuses on the food resources and food chain relationships, and unique habitat features supported by the Salton Sea.

Food Chain Relationships

The Salton Sea is considered eutrophic with plentiful phytoplankton, a condition that often results in algal blooms (Hurlbert 1999a). The dominant primary producers are phytoplankton and phytobenthos; plant life in the Salton Sea predominantly is single-celled algae. Major groups of algae include diatoms (*Chrysophyta*), dinoflagellates (*Pyrrophyta*), and green algae (*Chlorophyta*) (Carpelan 1961). Blue-green algae (*Cyanophyta*) have also been found on the seafloor in shallow water and on buoys and pilings in the Salton Sea. During recent sampling, several new species of diatoms were observed (Hurlbert 1999b). Many of the previously observed species are still present in the Salton Sea. The phytoplankton composition changes may be caused by an increase in the salinity of the Salton Sea, as well as from the introduction of tilapia (Hurlbert 1999b).

Within the Salton Sea, five phyla of invertebrates are represented: Protozoa, Rotifera, Nematoda, Annelida, and Arthropoda. Some of the common invertebrates found in the Salton Sea include ciliate protozoans, foraminifera, rotifers, copepods, barnacle, pileworm, amphipod, and the water boatman (a corixid). The rotifer *Brachionus plicatilis* is the dominant rotifer species, is completely planktonic, and has great value as food for larval fishes. The pileworm *Neanthes* is a major food source for fish and some birds and is a significant species in the benthos of the Salton Sea. Pileworms have been abundant since their introduction to the Salton Sea during the 1930s and are the principal detritus-feeding benthic organisms in the Salton Sea.

The major zooplanktonic organisms in the Salton Sea include *Brachionus*, copepods (*Apocyclops dengizicus, Cletocamptus dietersi*), the egg and larval stages of the pileworm, and the larval stages of the barnacle (*Balanus amphitrite saltonensis*). Other zooplanktonic species

TABLE 2.3-7
Crops Produced (Greater Than 200 Acres) in IID Service Area During 1999

Crop Description	Acres	Percentage
Alfalfa (all)	192,633	35.56
Sudan grass (all)	62,881	11.61
Bermuda grass (all)	55,179	10.19
Wheat	42,464	7.84
Sugar beets	33,997	6.28
Lettuce (all)	22,558	4.16
Carrots	16,995	3.14
Melons, spring (all)	14,293	2.64
Broccoli	12,305	2.27
Onions	11,526	2.13
Duck ponds (feed)	9,105	1.68
Cotton	7,131	1.32
Ear corn	6,790	1.25
Citrus (all)	6,169	1.14
Asparagus	6,166	1.14
Cauliflower	3,960	0.73
Onions (seed)	3,541	0.65
Potatoes	3,159	0.58
Klien grass	3,113	0.57
Rape	3,034	0.56
Rye grass	3,034	0.56
Vegetables, mixed	2,162	0.40
Watermelons	2,158	0.40
Tomatoes, spring	2,024	0.37
Melons, fall (all)	2,019	0.37
Rapini	1,323	0.24
Fish farms	1,293	0.24
Cabbage	1,284	0.24
Spinach	1,229	0.23
Garbanzo beans	1,057	0.20
Barley	868	0.16
Field corn	844	0.16
Pasture, permanent	701	0.13
Peppers, bell	429	0.08
Garlic	308	0.06
Flowers	279	0.05
Oats	212	0.04

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that occur in the Salton Sea include brine shrimp, brinefly larva, and some surface-dwelling insects. The remaining invertebrate species or life stages are primarily benthic. Organisms that need to attach permanently to a hard surface are limited to the few rocky areas, docks, debris, or inundated brush along the shore.

Fish species inhabiting the Salton Sea are adapted to living in high-salinity waters. Most of the fish are nonnative species (Walker 1961; Dritschilo and Pluym 1984; and Setmire et al. 1993) that have been introduced from the Gulf of California by CDFG. Fish found in the Salton Sea include the sport fish sargo (*Anisotremus davidsoni*), orangemouth corvina (*Cynoscion xanthulus*), Gulf croaker (*Bairdiella icistia*), and other fish species listed in Table 2.3-8.

TABLE 2.3-8
Fish Species Present in the Salton Sea

Sargo (*Anisotremus davidsoni*)	Mosquitofish (*Gambusia affinis*)
Gulf croaker (*Bairdiella icistia*)	Longjaw mudsucker (*Gillichthys mirabilis*)
Orangemouth corvina (*Cynoscion xanthulus*)	Sailfin molly (*Poecilia latapinna*)
Desert pupfish (*Cyprinodon macularis*)	Mozambique tilapia (*Oreochromis mossambicus*)
Common carp (*Cyprinus carpio*)	Zill's tilapia (*Tilapia zilli*)
Threadfin shad (*Dorosoma petenense*)	

Source: Black 1988

Gulf croaker, sargo, and corvina are marine species, while the remaining species are estuarine or freshwater fish with extreme salinity tolerances. Tilapia are the most abundant fish in the Salton Sea. Tilapia were introduced into drainage ditches to control aquatic weeds in the late 1960s and early 1970s. They were also produced on fish farms close to the Salton Sea. The Salton Sea was colonized by tilapia that escaped from the fish farm and from those stocked in the drainage system. Anglers first reported catching tilapia in the Salton Sea in 1967 (Costa-Pierce and Riedel 2000a). The highest densities were reported from areas around the New and Alamo rivers and nearshore areas extending about 1,970 feet (600 m) from the shoreline (Costa-Pierce and Riedel 2000a; Costa-Pierce, pers. comm.). Tilapia productivity of the nearshore area has been estimated at 3,600 kg/ha/yr, far exceeding productivity of tilapia in tropical lakes (Costa-Pierce and Riedel 2000a). The abundant fish population attracts and supports large numbers of piscivorous birds, particularly during winter.

The Salton Sea represents one of the centers for avian biodiversity in the American Southwest, with occurrence records for more than 400 species and an annual average abundance of waterbirds of 1.5 to 2 million (Reclamation and SSA 2000; Hart et al. 1998; and Shuford et al. 1999). Numbers of birds can exceed this average by several million during certain years; (e.g., the maximum number of wintering eared grebes alone has exceeded 3.5 million individuals [Jehl 1988], representing the majority of the population of eared grebes in western North America). Populations of some species that use the Salton Sea are similarly of regional, continental, or worldwide importance, representing significant portions of the total populations for those species. The Salton Sea is an integral part of the Pacific Flyway, providing an important migratory stopover for fall and spring shorebirds, and supporting large populations of wintering waterfowl. In surveys from 1978 to 1987, midwinter waterfowl numbers averaged more than 75,000 (Heitmeyer et al. 1989); species typically present in large numbers include snow and Ross's geese, ruddy ducks, pintail, white-faced ibis (*Plegadis chihi*), and others. The Salton Sea represents one of only four remaining interior sites along the Pacific Flyway that supports more than 100,000 shorebirds during migration (Page et al. 1992), with as many as 44 species represented (McCaskie 1970; and Shuford et al. 1999). The Salton Sea also supports large breeding populations of waterbirds.

The overall high productivity of the Salton Sea can be attributed to a number of factors, including relatively mild-warm year-round temperatures, ample nutrient input through agricultural runoff and wastewater discharges to the tributary rivers, and a generally high morpho-edaphic index in the Salton Sea. A high morpho-edaphic index reflects the high surface-to-volume ratio of the Salton Sea (i.e., it has a large area, but is relatively shallow), which results in a number of conditions that can generate higher productivity (e.g., with more of the water column within the zone of light penetration, there is greater production of phytoplankton and other photosynthetic organisms relative to the overall quantity of water). The higher productivity transfers steadily up the food chain, resulting in higher densities of prey species for birds.

Aquatic invertebrates are important as food resources for species of birds in the Salton Sea include brine shrimp (*Artemia salina*), brine fly larvae (*Ephydra sp.*), adult pileworm (*Neanthes succinea*), and the nauplia and cypris of the barnacle (*Balanus amphitrite saltonensis;* Reclamation and SSA 2000). These species are forage for a wide variety of species including diving ducks, grebes, phalaropes (*Phalaropus* spp.), and a number of piscivorous fish that supplement their diet with invertebrates. Dabbling ducks also may forage on aquatic invertebrates in shallow areas, and many shorebirds will forage for invertebrates in shallow flooded areas and mudflats. Other bird species forage on fish including cormorants, diving ducks, pelicans, black skimmer, terns, egrets, and herons. Species of fish in Salton Sea used as prey include tilapia, bairdiella, sargo, mosquito fish, and larval orange-mouthed corvina (Reclamation and SSA 2000).

Since the early 1990s, there has been an unprecedented series of fish and bird die-offs at the Salton Sea (USFWS 2000; and Kuperman and Matey 1999). Fish kills often are massive, averaging between 10,000 and 100,000 fish, but sometimes several million fish. Fish die-offs produce substantial amounts of carrion for piscivorous birds, but can have adverse effects on bird populations by contributing to disease outbreaks. Causes of the fish die-offs are not always clear, but a number of potential pathogens have been identified; low oxygen levels also could be responsible for some fish kills. Pathogens implicated in fish kills include infestations with a lethal parasitic dinoflagellate (*Amyloodinium ocellatum*) and acute bacterial infections from bacteria of the genus *Vibrio* (USFWS 2000).

Large fish kills have been associated with avian botulism die-offs. It is likely that septicemia in fish produces the conditions in the intestinal tract of sick fish that allow botulism spores to germinate and produce the toxin. Birds foraging on sick fish may ingest fatal doses of the botulism toxin (USFWS 2000). A large botulism die-off in birds occurred in 1996, when 8,538 white pelicans and 1,129 brown pelicans died along with large numbers of great egret, snowy egret, eared grebe, black-crowned night heron, and numerous other birds (Jehl 1996). The total bird mortality in this event was more than 14,000 birds (USFWS 1996b).

Since 1987, significant avian die-offs have been recorded on an almost annual basis. While avian disease has been present at the Salton Sea for many years, the recent increase of disease occurrence, the magnitude of losses, and the variety of diseases has increased concern for birds using the Salton Sea (Reclamation and SSA 2000). Significant events have included a die-off of 4,515 cattle egrets in 1989 from salmonellosis; a die-off of an estimated 150,000 eared grebes in 1992 from unknown causes; a loss of more than 14,000 birds, including nearly 10,000 pelicans, in 1996 from avian botulism; a die-off of 6,845 birds in 1997; and a loss of 18,140 birds in 1998 from various agents, including avian cholera, botulism, Newcastle disease, and salmonella (USFWS 1996b).

Habitat Features

Most of the bird activity at the Salton Sea is concentrated at three primary locations. These locations include along the north and south shores (particularly at the New and Alamo river deltas), and near the mouth of Salt Creek on the eastern shore (Reclamation and SSA 2000). In these areas, concentrations of breeding colonies for colonial breeding birds occur. Suitable habitat conditions for colonial birds include an easily accessible and abundant food source and nest and roost sites that are generally protected from predators, such as trees or islands.

Some natural islands are available for nesting at the Salton Sea; however, a number of sites consists of old levees now inundated in sections and separated from the mainland, or other man-made islands. With the exception of Mullet Island at the south end of the Salton Sea, most sites are less than 10,750 square feet in area. Fluctuations in the level of the Salton Sea can increase or decrease the available habitat for island nesting birds.

Nesting islands in the Salton Sea are described in Molina (1996). Mullet Island is located 1.6 miles from the Alamo River mouth and has relatively high relief and ample nesting areas. It has historically supported nesting black skimmers, double-crested cormorants, gull-billed terns, and Caspian terns; since 1992 gulls have also nested there. The site is subjected to some human disturbance, with the Red Hill Marina only 1.9 miles from the island. Other nesting sites in the south portion of the sea include Morton Bay, which consists of an eroded impoundment east of the mouth of the Alamo River. It has two low-lying nesting islets, protected from wave inundation by a nearly continuous perimeter levee. Near Rock Hill, a series of small flat earthen islets within a freshwater impoundment have been suitable for nesting since 1995; this site is located within Sonny Bono-Salton Sea NWR and is under active management, including water-level control and protection from disturbance. Adjacent to Obsidian Butte, a nesting site is located on a small, low islet, consisting of a rocky perimeter and an interior beach composed of crushed barnacle. At Ramer Lake, located along the Alamo River 3.1 miles southeast of the Salton Sea, small, man-made, compacted earth islets provide nesting habitat. However, heavy recreational use in this area results in a high potential for colony disturbance. A small nesting site is present at Elmore Ranch on the southwest shore of the Salton Sea; it lies on a single, earthen levee remnant and is susceptible to wave action, erosion, and inundation. On the north end of the Salton Sea, one site is present at Johnson Street near the mouth of the Whitewater River. This site consists of remnants of earthen levees isolated from the Salton Sea by rising water levels.

2.3.2.5 Desert Habitat

The HCP area supports little native desert habitat. The primary occurrence of native desert habitat in the HCP area is along the AAC within IID's right-of-way (Figure 2.3-8). The 82-mile AAC traverses desert habitat for 60 miles; the remaining 22 miles of the canal lie within agricultural areas of the Imperial Valley. Desert habitat also occurs adjacent to rights-of-ways of the East Highline, Thistle, Trifolium, and Westside Main canals, but not within the rights-of-way. Within Imperial Valley, desert plant species have colonized small areas that have not been under agricultural production for many years. These areas occur as inclusions within the predominantly agricultural landscape. Two principal desert habitats are supported in the HCP area: creosote bush scrub and dunes. The characteristics and distribution of each of these habitats are described below.

Creosote Bush Scrub

Creosote bush scrub is characterized by widely spaced shrubs, approximately 1.6 to 9.8 feet tall, usually with largely bare ground between. It is the basic creosote scrub community of the Colorado Desert, typically occurring on well-drained secondary soils of slopes, fans, and valleys. Characteristic species include creosote bush (*Larrea divaricata*), burro weed (*Ambrosia dumosa*), brittle brush (*Encelia farinosa*), and ocotilla (*Fouquieria splendens*). Succulents are common, and ephemeral annual herbs are present and generally bloom during late February and March. Mesquite thickets, an important wildlife habitat component, are present in creosote bush scrub habitat.

Creosote bush scrub is the predominant desert habitat in the HCP area and occurs along much of the AAC. It is also present adjacent to the HCP area along the East Highline and Westside Main Canals. Plant species comprising this habitat may occur in the Imperial Valley in areas that have been fallowed.

Desert Dunes

AAC traverses the Algodones Dunes. The dunes consist of both active desert dunes and stabilized or partially stabilized dunes. Active desert dune communities are characterized as essentially barren expanses of actively moving wind-deposited sand with little or no stabilizing vegetation. Dune size and shape are determined by abiotic site factors, including wind patterns, site topography, and source of sand deposits. Characteristic plant species may include bee plant (*Cleome sparsifolia*), *Dicoria canescens*, evening primrose (*Oenothera avita*), and *Tiquilia plicata*.

Some desert dunes have been stabilized or partially stabilized by shrubs, scattered low annuals, and perennial grasses in areas with less wind or higher water availability. These dunes typically occupy sites that are lower and more sheltered than active dunes, with soil moisture retained just below the sand surface, allowing perennial vegetation to survive long drought periods. Mesquite (*Prosopis glandulosa, P. pubescens*) scrub is often associated with this community. Other characteristic plant species include sand verbena (*Abronia villosa*), burro weed, ankle grass (*Astragalus* spp.), salt cedar (*Tamarix* spp.), saltbrush (*Atriplex canescens*), croton (*Croton californicus* var. *mojavensis*), dalea grass, wild buckwheat (*Eriogonum deserticola*), desert sunflower (*Geraea canescens*), and others. Plant cover increases as dunes are progressively stabilized. This community intergrades with sandier phases of creosote bush scrub.

2.3.2.6 Aquatic Habitat

Aquatic habitat occurs in the HCP area within IID's conveyance and drainage infrastructure as well as in the New and Alamo Rivers. Aquatic habitat conditions associated with these features are described in the following section. The Salton Sea also provides aquatic habitat, but was discussed previously (Section 2.3.2.4).

The IID diverts water from the Colorado River into the AAC at Imperial Dam. The AAC conveys water to three main canals in Imperial Valley: the East Highline Canal, Westside Main Canal, and Central Main Canal (Figure 2.3-5). Customers take water from the main canals or lateral canals that branch off of the main canals. To service customers in Imperial Valley, IID maintains 1,667 miles of canals (cited from IID Memorandum, dated October 4, 2000). Most of the canals (1,114 miles) are concrete lined. About 16 miles of the conveyance are pipelines, while the remaining 537 miles are earthen canals (cited from IID Memorandum, dated October 4, 2000). IID also operates the 82-mile AAC, which conveys water from Imperial Dam on the Colorado River to IID's conveyance system in the valley. The AAC is currently unlined, but 24 miles are planned to be concrete lined in the future (Reclamation and IID 1994).

Water levels in the AAC are maintained as high as possible to maximize power generation from the hydropower facilities. Although other canals do not contain hydroelectric power generation facilities, water levels also are tightly controlled. Lowest flows in the canal system occur in January and February when irrigation demand is lowest. Water velocity in the AAC ranges from about 0.5 to 1 foot per second (ft/s) during these months. The highest flows occur during March through August, which is the main irrigation season. During this period, water velocities in the AAC increase to about 2.5 to 3.5 ft/s (USACOE 1996).

Within the AAC and main canals in the Imperial Valley, aquatic habitat in the center of the canals is characterized by high water velocities and a lack of aquatic vegetation and aquatic invertebrates. This portion of the main canals provides poor conditions for fish and other aquatic organisms. Along the canal edges, lower water velocities and deposition of sediment allow limited development of submerged and emergent vegetation. The lower water velocities and cover provided by aquatic vegetation, in combination with vegetation on the canal banks (primarily the common reed), provide better habitat conditions for aquatic invertebrates and fish. Submerged vegetation consists primarily of Eurasian water-milfoil with some sago pondweed (*Potamogetou pectinatus;* Reclamation and IID 1994). The noxious aquatic weed hydrilla (*Hydrilla verticillata*) is common in the canal system within the Imperial Valley, but is rare in the AAC (Reclamation and IID 1994). The canals are routinely cleaned of vegetation, thus limiting aquatic habitat quality.

As a result of high water velocities, concrete substrates in many canals, and the lack of submerged and aquatic vegetation, the canals (with the exception of the AAC) support few invertebrates. In the AAC, mollusks, particularly the exotic Asiatic clam and aquatic snail, are common along the shoreline where sediment deposits and submerged and emergent vegetation develops (USACOE 1996). Crayfish are present in small numbers (USACOE 1996).

Drainage Network

A system of subsurface tile drains, surface drainage ditches, and river channels collect and convey agricultural drainwater in the IID service area. Currently, IID operates and

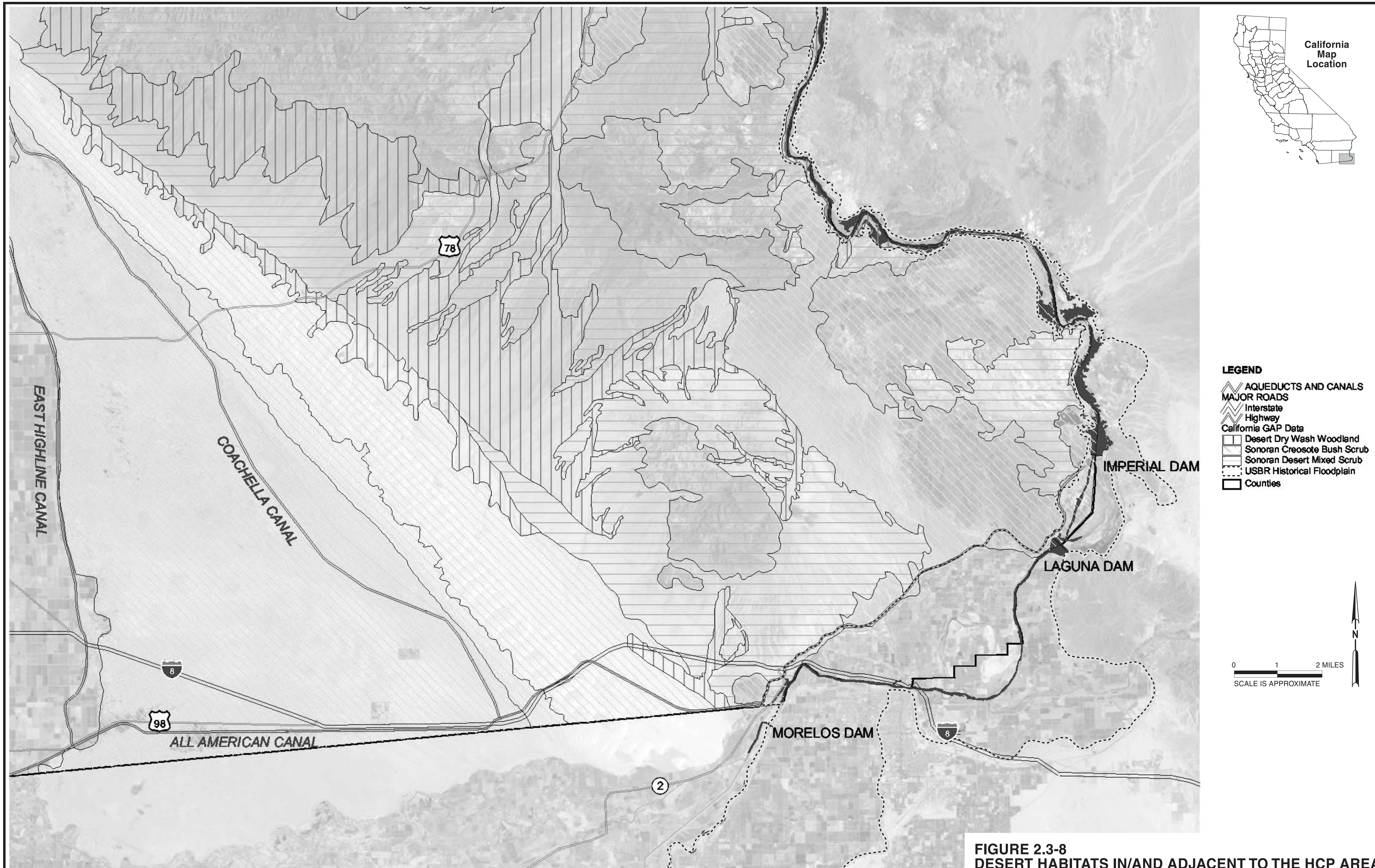

FIGURE 2.3-8
DESERT HABITATS IN/AND ADJACENT TO THE HCP AREA
IID WATER CONSERVATIO NSFER PROJECT DRAFT HCP

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maintains 1,456 miles of drains (cited from IID Memorandum, dated October 4, 2000). These drains are primarily unlined earthen channels.

Aquatic habitat in the drains is of poor quality as a result of silty substrates, poor water quality, and shallow depth. Portions of the drains support rooted vegetation, such as cattails, common reed, or filamentous and mat-forming algae. These areas are more frequently found where canal (operational) discharge provides better water quality. However, vegetation is regularly cleared from the drains.

The availability of aquatic habitat in drains depends on drainwater from agricultural fields. This water comes from both surface and subsurface (tile) sources. As a result, the amount of water in the drains varies throughout the year in response to the level of irrigation. When the agricultural fields discharging into a drain are not being irrigated (i.e., little surface runoff), the drainwater flows are dominated by the highly saline subsurface (tile) water. In the upper portions of the drain watersheds, a lack of irrigation activity can result in drains experiencing a dry out condition and might not support aquatic habitat.

The drainage network supports abundant aquatic invertebrates, especially waterboatmen (*Corixa* sp.; Radke 1994). Analysis of benthic invertebrate communities in several of the irrigation drains indicates that the communities are composed of relatively few species and are dominated by one or two taxa. Of the 10 drains sampled, the mollusk family Thiaridae was the most abundant taxa in 8 of the drains, comprising between 50 and 95 percent of the sample (Setmire et al. 1996). Another taxon observed frequently, but with lesser abundance than Thiaridae, was the mollusk family Physidae. The pollution-sensitive mayflies, stoneflies, and caddisflies (Ephemeroptera, Plecoptera, and Trichoptera) were poorly represented. A single caddisfly larvae of the family Philopotamidae was the only pollution-sensitive taxon documented in the benthic samples (Setmire et al. 1996).

Invertebrate densities were found to be much lower in the water column than in the benthic samples (Setmire et al. 1996). The number of taxa ranged from a low of 4 to a high of 10. Chironomid larvae were the most abundant invertebrates found in 6 of the 10 drainwater column samples (Setmire et al. 1996). Other frequently observed taxa included mosquito larvae (*Culicidae*) and oligochaete worms. Larval chironomids are a food source for other invertebrates and fish, and adults are eaten by many kinds of birds.

New and Alamo Rivers

The New River was enlarged in the early 1900s when the Colorado River overflowed its banks and formed a new channel to the Salton Sea. When it crosses into the U.S., the New River is primarily composed of agricultural drainage water and wastewater from the Mexicali Valley in Mexico. In the Imperial Valley, agricultural drains discharge into the river. The Alamo River also enters the U.S. from Mexico and receives agricultural drainage water in the Imperial Valley. Aquatic habitat quality in the New and Alamo Rivers is poor because of poor water quality, as well as high turbidity and unstable substrates that inhibit production of benthic invertebrates and rooted vegetation.

2.3.3 Water Quality and Biological Resources

Water quality is a concern for biological resources in Imperial Valley and the Salton Sea. In the Imperial Valley, wildlife can be exposed to poor water quality conditions in the drains that carry agricultural drainage water. Much of the drain water empties into the Salton Sea where wildlife species also can be exposed to poor water quality conditions. The quality of water in drains and the Salton Sea can affect wildlife in a number of ways. Some contaminants (e.g., selenium) can bioaccumulate and have direct or indirect toxic effects. The concentrations of other constituents (e.g., salts) can affect survival or reproductive success of aquatic species inhabiting the Salton Sea. Finally, water quality can influence plant species composition of habitats supported along the Salton Sea or in agricultural drains, and thereby alter habitat suitability for species using these habitats. The constituents of greatest concern in the Imperial Valley and Salton Sea and potentially affected by the water conservation and transfer programs are salinity and selenium. These constituents are the focus of the following discussion. The IID Water Conservation and Transfer Project EIR/EIS provides information on other water quality constituents.

2.3.3.1 Salinity

The salinity of the Salton Sea has been increasing because of high evaporative water loss and continued input of salts from irrigation drainage water. The sea is currently hypersaline with a salinity greater than the ocean. The present salinity levels in the Salton Sea are 44 grams per liter (g/L; equivalent to parts per thousand). Tilapia are the most abundant fish in the Salton Sea and are the primary prey of piscivorous birds. Therefore, the salinity tolerance of tilapia is key to predicting the effects of the water conservation and transfer programs on covered species of piscivorous birds. The salinity tolerances of other fish species inhabiting the Salton Sea is provided in the IID Water Conservation and Transfer Project EIR/EIS.

Tilapia have been collected at a salinity level of 120 parts per thousand (ppt),[5] but reproduction has not been reported at this salinity level (Whitfield and Blaber 1979). Costa-Pierce and Riedel (2000a) provide a review of reported salinity tolerances of tilapia. Highest growth rates were reported at 14 parts per thousand (ppt), but growth was still good and tilapia reproduced at 30 ppt. At 69 ppt, tilapia grew poorly, but reproduced well. In the Salton Sea at about 44 ppt, tilapia also grew poorly, but reproduced well. Based on these studies, Costa-Pierce and Riedel (2000a) suggested that tilapia in the Salton Sea could successfully acclimate to and continue to reproduce at a salinity level of 60 ppt. In areas with higher salinity, growth, survival, and reproduction would be expected to decline (Costa-Pierce, pers. comm. January 12, 2001).

2.3.3.2 Selenium

Soil derived from parent rocks containing high amounts of selenium is found throughout much of the West (Seiler et al. 1999). Selenium enters soils, groundwater, and surface waters through irrigation of selenium-bearing soils, through selenium-bearing sediments brought in through local drainages, or through water imported for irrigation. Selenium enters the Imperial Valley through Colorado River water brought in for irrigation; its ultimate source is upstream from Parker Dam (Engberg 1992). Selenium is concentrated in irrigated soils through evapotranspiration and flushed into water sources through irrigation practices (Ohlendorf and Skorupa 1989; and Seiler et al. 1999). The primary source of selenium in

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5 Many of the studies regarding salinity tolerance of various species report the results in parts-per-thousand (ppt). Modeling conducted for this HCP utilized concentrations in mg/L (converted to g/L) which differs slightly from ppt as salinity increases due to the difference in the specific gravity of saltwater versus freshwater. Model results are reported in ppt for simplicity and to allow direct comparison with reported tolerances.

surface drains is from subsurface drainage discharges from sumps and tile drains (Setmire et al. 1996); subsequently it is discharged into rivers and the Salton Sea.

Selenium is essential in trace amounts for both plants and animals but toxic at higher concentrations (Rosenfeld and Beath 1946). At excessive levels, selenium can cause adverse effects in mammalian reproduction, but it is especially toxic to egg-laying organisms including birds and fish. Reproductive impairment is generally a more sensitive response variable than adult mortality. Selenium bioaccumulates readily in invertebrates (typically 1,000 times the waterborne concentration) and fish; hence, fish and birds that feed on aquatic organisms are most at risk for showing adverse effects (Ohlendorf 1989; and Eisler 2000).

Selenium concentrations were measured from Imperial Valley and Salton Sea in a number of different studies. These include broad-based studies of selenium in water, sediment, and biotic samples (Setmire et al. 1990; Setmire et al. 1993; and Rasmussen 1997) and more focused surveys looking at concentrations in tissues of specific fish or bird species (Ohlendorf and Marois 1990; Bruehler and de Peyster 1999; and Audet et al. 1997). These studies are reviewed below.

Early sampling (Rasmussen 1988) identified levels of selenium higher in Salton Sea fish than those occurring in the New and Alamo Rivers, reflecting the primary source of bioaccumulation of selenium from benthic food sources of the Salton Sea. More recent data show a similar pattern (Table 2.3-9).

TABLE 2.3-9
Selenium Concentrations in Freshwater and Marine Fish from Imperial Valley Rivers and the Salton Sea

Station No.	Station Name	Species	Tissue	Sample Date	Selenium (mg/kg WW)
719.47.00	Coachella Valley Stormwater Channel	Tilapia *Tilapia sp.*	Fillet	11/17/97	1.020
723.10.01	Alamo River / Calipatria	Channel Catfish *Ictalurus punctatus*	Fillet	11/20/97	1.060
723.10.02	New River / Westmorland	Channel Catfish *Ictalurus punctatus*	Fillet	11/20/97	0.360
723.10.02	New River / Westmorland	Channel Catfish *Ictalurus punctatus*	Liver	11/20/97	3.230
723.10.58	New River / Interboundary	Carp *Cyprinus carpio*	Fillet	12/10/97	0.460
728.00.90	Salton Sea / South	Tilapia *Tilapia sp.*	Fillet	11/20/97	1.310
728.00.90	Salton Sea / South	Tilapia *Tilapia sp.*	Liver	11/20/97	6.650
728.00.92	Salton Sea / North	Orangemouth Corvina *Cynoscion xanthulus*	Fillet	11/18/97	1.360
728.00.92	Salton Sea / North	Orangemouth Corvina *Cynoscion xanthulus*	Liver	11/18/97	2.040

Source: Rassmussen 1997
Notes:
WW Concentrations in wet weight
mg/kg milligrams per kilogram

Other early studies on selenium in tissues include the Selenium Verification Study (White et al. 1987), the reconnaissance investigation by the Department of Interior (DOI) in 1986 and 1987 (Setmire et al. 1990), and a follow-on detailed study by DOI from 1988 to 1990 (Setmire et al. 1993; and Schroeder et al. 1993). The Selenium Verification Study also identified higher selenium concentrations in samples from the Salton Sea fish than those reported in freshwater fish from the Alamo and New Rivers. In the reconnaissance investigation by DOI (Setmire et al. 1990), samples were taken of water, sediment, and biota in the Imperial Valley. Levels in fish and waterfowl in this study indicated bioaccumulation of selenium. Selenium concentrations in mollies and mosquitofish and in invertebrates are shown in Tables 2.3-10 and 2.3-11, respectively.

TABLE 2.3-10
Selenium Concentrations in Mosquitofish and Sailfin Molly from the New and Alamo Rivers and Irrigation Drains and San Felipe and Salt Creeks, Salton Sea, 1988-1990

	New and Alamo Rivers and Irrigation Drains			San Felipe and Salt Creeks		
Fish Species	**N/DV**	**GM (µg/g DW)**	**Range (µg/g DW)**	**N/DV**	**GM (µg/g DW)**	**Range (µg/g DW)**
Mosquitofish	3/3	3.5	2.6-4.7	2/2	6.9	6.4-7.4
Sailfin molly	4/4	3.9	2.5-5.8	2/2	6.4	5.5-7.4

Source: Setmire et al. 1993.
Notes:
DW Concentrations in dry weight
N/DV number of samples collected per number of samples with detectable values
GM Geometric mean; calculated using one-half detection limit when data set has more than 50 percent detectable values.

TABLE 2.3-11
Selenium Concentrations in Pelagic Invertebrates from the New and Alamo Rivers and Irrigation Drains and San Felipe and Salt Creeks, Salton Sea, 1988-1990

	New and Alamo Rivers and Irrigation Drains			San Felipe and Salt Creeks		
Pelagic Invertebrate Species	**N/DV**	**GM (µg/g DW)**	**Range (µg/g DW)**	**N/DV**	**GM (µg/g DW)**	**Range (µg/g DW)**
Amphipod, pileworm, waterboatman composite	-	-	-	2/2	2.8	2.6-3.1
Asiatic river clam	5/5	4.4	2.6-6.4	-	-	-
Crayfish	-	-	-	2/2	3.1	2.4-3.3
Pileworm	8/8	3.1	0.8-12.1	-	-	-
Waterboatman	3/3	2.1	1.4-3.3	-	-	-

Source: Setmire et al. 1993.
Notes:
DW Concentrations in dry weight
– no data
N/DV number of samples collected per number of samples with detectable values
GM Geometric mean; calculated using one-half detection limit when data set has more than 50 percent detectable values.

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Selenium concentrations found in most invertebrates were generally below 5 µg/g dry weight (DW), which has been recommended as a dietary threshold to avoid adverse effects in fish and birds that prey on invertebrates (Setmire et al. 1993). This finding indicates that selenium in invertebrates at the Salton Sea are unlikely to cause toxicity to predators feeding on invertebrates. However, some of the pileworms analyzed did exceed 5 µg/g DW with concentrations ranging from 0.8 to 12.1 µg/g DW.

Several species of aquatic birds or eggs were also sampled (Table 2.3-12) (Setmire et al. 1993). Selenium exposure and potential effects in birds can be assessed most directly through the selenium concentrations in eggs (Skorupa and Ohlendorf 1991; and DOI 1998). In the detailed study, black-necked stilts were the only species for which eggs were sampled. Stilt eggs had geometric mean concentrations of 6.2 µg/g or less at all locations. Based on Lemly (1996), the geometric mean indicates that risks are low to none for reproductive impairment in black-necked stilts though the range of concentrations likely exceeds 6.2 µg/g and could result in some reproductive impairment. In fact, Bennett (1998) conducted a study that evaluated nesting proficiency in comparison to egg selenium concentrations, and the results indicated that the species is likely experiencing a low level of selenium-induced reproductive depression at the Salton Sea.

TABLE 2.3-12
Selenium Concentrations in Migratory Birds and Estimated Egg Concentrations from the New and Alamo Rivers, Agricultural Drains, San Felipe Creek, Salt Creek and the Salton Sea Collected During 1988-1990

	Salton Sea				New and Alamo Rivers and IID Drains			
Bird species	**N/DV**	**GM (µg/g DW)**	**Range (µg/g/DW)**	**Est. egg Conc. (µg/g DW)[a]**	**N/DV**	**GM (µg/g DW)**	**Range (µg/g DW)**	**Est. Egg Conc. (µg/g DW)[a]**
Migratory Birds								
Eared grebe (muscle)	5/5	12.7	2.7-35.1	-	-	-	-	-
Northern shoveler (liver)	-	-	-	-	19/19	19.1	9.1-47.0	6.3
Northern shoveler (muscle)	-	-	-	-	6/6	5.2	3.8-12.0	-
Ruddy duck (liver)	57/57	11.7	5.2-41.5	3.86	-	-	-	-
Ruddy duck (muscle)	17/17	4.8	2.7-7.2	-	-	-	-	-
White-faced ibis (carcass)	-	-	-	-	9/9	5.3	3.9-6.6	-
White faced ibis (liver)	-	-	-	-	9/9	7.4	5.0-13.2	2.44
Resident Birds								
American coot (liver)	-	-	-	-	3/3	10.3	7.9-16.3	3.4
Black-necked stilt (egg)	127/127	4.3	1.6-35.0	-	-	-	-	-
Black-necked stilt (carcass)	19/19	5.4	3.2-11.3	-	-	-	-	-

TABLE 2.3-12
Selenium Concentrations in Migratory Birds and Estimated Egg Concentrations from the New and Alamo Rivers, Agricultural Drains, San Felipe Creek, Salt Creek and the Salton Sea Collected During 1988-1990

	Salton Sea				New and Alamo Rivers and IID Drains			
Bird species	N/DV	GM (µg/g DW)	Range (µg/g/DW)	Est. egg Conc. (µg/g DW)[a]	N/DV	GM (µg/g DW)	Range (µg/g DW)	Est. Egg Conc. (µg/g DW)[a]
Listed Birds								
Yuma clapper rail (whole body)	-	-	-	-	1/1	-	4.8	-

Source: Setmire et al. 1993.
[a] Estimated from geometric mean using conversion factor from Lemly (1996)
Notes:
DW Concentrations in dry weight
- No data
N/DV number of samples collected per number of samples with detectable values

A focused survey was conducted on selenium concentrations in subsurface drainwater, surface drainwater, bottom sediments, and transplanted Asiatic river clams at 48 irrigation drain sites in the Imperial Valley (Setmire et al. 1996; Roberts 1996; and Hurlbert 1997). Tilewater had the highest concentrations of selenium (median 28 µg/L). Drain samples showed considerable dilution of tilewater selenium (median 6 µg/L). Selenium in bottom sediments was correlated (r^2=0.55) with the percent material finer than 0.062 mm (median 0.5 µg/g).

In an attempt to evaluate concentrations of various compounds in colonial waterbirds, Audet et al. (1997) sampled eggs, bird livers, and fish from waterbird nesting colonies or adjacent areas at the Salton Sea. The results for selenium concentrations for bird egg and liver samples are presented in Table 2.3-13. Selenium concentrations found in eggs at the Salton Sea were below all teratogenesis thresholds indicating that selenium levels are below those found to cause teratogenesis. However, selenium concentrations in eggs were within the range at which reproductive performance could be affected. Fish samples were within the range of earlier studies (Saiki 1990; and Setmire et al. 1993).

TABLE 2.3-13
Selenium Concentrations in Bird Eggs and Livers Collected at the Salton Sea, 1991

	Egg Samples			Liver Samples		
Species	N	GM (µg/g DW)	Range (µg/g DW)	N	GM (µg/g DW)	Range (µg/g DW)
Double-crested cormorant	–	–	–	6	21.96	17-29
Great-blue heron	4	3.86	2.8-5	10	9.57	3.5-17
Black-crowned night-heron	3	5.27	4.6-6.5	4	12.24	4.8-20
White pelican	–	–	–	6	14.79	11-22
Black skimmer	12	4.65	2.2-8.2	–	–	–
Cattle egret	3	3.6	2.7-5.4	–	–	–

TABLE 2.3-13
Selenium Concentrations in Bird Eggs and Livers Collected at the Salton Sea, 1991

	Egg Samples			Liver Samples		
Species	N	GM (µg/g DW)	Range (µg/g DW)	N	GM (µg/g DW)	Range (µg/g DW)
Great egret	9	4.77	3.5-7.1	–	–	–
Gull-billed tern	6	4.1	3.4-5.3	–	–	–

Source: Audet et al. 1997.
Notes:
DW concentrations in dry weight;
– no data

Studies conducted on Yuma clapper rails (Roberts 1996; and USFWS 1994) involved analyses of sediment, crayfish, bird egg, kidney, liver, and whole body samples from salvaged birds for selenium and organochlorines. Egg and bird tissue samples were taken in the CDFG Wister Wildlife Management Unit when drainwater was being used as a water source for managed marshes. Concentrations of selenium from the study are presented in Table 2.3-14. The other samples (sediment and crayfish) were collected when most of the Wister Unit had been converted to the use of Colorado River water.

TABLE 2.3-14
Detection Frequency and Summary Statistics for Selenium in Yuma Clapper Rail Diet and Tissue Samples

Matrix	N/DV	Geometric Mean (µg/g DW)	Range (µg/g DW)
Sediments	19/19	1.43	0.55-9.57
Crayfish	19/19	2.16	0.92-4.67
Rail eggs	2/2	–	4.98-7.75
Rail liver	2/2	–	3.09-11.78
Rail kidney	1/1	–	3.69

Source: Roberts 1996.
Notes:
DW concentrations in dry weight
– no data
N/DV number of samples collected per number of samples with detected value

2.3.4 Covered Species and Habitat Associations

This HCP covers 96 species (Table 1.5-1). The covered species use one or more of the six general habitat types described below:

- Salton Sea
- Tamarisk scrub habitat
- Drain habitat
- Desert habitat
- Freshwater aquatic habitats
- Agricultural fields

The covered species can be grouped based on their habitat association and how they use the habitat. The following identifies the covered species associated with each of the habitat types in the HCP area, and describes how the habitat is used and the relative quality of the habitat for the covered species. Some species use more than one habitat in the HCP area and could be exposed to impacts in each of the habitats that they use. Such species are assigned to multiple habitats. More specific information on each of covered species' habitat requirements, status and distribution and life history traits is provided in Appendix A.

2.3.4.1 Salton Sea Habitat Associates

The Salton Sea is a large inland sea that attracts many species associated with large waterbodies as well as species that are more typically associated with coastal areas. Since its formation in the early 1900s the diversity and number of species using the Salton Sea has increased. The sea has become an important breeding location for several species. For example, the Salton Sea supports the largest inland breeding population of western snowy plovers. However, the Salton Sea is most well-known for the large populations of wintering birds. Located on the Pacific Flyway, many birds also pass through the Salton Sea area on migrations to and from Central and South America.

Table 2.3-15 identifies the covered species that are primarily associated with the Salton Sea. In the HCP area, some species (e.g., pelicans) only occur at the Salton Sea, while others use the Salton Sea in addition to other habitats within the HCP (e.g., western snowy plover).

TABLE 2.3-15
Covered Species Associated with the Salton Sea in the HCP Area

Resident Breeders[a]	Migratory Breeders[b]	Short-Term Residents[c]	Transient Species[d]
Desert pupfish	Van Rossem's gull-billed tern	Osprey	California least tern
Double-crested cormorant	Black skimmer	Black tern	Elegant tern
Western snowy plover		Laughing gull	Merlin
		American white pelican	Black swift
		Wood stork	Vaux's swift
		Long-billed curlew	Purple martin
		California brown pelican	Bank swallow
			Reddish egret
			Bald eagle
			Prairie falcon

[a] Resident breeders are species that occur at the Salton Sea year-round and breed in this habitat in the HCP area.
[b] Migratory breeders are species that breed at the Salton Sea, but migrate out of the HCP area or into other habitats for the non-breeding season.
[c] Short-term residents are species that do not breed in the HCP area, but migrate into the HCP area and use the Salton Sea for several months (e.g., during winter).
[d] Transient species are species that do not breed in the HCP area, but use the Salton Sea in the HCP area for short periods of time, typically during migration.

2.3.4.2 Tamarisk Scrub

The species associated with tamarisk scrub habitat are primarily riparian species that find optimal habitat in native riparian habitats consisting of cottonwoods, willows, and other native riparian plant species. As previously described, tamarisk invaded many areas and supplanted native riparian vegetation in the HCP area in most locations. Tamarisk also colonized non-riparian areas along drains or seepage areas. Tamarisk scrub habitat does not represent optimal habitat for the species that use this habitat in the HCP area. Rather, it constitutes the only available tree-dominated habitat in the HCP area. As such, it is used although not preferred. Table 2.3-16 identifies the covered species that use tamarisk scrub habitat in the HCP area.

2.3.4.3 Drain Habitat Associates

Covered species using drain habitat in the HCP area include species that use it exclusively (e.g., Yuma clapper rail) as well as species that will exploit the resources of the habitat, but are not dependent upon it (e.g., northern harrier; Table 2.3-17). The highest quality drain habitat within the HCP area occurs on the state and federal refuges where active management promotes development of emergent aquatic vegetation such as cattails and bulrushes. The drains themselves also provide habitat; however, much of the vegetation in the drains consists of common reed or salt cedar, and only a small proportion of the drains supports cattails or bulrushes. Thus, for species with an affinity for emergent vegetation, habitat quality and availability is limited outside of the state and federal refuges.

TABLE 2.3-16
Covered Species Associated with Tamarisk Scrub Habitat in the HCP Area

Resident Breeders	Migratory Breeders	Short-Term Residents	Transient Species
White-tailed kite	Elf owl[a]	Large-billed savannah sparrow	Merlin
Summer tanager	Brown-crested flycatcher	Sharp-shinned hawk	Black swift
Vermilion flycatcher	Yellow-breasted chat	Cooper's hawk	Vaux's swift
Gila woodpecker[a]	Yellow warbler		Long-eared owl
Gilded flicker[a]			Least Bell's vireo
Harris hawk			Purple martin
Crissal thrasher			Western yellow-billed cuckoo[a]
			Bank swallow
			Willow flycatcher
			Arizona Bell's vireo

[a] Species not known to use tamarisk, but could use native tree habitats.

TABLE 2.3-17
Covered Species Associated with Drain Habitats in the HCP Area

Resident Breeders	Migratory Breeders	Short-Term Residents	Transient Species
Yuma clapper rail	Fulvous whistling-duck	Short-eared owl	Golden eagle
California black rail		Northern harrier	Merlin
Desert pupfish[a]			Black swift
White-faced ibis			Vaux's swift
Least bittern			Purple martin
Lowland leopard frog[b]			Bank swallow
			Tricolored blackbird
			Bald eagle

[a] This species is addressed through a species-specific strategy.
[b] This species is addressed separately from the other species in this habitat group.

2.3.4.4 Desert Habitat Associates

Native desert habitat primarily occurs in the HCP area along the AAC. This portion of the HCP area consists of creosote bush scrub and desert dune habitats. This habitat has not been converted to another use, but is subject to disturbance from maintenance and recreational activities. Most of the covered species associated with desert habitat are limited to this habitat type (e.g., desert tortoise) and would not occur in other habitats in the HCP area. A few (e.g., loggerhead shrike) use desert habitats in addition to other habitats in the HCP area. Table 2.3-18 identifies the covered species associated with desert habitats.

TABLE 2.3-18
Covered Species Associated with Desert Habitat in the HCP Area

Resident Breeders	Migratory Breeders	Short-Term Residents	Transient Species
Cheeseweed moth lacewing[a]	Elf owl		Golden eagle
Andrew's scarab beetle[a]			Prairie falcon
Desert tortoise			
Colorado desert fringe-toed lizard			
Western chuckwalla			
Couch's spadefoot toad			
Colorado River toad[a]			
Flat-tailed horned lizard			
Banded gila monster[a]			
Harris' hawk			
Loggerhead shrike			
Le Conte's thrasher			

TABLE 2.3-18
Covered Species Associated with Desert Habitat in the HCP Area

Resident Breeders	Migratory Breeders	Short-Term Residents	Transient Species
Crissal thrasher			
Jacumba little pocket mouse[a]			
Nelson's bighorn sheep			
Peirson's milk-vetch			
Algodones Dunes sunflower			
Wiggin's croton			
Flat-seeded spurge[a]			
Foxtail cactus[a]			
Munz's cactus[a]			
Giant Spanish needle			
Sand food			
Orocopia sage[a]			
Orcutt's aster[a]			

[a] These species are addressed separately from the other species in this habitat group.

2.3.4.5 Aquatic Habitat Associates

The conveyance and drainage systems provide aquatic habitat. Most of the fish species present in these systems are foreign species. Razorback suckers are the only covered species that are residents in the canal system. Desert pupfish are the only covered species that are residents in drains.

2.3.4.6 Agricultural Field Habitat Associates

Agricultural fields make up most of the habitat in the Imperial Valley. While not a native habitat, many of the covered species have adapted to using agricultural fields in fulfilling one or more life requisites (Table 2.3-19). Often species show an association with certain crop types. Most of the covered species associated with agricultural fields use this habitat for foraging; only a few actually breed in agricultural habitats. Loggerhead shrike and Yuma cotton rat are the only species expected to breed in agricultural habitats. Actual nest locations of these species are on the margins of the fields. The remaining resident and migratory breeders breed in other habitats of the HCP area, but forage in agricultural fields during the breeding season. Agricultural habitats in the HCP area also provide foraging opportunities for wintering birds (i.e., short-term residents) and transient species.

TABLE 2.3-19
Covered Species Associated with Agricultural Fields in the HCP Area

Resident Breeders	Migratory Breeders	Short-Term Residents	Transient Species
Loggerhead shrike	Fulvous whistling-duck	Black tern	Prairie falcon
White-tailed kite		Mountain plover	Golden eagle
White-faced ibis		Ferruginous hawk	Swainson's hawk
Western snowy plover		Aleutian Canada goose	Merlin
Greater sandhill crane		Short-eared owl	Black swift
Yuma hispid cotton rat[a]		Northern harrier	Vaux's swift
Colorado River hispid cotton rat[a]		Long-billed curlew	Purple martin
			American peregrine falcon
			Bank swallow

[a]These species are addressed separately from the other species in this habitat group.

2.3.4.7 Other Species

Most of the covered species can be grouped according to their habitat associations. However, the occurrence of burrowing owls and the 12 bat species covered by the HCP are more a function of the occurrence of unique habitat features than the presence and quality of a general habitat type. Burrowing owls occur at high densities in the Imperial Valley and are associated with the general agricultural landscape. They are however, strongly associated with canals and drains where they inhabit burrows in the unlined banks of these structures. While the surrounding agricultural fields provide foraging opportunities, it is the presence of suitable burrows created by burrowing rodents that largely determine the occurrence of burrowing owls.

The HCP covers 12 bat species (Table 2.3-20). For foraging, it is likely that they use a wide range of habitats, exploiting localized areas of insect abundance. Habitats in the HCP area could be used for foraging. Whether any of the covered bat species roost in the HCP area and the types of structures that they use are unknown. Some bats probably roost outside of the HCP area but come into the HCP area to forage, while others can probably find suitable roosts within the HCP area in buildings, trees, bridges, or other structures. The location of suitable roosting sites is probably an important factor in the extent to which these species occur in the HCP area.

TABLE 2.3-20
Covered Bat Species in the HCP Area[a]

Spotted bat	Pale western big-eared bat
Western mastiff bat	Big free-tailed bat
California leaf-nosed bat	Mexican long-tongued bat
Occult little brown bat	Southwestern cave myotis
Western small-footed myotis	Pocketed free-tailed bat
Pallid bat	Yuma myotis

[a] The process for ensuring Federal Endangered Species Act and California Endangered Species Act coverage for these species is being developed.

CHAPTER 3

Habitat Conservation Plan Components and Effects on Covered Species

3.1 Approach to and Framework for the Conservation Strategy

The habitat conservation plan (HCP) employs both habitat-based and species-specific approaches. The habitat-based component of the conservation strategy of the HCP focuses on mitigating the potential loss of habitat values (quality and quantity) of each habitat type within the HCP area. This is accomplished primarily by creating or acquiring replacement habitat. The overall conservation strategy for the Imperial Irrigation District (IID) HCP is to maintain or increase the value (amount and/or quality) of each habitat in the HCP area in addition to implementing measures to minimize direct effects to covered species from operation and maintenance (O&M) and construction activities. The habitat-based conservation approach of the HCP is augmented by a species-specific treatment of individual species (i.e., burrowing owls, desert pupfish, and razorback sucker) that are not easily accommodated by a habitat approach. Consistent with the guidance provided by the U.S. Fish and Wildlife Service (USFWS), all HCP effects are evaluated on a species-by-species basis. In addition to the habitat-based and species-specific strategies, the HCP contains general commitments that guide and facilitate the implementation of the plan.

The area for which IID seeks coverage supports six general habitats as follows:

- Salton Sea
- Tamarisk scrub
- Drain vegetation
- Desert
- Aquatic
- Agricultural fields

Covered species are assigned to one or more habitat groups based on the habitats that they use in the HCP area. The overall conservation strategy for the IID HCP is to maintain or increase the value (amount and/or quality) of each habitat in the HCP area. Species for which the ecology is best understood are used to develop the appropriate level of mitigation for each of the habitats occurring in the HCP area. By ensuring the habitat representation and quality in the HCP area, the persistence of covered species using these habitats can be reasonably assumed.

Although the HCP predominantly follows a habitat-based approach, the effect of the covered activities and implementation of the HCP measures on each covered species are evaluated as required under the USFWS's 5-Point Policy. Life history, habitat requirements, occurrence and distribution in the HCP area, and overall population status of each species are used to predict the potential effects of implementing the HCP. By considering each species individually within the habitat-based framework, the adequacy of the HCP measures in meeting the issuance criteria for each covered species is demonstrated.

The occurrence and distribution of burrowing owls in the HCP area is determined more by the availability of unique features (e.g., burrows) than the occurrence and distribution of a particular habitat type. A species-specific conservation strategy was developed for burrowing owls to ensure adequate coverage by the HCP measures. Further, the Aquatic Habitat group contains desert pupfish and razorback suckers. However, these species occupy two different aquatic habitats, the IID drainage system, and the IID conveyance system, respectively, and the effects of covered activities on these species are distinctly different. Therefore, desert pupfish and razorback suckers are also addressed individually.

IID’s HCP consists of five habitat conservation strategies and three species-specific strategies. The habitat conservation strategies are as follows:

- Salton Sea habitat
- Tamarisk scrub habitat
- Drain habitat
- Desert habitat
- Agricultural field habitat

The four species-specific strategies are as follows:

- Burrowing owl
- Desert pupfish
- Razorback sucker
- Other covered species

Each of these conservation strategies, described in the following sections, were developed based on the potential for and magnitude of the effects the covered activities could have on covered species using each habitat. The following description of the specific strategies and habitat conservation measures is presented to help facilitate an understanding of the details of the commitments made by IID. The italicized language presented within text boxes represents the specifics of the measure; the text that follows each measure provides a justification for the measure and additional clarification. This format is intended to improve the readers’ ability to understand and distinguish the key elements and commitments of the plan. However, the document as a whole, not just the language contained in the text boxes, forms the basis of IID’s HCP and its commitments.

The elements of this HCP that address the effects related to changes at the Salton Sea were not developed in anticipation that a project to restore the Salton Sea would be implemented nor are they dependent upon implementation of a future restoration project. However, because a future project could influence the appropriateness or need for certain mitigation measures, several of the measures contain alternative direction in the event that a restoration project is implemented.

3.2 General HCP Commitments

To ensure proper implementation of the HCP measures presented in the following sections and the Monitoring and Adaptive Management Program (Chapter 4), IID will hire a full-time biologist to oversee implementation of the HCP measures and convene an HCP Implementation Team (HCP IT) to guide implementation of and adjustments to the HCP. These commitments are described in more detail below.

General–1. *Within 1 year of issuance of the incidental take permit (ITP), IID will appoint a full-time equivalent biologist/project manager (HCP Implementation Biologist) to manage the proper implementation of the HCP. Responsibilities will include ensuring adequate staffing and resources. Prior to securing a full-time equivalent biologist/project manager, IID's existing environmental compliance staff will ensure compliance with the HCP requirements.*

The HCP contains a suite of measures covering a variety of habitats and species and requires a comprehensive monitoring program. To ensure that the terms of the HCP are carried out, IID will hire a full-time biologist. The HCP Implementation Biologist will be responsible for ensuring that IID is complying with the HCP conditions.

General–2. *Within 3 months of issuance of the ITP, IID will convene an HCP Implementation Team consisting of representatives from IID, USFWS, and California Department of Fish and Game (CDFG).*

IID will convene an HCP Implementation Team consisting of representatives from IID, USFWS, and CDFG to guide execution of the HCP over the term of the HCP. The purpose of the HCP IT is to collaboratively guide and coordinate execution of the HCP over the term of the permit. The HCP IT will be responsible for the following:

- Guiding implementation of the HCP measures (e.g., identifying the location and characteristics for managed marsh habitat to be created under the Drain Habitat Conservation Strategy)
- Developing specific methodologies for survey programs and studies
- Adjusting the HCP measures under the Adaptive Management Program

Specific responsibilities of the HCP IT are identified in the HCP measures presented in the following sections, in Chapter 4: Monitoring and Adaptive Management and Chapter 5: Plan Implementation.

3.3 Salton Sea Habitat Conservation Strategy

3.3.1 Amount and Quality of Salton Sea Habitat

For the species covered by the HCP, use of the Salton Sea is a function of the abundant food resources, availability of a large, open body of water, and the presence of unique habitat features. The attractiveness of the Salton Sea to piscivorous birds stems from the very high abundance of fish at the Salton Sea. The availability of protected nesting and roosting locations adds to the attractiveness of the Salton Sea to these birds and other colonial-nesting birds. For nonpiscivorous bird species, abundant aquatic invertebrates are an important food resource. Aquatic invertebrates include brine shrimp, brine fly larvae, adult

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pileworm, and barnacle nauplia and cypris. In addition to the food resources and nesting/roosting areas for birds, the Salton Sea provides habitat for desert pupfish and could play a role in supporting shoreline strand and adjacent wetland vegetation. Potential impacts of the covered activities to covered species using these resources relate to changes in salinity and the water surface elevation of the Salton Sea.

3.3.1.1 Fish Abundance

The tilapia, *Oreochromis mossambicus,* is the primary prey for covered species of piscivorous birds at the Salton Sea. Changes in the abundance of tilapia could alter the level of use of the Salton Sea by covered species of piscivorous birds. Thus, it is important to consider the ecology of tilapia at the Salton Sea in assessing the potential effects of the water conservation and transfer programs on covered piscivorous birds.

The Salton Sea supports the highest density of tilapia reported. Costa-Pierce and Riedel (2000a) estimated the standing crop of tilapia as 3,200 pounds per acre (lb/acre), 3.6 to 14.4 times greater than some tropical lakes in Southeast Asia. Within the Salton Sea, the highest densities of tilapia occur at the New and Alamo River deltas and in nearshore areas (Costa-Pierce and Riedel 2000a; Costa-Pierce pers. comm. 2000). The nearshore area of high tilapia density extends about 1,970 feet from the shoreline and at the deltas areas about 0.39 square miles (mi^2) in size around each river mouth support high tilapia density. The catches per unit effort of tilapia in the deltas and nearshore areas were more than 10 to 30 times greater than in pelagic areas of the sea and in the rivers (Table 3.3-1).

TABLE 3.3-1
Catch Per Unit Effort for Tilapia in the Salton Sea

Area	Catch Per Unit Effort (kg/hr)
Pelagic	0.22
Nearshore	2.37
River deltas	3.29
River channels	0.1

Source: Costa-Pierce and Riedel (2000a)

A food habit study of tilapia in the Salton Sea showed that in pelagic areas tilapia feed on zooplankton, particularly copepods and rotifers, whereas in the nearshore and deltaic areas, the diet was much more diverse and included a substantial amount of sediment and detrital matter (Costa-Pierce and Riedel 2000b). The high concentration of tilapia in the river deltas and nearshore areas may be related to the high levels of organic matter in the river and drain discharges to the sea at these locations. The nearshore and delta areas also support breeding by tilapia. In addition to nearshore and delta areas, tilapia spawn in drains.

Tilapia have a high salinity tolerance and they are able to adapt to very high salinity levels, particularly if the increase in salinity is gradual (Phillipart and Ruwet 1982 cited in Costa-Pierce and Riedel 2000a). Tilapia have been collected at a salinity of 120 parts per thousand (ppt),[1] but reproduction has not been reported at this salinity level (Whitfield and Blaber 1979). Costa-Pierce and Riedel (2000a) provide a review of reported salinity tolerances of

[1] Many of the studies regarding salinity tolerance of various species report the results in parts-per-thousand (ppt). Modeling conducted for this HCP utilized concentrations in mg/L (converted to g/L) which differs slightly from ppt as salinity increases due to the difference in the specific gravity of saltwater versus freshwater. Model results are reported in ppt for simplicity and to allow direct comparison with reported tolerances.

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tilapia. Highest growth rates were reported at 14 ppt, but growth was still good and tilapia reproduced at 30 ppt. At 69 ppt, tilapia grew poorly, but reproduced well. In the Salton Sea at about 44 ppt, tilapia also grew poorly, but reproduced well. Based on these studies, Costa-Pierce and Riedel (2000a) suggested that tilapia in the Salton Sea could successfully acclimate to and continue to reproduce at a salinity level of 60 ppt. Above a salinity level of 60 to 70 ppt, growth, survival, and reproduction would decline (Costa-Pierce, pers. comm. January 12, 2001). While evidence suggests that reproduction of tilapia will begin to decline at a salinity level above 60 ppt, the actual salinity thresholds for reproduction and survival in the Salton Sea could be higher.

3.3.1.2 Nesting and Roosting Sites

Nesting and roosting sites used by covered species (i.e., black skimmers, gull-billed terns, white pelicans, brown pelicans, and double-crested cormorants) are presently available at several locations around the Salton Sea. Most sites are small, generally less than 0.25 acres, and with low relief, sometimes only a few inches above the level of wind-driven wave inundation. Water depth between islands and the mainland is only a few feet. Mullet Island is the largest island and used heavily as a nesting and roosting site. Other smaller islands consisting of old earthen levees are also available. Fewer islands are present in the northern portion of the sea; remnants of earthen levees near the mouth of the Whitewater River provide some nesting and roosting sites.

3.3.1.3 Desert Pupfish

Desert pupfish inhabit pools formed by barnacle bars located in near-shore and shoreline areas of the Salton Sea and at Salt and San Felipe creeks. Barnacle bars are deposits of barnacle shells on beaches, near the shore, and at the mouths of drains that discharge to the Salton Sea. Pools form behind the barnacle bars. These pools provide habitat for pupfish and also are believed to be important for allowing pupfish movement among drains, shoreline pools and smaller tributaries such as Salt and San Felipe creeks.

3.3.1.4 Shoreline Strand and Adjacent Wetland Habitat

The Salton Sea database identifies 293 acres of shoreline strand habitat along the Salton Sea. Shoreline strand habitat consists of tamarisk and iodine bush. In addition to the shoreline strand, the Salton Sea database identifies 2,349 acres of adjacent wetlands dominated by tamarisk. The source of the water that supports the shoreline strand community is uncertain but could consist of a combination of shallow groundwater and seepage from the Salton Sea. These areas potentially provide habitat for covered species associated with tamarisk scrub habitat.

3.3.2 Effects of the Covered Activities

The primary potential effects of the covered activities on covered species using the Salton Sea relate to changes in the rate of salinization of the sea and changes in the water surface elevation. The salinity level influences the abundance and persistence of fish that support foraging by piscivorous birds and also could influence the ability for pupfish to use the sea to move among drains and to move from Salton Sea to San Felipe Creek and mouth of Salt Creek. Reductions in the water surface elevation could influence the availability and suitability of nesting and roosting areas for colonial nesting birds and also the extent of tamarisk along the sea's margins. The projected changes in salinity and water surface

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elevation with and without implementation of the water conservation and transfer programs and the potential responses of covered species to these changes are described below.

3.3.2.1 Increased Salinity

Since its formation, the salinity of the Salton Sea has been increasing because of high evaporative water loss and continued input of salts from irrigation drainage water. Increasing salinity of Colorado River water delivered at Imperial Dam, which is the sole source for irrigation water in Imperial Valley, also is a factor. The Salton Sea is currently hypersaline, with salinity greater than the ocean.

The Mozambique tilapia is the most abundant fish species in the Salton Sea (Costa-Pierce and Riedel 2000a; Black 1988) and is the primary forage species for piscivorous birds at the Salton Sea (Molina 1996; S. Johnson, pers. comm. 2000). Because of the importance of tilapia in the diet of piscivorous birds at the Salton Sea, the potential change in the tilapia population of the Salton Sea is the focus of assessing the impact of the covered activities on covered piscivorous bird species.

Modeling by Reclamation (January 2002) indicates that the salinity of the Salton Sea would continue to gradually increase over the next 75 years in the absence of the water conservation and transfer programs. The mean of the salinity projections show the salinity of the Salton Sea surpassing 60 ppt in 2023 (Table 3.3-2; Figure 3.3-1). Costa-Pierce and Riedel (2000a) stated that survival, growth and reproduction would decline at a salinity above 60 ppt. Thus, once the salinity of the Salton Sea surpassed 60 ppt, tilapia abundance would be expected to decline as the increasing salinity impaired reproduction. However, relatively freshwater inflow from the New and Alamo Rivers creates an estuarine environment in the river deltas where salinity levels are lower than in the main body of the Salton Sea. Under current conditions, Costa-Pierce and Riedel (2000c) reported salinity levels ranging from 10 to 30 ppt in the river deltas. Tilapia could persist at the Salton Sea if the deltas continued to provide lower salinity environments.

TABLE 3.3-2
Mean and Upper and Lower Bounds of the 95 Percent Confidence Interval Around the Year that Salinity of the Salton Sea is Projected to Exceed 60 ppt Under the Baseline Condition and Various Water Conservation and Transfer Scenarios

Scenario	Upper Bound	Mean	Lower Bound
Baseline	2030	2023	2018
300 KAFY to SDCWA by Fallowing	2021	2017	2014
130 KAFY to SDCWA	2015	2013	2011
230 KAFY to SDCWA	2014	2012	2011
300 KAFY to SDCWA	2014	2012	2011

Source: Reclamation (January 2002)
KAFY = thousand acre-feet per year

Water conserved through IID's water conservation programs would result in a reduction in inflows to the Salton Sea. This inflow reduction would increase the rate of salinization of the sea. IID could achieve water conservation through a combination of on-farm and system-based measures, and fallowing. The degree to which water conservation would

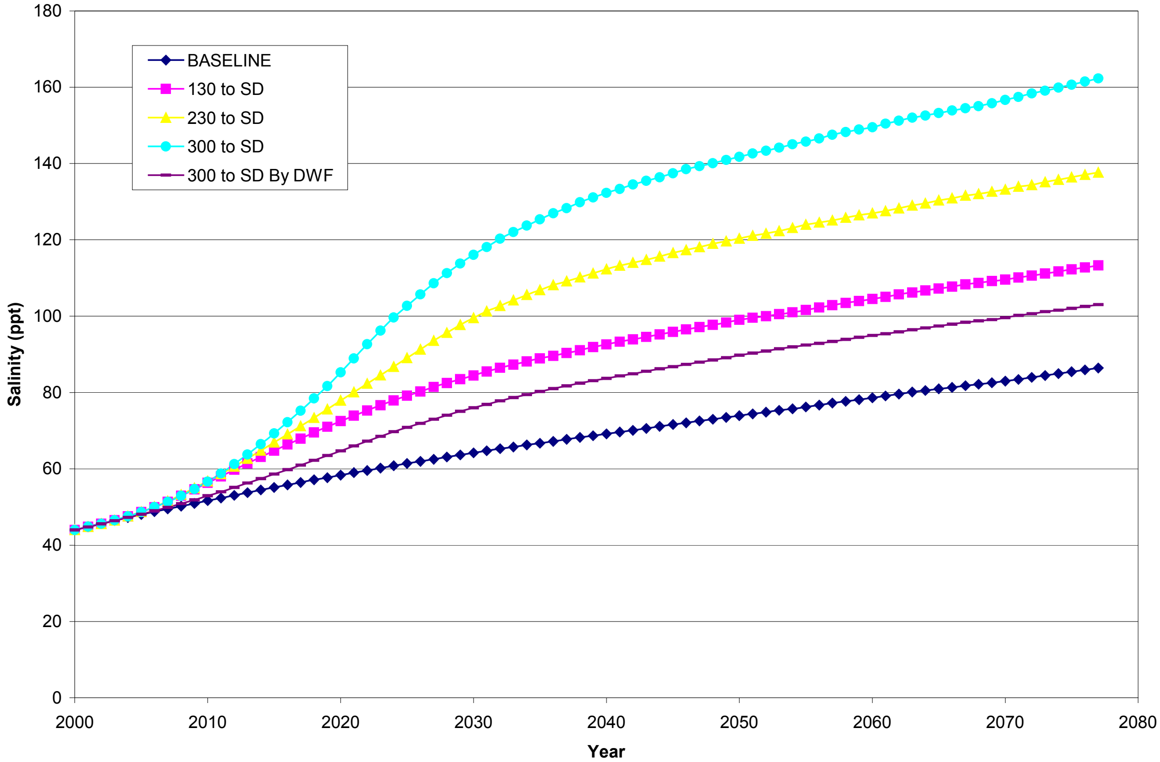

FIGURE 3.3-1
Projected Salinity Levels With and Without Implementation of the Water Conservation and Transfer Programs

accelerate salinization would depend on the method of water conservation, the amount of water conserved, and the amount of water transferred out of the Salton Sea basin.

The potential effects of the water conservation and transfer programs on the rate of salinization are bounded by projections of (1) using all on-farm and system-based measures to achieve 300 thousand acre-feet per year (KAFY) of conservation and (2) using all fallowing to achieve 300 KAFY of conservation (Figure 3.3-1). With conservation and transfer of 300 KAF using on-farm and system-based measures the mean salinity of the Salton Sea is predicted to surpass 60 ppt in 2012 (Figure 3.3-2), 11 years earlier than under the baseline projections. Using all fallowing to achieve the same level of conservation, the mean salinity of the Salton Sea is predicted to exceed 60 ppt in 2017, six years earlier than under the baseline condition.

The preceding discussion could be interpreted as suggesting that the rate and magnitude of future changes in salinity and the response of tilapia are certain and determinant. The modeling conducted by Reclamation constitutes the best available information on the rate and magnitude of salinity increases at the Salton Sea. However, models are necessarily simplified representations of complex systems that can and do react unpredictably. Myriad factors will influence the actual salinity trajectory of the sea. Factors potentially influencing the salinity trajectory include but are not limited to future weather conditions; unknown chemical dynamics; variations in inflows from Mexico; implementation of a Salton Sea

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Restoration Project; variations in IID diversion levels because of legal or political changes, drought in the upper basins states, or others factors.

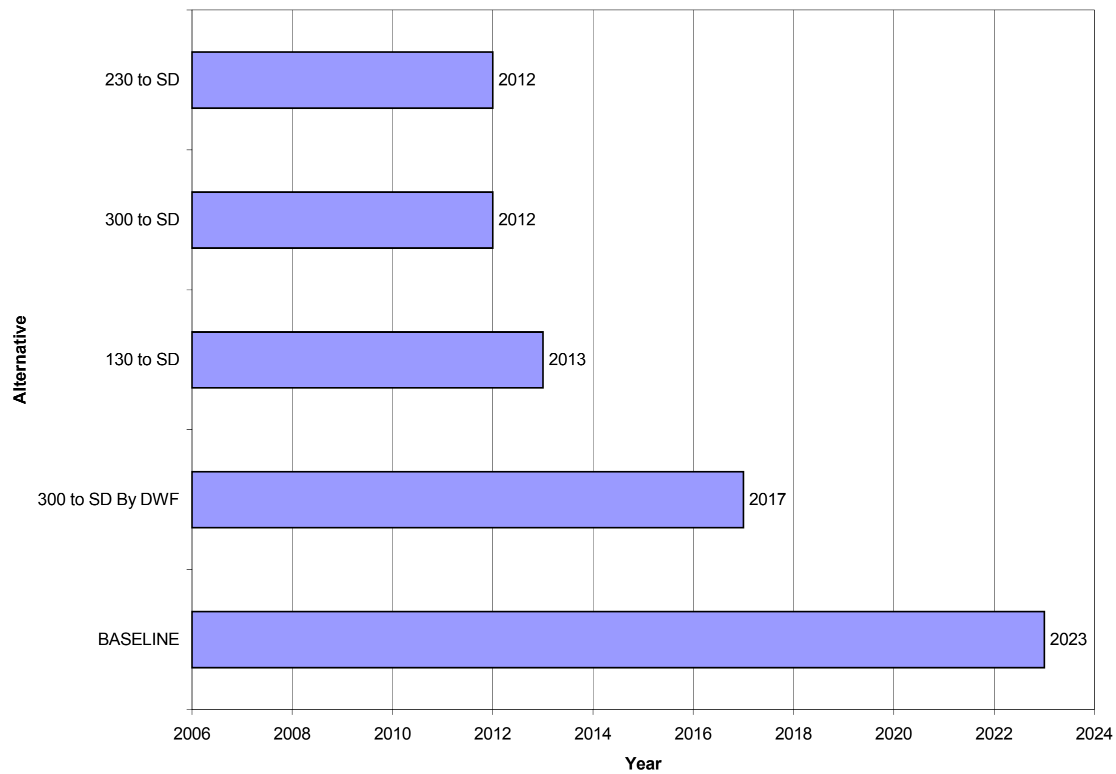

FIGURE 3.3-2
Year that Mean Salinity of the Salton Sea is Projected to Exceed 60 ppt Under the Baseline Condition and the Potential Range of Water Conservation Amounts and Transfer Locations

These unknowns could accelerate or decelerate the salinization of the Sea relative to the current projections. However, these factors would be expected to equally affect the projections with and without implementation of the water conservation and transfer programs. As such, the differences between the salinity projections with implementation of the water conservation and transfer programs and the baseline would not be expected to change substantially.

In the preceding discussion, tilapia were assumed to no longer be able to reproduce once the salinity of the sea reached 60 ppt and at that point their abundance at the sea would decline. The actual response of tilapia to increased salinity at the Salton Sea likely will be much less definitive for several reasons. First, relatively freshwater will continue to flow into the Salton Sea at the New, Alamo and Whitewater rivers and from the drains. Some tilapia could persist at the Salton Sea if low salinity areas persisted around the deltas and potentially near drain outlets. Second, given tilapia's ability to tolerate very high salinity levels as juveniles and adults, the deltas and drains could serve as a breeding population from which individuals could disperse to populate other areas of the sea until the salinity of the main body became intolerable to adults and juveniles. Third, tilapia at the Salton Sea could adapt or evolve to tolerate higher salinities. These three factors could act to extend the persistence and abundance of tilapia at the Salton Sea. Alternatively, increased stress associated with higher salinity could increase the susceptibility of tilapia to disease and lead to an increased incidence of massive die-offs. Although the exact response of tilapia to increased salinity cannot be predicted with certainty, it is reasonable to expect that the total tilapia population supported in the Salton Sea would be reduced relative to existing conditions. This reduction would occur with or without implementation of the water conservation and transfer programs. The potential effects of a reduction in tilapia at the Salton Sea on the four major piscivorous birds covered by the HCP are described below.

American White Pelican

White pelicans use the Salton Sea as a migratory stopover and wintering area. As a migratory stopover, individual pelicans appear to use the Salton Sea for a few weeks to a few months before continuing on their migration to Mexico (Shuford et al. 1999). Some birds probably remain at the Salton Sea throughout the winter rather than continuing on to Mexico.

The number of pelicans using the Salton Sea at any time varies substantially. According to counts reported by USFWS and aerial surveys conducted by Point Reyes Bird Observatory (Shuford et al. 2000), the Salton Sea at times supports one of the largest concentrations of white pelicans in the Pacific Flyway. McKay reported maximum counts of white pelicans at the Salton Sea during 1984 to 1990. The maximum counts ranged from 2,000 to 17,000 and usually occurred in February. The average of maximum counts for these years was 6,500 white pelicans. Based on a sharp decline in counts between 1985 and 1990, the population of pelicans using the Salton Sea was believed to be declining. However, the aerial surveys conducted in 1999 found 16,697 pelicans using the Salton Sea in January and February, a similar number as reported by McKay in 1985 (17,000; Shuford et al. 2000). The following November, Shuford et al. (2000) reported 19,197 pelicans at the Salton Sea. Christmas Bird count data show white pelicans at the Salton Sea in every year since 1979 (Figure 3.3-3). The number of birds observed in Christmas Bird Counts at the Salton Sea from 1979 to 2000 averages about 2,195. The USFWS recorded numbers of white pelicans at the Salton Sea for a 21-month period between December 1999 and August 2001. White pelican numbers were highest (24,110) in February 2000 and lowest (770) in June 2001 (Table 3.3-3).

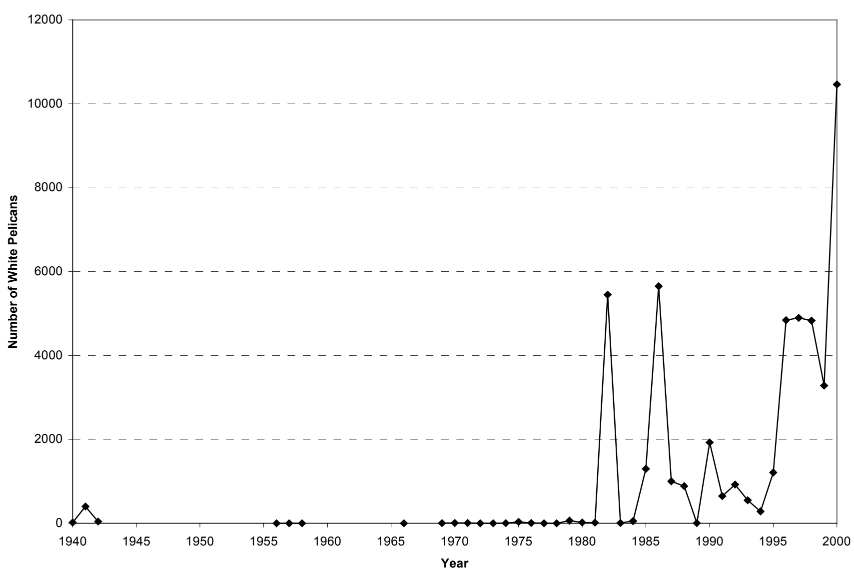

FIGURE 3.3-3
Number of White Pelicans Reported in Christmas Bird Counts at the Salton Sea from 1940 to 2000

TABLE 3.3-3
American White Pelicans Reported at the Salton Sea, California

Date	Number Counted
December 1999	5,000
January 2000	8,875
February 2000	24,110
March 2000	15,408
April 2000	7,255
May 2000	3,510
June 2000	3,459
July 2000	1,147
August 2000	994
September 2000	13,997
October 2000	5,075
November 2000	3,000
December 2000	7,380
January 2001	8,736
February 2001	18,705
March 2001	15,036
April 2001	3,200
May 2001	1,245
June 2001	770
July 2001	1,320
August 2001	7,430
Average	**7,412**

Source: Salton Sea Authority, Wildlife Disease Program

These data indicate that winter and migratory use of the Salton Sea is highly variable within and among years. While large numbers of white pelicans stop at the Salton Sea for brief periods of time on migration or exploit food resources at the sea sporadically during the winter, the average wintering population is much lower. Pelicans that overwinter at the Salton Sea usually are present in greatest numbers at the Salton Sea from November to April (Shuford et al. 2000). In addition to the Salton Sea, pelicans using the Pacific Flyway also overwinter along the California coast south of San Francisco, the San Joaquin Valley, throughout Baja California, and in the Gulf of California (Johnsgard 1993).

Pelicans are highly opportunistic and mobile in selecting foraging sites, and have been reported to travel long distances to forage even during breeding, an energetically stressful time (Knopf and Kennedy 1980). At Pyramid Lake, Nevada, pelicans have been reported foraging at seven different lakes during the breeding season. With the exception of Pyramid Lake where the breeding colony is located, all of the foraging sites were more than 37 miles from Pyramid Lake, with the farthest foraging site (Stillwater National Wildlife Refuge [NWR]), nearly 62 miles away (Knopf and Kennedy 1980). Knopf and Kennedy (1980) found that pelicans nesting at Pyramid Lake switched foraging locations frequently during the nesting season. Changes in foraging location appeared to be linked to the availability of fish. For example, pelicans used Pyramid Lake, the closest foraging location to the breeding colony, at relatively low levels except for June when tui chub became available in shoreline areas. Knopf and Kennedy (1980) characterized pelicans as "opportunistic in selecting foraging sites where fish are most readily available." Johnsgard (1993) also notes the great distances that pelicans will travel to forage. Summarizing data from other studies, Johnsgard (1993) reports one-way foraging flights of up to 100 miles (Great Salt Lake), round trips of 60 to 380 miles (Chase Lake, ND), and one-way distances of 90 miles (Harvey and Warner basins).

The reported foraging behavior of white pelicans indicates that they seek the most favorable foraging area within a wide area. The availability of an abundant source of fish, tilapia in particular, makes the Salton Sea attractive to pelicans. With increased salinity of the Salton Sea, the abundance of tilapia would likely decline as described above. However, tilapia could persist at the Salton Sea, particularly in the New and Alamo River deltas. Pelicans currently concentrate foraging in the deltas (Shuford et al. 2000). With the continued persistence of tilapia at the Salton Sea, pelicans would likely continue to use the Salton Sea as a migratory stopover and wintering area. However, if salinity increases result in a substantial decline in the abundance of tilapia, it is reasonable to expect that the level of use of the Salton Sea by white pelicans would decline. A decline in the level of use of the Salton Sea by pelicans could be manifested as a shorter stopover time for birds that continue to wintering grounds farther south, lower numbers of birds, or shorter residence periods of overwintering birds. Given their opportunistic foraging strategy and ability to travel long distances, it is likely that pelicans would switch to other wintering areas if fish at the Salton Sea became less abundant and if the energetic costs of foraging there became greater than at other locations in California and Mexico. Other locations where white pelicans have been reported during migration and overwintering include the Lower Colorado River (LCR) (USFWS unpublished data), Mystic Lake and Lake Elsinore in southern California (G. Black, pers. comm. 2001), coastal bays along the southern California and Mexican coasts (Small 1994; Johnsgard 1993). As such, the actual level of take resulting from changes in fish abundance at the Salton Sea is uncertain. However, it is reasonably likely that the level of use of the Salton Sea by white pelicans would decline as tilapia abundance declined. This effect would occur with and without implementation of the water conservation programs. The effect of the water conservation programs would be to accelerate the rate at which this effect would be manifested.

Adult pelicans are capable of moving long distances to find food. As such, with a decline in the abundance of fish at the Salton Sea, at least some of the adult pelicans, albeit possibly not all, should be able to find alternate food resources. The segment of the population most at risk to adverse effects of reduced fish abundance at the Salton Sea likely would be first year birds. First year birds are not as experienced as older birds at locating food and exploiting food resources. For brown pelicans, Johnsgard (1993) suggested that the high mortality rate of first year birds and substantially lower mortality rate of birds older than 1 year reflected an improved foraging efficiency of older birds. Similarly, first year white pelicans could be the least adept segment of the population at finding and exploiting alternate foraging habitat with a decline in the abundance of fish at the Salton Sea. A portion of the birds using the Salton Sea, possibly disproportionately first year birds, could be injured or killed if they could not find alternate foraging habitat or forage efficiently.

California Brown Pelican

Brown pelicans probably had little historical use of the Salton Sea (Anderson, pers. comm. 1993). Some postbreeding pelicans were documented at the sea in the late 1970s. Use of the Salton Sea by brown pelicans subsequently increased, with the maximum summer usage estimated at 5,000 birds. Nearly 2,000 were recorded in 1999, but a maximum of only 1,000 were recorded in 2000 (Shuford et al. 2000). The USFWS recorded numbers of brown pelicans at the Salton Sea for a 21-month period between December 1999 and August 2001. Brown pelican numbers were highest (3,990) in July 2001 and lowest (5) March 2000 (Table 3.3-4).

TABLE 3.3-4
California Brown Pelicans Reported at the Salton Sea, California.

Date	Number Counted
December 1999	100
January 2000	50
February 2000	40
March 2000	5
April 2000	10
May 2000	82
June 2000	2,563
July 2000	1,948
August 2000	1,354
September 2000	918
October 2000	300
November 2000	319
December 2000	96
January 2001	38
February 2001	65
March 2001	6
April 2001	16
May 2001	530
June 2001	2,650
July 2001	3,990
August 2001	3,280
Average	**874**

Source: Salton Sea Authority, Wildlife Disease Program

The post-breeding visitors are mostly young birds that disperse northward from breeding areas in the Gulf of California (Hazard, pers. comm.). Most use of the Salton Sea is by post-breeding visitors, with more limited use for wintering. Shuford et al. (2000) reported that brown pelicans occur at the Salton Sea primarily from mid-June to early October. They observed the highest numbers in August. The primary wintering area in the United States is along the California coast (Johnsgard 1993).

Brown pelicans only recently, in 1996, started nesting at the Salton Sea (Shuford et al. 1999). The number of breeding birds has been low with 6 pairs nesting in 1996 and several pairs attempting to nest in most years since then (Shuford et al. 1999). Brown pelicans did not nest at the Salton Sea in 1999 (Shuford et al. 2000). Nesting birds have used tamarisk at the Alamo River delta and also attempted to nest at Obsidian Butte (S. Johnson, pers. comm. 2000). Compared to the nearest breeding colonies of brown pelicans located in the Gulf of California on San Luis Island (4,000 to 12,000 pairs), Puerto Refugio (1,000 to 4,000 breeding pairs) and Salsipuedes/Animas/San Lorenzo area (3,000 to 18,000 pairs), the population nesting at the Salton Sea makes a small contribution to the overall population. Other breeding populations occur off the southern California Coast and the western coast of Baja California (Johnsgard 1993).

Dispersing juveniles wander considerably from nesting locations and can travel long distances (Johnsgard 1993). Young eastern brown pelicans can move more than 310 miles from breeding areas (Johnsgard 1993). Similarly in California, most banded birds were recovered within 310 miles of the breeding site but one was found in Mexico, 1,375 miles away from the banding location (Johnsgard 1993). Adults also appear to become wanderers after breeding and have been reported to move 280 to 360 miles from nesting areas (Johnsgard 1993).

As previously described, the abundance of tilapia is expected to decline as the salinity of the sea increases. However, tilapia could persist at the Salton Sea, particularly in the New and

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Alamo River deltas. Pelicans currently concentrate foraging in the deltas (Shuford et al. 2000). With the continued persistence of tilapia at the Salton Sea, brown pelicans would likely continue to visit the Salton Sea as post-breeders. Because post-breeding pelicans are known to wander over large areas, it is likely that the pelicans would remain at the Salton Sea for a shorter period of time and/or seek out more favorable foraging areas in the Gulf of California or along the Pacific Coast, if foraging becomes energetically unfavorable at the Salton Sea. These areas are within the distances that brown pelicans can travel. As such, the actual level of take of post-breeding visitors resulting from changes in fish abundance is uncertain. However, it is reasonably likely that the level of use of the Salton Sea by brown pelicans would decline as tilapia abundance declined. This effect would occur with and without implementation of the water conservation programs. The water conservation programs would only act to accelerate the rate at which this effect would be manifested.

Breeding only recently was initiated at the Salton Sea and only in small numbers of birds (6 pairs or fewer). Brown pelicans did not nest at the sea in 1999 (Shuford et al. 2000). Brown pelicans that have nested at the Salton Sea represent less than 1 percent of the California breeding population (Johnsgard 1993) and a far smaller percentage of the subspecies' entire population. Depending on the degree to which the tilapia population declines, brown pelicans might not nest at the Salton Sea again in the future Because of the small number of birds that have nested at the sea and the infrequency of nesting, the impact associated with the potential loss of future breeding opportunities for brown pelicans at the Salton Sea would be minor.

Black Skimmer

Black skimmers first appeared in California in 1962. Six years later five skimmers were sighted at the Salton Sea (Collins and Garrett 1996). The first nesting by black skimmers in California occurred in 1972 at the Salton Sea (Collins and Garrett 1996). Since black skimmers were first observed in California, their numbers have been steadily increasing. New breeding locations have been reported at several locations along the California coast from San Diego to San Francisco Bay and the number of birds using these various locations has generally been increasing (Table 3.3-5). In addition to the California nesting sites, black skimmers nest at Montague Island in the Gulf of California (Collins and Garret 1996).

At the Salton Sea, nesting colonies of black skimmers have ranged in size from 10 to several hundred pairs; most colonies consist of 50 to 200 pairs (Molina 1996). As many as 777 black skimmers have been reported in summer (Shuford et al. 2000). The Salton Sea is unique in being the only inland breeding site of this species and currently supports about 30 percent of the known breeding population in California. Skimmers nest on bare earthen slopes, terraces, and levees adjacent to the Sea. Specific nesting locations include Mullet Island, the Whitewater River delta, Morton Bay, Rock Hill, and Obsidian Butte.

After breeding, skimmers appear to be very mobile, moving among a number of wintering locations. Gazzaniga (1996) showed wide month-to-month fluctuations in the number of skimmers using five locations on the California coast. The reasons for the fluctuations were unclear, but she suggested that weather and food resources could play a role. Long distance movements by black skimmers also have been reported. Palacios and Alfaro (1992) captured birds banded at Bolsa Chica along the coast of Baja California and Gazzaniga (1996) observed a bird banded at Bolsa Chica at Princeton Harbor, 160 miles north of Bolsa Chica. Skimmers banded as chicks at Bolsa Chica have also been found breeding at Montague

Island in the Gulf of California (Collins and Garret 1996). In combination with the observed colonization of several locations on the California coast since the 1970s, these observations suggest that skimmers regularly travel long distances during the winter and will establish breeding colonies where suitable nesting conditions exist.

TABLE 3.3-5
Number of Pairs or Nest Initiations* by Black Skimmers at Various Locations in California, 1972-1995

Year	Salton Sea	San Diego Bay	Bolsa Chica	Upper Newport Bay	San Francisco Bay	Batiquitos Lagoon
1972	5					
1973	3					
1974	10					
1975	9					
1976	25	1				
1977	100	3				
1978	100	6				
1979	ND	14				
1980	0	30				
1981	0	25				
1982	0	35				
1983	0	50				
1984	0	++				
1985	47	150	10*			
1986	300	130	60*	2		
1987	500	++	106*	ND		
1988	100	200	150*	15		
1989	0	++	112*	45		
1990	100	++	338*	14		
1991	80	>157	398*	40		
1992	100	++	278*	++		
1993	300	326 (473*)	284*	++		
1994	450	310 (420*)	353*	++	2*	
1995	487	>200	201*	451*	2*	14*

Source: Collins and Garrett (1996)
ND: no data available
++ birds seen, possibly in large numbers, but no nest census data available.

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Black skimmers could be adversely affected by the changes predicted at the Salton Sea in two ways. First, the water surface elevation of the Salton Sea is projected to decline and to create a land bridge to Mullet Island (see Section 3.3.2.2). The suitability of this nesting location for black skimmers could decline if predation or disturbance increased as a result of formation of the land bridge. In addition, other nesting and roosting locations could become less suitable for black skimmers as the sea elevation declines. Second, the increased salinity is expected to result in reduced abundance of tilapia. These effects would occur with or without implementation of the water conservation and transfer programs. However, the projected salinity change and decline in tilapia abundance could be accelerated by the water conservation programs.

Skimmers are believed to feed on young tilapia to a large extent at the Salton Sea (Molina 1996). While tilapia could persist at the Salton Sea, their abundance and reproductive rate is expected to decline. As a result, prey availability for skimmers could decline, and nesting might not be sustained or could occur at a lower level than currently is supported at the Salton Sea.

Double-Crested Cormorant

At the Salton Sea, cormorants nest on rocky ledges on Mullet Island or on dead vegetation at the deltas of the New and Alamo rivers. Snags in the Salton Sea are important for providing protected roost sites for double-crested cormorants. Cormorants regularly move between the Salton Sea and the lakes at the Finney-Ramer Unit of the Imperial Wildlife Area where they forage. Lakes at the Finney-Ramer Unit of Imperial WA also support double-crested cormorant nesting and roosting.

Double-crested cormorants are a common and abundant species at Salton Sea, with counts of up to 10,000 individuals (USFWS 1993; IID 1994). Small nesting colonies were documented at the north end of the sea in 1995 (USFWS 1996), but recently (1999) more than 7,000 double-crested cormorants and 4,500 nests were counted on Mullet Island. Mullet Island now represents the largest breeding colony of double-crested cormorants in California (Shuford et al. 1999). The year-round resident population is about 3,000 birds (Shuford et al. 2000).

With increased salinity of the Salton Sea, the abundance of cormorants at the Salton Sea could decline with reduced prey availability (i.e., tilapia). Increased salinity and reduced fish abundance at the Salton Sea would occur irrespective of the water conservation programs. However, the implementation of the water conservation programs could accelerate the occurrence of these changes. Changes in the suitability of nest and roost sites as the sea's elevation recedes also could occur. As described below, the sea's elevation is projected to decline under the baseline condition and with the water conservation and transfer programs. As a result, Mullet Island would become connected to the mainland potentially leading to increased disturbance or predation at the cormorant colony. Cormorants could abandon the colony on Mullet Island as a result of changes in the suitability of the site and/or changes in prey availability.

Even with changes in the suitability of foraging, roosting, and nesting habitat quality at the Salton Sea, cormorants would still inhabit the HCP area. They currently nest and roost on the Finney-Ramer Unit of the Imperial Wildlife Area (WA) and forage at lakes on this unit as well as in agricultural drains, reservoirs, and Fig Lagoon. The New, Alamo, and

Whitewater River deltas currently support nesting colonies of double-crested cormorants (Shuford et al. 2000) and would continue to provide nesting, roosting, and foraging opportunities. However, the large colony on Mullet Island would probably not persist.

Desert Pupfish

Desert pupfish have a high salinity tolerance. They have been collected and grown at salinities as high as 90 ppt (Kinne and Kinne 1962). Under baseline conditions, the projections show that the mean salinity of the Salton Sea would not exceed 90 ppt in 75 years. (Table 3.3-6). Thus, under baseline conditions, pupfish would be expected to be able to continue to use the sea to move among drains.

TABLE 3.3-6
Mean and Upper and Lower Bounds of the 95 Percent Confidence Interval Around the Year that Salinity of the Salton Sea is Projected to Exceed 90 ppt Under the Baseline Condition and Various Water Conservation and Transfer Scenarios

Scenario	Upper Bound	Mean	Lower Bound
Baseline	>2077 [a]	>2077[a]	2072
300 KAFY to SDCWA by Fallowing	2063	2051	2042
130 KAFY to SDCWA	2046	2037	2030
230 KAFY to SDCWA	2029	2026	2023
300 KAFY to SDCWA	2024	2022	2020

[a] The model projections stopped in 2077.
Source: Reclamation (January 2002)

With conservation using on-farm and system-based measures to conserve 300 KAFY, the mean projections show the salinity of the Salton Sea exceeding 90 ppt in 2022 (Table 3.3-6). At this salinity, the sea could become intolerable to pupfish and prevent them from moving among drains. If the sea becomes a barrier to pupfish, pupfish could be isolated in individual drains. Small, isolated populations are at risk of extinction because of environmental and genetic stochasticity. Ultimately, this condition also would occur under the baseline and with water conservation achieved with all fallowing, but at a later time.

3.3.2.2 Water Surface Elevation

The water surface elevation of the Salton Sea is projected to decline under both the baseline condition and with implementation of the water conservation and transfer programs. Under the baseline condition, the water surface elevation is projected to decline until a new equilibrium (evaporation equals inflows) is reached at about –235 ft mean sea level (msl) in the years 2070 to 2077 (Figure 3.3-4). The projected baseline is based on changes in current inflows as a result of the following:

- Continued and full implementation of the existing IID/MWD transfer
- Higher salinity in the Colorado River at Imperial Dam
- Reduced surplus flows available from the Colorado River
- Reduced contributions from the Coachella Aquifer

The IID/Metropolitan Water District of Southern California (MWD) transfer began producing water in about 1990, ramping up to full implementation in 1999. The projected baseline continues this transfer for the 75-year period at full implementation of 100 to 110 KAFY. The continued and full implementation of the IID/MWD transfer for the 75-year

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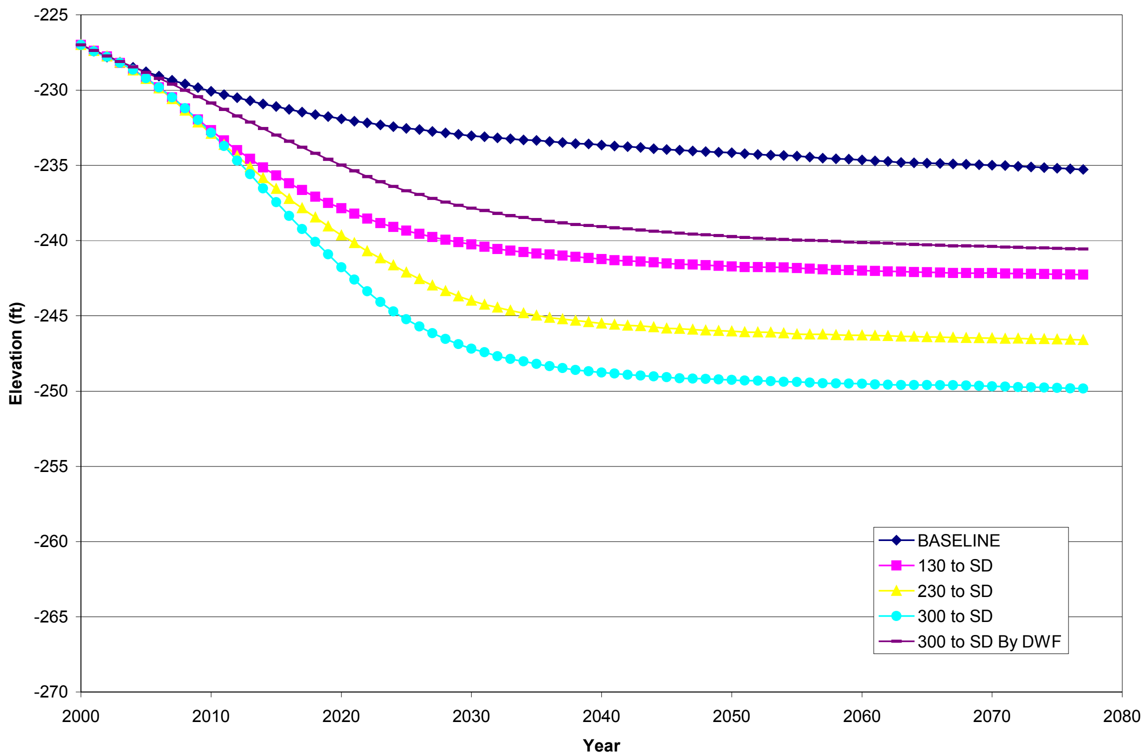

FIGURE 3.3-4
Projected Water Surface Elevation With and Without Implementation of the Water Conservation and Transfer Programs

period as projected in the IID/MWD Transfer EIR will on average reduce flows to the Salton Sea approximately 100 KAFY.

Higher salinity in the Colorado River will require that IID and Coachella Valley Water District (CVWD) divert more water from the Colorado River to leach salt from the agricultural fields for crop production. This however will be offset by California's Colorado River agriculture entitlement of 3.85 million acre-feet per year (MAFY) which will limit additional diversions from the Colorado River for this required additional salt leaching. As a result, crop yields and eventually crop production could decline resulting in less need for water and less return flows to the Salton Sea. In addition, some farmers may choose to idle some of their agriculture ground to allow for additional leaching of other more productive ground. The baseline modeling assumptions include this combination of a limit on agriculture diversions and the potential of idle ground for salt leaching. The net result to the baseline will be reduced flows to the Salton Sea over time.

Based on long-range forecasts of snowmelt runoff in the Colorado River Basin and the fact that all lower basin states are using their full entitlements leads to the conclusion of less surplus flows available from the Colorado River. As a result, the California agriculture water users will be limited to their entitlement of 3.85 MAFY. Currently CVWD requires surplus Colorado River water to meet its full demand. The projected baseline assumes that CVWD and IID would be limited to a maximum diversion of 3.43 MAFY (Palo Verde Irrigation District will continue to use 420 KAFY) in order to maintain the California

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agriculture entitlement of 3.85 MAFY. This is included in the baseline and, combined with the salt leaching projection, results in less diversion of Colorado River water by IID and CVWD, which reduces flows to the Salton Sea.

CVWD derives a portion of its water supply from groundwater. Based on population and agricultural growth within the CVWD and the limited water supply entitlement from the Colorado River, groundwater usage within the CVWD is required to continue into the future. Without additional recharge to this aquifer, the water table will continue to decline causing less inflows to the Salton Sea and CVWD projects that the Salton Sea water will eventually intrude into the CVWD aquifer. This assumption was included in the baseline projection and resulted in less flow to the Salton Sea over the modeling period.

Implementation of the water conservation and transfer programs would result in less inflow to the sea and would result in a more rapid decline in water surface elevation than under the baseline. With conservation of 300 KAFY through on-farm and system-based measures, the water surface elevation would decline rapidly for the first 35 years. After this period, the rate of elevation decline would lessen and the water surface elevation would stabilize at about –250 ft msl (Figure 3.3-5). With conservation of 300 KAFY through fallowing, the water surface elevation would decline at a faster rate than under the baseline condition (Figure 3.3-4), and stabilize at about –241 ft msl. Figure 3.3-5 shows the location of the shoreline at various surface elevations.

Nesting and Roosting Sites

Colonial nesting birds, including several covered species nest and roost on a number of small islands (islets) around the Salton Sea and a large island, Mullet Island. Bathymetry data of the Salton Sea indicates that the elevation of the land between the mainland and Mullet Island is less than –231 feet, or less than 4 feet below the existing surface water elevation (University of Redlands 1999). Thus, Mullet Island would be connected to the mainland with a decline in sea level of about 4 feet. Other islands used for nesting in addition to Mullet Island that could be connected to the mainland include a small barren islet at Johnson Street that supports gull-billed terns and black skimmers, and a single levee remnant at Elmore Ranch that has supported several species of ground-nesting birds. These sites are separated from the mainland by water that is about 2 to 3 feet deep.

The decline in water surface elevation projected for the baseline and the water conservation scenarios would result in these islands becoming connected to the mainland. Under the baseline condition, the water surface elevation would decline by about 8 feet. With conservation of 300 KAFY through on-farm and system-based measures, the water surface elevation is projected to decline about 27 feet. Although the islands would become connected to the mainland under all levels of conservation including the baseline condition, the timing would vary by a few years depending on the methods used to conserve water, the amount of conservation, and where the water is transferred (Table 3.3-7). With water conservation through on-farm and system-based measures, nesting islands could become connected to the mainland from 1 to 7 years earlier than under the baseline. Use of all fallowing to conserve water would decrease this difference to 0 to 4 years.